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INSTITUTE OF SCIENCE AND TECHNOLOGY

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SCHOOL OF BUILDING AND ENVIRONMENT

DEPARTMENT OF ARCHITECTURE

UNIT - I - MATERIALS & CONSTRUCTION- II - SAR1205

I. Manufactured Building Materials

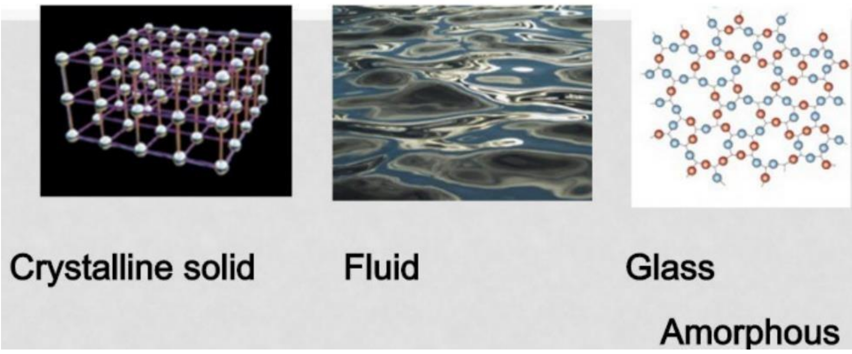
Unit 1 - Syllabus:

Classification of glass - Composition of glass, its properties and uses - Various types of glass e.g. plate glass, figured glass, float glass (toughened glass, laminated glass), tinted glass, reflective glass, wired glass, foam glass, glass block, fiber glass, float glass, obscured glass etc - Decorative glass, insulated glass (sound, heat) - properties and application in building industry, glazing and energy conservation measure

1.1. Glass as a building material

What is Glass ?

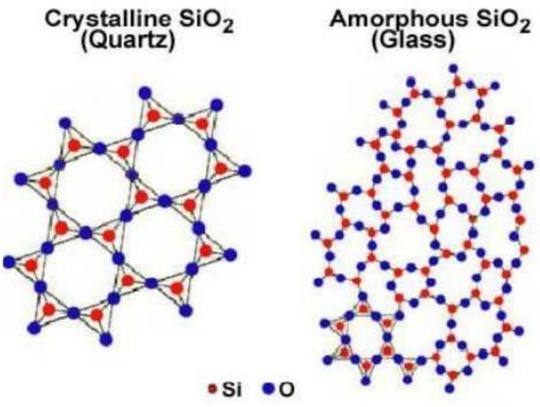
Glass is a non-crystalline, amorphous solid that is often transparent and has numerous applications over diverse fields.

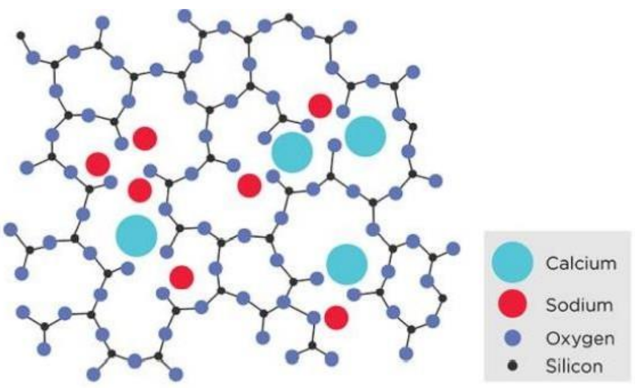


- Glass is neither a crystalline solid nor fluid, but it's an amorphous material
- Glass is considered as solid because it's rigid.
- It is a fusion sand (SiO_2), soda ($Na_2 Co_3$) and lime (CaO), that produces a transparent solid when cooled.
- A 3D network of atoms that lacks any repetition or orderly arrangement – Typical of a crystalline material.

Silicon and oxygen are the most abundant elements on the earth's crust. Silicon is found in nature always chemically combined with oxygen to which it binds with the strong chemical bond Si-O. This simple combination of these elements (Silicon Oxide) is known as Silica.

The amorphous form of silica is glass. When the molten silica is cooled, the very viscous liquid composed of silicon and oxygen, due to the strong bonds between these atoms, can not reorganize into a crystalline matrix, and the "chaotic" structure of the liquid is preserved in a material which in all practical respects is a solid.





Glasses can be formed through several methods but the most common method involves heating raw materials into a molten liquid and then rapidly cooling the liquid in such a way that the atoms remain in a randomly arranged atomic state. When using the melting/cooling method to form glass, the process often begins as a mixture of several critical raw material powders. These powder mixtures are composed of many different components, with each playing an important role.

Natural occurrences of glass

Silicon dioxide exists naturally in the crystalline form known as quartz. Quartz crystallizes with difficulty but the "geological" times allow to obtain well-defined crystals, which is why it is relatively easy to find quartz crystals.

Glass Vs Crystal

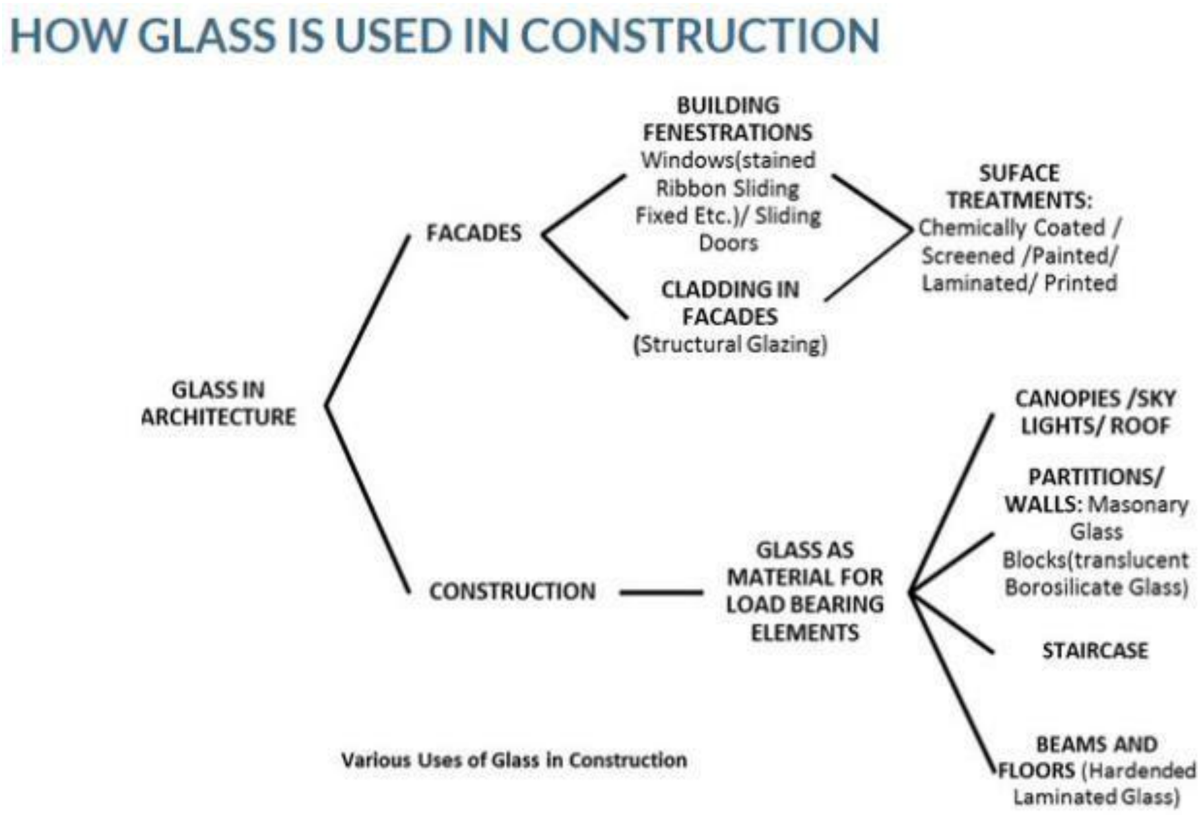
The primary difference between crystals vs. glass is that crystal glass contains anywhere from 2–30% minerals (lead or leadfree). The key feature of crystal glasses is that the minerals strengthen the material, making it possible to produce durable but thin beverage glasses.

Physical Properties of glass

- Hard
- Elastic
- Brittle
- Non-conductor
- Dense
- Posses refractive index

Chemical Properties of glass

- Resistant to all
- Reactive with Flourine
- Reactive with very strong bases



Various Uses of Glass in Construction

1.1.1. Glass Discovery – History and origin

The ancient Roman historian Pliny suggested that Phoenician merchants had made the first glass in the region of Syria around 5000BC. But according to the archaeological evidence, the first man made glass was in Eastern Mesopotamia and Egypt around 3500BC and the first glass vessels were made about 1500BC in Egypt and Mesopotamia.

For the next 300 years, the glass industry was increased rapidly and then declined. In Mesopotamia it was revived in the 700BC and in Egypt in the 500’s BC. For the next 500 years, Egypt, Syria and the other countries along the eastern coast of the Mediterranean Sea were centers for glass manufacturing.

In the beginning it was very hard and slow to manufacture glass. Glass melting furnaces were small and the heat they produced was hardly enough to melt glass. But in the 1st century BC, Syrian craftsmen invented the blow pipe. This revolutionary discovery made glass production easier, faster and cheaper.

Glass production flourished in the Roman Empire and spread from Italy to all countries under its rule. In 1000 AD the Egyptian city of Alexandria was the most important center of glass manufacture. Throughout Europe the miraculous art of making stained glass on churches and cathedrals across the continent reached its height in the finest Chatres and Conterbury cathedral windows produced in the 13th and 14th centuries.

Long before man discovered the secret of making glass, natural glass occurred in the following ways:

- The extreme heat from volcanic eruptions fused rocks and sand into a glass substance called obsidian, which one day would be shaped by stone age man into such useful applications as knives, arrowheads, beads, and bowls.
- The impact of meteorites on the earth's surface may have formed tektites, a variety of small, rounded objects, dark brown to green in color, composed of silicate glass. Another ancient composite is concrete. Concrete is a mix of coarse aggregate, cement and sand. It has good compressive strength, adding metal rods or wires to the concrete can increase its tensile (bending) strength.
- Then about 50 B.C., glassmakers on the Syro-Palestinian coast, then part of the Roman Empire, discovered that they could more easily form objects by inflating a gob of glass on the end of a hollow tube.

1.1.2. Properties of glass

- **Transparency**: This property allows visual connection with the outside world. Its transparency can be permanently altered by adding admixtures to the initial batch mix.
- **U value**: The U-value is the measure of how much heat is transferred through the window. The lower the U-value the better the insulation

- **Strength**: a brittle material but with the advent of science and technology, certain laminates and admixtures can increase its modulus of rupture (ability to resist deformation under load).
- **Greenhouse effect**: The greenhouse effect refers to circumstances where the short wavelengths of visible light from the sun pass through glass and are absorbed, but the longer infrared re- radiation from the heated objects are unable to pass through the glass. This trapping leads to more heating and a higher resultant temperature.
- **Workability**: It can be blown, drawn or pressed. It is possible to obtain glass with diversified properties- clear, colourless, diffused and stained.
- **Recyclable**: Glass is 100% recyclable, cullets (Scraps of broken or waste glass gathered for re-melting) are used as raw materials in glass manufacture, as aggregates in concrete construction etc.
- **Energy efficiency and acoustic control**: Energy-efficient glazing is the term used to describe the double glazing or triple glazing use in modern windows in homes. The air barrier also enhances acoustic control.

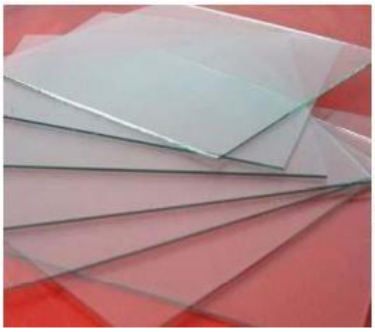
1.2. Types of glass

The following list are the main types of glass that this handout will elaborate in detail

- Plate Glass
- Annealed glass
- Toughened glass
- Laminated glass
- Coated glass
- Mirrored glass
- Patterned glass

1.1.1. Plate glass

Plate glass, flat glass or sheet glass is a type of glass, initially produced in plane form, commonly used for windows, glass doors, transparent walls and windscreens. Making plate glass requires pouring molten glass onto flat plates or metal tables and rolling it until smooth & uniform and then left to cool. Large sheets of glass for storefronts and shop windows were made this way, and the same technology was used to make mirrors. Although the plate glass process was replaced by the float glass method in the 1960s, people still tend to refer to a large flat pane of unstained glass as "plate glass."



1.1.2. Annealed Glass or Float Glass

Float glass is a sheet of glass made by floating molten glass on a bed of molten metal, typically tin, although lead and other various low-melting-point alloys were used in the past. This method gives the sheet uniform thickness and very flat surfaces. Modern windows are made from float glass. Most float glass is soda-lime glass, but relatively minor quantities of specialty borosilicate and flat panel display glass are also produced using the float glass process. The float glass process is also known as the Pilkington process, named after the British glass manufacturer Pilkington, which pioneered the technique (invented by Sir Alastair Pilkington) in the 1950s

Annealed glass is also known as float glass

A Float glass that has not been toughened or heat strengthened

These are the most common glass used in windows

A process of slowly cooling glass to relieve internal stresses after it is formed.

1.1.3. Toughened or Tempered glass

- Toughened glass is more like a safety glass
- Processed by controlled thermal or chemical treatments to increase its strength.
- Tempering puts the outer surfaces into compression and the inner surfaces into tension.
- Strength & Safety Considerations
- Four to five times stronger than annealed glass

- Fragments into small, relatively harmless pieces, reducing the likelihood of injury




Applications of toughened glass

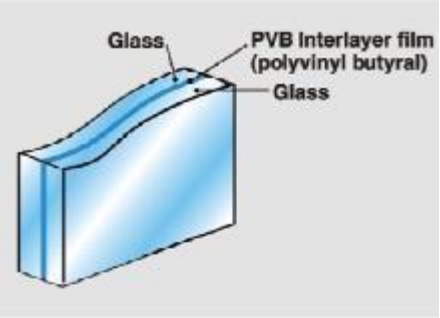
- Automotive Glass
- Monitor Screens
- Construction – frameless glass doors or sliding doors
- Commercial Uses – phone booths, glass bus stops, escalators, stairways, solar panels

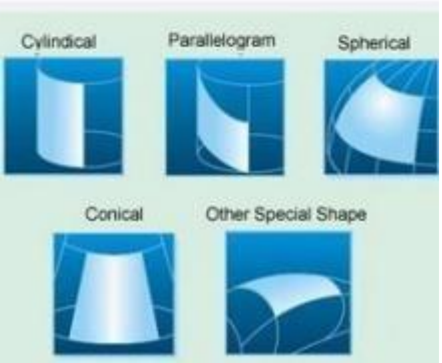
1.1.4. Laminated Glass

Laminated glass is always made of two or more layers of glass with one or more "interlayers" of polymeric material bonded between the glass layers.

- Laminated glass is produced using one of two methods:

- Poly Vinyl Butyral (PVB) / Ethyl Vinyl Acetate (EVA) / Polyurethane (PU) are Cast in Place (CIP) laminated glass is made by pouring a resin into the space between two sheets of glass that are held parallel and very close to each other.
- Safety and security are the best known of these, so rather than shattering on impact, laminated glass is held together by the interlayer.
- Interlayer - colouring, sound dampening, resistance to fire, ultraviolet filtering and other technologies that can be embedded in or with the interlayer.
- **Applications** : automotive and transport industries, building facades





1.1.5. Pyrex Glass

- Laminated Pyrex glass is highly heat resistant. In ordinary glass, silica is the main constituent.
- In pyrex glass some of the silica is replaced by boron oxide.
- Boron oxide expands very little when heated, thus, pyrex glass does not crack on strong heating.

1.1.6. Photochromic glass

Lenses are clear when indoors, or at night

Automatically darkens to a sunglass tint when exposed to sunlight.

1.1.7. Coated glass

Lenses are clear when indoors, or at night

Surface coatings can be applied to glass to modify its appearance and give it many of the advanced characteristics and functions available in today's flat glass products, such as …

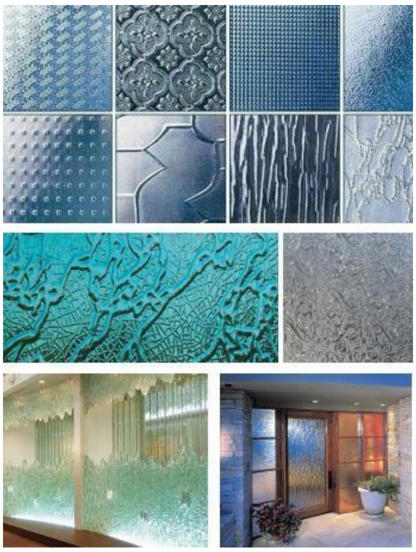
- Low maintenance
- Special reflection
- Transmission
- Absorption properties
- Scratch resistance
- Corrosion resistance

1.1.8. Mirrored glass

To produce mirrored glass, a metal coating is applied to one side of the glass.

- Coating is generally made of silver, aluminium, gold or chrome.
- Mirrored glass is gaining a more prominent place in architecture, for important
- Functional reasons as well as for the aesthetic effect.

1.1.9. Patterned glass



- Display a regular pattern
- Made as a textured material
- Interior design – reduces the visual transparency

1.1.10. Extra clear glass

To a specific type of melted glass.

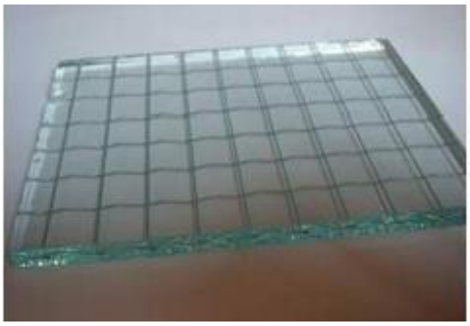
- Extra clear glass differs from other types of glass by its basic raw material composition is made with a very low iron content in order to minimize its sun reflection properties.
- It is most particularly of use for solar energy applications.
- Anti-reflective properties can be further increased by applying a special coating on the low-iron glass.
- It can also be used in windows or facades as it offers excellent clarity, which allows occupants to appreciate true colours and to enjoy unimpaired views.

1.1.11. Flat glass

- Flat glass, sheet glass or plate glass is a type of glass, initially produced in plane form, commonly used for windows, glass doors, transparent walls, and windshields.
- For modern architectural and automotive applications, the flat glass is sometimes bent after production of the plane sheet.

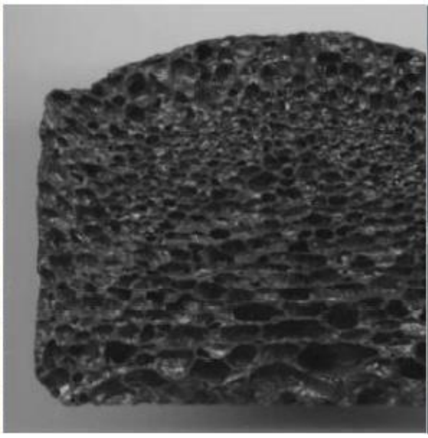
1.1.12. Wired glass

- It is manufactured primarily as a fire retardant, with wire mesh inlaid in the glass to prevent it from shattering and breaking out under stress or when exposed to high temperatures.



1.1.13. Foam glass

- A novel gassy material and is a kind of thermal insulation, not flammable building material, in which there are numerous closed tiny pores.
- Advantages about - light weight, high strength, low thermal conductivity.


1.1.14. Tinted glass

Glass is available in a number of tints (adding color pigments to the raw materials in the float process) which absorb a portion of the solar heat and block daylight. Tinting changes the color of the window and can increase visual privacy.

The primary uses for tinted glass are reducing glare from the bright outdoors and reducing the amount of solar energy transmitted through the glass. Tinted glazing retain their transparency from the inside, although the brightness of the outward view is reduced and the color is changed.


1.1.15. Reflective glass

Reflective glass is essentially ordinary float glass with a metallic coating that cuts off solar heat. This special metallic coating also provides a one-way mirror effect, preventing visibility from the outside and thus preserving privacy. (The reflective coating is applied during the float process.)

The thicker the glass is, the less light will pass through the window. The reflective coating reduces heat gain and glare from the outside while allowing visible light to enter. Reflective glass is used primarily for structural façade glazing



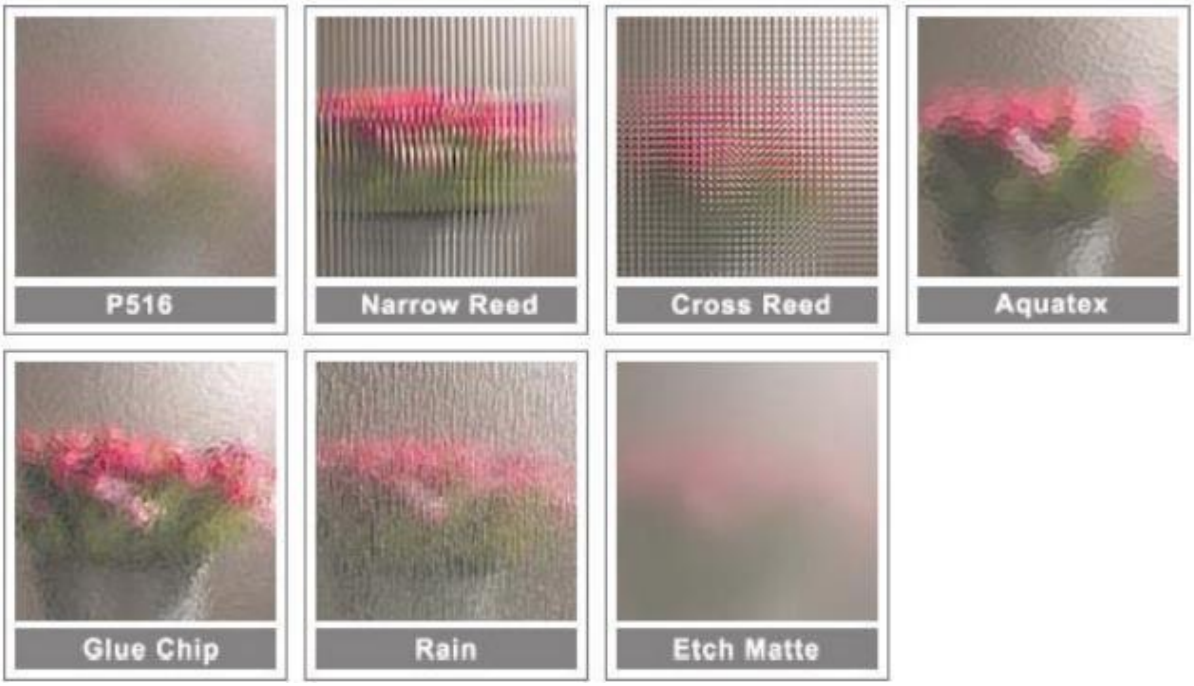
1.1.16. Fiber Glass

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. The plastic matrix may be a thermoset polymer matrix—most often based on thermosetting polymers such as epoxy, polyester resin, or vinylester—or a thermoplastic.

Cheaper and more flexible than carbon fiber, it is stronger than many metals by weight, is non-magnetic, non-conductive, transparent to electromagnetic radiation, can be moulded into complex shapes, and is chemically inert under many circumstances. Applications include aircraft, boats, automobiles, bath tubs and enclosures, swimming pools, hot tubs, septic tanks, water tanks, roofing, pipes, cladding, orthopaedic casts, surfboards, and external door skins.



1.1.17. Obscure glass



1.1.18. Glass bricks / Glass blocks

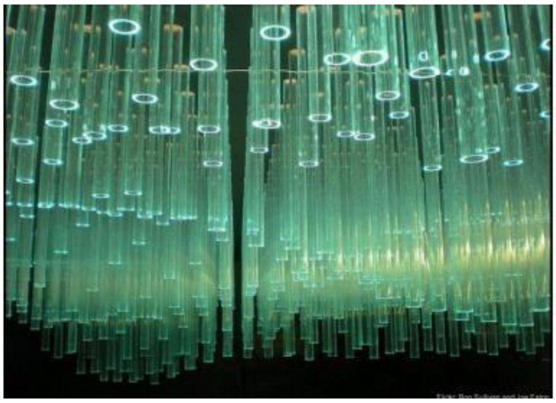
Glass brick, also known as glass block, is an architectural element made from glass. The appearance of glass blocks can vary in color, size, texture and form. Glass bricks provide visual obscuration while admitting light. The modern glass block was developed from pre-existing prism lighting principles in the early

1900s to provide natural light in manufacturing plants.

Today glass blocks are used in walls, skylights, and sidewalk lights

1.1.19. Decorative glass

Glass that is used for more than just a functional purpose—particularly if it is designed to be decorative , artistic or change the look of the space in which it is used—is decorative glass.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SAR1205 – MATERIALS AND CONSTRUCTION II

UNIT – II - TIMBER IN CONSTRUCTION - SAR1205

UNIT 2 - TIMBER IN CONSTRUCTION

Timbers -Methods of construction using natural timber in joinery works including methods of fixing and options for finishing - Exercises involving the above through drawings - Introduction to simple trusses - Mangalore tiles, madras terrace roofing, - fixing details.

TIMBER – DEFINITION AND INTRODUCTION

WOOD – The organic matter obtained from the tree trunks is called wood

TIMBER - Wood prepared for use in building and carpentry. This preparation of the wood includes the treating and seasoning of the wood before it's used for construction.

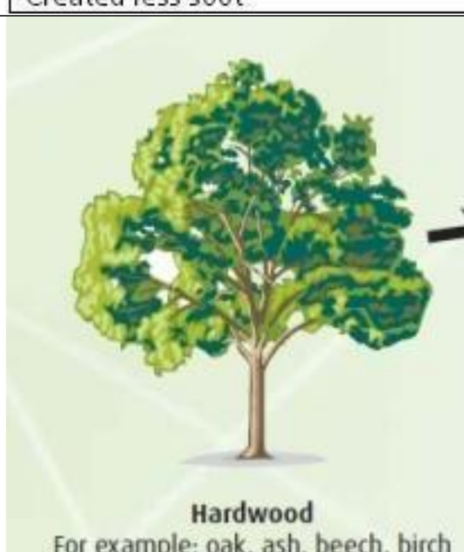
TYPES OF TREES

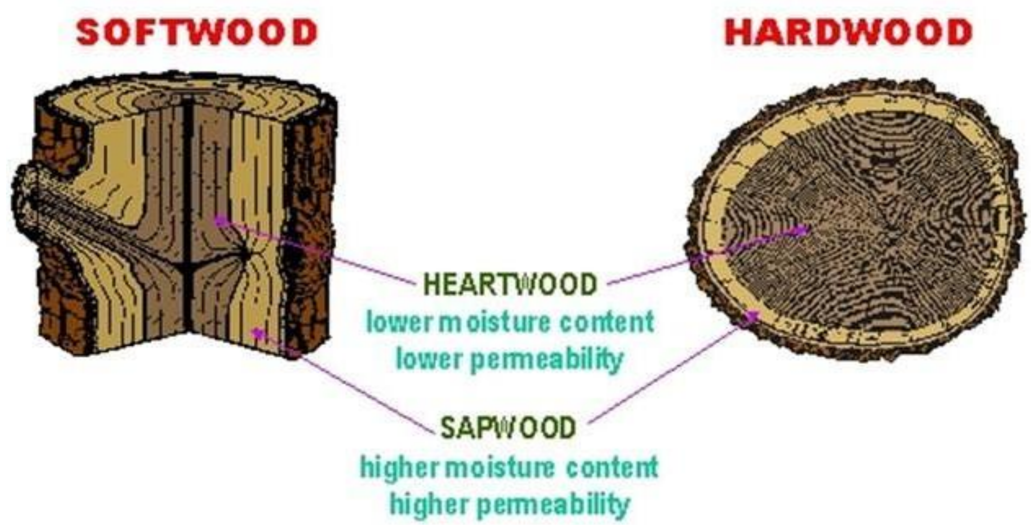
Exogenous trees - grow by the addition of new wood outwards, immediately under the bark.

Endogenous trees - grow by addition of new material inwards.

Exogenous trees – Wood /Timber from these trees are only fit for use in building construction. THE BASIC CLASSIFICATION OF THE WOOD FROM EXOGENOUS TREES

HARD WOOD	SOFT WOOD
Deciduous Tree(loses its leaves annually)	Conifer (Evergreen)
Grow slow and mix with variety of trees	Grow fast and spread
More dense	Less dense
Hardwood trees are angiosperms, plants that produce seeds with some sort of covering. This might be a fruit, such as an apple, or a hard shell, such as an acorn or hickory nut.	Softwoods, on the other hand, are gymnosperms (conifers) with "naked" seed. These plants have seeds that fall to the ground with no covering. In conifers, seeds are released into the wind once they mature. This spreads the plant's seed over a wide area.
Eucalyptus(gum) , black wattle ,white and red oak, apple, honey locust, black and yellow birch, sugar maple and black walnut.	Black willow, Redwood, Sugar and White pine.
Used to make paper and pulp	Used to make paper, pulp and solid wood products
Burn at a slow rate	Burn at a fast rate
Created less soot	Creates more soot





Both these types of wood can be used in timber joinery provided their densities are @500kg/m3.

SEASONING OF TIMBER

SEASONING - the controlled process of reducing the moisture content (MC) or sap of the timber so that it is suitable for the intended use in building construction.

WHY IS SEASONING REQUIRED

- Every time the MC reduces, the timber shrinks especially tangentially, and its weight also reduces.
- Consequently it will show fewer tendencies to warp, split or shake.
- The sap in timber is a food for fungi and wood parasites. Dry well seasoned timber has resistance to decay and rot.
- Dry well seasoned timber is stronger & durable.
- Dry well seasoned timber is easier to work with and consequently safer especially for machine working.
- Timber with higher moisture content is difficult to finish i.e. paint, varnish, etc. Dry well seasoned timber is takes high polish.
- Dry well seasoned timber has more life.

Fresh timber from trees contains 30-40% sap or moisture.

For construction grade timber the timber MC must be below 12-15% MC to reduce the chances of Dry Rot and other fungi infestations.

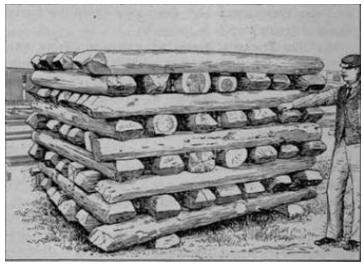
TYPES OF TIMBER SEASONING

- Natural Seasoning
- Artificial Seasoning
  a. Kiln seasoning
  b. Chemical seasoning
  c. Electric seasoning
- Water Seasoning

NATURAL SEASONING –

In the air seasoning or natural seasoning or natural drying, seasoning of timber, timber is dried by direct action of air, wind and sun. In this method, the timber logs are arranged one over the other, keeping some space or distance between them for air circulation of fresh air.

Generally this type of seasoning requires few months to over a year, this is very slow process.



ARTIFICIAL SEASONING –

A. KILN SEASONING

In kiln seasoning timber is placed in a chamber with some special heating arrangement.

In this process one thing should be kept in mind that heating system should be under control, other wise timber will be crack or wrap. The time required for this seasoning is 3 to 12 days. This is quick process.

B. CHEMICAL SEASONING

In chemical seasoning carbon dioxide, ammonium carbonate or urea are used as agents for seasoning, those are applied in dry state, the inter surface of timber dries first than outer side.

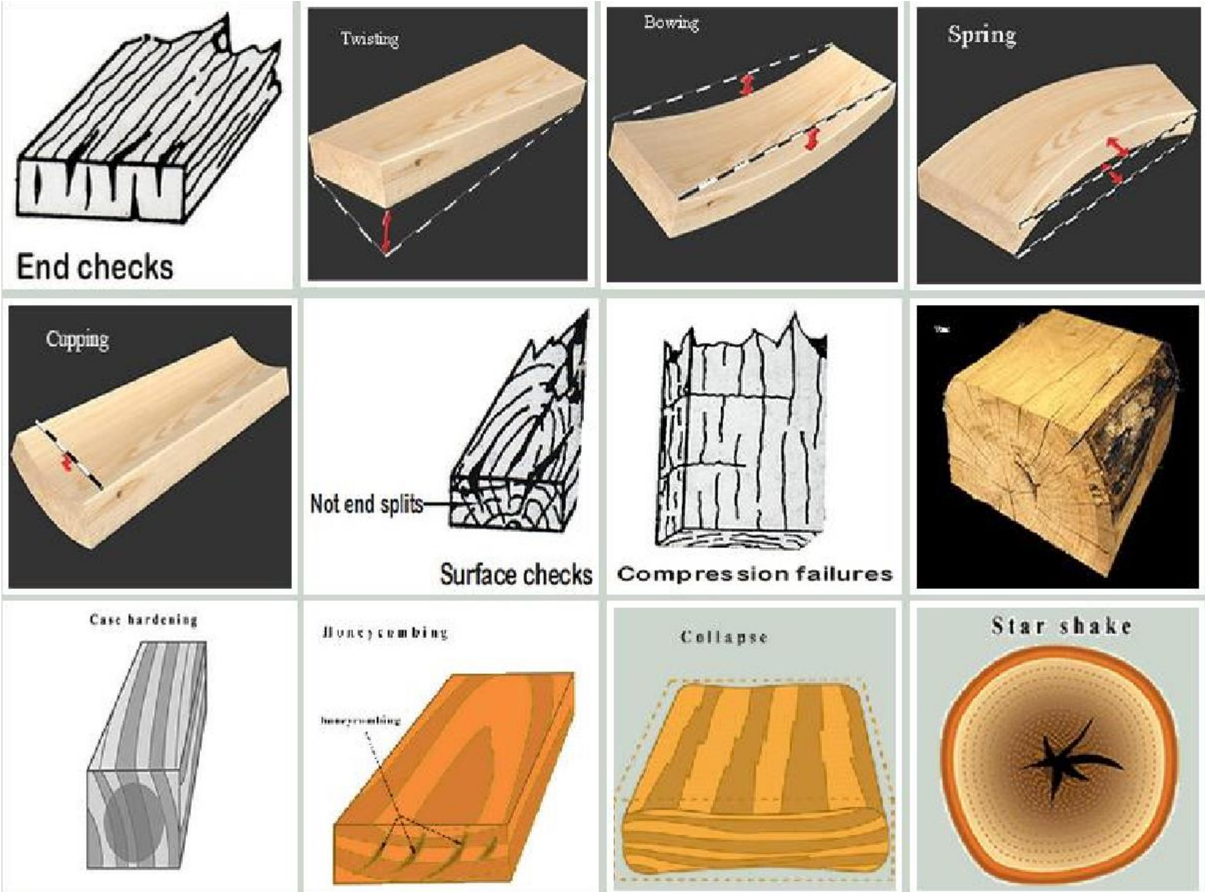
This ensures uniform seasoning. The time required for this seasoning is 30 to 40 days.

C. ELECTRICAL SEASONING

In this method electric current is passed through the timber logs. The time required for this seasoning is 05 to 08 hours.

WATER SEASONING –
Timber logs are kept immersed whole in flowing water. The sap present in timber is washed away. After that, the logs are taken out from water and are kept in open air, so water present in timber would be dried by air. The time required for this type of seasoning is 2-4 weeks.

SEASONING DEFECTS – Improper/ non-uniform seasoning can result to the following defects in the timber sections.


End checks
Twisting
Bowing
Spring
Cupping
Not end splits
Surface checks
Compression failures
Case hardening
Honeycombing
honeycombing
Collapse
Star shake

TIMBER FINISHING - PRESERVATION OF TIMBER

If the rough finish is the requirement can we leave it like that??? – If the timber surface needs to be protected from physical wear-tear and abuse, protective layer of preservative coat is most necessary. The type of preservative is selected based on the desired finished look. For eg is the natural rough finished look is desired then, a mineral oil based varnish with a matte finish can be used.

Timber has to be protected from the attack of insects, e.g. white ants etc., and from internal decay due to dry and wet rots.
Perfect seasoning is the most effective means of preservation. Timber should be so used that either it is wholly dry and well ventilated or is wholly under water. It will not decay when kept under water but it will become soft and weak.
Proper damp proofing of the building and providing free circulation of air around the built in portions of timber are essential for the preservation of the timber used. However, when these conditions cannot be obtained then preservatives have to be applied for preservation.
Timber should be well seasoned before the application of preservatives as otherwise the preservatives would block the pores of timber thereby causing its decay due to the entrapped moisture.
Direct contact with lime mortar should be avoided while using preservative with masonry.

METHODS OF PRESERVATION OF TIMBER

Following are some of the common methods of preservation adopted

- Charring
- Tarring
- Painting

Charring

Lower ends of the posts that are to be embedded in ground are generally charred with a view to prevent dry rot and attack of worms. It is done by quenching the ends of posts in water after they are charred on wood fire to a depth of 1.5 cm.

Tarring

It consists in coating with tar or tar mixed with pitch. Embedded portions of timber fence posts, ends of door and window frames, battens and beams built in wall are usually tarred. Tarring is not done in case of those portions of structural members that are open to view, because of unsightly black colour.

Painting

A paint when applied to timber acts not only as a good preservative but also it enhances the appearance of the surface so treated. Only well seasoned timber should be painted as otherwise the moisture entrapped in the timber, because of the closing of timber bores by paint, would cause decay. Paints however, protect seasoned timber against moisture thereby prolonging its life.

TIMBER JOINTS

The method used for joining or fixing two or more timber pieces together will depend on the function, strength and quality of the product.
There are several types of Timber joints, few of which are mentioned below:

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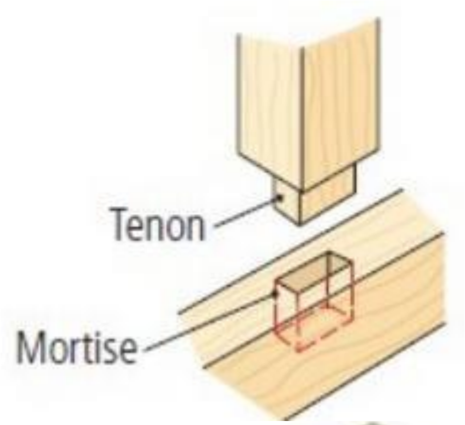

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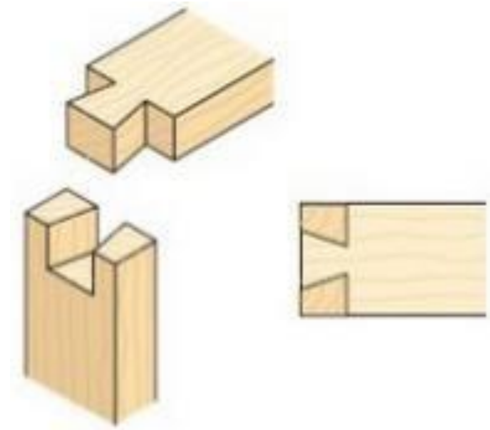
<td>DOVETAIL JOINT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<tr>
<td>HOUSING JOINT

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<td>TONGUE AND GROOVE JOINT


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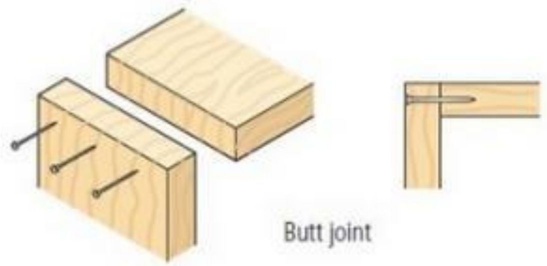
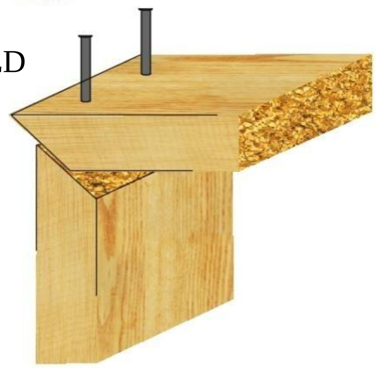
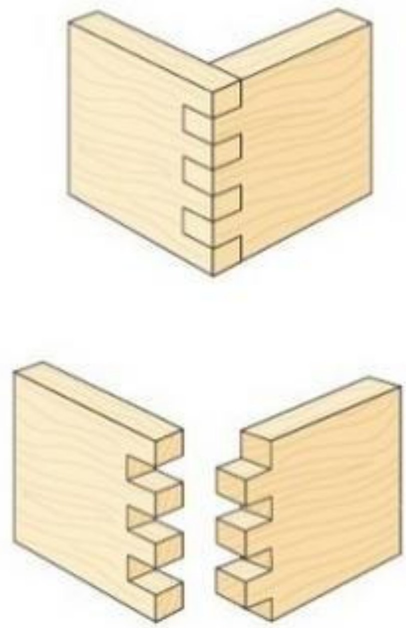
BUTT JOINT



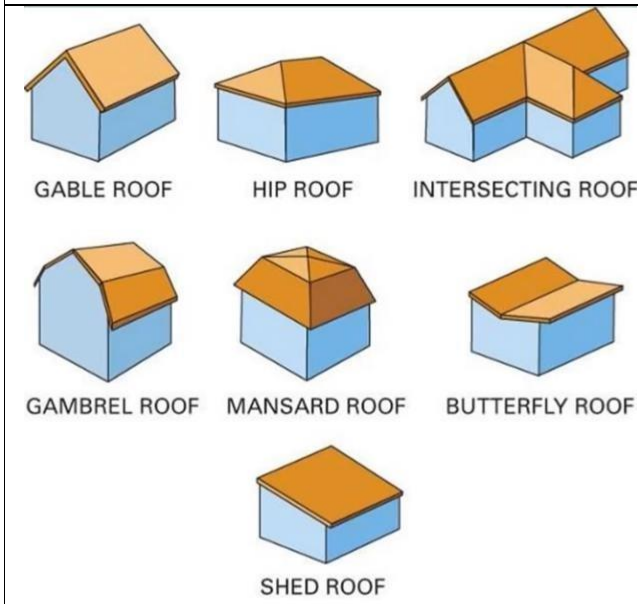
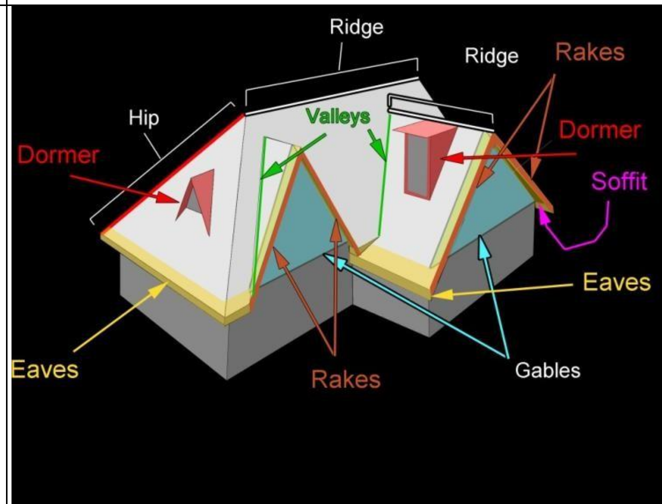
BEVELLED BUTT JOINT



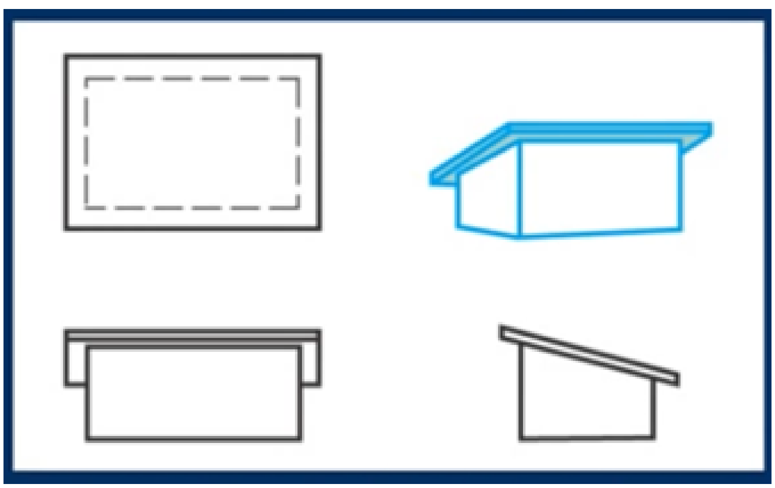
FINGER JOINT



TIMBER ROOFS

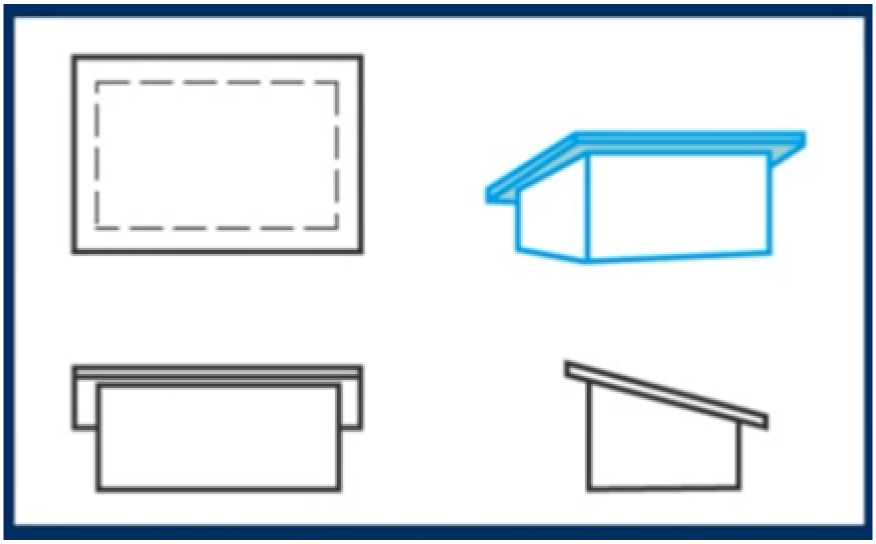
TYPES OF SLOPED ROOF	PARTS OF SLOPED ROOF
	

SHED ROOF



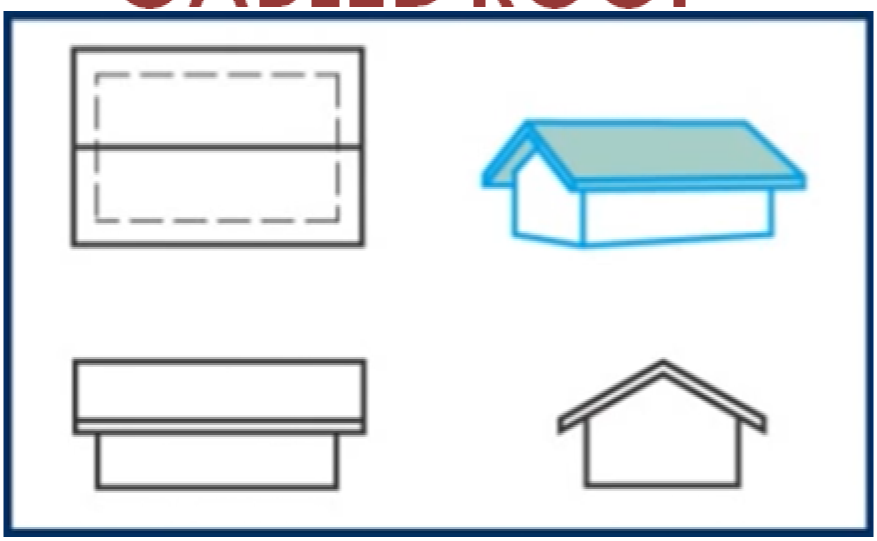
- SLOPES ONE WAY
- SIMILAR TO FLAT ROOF WITH A SLOPE
- OVERHANG / PROJECTION ON ALL FOUR SIDES FOR PROTECTION FROM WEATHER
- MOSTLY USED AS ADDITION TO OTHER ROOF STYLES

LEAN-TO ROOF

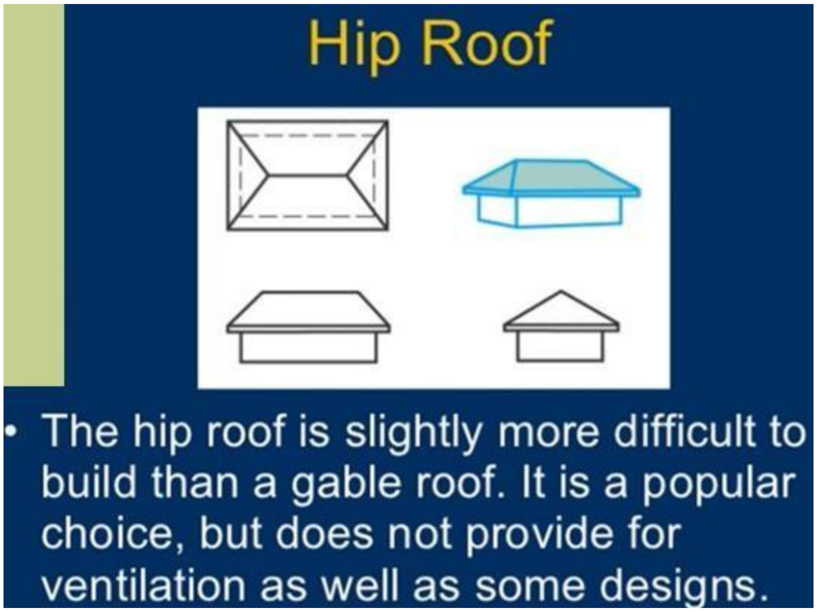


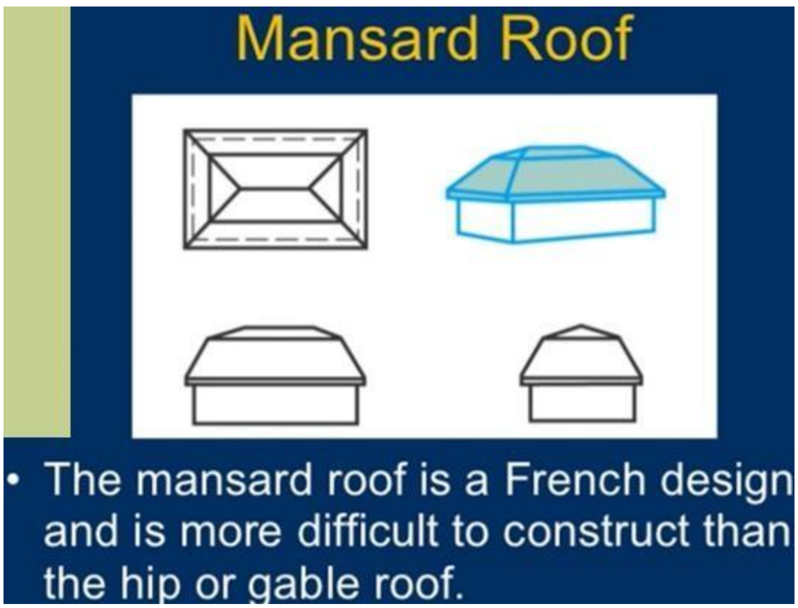
- SLOPES ONE WAY

GABLED ROOF



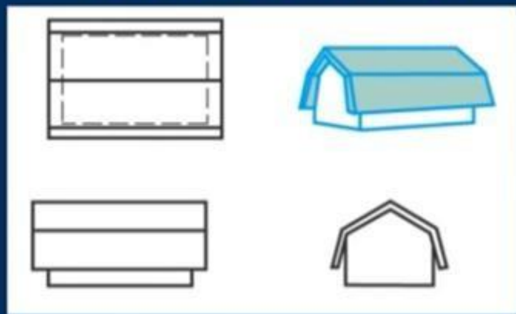
- SLOPES TWO WAY
- CENTRAL RIDGE
- OVERHANG ON ALL FOUR SIDES
- LOWER OVERHANG – CALLED EAVES
- UPPER OVERHANG – GABLE END OVERHANG – OR RAKE


Hip Roof
• The hip roof is slightly more difficult to build than a gable roof. It is a popular choice, but does not provide for ventilation as well as some designs.


Mansard Roof
• The mansard roof is a French design and is more difficult to construct than the hip or gable roof.

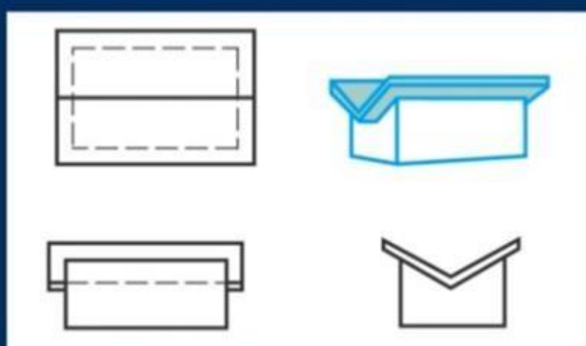

Dutch Hip Roof
• The Dutch hip roof is basically a hip roof with a small gable at either end. The gables can be used for ventilation.

Gambrel Roof



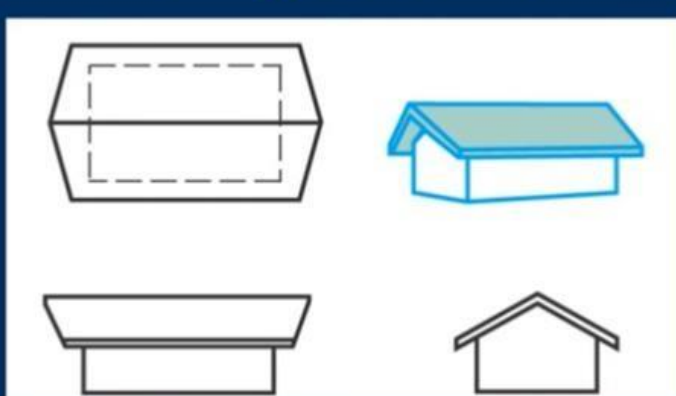
- The gambrel roof is sometimes called a barn roof because it has been used extensively on barns. It provides additional headroom in the attic.

Butterfly Roof



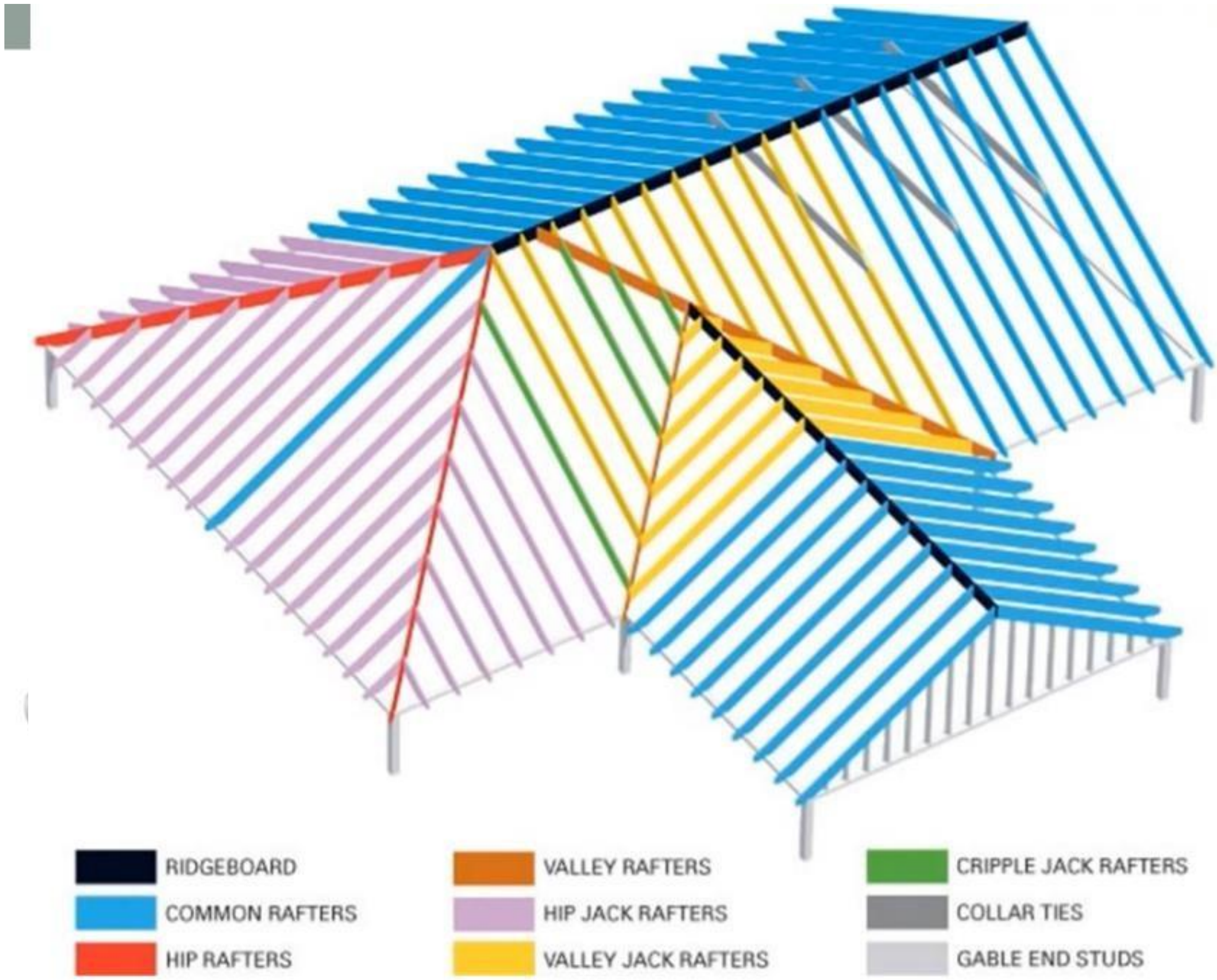
- The butterfly roof is not widely used. It provides plenty of light and ventilation, but drainage is a problem.

Winged Gable



- The winged gable is essentially a gable roof, extended at the peak.

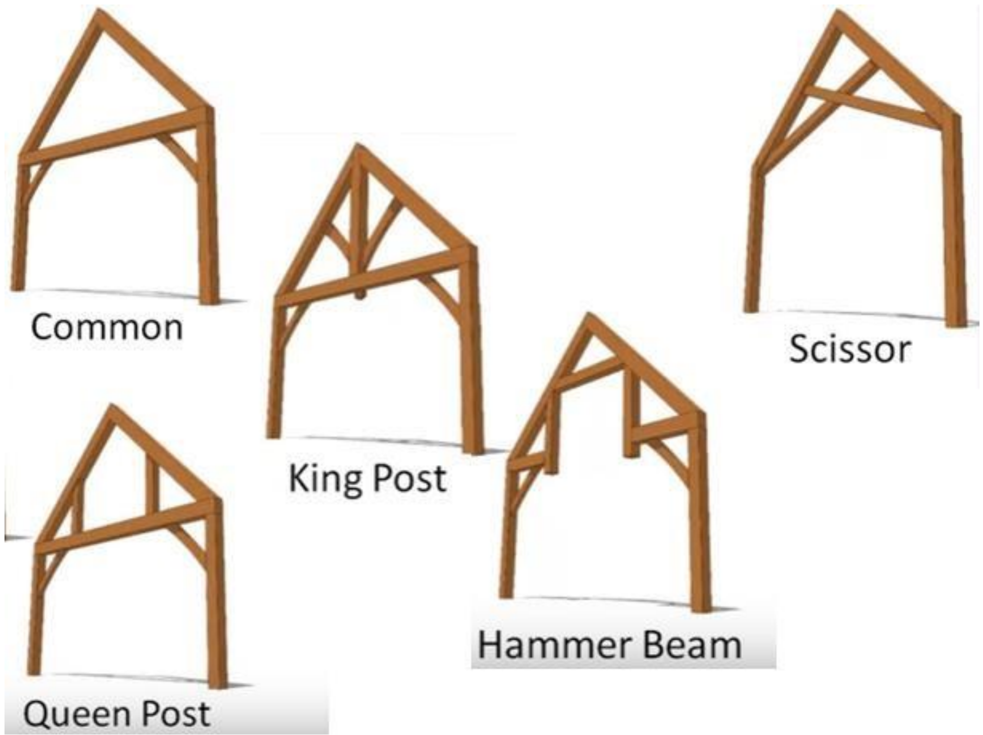
TYPES OF RAFTERS



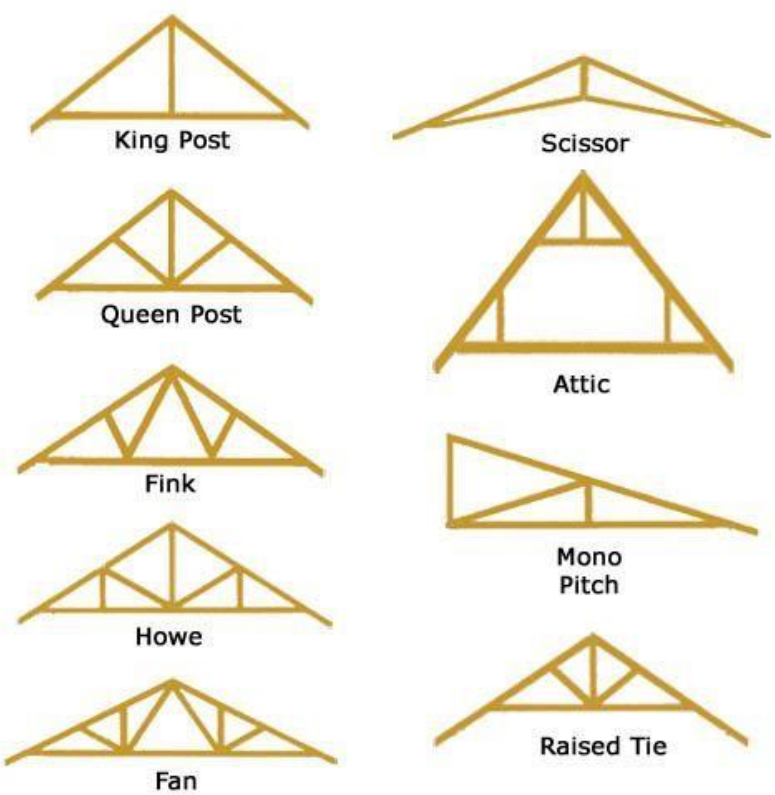
TIMBER TRUSSES

a framework, typically consisting of rafters, posts, and struts, supporting a roof, bridge, or other structure

5 MOST COMMON TYPES OF TIMBER TRUSSES



OTHER TYPES OF TIMBER TRUSSES

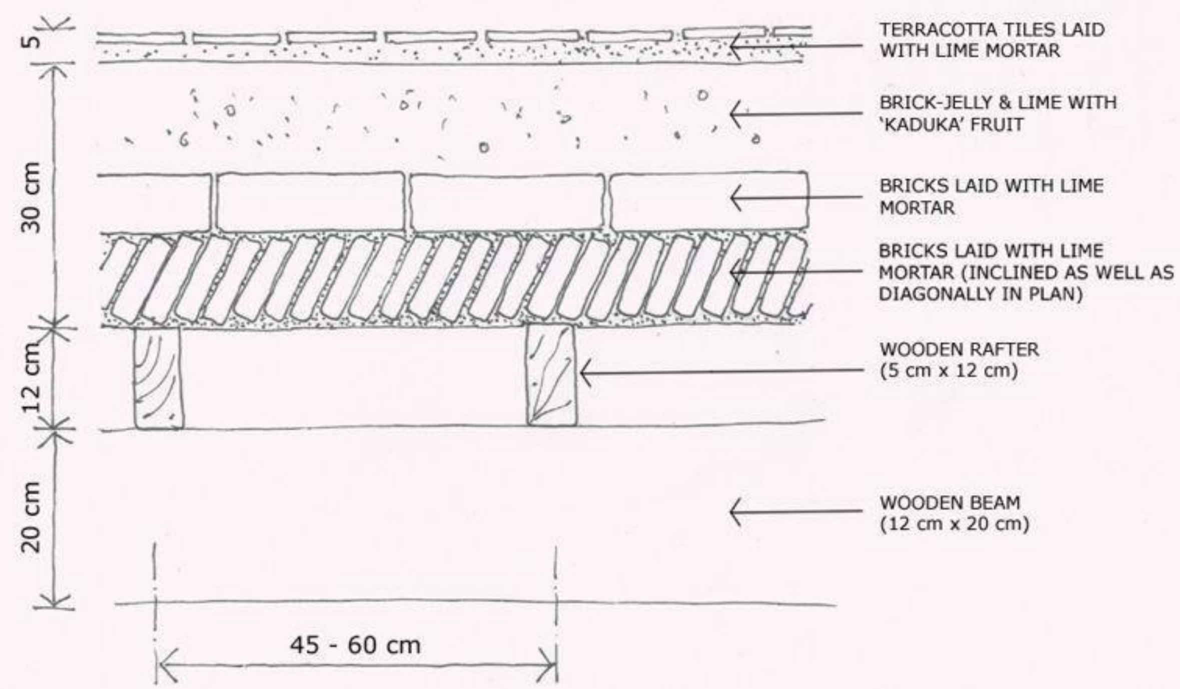


MADRAS TERRACE ROOF

This is a traditional ROOFING technique found particularly practiced in south India. It involves the use of wood and " aachikal " (a locally termed material which is a small brick)and lime plaster. Commonly used for small spans. Wooden beams are used to cover the span. Over this wooden beams are laid at intervals of less than 45cms from each other. The gaps between is filled with bricks on edge with lime plaster. Upon this " aactchikal brick "is laid on edge across in diagonal fashion plastered with lime.

MATERIALS USED

- 'AACHIKAAL' Brick
- Lime Plaster
- Wooden rafters & Wooden Beam
- Steel girders can replace wooden beam
- Brick Jelly
- lime
- 'Kaduka' Fruit/Jaggery etc



TYPICAL SECTION OF MADRAS TERRACE

CONSTRUCTION PROCEDURE

A load of mixed lime mortar may be allowed to sit as a lump for some time, without it drying out (it may get a thin crust). When ready to use, this lump may be remixed ('knocked up') again and then used. Traditionally on building sites, prior to the use of mechanical mixers, the lime putty (slaked on site in a pit) was mixed with sand by a labourer who would "beat and ram" the mix with a "larry" (a wide hoe with large holes). This was then covered with sand and allowed to sit for a while (from days to weeks) - a process known as 'banking'. This lump was then remixed and used as necessary. This process cannot be done with OPC.

- this system uses only lime plaster, which means even the ceiling plaster is in lime.

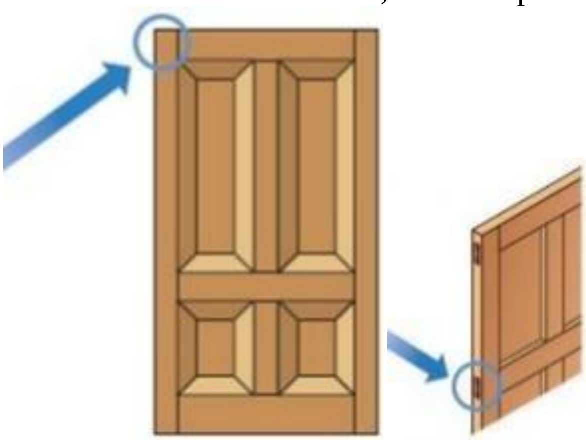
- This type of roof has a better insulation property than RCC roof but it is also heavy and that's why the load bearing wall thickness used to be 335 mm.




ADVANTAGES

- Lime mortar is not as strong in compression as OPC mortar, but both are sufficiently strong for construction of non-high-rise domestic properties.
- Lime mortar does not adhere as strongly to masonry as OPC. This is an advantage with softer types of masonry, where use of cement in many cases eventually results in cement pulling away some masonry material when it reaches the end of its life. The mortar is a sacrificial element which should be weaker than the bricks so it will crack before the bricks. It is less expensive to replace cracked mortar than cracked bricks.
- Under cracking conditions, OPC breaks, whereas lime often produces numerous micro cracks if the amount of movement is small. These micro cracks recrystallize through the action of 'free lime' effectively self-healing the affected area.
- Historic buildings are frequently constructed with relatively soft masonry units (e.g. soft brick and many types of stone), and minor movement in such buildings is quite common due to the nature of the foundations. This movement breaks the weakest part of the wall, and with OPC mortar this is usually the masonry. When lime mortar is used, the lime is the weaker element, and the mortar cracks in preference to the masonry. This results in much less damage, and is relatively simple to repair.

- Lime mortar is more porous than cement mortars, and it wicks any dampness in the wall to the surface where it evaporates. Thus any salt content in the water crystallises on the lime, damaging the lime and thus saving the masonry. Cement on the other hand evaporates water less than soft brick, so damp issues are liable to cause salt formation and spalling on brick surfaces and consequent disintegration of bricks. This damp evaporation ability is widely referred to as 'breathability'.
- Lime mortar should not be used below temperatures of 5 °C (41 °F) and takes longer to set so it should be protected from freezing for three months.
- Usually any dampness in the wall will cause the lime mortar to change colour, indicating the presence of moisture. The effect will create an often mottled appearance of a limewashed wall. As the moisture levels within a wall alter, so will the shade of a limewash. The darker the shade of limewash, the more pronounced this effect will become.



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SCHOOL OF BUILDING SCIENCE AND TECHNOLOGY

DEPARTMENT OF ARCHITECTURE

UNIT – III - MATERIAL AND CONSTRUCTION II – SAR 1205

WINDOW

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

WINDOW consists of two parts:-

1. Window frame

2. Window shutter

SOME TECHNICAL TERMS

FRAME:- It is an assembly of horizontal and vertical members, forming an enclosure,to which the shutters are fixed

SHUTTERS:-These are the openable parts of a door or window.

HEAD:-This is the top or uppermost horizontal part of frame

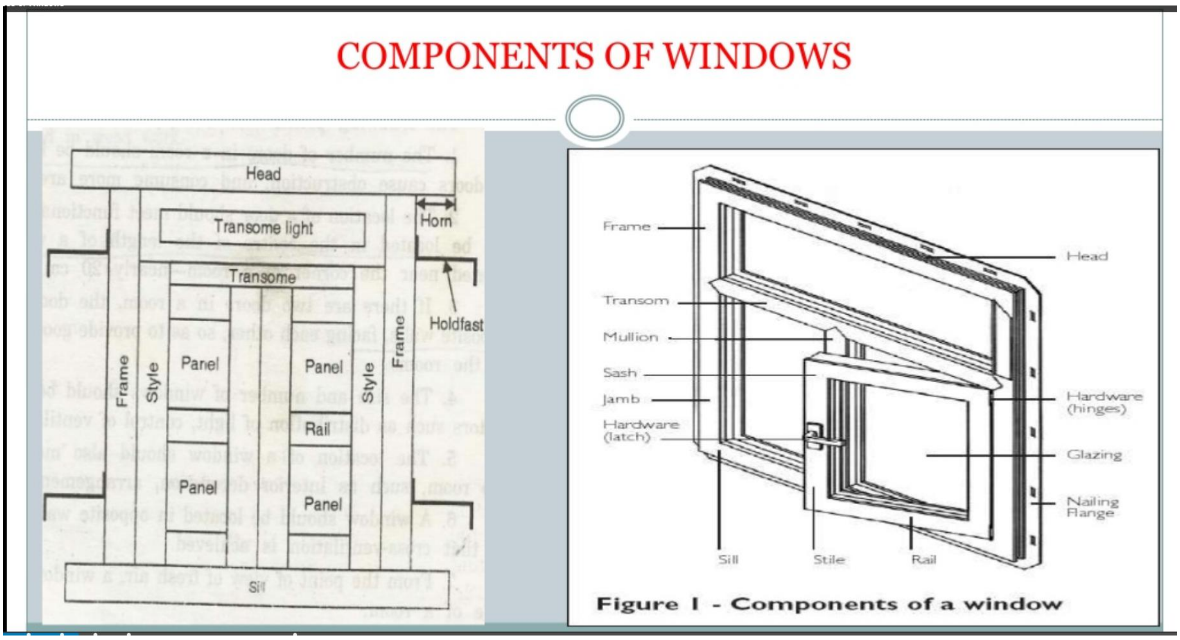
SILL:-This is the lowest or bottom horizontal part of a window frame, not provided in door frames.

HORN:- These are the horizontal projections of a frame.

LOCATION OF WINDOWS

The window should be located in opposite wall, facing a door or another window, to achieve cross ventilation.

The sill should be located about 70 t0 80 cm about floor level of the room.



How to select the timber for window and Ventilator ?

important to select right type of timber-best local or regional wood,

In Tamilnadu-TEAK,Vengai,jackfruit,mahogany and salwood are commenly used local wood

seasoning range should be 12-15% in colder region the range will be more

Anti termite treatment-The timber should be chemically treated to protect from termitr attacks,except in case of teak,paduak are naturally resistance to termite.

Mature wood of 20 -40 years old

Sustainability- wastage in timber

WHAT ARE THE FACTOR TO BE CONSIDER FOR WINDOW PLACEMENT IN DESIGN?

Lighting

Ventilation

View

Orientation -sun path

Privacy

Direct radiation

REBATE :- It is the

depression or recess made inside the door frame to receive the door shutter.

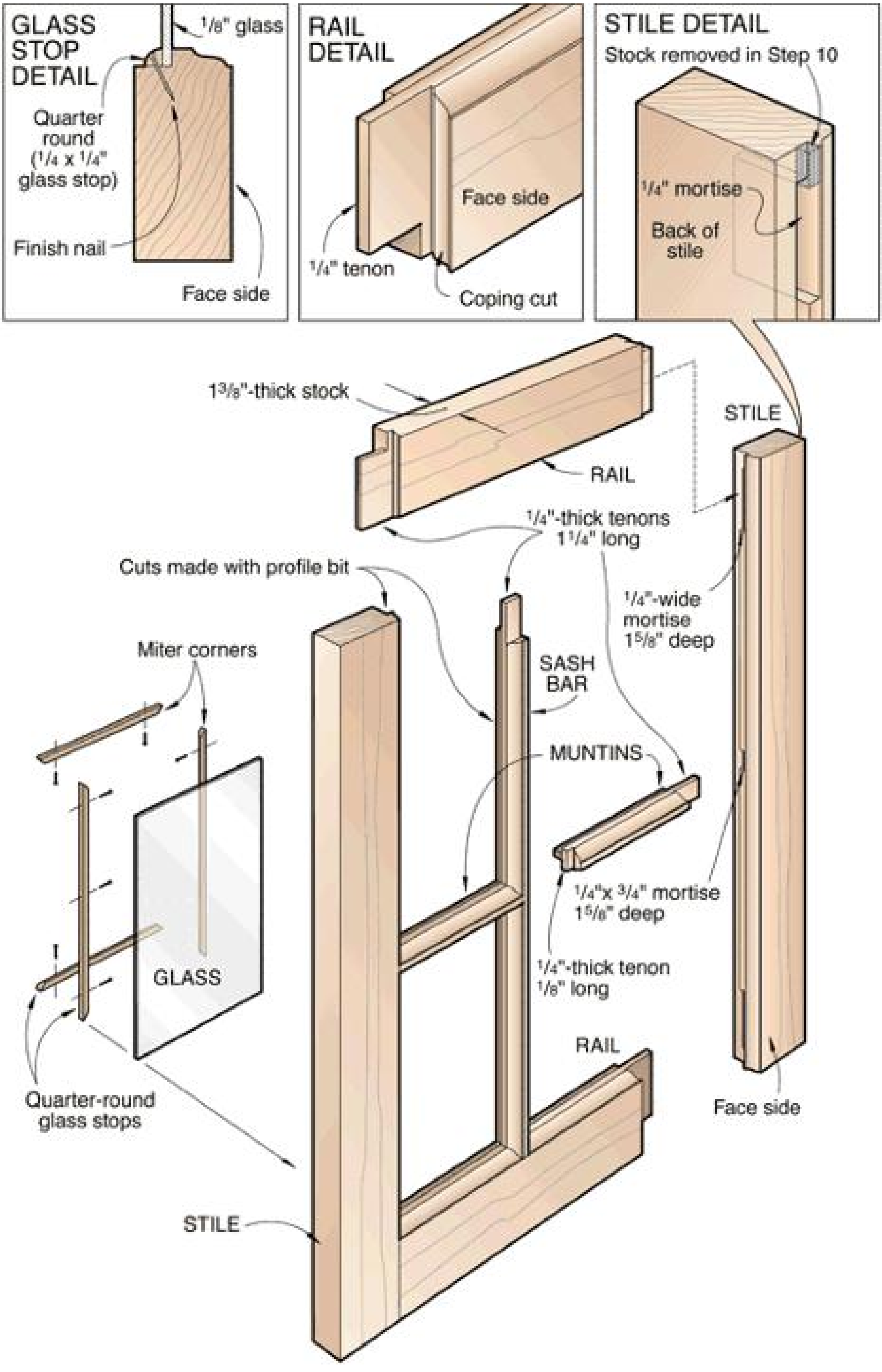
Standard Size of the Frame is 100 X 62 mm

The size of single shutter window-600mm+ 44mm+44mm

Conventional window

Shutter size - 530 mm width

1350 mm height



GLASS STOP DETAIL
1/8" glass
Quarter round (1/4 x 1/4" glass stop)
Finish nail
Face side
RAIL DETAIL
Face side
1/4" tenon
Coping cut
STILE DETAIL
Stock removed in Step 10
1/4" mortise
Back of stile
1 3/8"-thick stock
RAIL
STILE
1/4"-thick tenons 1 1/4" long
Cuts made with profile bit
1/4"-wide mortise 1 5/8" deep
Miter corners
SASH BAR
MUNTINS
1/4"x 3/4" mortise 1 5/8" deep
1/4"-thick tenon 1/8" long
GLASS
RAIL
Face side
Quarter-round glass stops
STILE

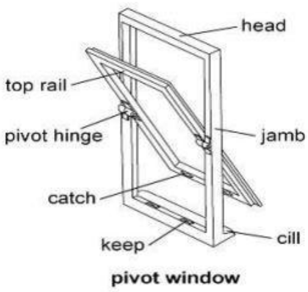
❖ Fixed Window

- In this type, the glass pane is permanently fixed in the opening of the wall.
- The shutter can't be opened or closed.
- The function is limited to allowing light and or permit vision in the room.
- No rebates are provided to the frame.
- The shutters are fully glazed.
- In homes they are generally decorative windows near doors, stairwells and high-places or are used in combination with other styles.

❖ Pivoted windows

- In this type of window, the shutter is capable of rotating about a pivot fixed to window frame.
- The frame has no rebate.
- The shutter can swing horizontally or vertically.

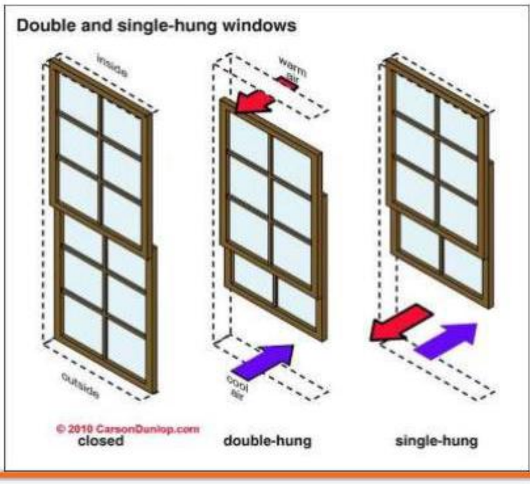
Horizontal pivoted

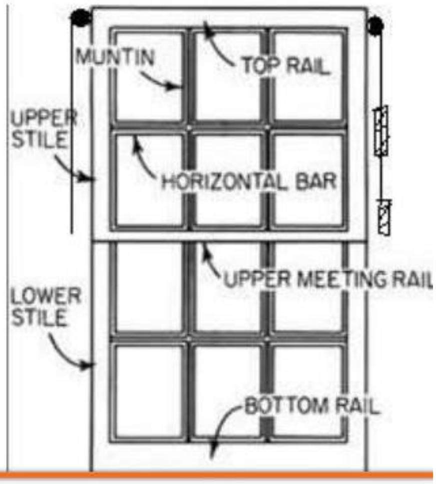


Vertical pivoted

DOUBLE HUNG WINDOW

- Special frames called boxed or cased frame is used, which consists of two vertical members spaced apart to create a groove to slide the shutter.
- A parting bead is provided in the groove of the frame to keep the two shutters apart.
- Only the bottom sash slides upward in a **single-hung** window. In single-hung windows the top sash is fixed and can't be moved.





❖ Sliding Window or Slider:

- Has two or more sashes that overlap slightly but slide horizontally within the frame.
- Suitable openings or grooves are left in the frame or wall to accommodate the shutters when are shutters are opened.

Pocket sliding window
The shutter slides inside the gap of the wall.

❖ Casement windows

- Casement windows are hinged at the sides.
- When fully opened, offer the maximum amount of ventilation.
- Operates like a hinged door, except that it opens and closes with a lever inside the window.
- The shutter consists of styles, top rail, bottom rail and intermediate rail.
- Depending upon the design, the frame can have additional vertical and horizontal members i.e. mullion and transom respectively.
- The panels may be either glazed, unglazed or partly glazed and are fixed in the grooves made in rails and styles.

❖ Glazed window

- This is a type of casement window where panels are fully glazed.
- The frame has styles, top rail and a bottom rail.
- The space between top and bottom rail is divided into number of panels with small timber members called, sash bars or glazing bars.
- The glass panels are cut 1.5-3.0 mm smaller in size than the panel size to permit movement of sash bars.
- Glass panes are fixed to sash bars by putty or by timber beads.

❖Louvered window

- They are provided for the sole function of ventilation and not for the vision outside.
- The styles are grooved to receive a series of louvers which may be of glass or wood slates.
- The louvers re usually fixed at 45^0 inclination sloping downward to the outside to run-off the rain water.
- The windows provide light and ventilation even if closed.
- Such windows are recommended for bath, WC, workshops etc., where privacy is more important.
- Venetian shutters uses louvers which can be opened or closed. The louvers are pivoted at both ends in the frame and in addition each blade is connected to a vertical batten by hinge.

❖ Bay window

- The window projecting outward from the external walls .
- Wide and decoratively impressive allow for 180° view.
- A multi-panel window, with at least three panels set at different angles to create an extension from the wall line.
- it is commonly used in cold country where snow often falls.
- They may be triangular, circular, rectangular or polygonal in plan.

❖ Clerestory window

- These are provided to permit light and ventilation to a room having more height than the adjoining rooms or when the ventilation is restricted.
- Generally provided near the top of main roof and they open above the slab of adjoining rooms.
- The shutters are generally pivoted at centre.
- The shutter can be opened or closed by means of two chords, each attached to the rails of the shutter.
- The shutter must swing in such a way that the upper part opens inside the room and lower part opens outside, to exclude rain water.

❖ Corner window

- These are provided at the corner of the room.
- Light and air is admitted from two directions.
- The jamb post at the corner is made of heavy section.

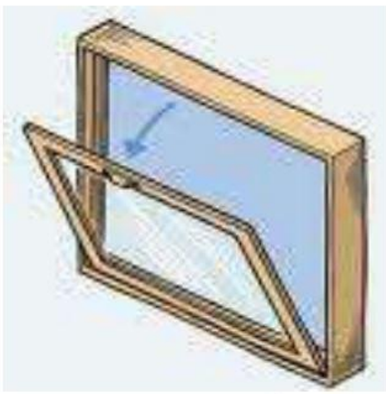
❖ Dormer window and Gable window

- The windows provided at the dormer end and gable end of the sloping roof to provide light and ventilation to the enclosed space below the roof.

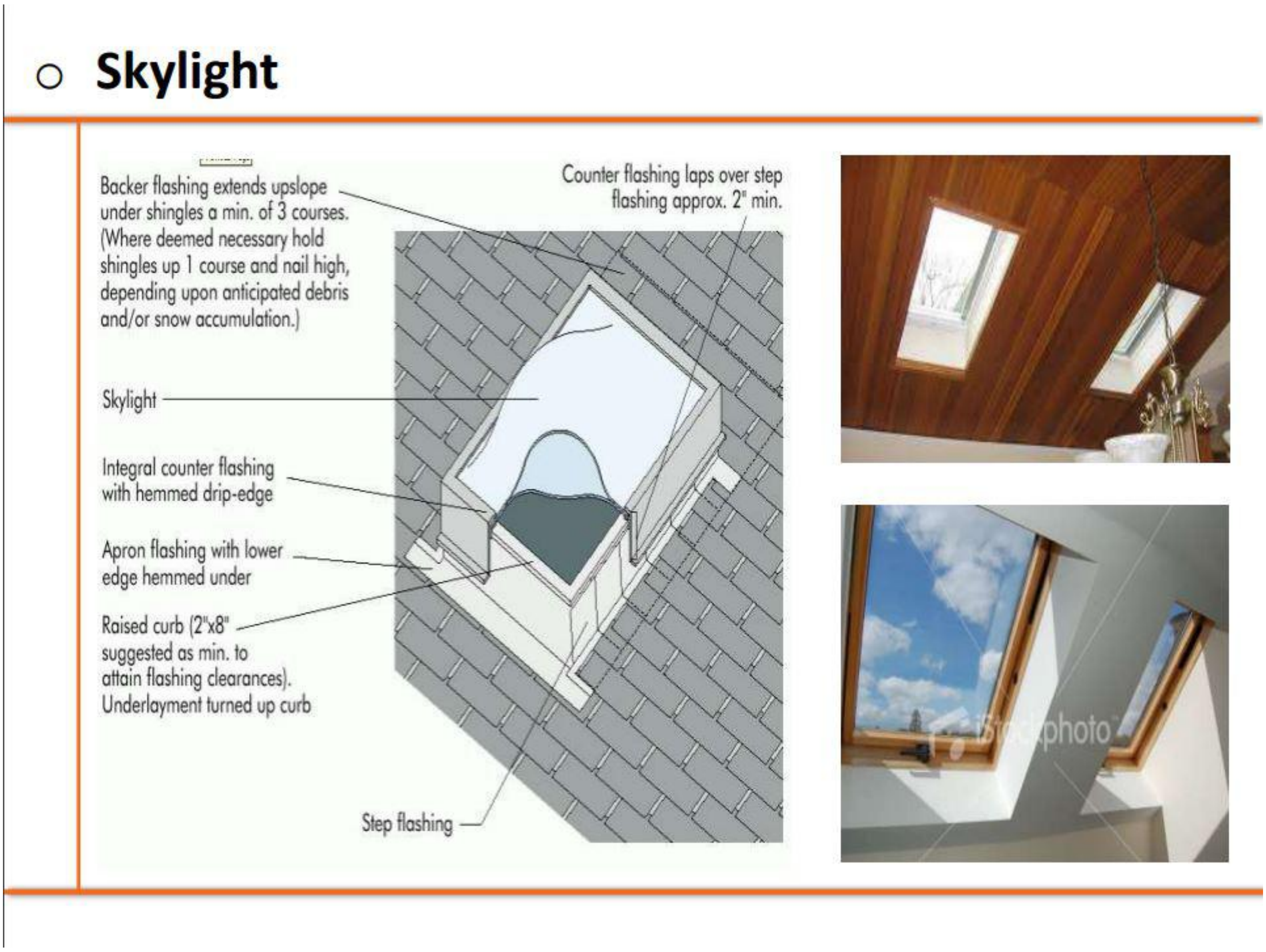
❖ Awning windows

- Awning windows are hinged at the top and open outward. They are designed to provide ventilation without letting in rain, etc.
- Awning windows can be used alone or in vertical or horizontal groups in combination with additional awning windows, other types of windows, or above doors.
-

Awning windows



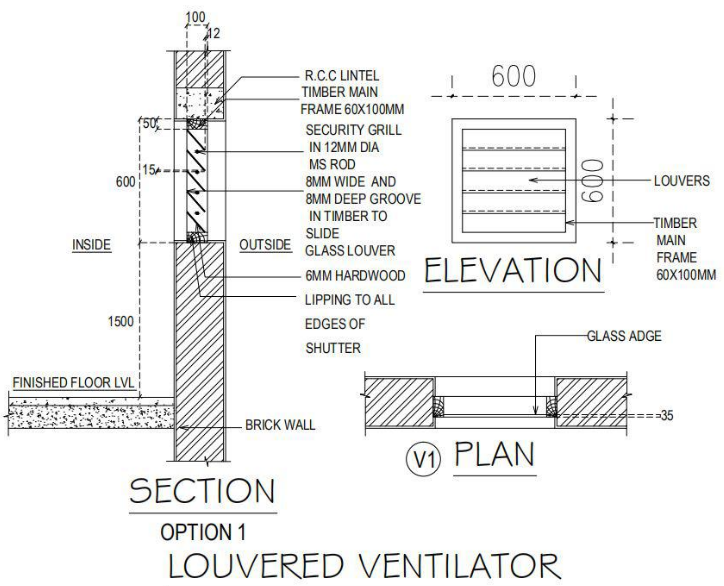
Hopper windows



Ventilator

It is a small window secured in an opening wall provided at greater height i.e. near to roof of room or at lintel level or at top of door or window for purpose of providing ventilation in room.

It generally provided in w.c. , bath & storeroom.



HINGES

BACK FLAP HINGE

COUNTER FLAP HINGE

BACK FLAP HINGE

FRICTION STAY HINGE

❖ Locks

Mortise lock

Rim lock

Cupboard lock

Lever handle lock

Pad lock

TIMBER DOORS

Definition of door :

– A door may be defined as "an open able barrier or as a framework of wood, steel , aluminum, glass or a combination of these materials secured in a wall opening".

Function of door :

– It is provided to give access to the inside of a room of a building.

– It serves as a connecting link between the various internal portion of building.

– They admit ventilation and light.

– Controls the physical atmosphere within a space by enclosing it, excluding air drafts, so that interiors may be more effectively heated or cooled.

– They act as a barrier to noise.

- Door should open outside in a public space for ease of emergency evacuation.

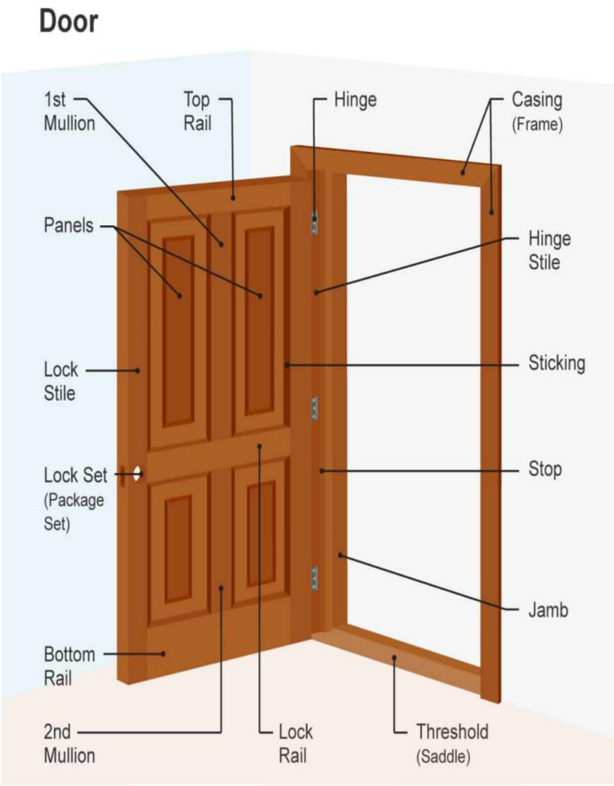
LOCATION OF doors

• The number should be kept as minimum.

• It should meet the functional requirement.

• It should preferably be located at the corner of the room, nearly 20 cm from corner.

• If in a room, more than 2 doors are there, they shall be aligned along one side without affecting function of the room.



WHAT ARE THE FACTOR TO BE CONSIDER FOR DOOR PLACEMENT IN DESIGN?

Lighting

Ventilation

View

Privacy

Circulation

Emergency

Safety and Security

Standard Size of the Frame is 100 X 62 mm

Toilet door width 830 or 750 mm.

Room door width 975 or 900.

The normal thickness of shutter is 32mm, main doors 43mm.

General sizes used:

a) Residential

External door – 1.0 x 2.1 to 1.1 x 2.1 m

Internal door - 0.9 x 2.1 to 0.975x 2.1 m

Bath & WC – 0.75 X 2.1 to 0.83 x 2.1 m

Garages for cars – 2.25 x 2.25 m to 2.40 x 2.25 m

b) Public

1.2 x 2.1 m or 1.2 x 2.25 m

Hinged doors

Most doors are hinged along one side to allow the door to pivot away from the doorway in one direction but not in the other. The axis of rotation is usually vertical.

The most common door type. It is a simple & rigid.

The panel swings, opens and closes, on hinges.

Hinged doors require a minimum amount of maintenance and cleaning, they are not expensive, and have an excellent insulating ability.

However, they take up precious room space to swing in.

Revolving doors

Such types are provided in public buildings, like

banks, museums, hotels, offices etc.

• A revolving door normally has four wings/leaves

that hang on a center shaft and rotate one way about

a vertical axis within a round enclosure. The central

shaft is fitted with ball bearing arrangement at the

bottom, which allows the shutters to move without

any jerk and making noise.

• The radiating shutters may be fully paneled, fully

glazed or partly glazed. The glass doors allow people

to see and anticipate each other while walking

through. Vertical rubber pieces are provided at the

rubbing end of the shutter to prevent drought of air.

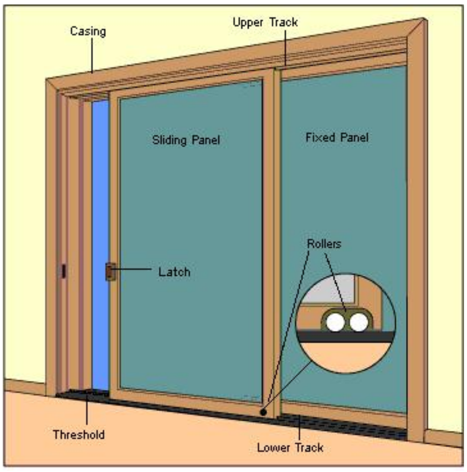
• People can walk out of and into the building at

the same time.

• The door closes automatically when not in use.

Sliding doors

In these doors, the shutter slide horizontally along tracks with the help of runners and rails. often for space or



• Sliding glass doors are common in places where there is no space to swing the door.

• Such doors are very popular for use for the entrances to commercial structures and also in residential buildings for aesthetic considerations.

• Sliding doors consist of either one, two or three doors that slide by each other on a track depending upon the size of opening and space available for sliding.

• They are pretty easily cleaned and maintained.

• These doors sound insulation is pretty poor usually, and they must be of high

quality and fitted exactly in their tracks or else they may slide out of them.

• When fully open these doors will allow half the space of the opening in double sliding doors, or one third if triple.

Swing doors

The shutter is fitted to its frame by special double action hinges.

• The hinges permits the shutter to move both ways, inward as well as outward.

• The doors are not rebated at the meeting styles.

• To open the door, a slight push is made and the spring action brings the shutter in closed position.

The return of the shutter is with force and thus, the door shall be either fully glazed Or provided with a peep hole at eye level, to avoid accidents.

Folded doors

• Made of many narrow vertical strips or creases that fold back to back into a compact bundle when doors are pushed open, these strips or creases will be hanged from the top, and run on a track. They save space as they do not swing out of the door opening, though their sound and weather isolation is poor. Folding doors are usually pretty noisy, and considered not so durable

Pivot doors

The pivot doors are designed to rotate in its vertical axis. Available with or without a stopper, this door can effortlessly rotate 360 degree in its own axis thus achieving an elegant swing in the space. The system is formed with sophisticated hinges hidden on the top and bottom of the door which forms the centre from where the door rotates. Since the hinges are concealed, the doors are designed and manufactured in large size to make it look elegant and functional.

POCKET DOOR

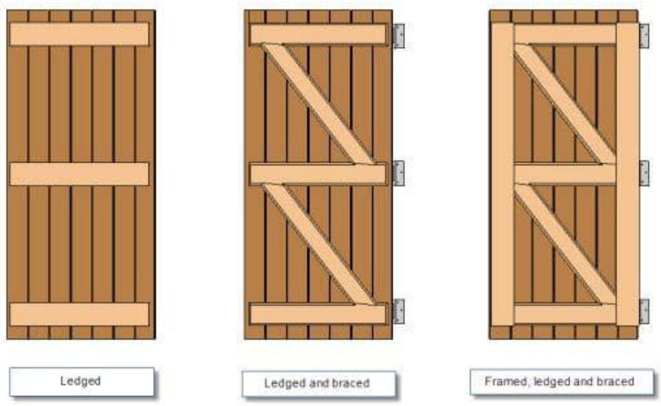
A pocket door is a sliding door that, when fully open, disappears into a compartment in the adjacent wall. Pocket doors are used for architectural effect, or when there is no room for the swing of a hinged door. They can travel on rollers suspended from an overhead track or tracks or guides along the floor. Single- and double-door versions are used, depending on how wide an entry is desired.

Battened & ledged doors

• These doors consist of vertical boards called battens which are nailed or screwed to the horizontal members, called ledges . Often the battens are about 15 to 18 cm wide and 2 to 3 cm thick. Doors made with narrow battens like these have a better appearance.

– With Braces

• This is a ledged and battened door to which braces have been added to prevent sagging. These braces must slope upwards from the hinge edge of the door, and they are housed with a skew notch into the ledges.



Framed & Paneled Door

– These doors consist of a frame made up of

(a) Stiles

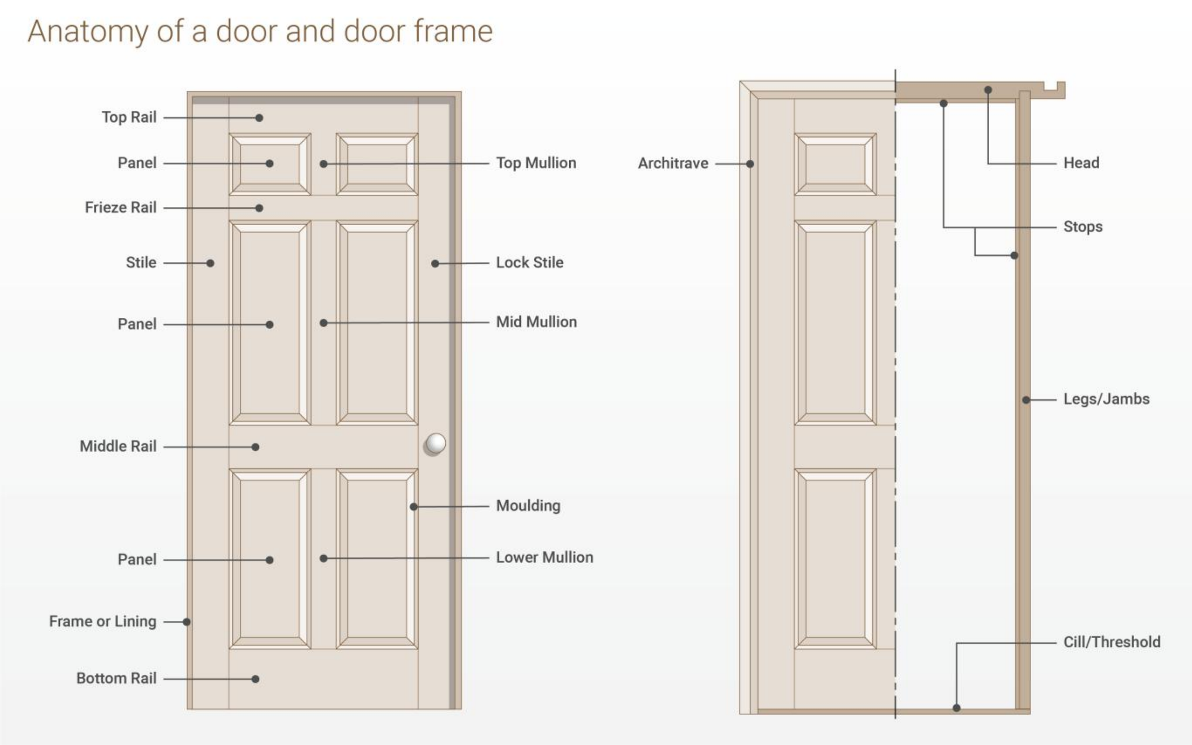
(b) a top rail

(c) sometimes an intermediate rail

(d) into this framework a plywood panel

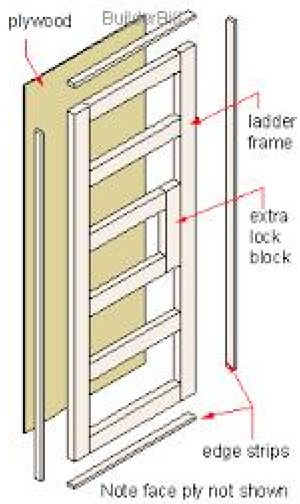
(e) is fitted

– This panel may fit into a groove or a rebate.



Flush Doors

• The flush door with a framed core is a type of door that we frequently make in Rural Building. This door consists of a frame which has stiles, top and bottom rails, and narrow intermediate rails. It is covered on each side by a sheet of Plywood-covered flush doors cannot be used where they will be exposed to rain and sun.



Flush Door Components

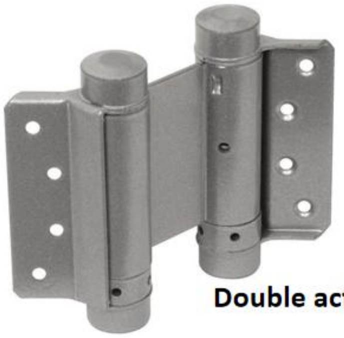
Louvered Doors

• These permit free ventilation through them and at the same time maintain the privacy of the room.

Moulded Skin Door

A Moulded Skin Door has the same structure as that of flush door. The only difference is that the surface material is a Moulded Skin made of HDF. It is commonly used as interior doors. The door shutters are most durable and highly dimensionally stable. Not recommended in humid areas and were rainfall is high. Not for exterior door.

HINGES



Double action spring Hinge

BACK FLAP HINGE

Pivot HINGE

Hydraulic Floor Hinge

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SCHOOL OF BUILDING AND ENVIRONMENT

DEPARTMENT OF ARCHITECTURE

UNIT – IV -PROTECTIVE COATINGS – SAR1205

SAR 1205 MATERIALS AND CONSTRUCTION II

COURSE OBJECTIVE:

To introduce the students to various assembly systems such as doors, windows and ventilators and to explore various possibilities in joineries through carpentry workshops.

UNIT 1 MANUFACTURED BUILDING MATERIALS

Classification of glass - Composition of glass, its properties and uses - Various types of glass e.g. plate glass, figured glass, float glass (toughened glass, laminated glass), tinted glass, reflective glass, wired glass, foam glass, glass block, fiber glass, float glass, obscured glass etc. - Decorative glass, insulated glass (sound, heat) - properties and application in building industry, glazing and energy conservation measures.

UNIT 2 TIMBER IN CONSTRUCTION

Timbers -Methods of construction using natural timber in joinery works including methods of fixing and options for finishing - Exercises involving the above through drawings - Introduction to simple trusses - Mangalore tiles, madras terrace roofing, - fixing details.

UNIT 3 TIMBER JOINERIES

Different types and methods of fixing - Windows (paneled, louvered, glazed, pivoted and sliding windows) - Doors (paneled, glazed, sliding, folding, louvered and pivoted) - Ventilators (top hung, louvered, and glazed) - Hardware for doors, windows and ventilators and application for a simple structure with schedule of joinery.

UNIT 4 PROTECTIVE COATINGS

Paints and Varnishes - Composition, manufacture and properties and uses of ordinary paints, enamels, distemper, plastic emulsion, special paints- fire retardant, luminous and bituminous paints, defects in paints-Varnishes and wood preservatives, method of distempering wall surfaces, painting of timber and iron work. Composition, characteristics, preparation, Primer, Painting different surfaces.

S Y L L A B U S

1. Holistic understanding of types of joinery used in timber construction and their construction techniques.
2. Construct knowledge on various roofing techniques.
3. Exploring timber joinery details related to openings such as doors and windows.
4. Criticize the various methods of timber construction based on strength and application.
5. Generate detailed drawings in order to express better design

COURSEOUTCOME - UNIT- 4

Protective Coatings - Paints & Varnishes

 Composition, manufacture and properties and uses Defects in Paints-Varnishes and wood preservatives Method of distempering wall surfaces Composition, characteristics, preparation, Primer Painting of timber and iron work Painting different surfaces

UNIT 4: PROTECTIVE COATINGS

PAINTS

DEFINITION

Paint is any liquid, liquefiable, or mastic composition that, after application to a substrate in a thin layer, converts to a solid film. It is most commonly used to protect, color, or provide texture to objects. Paint can be made or purchased in many colors—and in many different types, such as watercolor, synthetic, etc. Paint is typically stored, sold, and applied as a liquid, but most types dry into a solid.

COMPONENTS

Vehicle

The vehicle is composed of the binder; or, if it is necessary to thin the binder with a diluent like solvent or water, it is the combination of binder + diluent. In this case, once the paint has dried or cured very nearly all of the diluent has evaporated and only the binder is left on the coated surface. Thus, an important quantity in coatings formulation is the "vehicle solids", sometimes called the "resin solids" of the formula. This is the proportion of the wet coating weight that is binder, i.e. the polymer backbone of the film that will remain after drying or curing is complete.

Binder or film former/resin

The binder is the film-forming component of paint. It is the only component that is always present among all the various types of formulations. Many binders are too thick to be applied and must be thinned. The type of thinner, if present, varies with the binder. The binder imparts properties such as gloss, durability, flexibility, and toughness. Binders include synthetic or natural resins such as alkyds, acrylics, vinyl-acrylics, vinyl acetate/ethylene (VAE), polyurethanes, polyesters, melamine resins, epoxy, silanes or siloxanes or oils.

Binders can be categorized according to the mechanisms for film formation. Thermoplastic mechanisms include drying and coalescence. Drying refers to simple evaporation of the solvent or thinner to leave a coherent film behind. Coalescence refers to a mechanism that involves drying followed by actual interpenetration and fusion of formerly discrete particles. Thermoplastic film-forming mechanisms are sometimes described as "thermoplastic cure" but that is a misnomer because no chemical curing reactions are required to knit the film. Thermosetting mechanisms, on the other hand, are true curing mechanism that involve chemical reaction(s) among the polymers that make up the binder.

Thermoplastic mechanisms: Some films are formed by simple cooling of the binder. For example, encaustic or wax paints are liquid when warm, and harden upon cooling. In many cases, they resoften or liquify if reheated.

Paints that dry by solvent evaporation and contain the solid binder dissolved in a solvent are known as lacquers. A solid film forms when the solvent evaporates. Because no chemical crosslinking is involved, the film can re-dissolve in solvent; as such, lacquers are unsuitable for applications where chemical resistance is important. Classic nitrocellulose lacquers fall into this category, as do non-grain raising stains composed of dyes dissolved in solvent. Performance varies by formulation, but lacquers generally tend to have better UV resistance and lower corrosion resistance than comparable systems that cure by polymerization or coalescence.

The paint type known as Emulsion in the UK and Latex in the United States is a water-borne dispersion of sub-micrometer polymer particles. These terms in their respective countries cover all paints that use synthetic polymers such as acrylic, vinyl acrylic (PVA), styrene acrylic, etc. as binders. The term "latex" in the context of paint in the United States simply means an aqueous dispersion; latex rubber from the rubber tree is not an ingredient. These dispersions are prepared by emulsion polymerization. Such paints cure by a process called coalescence where first the water, and then the trace, or coalescing, solvent, evaporate and draw together and soften the binder particles and fuse them together into irreversibly bound networked structures, so that the paint cannot redissolve in the solvent/water that originally carried it. The residual surfactants in paint, as well as hydrolytic effects with some polymers cause the paint to remain susceptible to softening and, over time, degradation by water. The general term of latex paint is usually used in the United States, while the term emulsion paint is used for the same products in the UK and the term latex paint is not used at all.

Thermosetting mechanisms: Paints that cure by polymerization are generally one- or two package coatings that polymerize by way of a chemical reaction, and cure into a crosslinked film. Depending on composition they may need to dry first, by evaporation of solvent. Classic two-package epoxies or polyurethanes would fall into this category. The "drying oils", counter-intuitively, actually cure by a crosslinking reaction even if they are not put through an oven cycle and seem to simply dry in air. The film formation mechanism of the simplest examples involve first evaporation of solvents followed by reaction with oxygen from the environment over a period of days, weeks and even months to create a crosslinked network. Classic alkyd enamels would fall into this category. Oxidative cure coatings are catalyzed by metal complex driers such as cobalt naphthenate.

Recent environmental requirements restrict the use of volatile organic compounds (VOCs), and alternative means of curing have been developed, generally for industrial purposes. UV curing paints, for example, enable formulation with very low amounts of solvent, or even none at all. This can be achieved because of the monomers and oligomers used in the coating have relatively very low molecular weight, and are therefore low enough in viscosity to enable good fluid flow without the need for additional thinner. If solvent is present in significant amounts, generally it is mostly evaporated first and then crosslinking is initiated by ultraviolet light. Similarly, powder coatings contain little or no solvent. Flow and cure are produced by heating of the substrate after electrostatic application of the dry powder.

Combination mechanisms: So-called "catalyzed" lacquers" or "crosslinking latex" coatings are designed to form films by a combination of methods: classic drying plus a curing reaction that benefits from the catalyst. There are paints called plastisols/organosols, which are made by blending PVC granules with a plasticiser. These are stoved and the mix coalesces.

DILUENT OR SOLVENT OR THINNER

The main purposes of the diluent are to dissolve the polymer and adjust the viscosity of the paint. It is volatile and does not become part of the paint film. It also controls flow and application properties, and in some cases can affect the stability of the paint while in liquid state. Its main function is as the carrier for the non volatile components. To spread heavier oils (for example, linseed) as in oil-based interior house paint, a thinner oil is required. These volatile substances impart their properties temporarily—once the solvent has evaporated, the remaining paint is fixed to the surface.

This component is optional: some paints have no diluent.

Water is the main diluent for water-borne paints, even the co-solvent types. Solvent-borne, also called oil-based, paints can have various combinations of organic solvents as the diluent, including aliphatics, aromatics, alcohols, ketones and white spirit. Specific examples are organic solvents such as petroleum distillate, esters, glycol ethers,

and the like. Sometimes volatile low-molecular weight synthetic resins also serve as diluents.

PIGMENT AND FILLER

Pigments are granular solids incorporated in the paint to contribute color. Fillers are granular solids incorporate to impart toughness, texture, give the paint special properties, or to reduce the cost of the paint. Alternatively, some paints contain dyes instead of or in combination with pigments.

Pigments can be classified as either natural or synthetic. Natural pigments include various clays, calcium carbonate, mica, silicas, and talcs. Synthetics would include engineered molecules, calcined clays, blanc fixe, precipitated calcium carbonate, and synthetic pyrogenic silicas.

Hiding pigments, in making paint opaque, also protect the substrate from the harmful effects of ultraviolet light. Hiding pigments include titanium dioxide, phthalo blue, red iron oxide, and many others.

Fillers are a special type of pigment that serve to thicken the film, support its structure and increase the volume of the paint. Fillers are usually cheap and inert materials, such as diatomaceous earth, talc, lime, barytes, clay, etc. Floor paints that must resist abrasion may contain fine quartz sand as a filler. Not all paints include fillers. On the other hand, some paints contain large proportions of pigment/filler and binder.

Some pigments are toxic, such as the lead pigments that are used in lead paint. Paint manufacturers began replacing white lead pigments with titanium white (titanium dioxide), before lead was banned in paint for residential use in 1978 by the US Consumer Product Safety Commission. The titanium dioxide used in most paints today is often coated with silica/alumina/zirconium for various reasons, such as better exterior durability, or better hiding performance (opacity) promoted by more optimal spacing within the paint film.

Micaceous Iron Oxide (MIO) is another alternative to lead for protection of steel, giving more protection against water and light damage than most paints. When MIO pigments are ground into fine particles, most cleave into shiny layers, which reflect light, thus minimising UV degradation and protecting the resin binder. Most pigments used in paint tend to be spherical, but lamellar pigments, such as glass flake and MIO have overlapping plates, which impede the path of water molecules.[13] For optimum performance MIO should have a high content of thin flake-like particles resembling mica. ISO 10601 sets two levels of MIO content. MIO is often derived from a form of hematite.

ADDITIVES

Besides the three main categories of ingredients, paint can have a wide variety of miscellaneous additives, which are usually added in small amounts, yet provide a significant effect on the product. Some examples include additives to modify surface tension, improve flow properties, improve the finished appearance, increase wet edge, improve pigment stability, impart antifreeze properties, control foaming, control skinning, etc. Other types of additives include catalysts, thickeners, stabilizers, emulsifiers, texturizers, adhesion promoters, UV stabilizers, flatteners (de-glossing agents), biocides to fight bacterial growth, and the like.

Additives normally do not significantly alter the percentages of individual components in a formulation.

PROPERTIES OF GOOD PAINT

A good paint should have the following properties:
▪ The paint should be cheap.
▪ It should be easy and harmless to the user.
▪ It should retain its original colour for a long time.
▪ It should be able to cover maximum area of the surface with minimum quantities. ▪ The painted surface should dry neither too slowly nor too rapidly.
▪ When applied, the paint should form a thin uniform film on painted surface. ▪ The paint should form a hard and durable coat on the painted surface. ▪ The paint should not peel off from painted surface.
▪ It should be good fire and moisture resistant.
▪ The painted surface should not show any cracks.
▪ The painted surface should possess attractive and decorative pleasing appearance. ▪ Atmospheric agencies should not be able to affect the painted surface.

PROPERTIES AND USES OF PAINTS, EMULSIONS, PRIMER, DISTEMPER AND SPECIAL PAINTS. · Primer is a preparatory coating put on materials before applying the paint itself. The primed surface ensures better adhesion of the paint, thereby increasing the durability of the paint and providing improved protection for the painted surface. Suitable primers also may block and seal stains, or hide a color that is to be painted over.

· Emulsion paints are water-based paints in which the paint material is dispersed in a liquid that consists mainly of water. For suitable purposes this has advantages in fast drying, low toxicity, low cost, easier application, and easier cleaning of equipment, among other factors.

▪ Flat Finish paint is generally used on ceilings or walls that are in bad shape. This finish is useful for hiding imperfections in walls and it is economical in effectively covering relatively great areas. However this finish is not easily washable and is subject to staining.

▪ Matte Finish is generally similar to flat finish, but such paints commonly offer superiority washability and coverage.

▪ Eggshell Finish has some sheen, supposedly like that of the shell on an egg. This finish provides great washability, but is not very effective at hiding imperfections on walls and similar surfaces. Eggshell finish is valued for bathrooms because it washable and water repellent, so that it tends not to peel in a wet environment.

▪ Pearl (Satin) Finish is very durable in terms of washability and resistance to moisture, even in comparison to eggshell finish. It protects walls from dirt, moisture and stains. Accordingly, it is exceptionally valuable for bathrooms, furniture, and kitchens, but it is shinier than eggshell, so it is even more prone to show imperfections.

▪ Semi-Gloss Finish typically is used on trim to emphasise detail and elegance, and to show off woodwork, such as on doors and furniture. It provides a shiny surface and provides good protection from moisture and stains on walls. Its gloss does however emphasise imperfections on the walls and similar surfaces. It is popular in schools and factories where washability and durability are the main considerations.

· Varnish and shellac are in effect paints without pigment; they provide a protective coating without substantially changing the color of the surface, though they can emphasise the colour of the material.

· Wood stain is a type of paint that is formulated to be very "thin", meaning low in viscosity, so that the pigment soaks into a material such as wood rather than remaining in a film on the surface. Stain is mainly dissolved pigment or dye plus binder material in solvent. It is designed to add color without providing a surface coating.

· Lacquer is a solvent-based paint or varnish that produces an especially hard, durable finish. Usually it is a rapidly drying formulation.

· Enamel paint is formulated to give an especially hard, usually glossy, finish. Some enamel paints contain fine glass powder or metal flake instead of the color pigments in standard oil-based paints. Enamel paint sometimes is mixed with varnish or urethane to improve its shine and hardness.

· A glaze is an additive used with paint to slow drying time and increase translucency, as in faux painting and for some artistic effects.

· A roof coating is a fluid that sets as an elastic membrane that can stretch without harm. It provides UV protection to polyurethane foam and is widely used in roof restoration. · Fingerpaints are formulations suitable for application with the fingers; they are popular for use by children in primary school activities.

· Inks are similar to paints, except that they are typically made using finely ground pigments or dyes, and are not designed to leave a thick film of binder. They are used largely for writing or calligraphy.

· Anti-graffiti coatings are used to defeat the marking of surfaces by graffiti artists or vandals. There are two categories of anti-graffiti coatings: sacrificial and non-bonding: ▪ Sacrificial coatings are clear coatings that allow the removal of graffiti, usually by washing the surface with high-pressure water that removes the graffiti together with the coating (hence the term "sacrificial"). After removal of the graffiti, the sacrificial coating must be re-applied for continued protection. Such sacrificial protective coatings are most commonly used on natural-looking masonry surfaces, such as statuary and marble walls, and on rougher surfaces that are difficult to clean.

▪ Non-bonding coatings are clear, high-performance coatings, usually catalyzed polyurethanes, that do not bond strongly to paints used for graffiti. Graffiti on such a surface can be removed with a solvent wash, without damaging either the underlying surface or the protective non-bonding coating. These coatings work best on smooth surfaces, and are especially useful on decorative surfaces such as mosaics or painted murals, which might be expected to suffer harm from high pressure sprays.

· Anti-climb paint is a non-drying paint that appears normal but is extremely slippery. It is useful on drainpipes and ledges to deter burglars and vandals from climbing them, and is found in many public places. When a person attempts to climb objects coated with the paint, it rubs off onto the climber, as well as making it hard for them to climb.

· Anti-fouling paint, or bottom paint, prevents barnacles and other marine organisms from adhering to the hulls of ships.

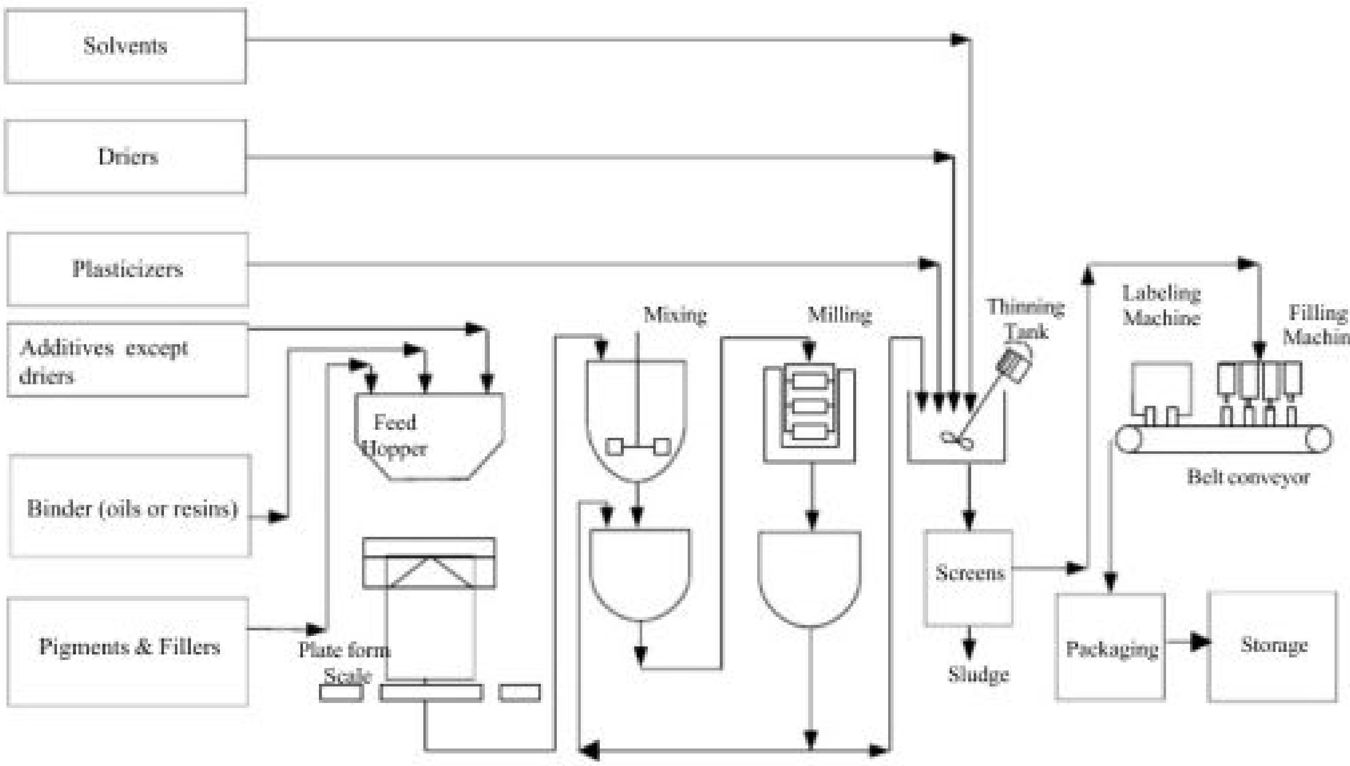
· Insulative paint or insulating paint, reduces the rate of thermal transfer through a surface it's applied to. One type of formulation is based on the addition of hollow microspheres to any suitable type of paint.

· Anti-slip paint contains chemicals or grit to increase the friction of a surface so as to decrease the risk of slipping, particularly in wet conditions.

· Road marking paint is specially used to marking and painting road traffic signs and lines, to form a durable coating film on the road surface. It must be fast drying, provide a thick coating, and resist wear and slipping, especially in wet conditions.

· Luminous paint or luminescent paint is paint that exhibits luminescence. In other words, it gives off visible light through fluorescence, phosphorescence, or radioluminescence.

MANUFACTURING PROCESS OF PAINT



THE MANUFACTURING PROCESS

Making the paste

· 1 Pigment manufacturers send bags of fine grain pigments to paint plants. There, the pigment is premixed with resin (a wetting agent that assists in moistening the pigment), one or more solvents, and additives to form a paste.

Dispersing the pigment

· 2 The paste mixture for most industrial and some consumer paints is now routed into a sand mill, a large cylinder that agitates tiny particles of sand or silica to grind the pigment particles, making them smaller and dispersing them throughout the mixture. The mixture is then filtered to remove the sand particles.

· 3 Instead of being processed in sand mills, up to 90 percent of the water-based latex paints designed for use by individual homeowners are instead processed in a high-speed dispersion tank. There, the premixed paste is subjected to high-speed agitation by a circular, toothed blade attached to a rotating shaft. This process blends the pigment into the solvent.

Thinning the paste

· 4 Whether created by a sand mill or a dispersion tank, the paste must now be thinned to produce the final product. Transferred to large kettles, it is agitated with the proper amount of solvent for the type of paint desired.

Canning the paint

· 5 The finished paint product is then pumped into the canning room. For the standard 8 pint (3.78 liter) paint can available to consumers, empty cans are first rolled horizontally onto labels, then set upright so that the paint can be pumped into them. A machine places lids onto the filled cans, and a second machine presses on the lids to seal them. From wire that is fed into it from coils, a bailometer cuts and shapes the handles before

hooking them into holes precut in the cans. A certain number of cans (usually four) are then boxed and stacked before being sent to the warehouse.

FAILURE/DEFECTS OF PAINT

The main reasons of paint failure after application on surface are the applicator and improper treatment of surface.

Application Defects can be attributed to:

Dilution

This usually occurs when the dilution of the paint is not done as per manufacturers recommendation. There can be a case of over dilution and under dilution, as well as dilution with the incorrect diluent.

Contamination

Foreign contaminants added without the manufacturers consent can cause various film defects.

Peeling/Blistering

Most commonly due to improper surface treatment before application and inherent moisture/dampness being present in the substrate.

Chalking

Chalking is the progressive powdering of the paint film on the painted surface. The primary reason for the problem is polymer degradation of the paint matrix due to exposure of UV radiation in sunshine and condensation from dew. The degree of chalking varies as epoxies react quickly while acrylics and polyurethanes can remain unchanged for long period. The degree of chalking can be assessed according to International Standard ISO 4628 Part 6 or 7 or American Society of Testing and Materials(ASTM) Method D4214 (Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films).

Cracking

Cracking of paint film is due to the unequal expansion or contraction of paint coats. It usually happens when the coats of the paint are not allowed to cure/dry completely before the next coat is applied. The degree of cracking can be assessed according to International Standard ISO 4628 Part 4 or ASTM Method D661 (Standard Test Method for Evaluating Degree of Cracking of Exterior Paints).

Erosion

Erosion is very quick chalking. It occurs due to external agents like air,water etc. It can be evaluated using ASTM Method ASTM D662 (Standard Test Method for Evaluating Degree of Erosion of Exterior Paints).

Blistering

Blistering is due to improper surface exposure of paint to strong sunshine. The degree of blistering can be assessed according to ISO 4628 Part 2 or ASTM Method D714 (Standard Test Method for Evaluating Degree of Blistering of Paints).

VARNISH

DEFINITION

Varnish is a transparent, hard, protective finish or film that is primarily used in wood finishing but also for other materials. Varnish is traditionally a combination of a drying oil, a resin, and a thinner or solvent. Varnish finishes are usually glossy but may be designed to produce satin or semi-gloss sheens by the addition of "flatting" agents. Varnish has little or no color, is transparent, and has no added pigment, as opposed to paints or wood stains, which contain pigment and generally range from opaque to translucent. Varnishes are

also applied over wood stains as a final step to achieve a film for gloss and protection. Some products are marketed as a combined stain and varnish.

After being applied, the film-forming substances in varnishes either harden directly, as soon as the solvent has fully evaporated, or harden after evaporation of the solvent through curing processes, primarily chemical reaction between oils and oxygen from the air (autoxidation) and chemical reactions between components of the varnish. Resin varnishes "dry" by evaporation of the solvent and harden almost immediately upon drying. Acrylic and waterborne varnishes "dry" upon evaporation of the water but will experience an extended curing period. Oil, polyurethane, and epoxy varnishes remain liquid even after evaporation of the solvent but quickly begin to cure, undergoing successive stages from liquid or syrupy, to tacky or sticky, to dry gummy, to "dry to the touch", to hard. Environmental factors such as heat and humidity play a very large role in the drying and curing times of varnishes. In classic varnish the cure rate depends on the type of oil used and, to some extent, on the ratio of oil to resin. The drying and curing time of all varnishes may be sped up by exposure to an energy source such as sunlight, ultraviolet light, or heat.

COMPONENTS OF VARNISH

Drying oil

There are many different types of drying oils, including linseed oil, tung oil, and walnut oil. These contain high levels of polyunsaturated fatty acids.

Resin

Resins that are used in varnishes include amber, kauri gum, dammar, copal, rosin (pine resin), sandarac, balsam, elemi, mastic, and others. Shellac is also a resin. In the 1900s in Canada, resins from local trees were used to finish piano. As a result, these now antique pianos are considered difficult to refinish. However, shellac can be used over the existing resins provided sufficient time is allowed for thin coats to cure. Thus the original finish can be returned to its original lustre while preserving the color and age-related crackle.

Solvent (traditionally turpentine)

Traditionally, natural (organic) turpentine was used as the thinner or solvent, but has been replaced by several mineral-based turpentine substitutes such as white spirit or "paint thinner", also known as "mineral spirit".

TYPES OF VARNISH

Violin

Violin varnishing is a multi-step process involving some or all of the following: primer, sealer, ground, color coats, and clear topcoat. Some systems use a drying oil varnish as described below, while others use spirit (or solvent) varnish. Touchup in repair or restoration is only done with spirit varnish.

Drying oil such as walnut oil or linseed oil may be used in combination with amber, copal, rosin or other resins. Traditionally the oil is prepared by cooking or exposure to air and sunlight, but modern "stand oil" is prepared by heating oil at high temperature without oxygen. The refined resin is sometimes available as a translucent solid and is then "run" by cooking or literally melting it in a pot over heat without solvents. The thickened oil and prepared resin are then cooked together and thinned with turpentine (away from open flame) into a brushable solution. The ingredients and processes of violin varnish are very diverse, with some highly regarded old examples showing defects (e.g. cracking, crazing) associated with incompatible varnish components.

Some violin finishing systems use vernice bianca (egg white and gum arabic) as a sealer or ground. There is also evidence that finely powdered minerals, possibly volcanic ash, were used in some grounds. Some violins made in the late 18th century used oxen's blood

to create a very deep-red coloration. Today this varnish would have faded and currently be a very warm, dark orange.

Resin

Most resin or "gum" varnishes consist of a natural, plant- or insect-derived substance dissolved in a solvent, called *spirit varnish* or *solvent varnish.* The solvent may be alcohol, turpentine, or petroleum-based. Some resins are soluble in both alcohol and turpentine. Generally, petroleum solvents, i.e. mineral spirits or paint thinner, can substitute for turpentine. The resins include amber, dammar, copal, rosin, sandarac, elemi, benzoin, mastic, balsam, shellac, and a multitude of lacquers.

Synthetic resins such as phenolic resin may be employed as a secondary component in certain varnishes and paints.

Over centuries, many recipes were developed which involved the combination of resins, oils, and other ingredients such as certain waxes. These were believed to impart special tonal qualities to musical instruments and thus were sometimes carefully guarded secrets. The interaction of different ingredients is difficult to predict or reproduce, so expert finishers were often prized professionals.

Shellac

Shellac is a very widely used single-component resin varnish that is alcohol-soluble. It is not used for outdoor surfaces or where it will come into repeated contact with water, such as around a sink or bathtub. The source of shellac resin is a brittle or flaky secretion of the female lac insect, *Kerria lacca*, found in the forests of Assam and Thailand and harvested from the bark of the trees where she deposits it to provide a sticky hold on the trunk. Shellac is the basis of French polish, which for centuries has been the preferred finish for fine furniture. Specified "dewaxed" shellac has been processed to remove the waxy substances from original shellac and can be used as a primer and sanding-sealer substrate for other finishes such as polyurethanes, alkyds, oils, and acrylics.

Prepared shellac is typically available in "clear" and "amber" (or "orange") varieties, generally as "three-pound cut" or three pounds dry shellac to one US gallon of alcohol. Other natural color shades such as ruby and yellow are available from specialty pigment or woodworker's supply outlets. Dry shellac is available as refined flakes, "sticklac," "button lac," or "seedlac." "White pigmented" shellac primer paint is widely available in retail outlets, billed as a fast-drying interior primer "problem solver", in that it adheres to a variety of surfaces and seals off odors and smoke stains. Shellac clean-up may be done either with pure alcohol or with ammonia cleansers.

Alkyd

Modern commercially produced varnishes employ some form of alkyd for producing a protective film. Alkyds are chemically modified vegetable oils which operate well in a wide range of conditions and can be engineered to speed up the cure rate and thus harden faster. Better (and more expensive) exterior varnishes employ alkyds made from high performance oils and contain UV-absorbers; this improves gloss-retention and extends the lifetime of the finish. Various resins may also be combined with alkyds as part of the formula for typical "oil" varnishes that are commercially available.

Spar varnish

Spar varnish (also called *marine varnish*) was originally intended for use on ship or boat spars, to protect the timber from the effects of sea and weather. Spars bend under the load of their sails. The primary requirements were water resistance and also elasticity, so as to remain adhering as the spars flexed. Elasticity was a pre-condition for weatherproofing too, as a finish that cracked would then allow water through, even if the remaining film

was impermeable. Appearance and gloss was of relatively low value. Modified tung oil and phenolic resins are often used.

When first developed, no varnishes had good UV-resistance. Even after more modern synthetic resins did become resistant, a true spar varnish maintained its elasticity above other virtues, even if this required a compromise in its UV-resistance. Spar varnishes are thus *not* necessarily the best choice for outdoor woodwork which does not need to bend in service.

Despite this, the widespread perception of "marine products" as "tough" led to domestic outdoor varnishes being branded as "Spar varnish" and sold on the virtue of their weather and UV-resistance. These claims may be more or less realistic, depending on individual products. Only relatively recently have spar varnishes been available that can offer both effective elasticity and UV-resistance.

Drying oils

By definition, drying oils, such as linseed and tung oil, are not true varnishes though often in modern terms they accomplish the same thing. Drying oils cure through an exothermic reaction between the polyunsaturated portion of the oil and oxygen from the air. Originally, the term "varnish" referred to finishes that were made entirely of resin dissolved in suitable solvents, either ethanol (alcohol) or turpentine. The advantage to finishes in previous centuries was that resin varnishes had a very rapid cure rate compared to oils; in most cases they are cured practically as soon as the solvent has fully evaporated. By contrast, untreated or "raw" oils may take weeks or months to cure, depending on ambient temperature and other environmental factors. In modern terms, "boiled" or partially polymerized drying oils with added siccatives or dryers (chemical catalysts) have cure times of less than 24 hours. However, certain non-toxic by-products of the curing process are emitted from the oil film even after it is dry to the touch and over a considerable period of time. It has long been a tradition to combine drying oils with resins to obtain favourable features of both substances.

Polyurethane

Polyurethane varnishes are typically hard, abrasion-resistant, and durable coatings. They are popular for hardwood floors but are considered by some wood finishers to be difficult or unsuitable for finishing furniture or other detailed pieces. Polyurethanes are comparable in hardness to certain alkyds but generally form a tougher film. Compared to simple oil or shellac varnishes, polyurethane varnish forms a harder, decidedly tougher and more waterproof film. However, a thick film of ordinary polyurethane may de

laminate if subjected to heat or shock, fracturing the film and leaving white patches. This tendency increases with long exposure to sunlight or when it is applied over soft woods like pine. This is also in part due to polyurethane's lesser penetration into the wood. Various priming techniques are employed to overcome this problem, including the use of certain oil varnishes, specified "dewaxed" shellac, clear penetrating epoxy sealer, or "oil-modified" polyurethane designed for the purpose. Polyurethane varnish may also lack the "hand

rubbed" lustre of drying oils such as linseed or tung oil; in contrast, however, it is capable of a much faster and higher "build" of film, accomplishing in two coats what may require multiple applications of oil. Polyurethane may also be applied over a straight oil finish, but because of the relatively slow curing time of oils, the emission of certain chemical byproducts, and the need for exposure to oxygen from the air, care must be taken that the oils are sufficiently cured to accept the polyurethane.

Unlike drying oils and alkyds which cure, after evaporation of the solvent, upon reaction with oxygen from the air, true polyurethane coatings cure, after evaporation of the solvent, by a variety of reactions of chemicals within the original mix, or by reaction with moisture from the air. Certain polyurethane products are "hybrids" and combine different

aspects of their parent components. "Oil-modified" polyurethanes, whether water-borne or solvent-borne, are currently the most widely used wood floor finishes. Exterior use of polyurethane varnish may be problematic due to its heightened susceptibility to deterioration through ultra-violet light exposure. All clear or translucent varnishes, and indeed all film-polymer coatings (e.g. paint, stain, epoxy, synthetic plastic, etc.) are susceptible to this damage in varying degrees. Pigments in paints and stains protect against UV damage.

UV-absorbers are added to polyurethane and other varnishes (e.g. spar varnish) to work against UV damage but are decreasingly effective over the course of 2–4 years, depending on the quantity and quality of UV-absorbers added, as well as the severity and duration of sun exposure. Water exposure, humidity, temperature extremes, and other environmental factors affect all finishes. By contrast, wooden items retrieved from the Egyptian pyramids have a new and fresh appearance after 4000 years of storage[*citation needed*]. Even there, however, fungal colonies were present, and mildew and fungus are another category of entities which attack varnish. In other words, the only coat of varnish with near perfect durability is the one stored in a vacuum, in darkness, at a low and unvarying temperature. Otherwise, care and upkeep are required.

Lacquer

The word *lacquer* refers to quick-drying, solvent-based varnishes or paints. Although their names may be similarly derived, lacquer is not the same as *shellac* and is not dissolved in alcohol. Lacquer is dissolved in lacquer thinner, which is a highly flammable solvent typically containing butyl acetate and xylene or toluene. Lacquer is typically sprayed on, within a *spray booth* that evacuates overspray and minimizes the risk of combustion.

Outside America, the rule of thumb is that a clear wood finish formulated to be sprayed is a lacquer, but if it is formulated to be brushed on then it is a varnish. Thus, by far most pieces of wooden furniture are lacquered.

Lacquer may be considered different from varnish because it can be re-dissolved later by a solvent (such as the one it was dissolved in when it was applied) and does not chemically change to a solid like other varnishes.

Acrylic

Acrylic varnishes are typically water-borne varnishes with the lowest refractive index of all finished and high transparency. They resist yellowing. Acrylics have the advantage of water clean-up and lack of solvent fumes, but typically do not penetrate into wood as well as oils. They sometimes lack the brushability and self-leveling qualities of solvent

based varnishes. Generally they have good UV-resistance.

In the art world, varnishes offer dust-resistance and a harder surface than bare paint – they sometimes have the benefit of ultraviolet light resistors, which help protect artwork from fading in exposure to light. Acrylic varnish should be applied using an isolation coat (a permanent, protective barrier between the painting and the varnish, preferably a soft, glossy gel medium) to make varnish removal and overall conservation easier. Acrylic varnishes used for such a final removable art protection layer are typically mineral-spirit–

based acrylic, rather than water-based.

Two-part

Various epoxies have been formulated as varnishes or floor finishes whereby two components are mixed directly before application. Often, the two parts are of equal volume and are referred to as "part A" and "part B". True polyurethanes are two-part systems. All two-part epoxies have a "pot-life" or "working time" during which the epoxy can be used. Usually the pot-life is a matter of a few hours but is also highly temperature dependent. Both water-borne and solvent-based epoxies are used.

Conversion

Used when a fast-curing, tough, hard finish is desired, such as for kitchen cabinets and office furniture. Comes in two parts: a resin and an acid catalyst. The first is a blend of an amino resin and an alkyd. The acid catalyst is added right before application in a set ratio determined by the manufacturer. Most produce minimal yellowing. There are, however, two downsides to this finish. The first is that as the finish cures, it gives off formaldehyde, which is toxic and carcinogenic. The second is that the finish can crack or craze if too many coats are applied.

DISTEMPER

The main object of applying distemper to the plastered surfaces is to create a smooth surface. The distempers are available in the market under different trade names. They are cheaper than paints and varnishes and they a present a neat appearance. They are available in a variety of colours.

PROPERTIES OF DISTEMPERS:

Following are the properties of distempers:

(1) On drying, the film of distemper shrinks. Hence it leads to cracking and flaking, if the surface to receive distemper is weak.

(2) The coatings of distemper are usually thick and they are more brittle than other types of water paints.

(3) The film developed by distemper is porous in character and it allows water vapour to pass through it. Hence it permits new walls to dry out without damaging the distemper film.

(4) They are generally light I colour and they provide a good reflective coating. (5) They

are less durable than oil paints.

(6) They are treated as water paints and they are easy to apply.

(7) They can be applied on brickwork, cement plastered surface, lime plastered surface, insulating boards, etc.

(8) They exhibit poor workability.

(9) They prove to be unsatisfactory n damp locations such as kitchen, bathroom, etc.

INGREDIENTS OF A DISTEMPER:

A distemper is composed of base, carrier, colouring pigments and size. For base, the whiting or chalk is used and for carrier, the water is used. Thus it is more or less a paint in which whiting or chalk is used as base instead of whit lead and the water is used as carrier instead of linseed oil.

The distempers are available I powder form or paste form. They are to be mixed with hot water before use. The oil-bound distempers are a variety of an oil paint in which the drying oil is so treated that it mixes with water. The emulsifying agent which is commonly used is glue or casein. As the water dries, the oil makes a hard surface which is washable.

It should be remembered that most of the manufacturers of readymade distempers supply completely directions for use of their products. These directions are to be strictly followed to achieve good results.

PROCESS OF DISTEMPERING:

The application of distemper is carried out in the following way:

(1) Preparation of surface:

NEW/FIRST TIME PAINT ; New plaster is allowed to dry for 2 months before applying distemper. WHY IS THIS DONE? This is done because

OLD SURFACE : The surface to receive the distemper is thoroughly rubbed and cleaned of all the dust, dirt, scales and grease. The holes or cracks, if any, are filled with a mixture of plaster of paris and dry distemper of the color to be used.

Whitewashing:

The fresh lime is slaked at site of work and mixed thoroughly with sufficient quantity of water in a tub. It is then screened through a clean cloth. The clan gum dissolved in hot water is then added at the rate of 20 N per m3 of lime. The rice may be used in place of gum.

The surface to be whitewashed should be cleaned before the work is started. For whitewashing walls which are whitewashed before, the old loose whitewash is to be first removed and repairing to the plaster is carried out, if necessary.

The lime is toxic for germs. It reflects light and thus it increases the brightness of the surface. The whitewashing therefore is extensively used for interior wall surfaces and ceilings of houses.

The process of whitewashing is sometimes used for exterior wall surfaces also. A satisfactory work gives an opaque smooth surface with uniform white colour and does not readily come off on the hand, when rubbed.

Colour washing:

This is prepared by adding the colouring pigment to the screened whitewash. It should be seen that the colouring pigment is not affected by the presence of lime. Ordinarily, the yellow earth is popular of colour washing. Generally, the walls are colour washed and ceilings are whitewashed. The mixture is to be kept constantly stirred during use.

The colourwash is applied in the same fashion as the whitewash. A satisfactory work does not give out powder when the finished surface is rubbed with the fingers.

The process of colour washing imparts cleanliness and pleasant appearance of the surfaces which are treated.

PAINTING OF TIMBER

Timber is a dimensionally unstable material that expands and contracts with changing moisture content. The timber surface is eroded by U.V. light, normally changing to a grey colour leaving cellulose fibres exposed on the surface. Timber also provides a source of nutrient for mould growth.

A protective system for timber needs to combat these three sources of aggression; viz. water, U.V. light and mould.

Some timbers contain resins and oils that may affect the performance of paint, such as resin pockets in pine that may soften and bleed through paints, oils in teak that may prevent penetration and adhesion of paint, and anti-oxidants in Kwila, Matai, Spotted Gum and Totara that will inhibit the drying of solvent borne paints

SURFACE PREPARATION

Remove all moss and mould

· Thoroughly clean down to remove all loosely adhered material. Treat areas of moss or mould infestation with a Moss & Mould Killer, correctly diluted with clean water. Leave for up to 48 hours to achieve full kill. For heavy infestations further applications may be needed. Wash thoroughly with clean water to remove all residues.

· Clean surfaces Thoroughly wash down with Resene Paint Prep and Housewash to remove all dirt, dust, grease, moss and mould residue, cobwebs and other contaminants. Rinse thoroughly with clean water. Allow to dry.

· Sand surfaces: Thoroughly sand along the grain to remove minor imperfections and any loose surface fibres. Loose fibres may be assumed to be present if the timber is left exposed to the weather for more than one week. For flooring, machine sanding is often required to achieve a satisfactory surface. Remove dust.

PRIMER

A **primer** (/ˈpraɪmər/) or **undercoat** is a preparatory coating put on materials before painting. Priming ensures better adhesion of paint to the surface, increases paint durability, and provides additional protection for the material being painted. 20%-30% synthetic resin, 60%-80% solvent and 2%-5% additive agent. Some primer contains polyethylene (plastic), for better durability

Primer is a paint product that allows finishing paint to adhere much better than if it were used alone. [2] For this purpose, primer is designed to adhere to surfaces and to form a binding layer that is better prepared to receive the paint. Because primers do not need to be engineered to have durable, finished surfaces, they can instead be engineered to have improved filling and binding properties with the material underneath. Sometimes, this is achieved with specific chemistry, as in the case of aluminium primer, but more often, this is achieved through controlling the primer's physical properties such as porosity, tackiness, and hygroscopy.

In practice, primer is often used when painting many kinds of porous materials, such as concrete and especially wood (see detailed description below). Priming is mandatory if the material is not water resistant and will be exposed to the elements. Priming gypsum board (drywall) is also standard practice with new construction because it seals the wall and aids in preventing mold. Primers can also be used for dirty surfaces that, for some reason, cannot be cleaned, or before painting light colors over existing dark colors.

Primers can usually be tinted to a close match with the color of the finishing paint. If the finishing paint is a deep color, tinting the primer can reduce the number of layers of finishing paint that are necessary for good uniformity across the painted surface.

There may be a maximum time frame within which a topcoat should be applied over the primer after the primer dries, in order to achieve maximum performance. Depending on the primer, the next coat of paint should be applied as quickly as 24 hours or as long as two weeks. Painting after the suggested timeframe may cause performance issues depending on the specific situation. Supposedly, you want to apply the finish coat of paint before the primer fully cures on a molecular level. Doing this allows maximum adhesion/bonding of the topcoat to the primer. If topcoating after the suggested timeframe, consider using a "self priming" topcoat. For definitive answers on recommended repainting timeframe, check the primer label/website, or contact the manufacturer directly. Recoat timeframe is most likely a more critical factor in exterior application because of the more extreme climatic exposure

Primers for wood

Using a primer on wood before painting is important for several reasons. First of all, wood is very porous and will absorb the solvent from paint, drying the paint prematurely. Because most paints undergo chemical reactions during the process of curing (for example, latex and alkyd-based paints actually polymerize when curing), they depend on water or solvent being evaporated slowly rather than being absorbed quickly by the underlying material. A layer of primer will help the paint to undergo its proper, complete curing cycle.

Secondly, without a primer, several layers of paint can be necessary to completely obscure the wood grain and ensure even color.

Lastly, if wood is exposed to moisture, a thin layer of paint will still be water permeable. The end result will be warped parts, mildew, and dry rot. Primer adds to the waterproofing effect of the paint.[3]

Quality primers are often comparable in price to finish paints, their cost influenced by the quality of binders that they use. Some specialty primers are in fact quite costly.

Primers are not necessary for a wood stain treatment that is designed to show the wood grain. On soft woods, a wood conditioner (thinned shellac or varnish) allows for more even coloring of stain. Sealers are designed to promote uniform finishes. They are designed with qualities that promote quick drying and they have high isocynate content and are not sandable,

Primers for metal

Some metals, such as untreated aluminium, require a primer; others may not. A primer designed for metal is still highly recommended if a part is to be exposed to moisture. Once water seeps through to the bare metal, oxidation will begin (plain steel will simply rust). Metal primers might contain additional materials to protect against corrosion, such as sacrificial zinc.

Metal hydroxides/oxides do not provide a solid surface for the paint to adhere to, and paint will come off in large flakes. Using a primer will provide extra insurance against such a scenario. An additional reason for using a primer on metal could be the poor condition of the surface. A steel part can be rusty, for example. Of course, the best solution is to thoroughly clean the metal (blasting), but when this is not a viable option, special kinds of primers can be used that chemically convert rust to the solid metal salts. And even though such surface is still lacking in comparison to the shiny clean metal, it is yet much better than weak, porous rust.

Painting and gluing aluminium is especially important in the aircraft industry, which uses toxic zinc chromate primers and chromating to add the necessary adhesion properties.

PAINTING ON DIFFERENT SURFACES

The process of painting depends on the nature of the surface to be painted. A brief description of painting on each of the various surfaces is given below:

(1) New wood work: Normally four coats of paint are required for new woodwork. The process of painting is carried out as follows: (i) The surface of wood work is prepared to receive the paint. For satisfactory working, it is necessary that the woodwork is sufficiently seasoned an it does not contain more than 15 per cent moisture at the time of painting. The surface of woodwork is thoroughly cleaned and the heads of nails are punched to a depth of 3 mm below the surface.

(ii) The surface of the woodwork is then knotted. (iii) The priming coat is then applied on the surface of new woodwork. Generally, the priming coat is applied before the woodwork is placed in position. (iv) The process of stopping is then carried out. (v) The subsequent coats of paint, namely, under costs and finishing coats, are the applied on the surface. The extreme care should be taken to see that the finishing coat presents smooth and even surface and that no brush marks are seen on the finished work.

(2) Repainting old woodwork: If the paint on the old woodwork has cracked or has developed blisters, it is to be removed. If the surface has become greasy, it should be cleaned by rubbing down sand-paper or fine pumice stone. The old paint can also be removed by applying any one of the following three paint solvents:

(i) A solution containing 2 N of caustic soda to a litre of water is prepared and used to wash the surface. The paint dissolves and the surface becomes clean. (ii) A mixture consisting of one part of soft soap and two parts of potash is prepared and one part of quicklime is then added after wards. The mixture is applied on the su

(5) Galvanized ironwork: As the paint will not adhere to their surface of galvanized ironwork, some treatment is to be given to the surface before a priming coat is applied. It is a general rule not to paint to galvanized iron work until it has been exposed to weather for a period of one year or so. However, if it is necessary to paint new galvanized ironwork, any one of the following tow solutions is applied on the surface:

(i) A solution containing 0.04 N of copper aceteate to a liter of water. (ii) A solution containing 0.13 N each of muriatic acid, copper chloride, copper nitrate and sal-ammoniac to a litre of soft water. This much quantity of solution will cover an area of about 250 to 300 m^2.

The solution is taken in a glass vessel or earthenware vessel. This will prevent the precipitation of copper salts. When the solution is applied on the galvanized iron work, the surface is turned black and after a period of about 12 hours, the coat of paint may be applied on the surface.

Alternately, a wash of washing soda or zinc sulphate may be given on the surface and when it dries, a priming coat of red lead mixed with linseed oil and turpentine may be applied on the surface. When priming coat dries, a suitable paint may be applied on the surface.

(6) Metals: The surface of the metal to be painted should be clean and free from dirt, grease, etc. It should be such as to provide key for the paint. Depending upon the nature of metal, suitable paint is selected. Depending upon the nature of metal, suitable paint is selected. For instance, the priming coat for aluminium surface should be of zinc chromate and that for zinc surface, it should be of zinc oxide.

(7) Plastered surfaces: For successful application of paint on cement plastered surfaces, the following factors should be carefully considered: