



SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)

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SCHOOL OF BUILDING AND ENVIRONMENT

DEPARTMENT OF ARCHITECTURE

UNIT – I –Materials and construction IV – SAR1304

PLASTICS

- Is a synthetic material made from a wide range of organic polymers (synthetic or semi-synthetic organic compounds) that can be moulded into various shapes while soft, and then set into rigid or slightly elastic form.

Plastic' is a general name given to a wide range of synthetic materials that are based on polymers.

- The construction industry uses plastic for a wide range of applications because of its versatility, strength-to-weight ratio, durability, corrosion resistance, and so on.
- Plastic can be manufactured into forms such as; pipes, cables, coverings, panels, films, sheets and so on; and can be formed or expanded to create low-density materials; and be dissolved in solvents or dispersed as emulsions.

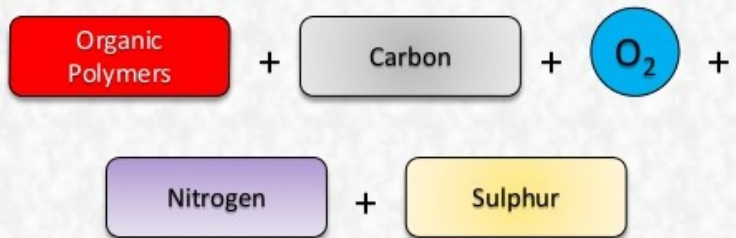
Some of the main types of plastic that are used in construction include:

- Acrylic.
- Composites.
- Expanded polystyrene.
- ETFE.
- Polycarbonate.
- Polyethylene.
- Polypropylene.
- Polyvinyl chloride (PVC).
- PTFE.

Origins of Plastics - **synthetic plastics.**

- The main source of synthetic plastics is **crude oil.**
- **Coal and natural gas are also used.**
- Petrol, paraffin, lubricating oils and high petroleum gases are bi-products, produced during the refining of crude oil.
- These gases are broken down into **monomers.** Monomers are chemical substances consisting of a single molecule.
- A process called **Polymerisation occurs when** thousands of monomers are linked together. The compounds formed are called **polymers.**
- Combining the element **carbon with one or more** other elements such as oxygen, hydrogen, chlorine, fluorine and nitrogen makes most polymers.

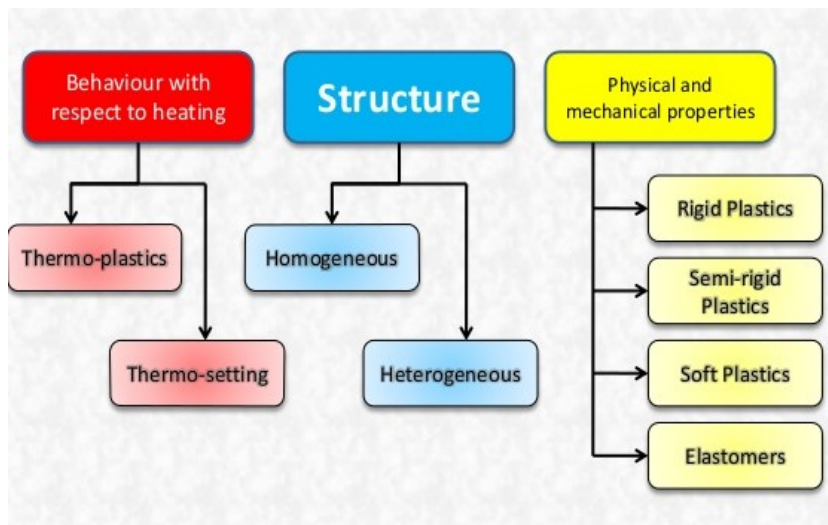
Composition of plastic



Organic Polymers may include:

CHALK, STARCH, IVORY DUST, WOOD FLOOR, ZINC OXIDE

Classification of plastics



Based on physical and chemical properties

Rigid Plastics

**Semi-rigid
Plastics**

Soft Plastics

Elastomers

Thermoplastic & thermosetting

Basic difference between Thermoplastics and Thermosetting plastics

THERMOPLASTICS	THERMO-SETTING PLASTICS
Thermoplastics variety softens by heat and hardens when cooled down. It can be used by remolding as many times as required.	Thermosetting plastics can not be reused .This variety requires a great pressure and momentary heat during molding which hardens on cooling.

POLYPOLYMERISATION

Rigid plastics

These plastics have a high modulus of elasticity and they retain their shape under exterior stresses applied at normal or moderately increased temperatures.

Semi-Rigid plastics

These plastics have a medium modulus of elasticity and the elongation under pressure completely disappears, when pressure is removed.

soft plastics

- These plastics have a low modulus of elasticity and the elongation under pressure disappears slowly, when pressure is removed.
- Soft plastics are available in a large range of colours, sizes and particularly shapes.

USES: Used in making children's toys eg: rattles etc., fishing baits.

Elastomers

These plastics are soft and elastic materials with a low modulus of elasticity. They deform considerably under load at room temperature and return to their original shape, when the load is released. The extensions can range upto ten times their original dimensions.



ADVANTAGES OF PLASTICS

Light in weight.

Can be easily moulded and have excellent finishing.

Possess very good strength and toughness.

Corrosion resistant and chemically inert.

Low thermal expansion of co-efficient and possess good thermal and electrical insulating property.

Very good water resistant and possess good adhesiveness.

Strong, good and cheap to produce.

Unbreakable.

DISADVANTAGES OF PLASTICS

- Plastic is a nonrenewable resources
- Causes CANCER
- Embrittlement at low temperature.
- Deformation under load.
- Low heat resistant and poor ductility.
- Combustibility.
- Produces toxic fumes when it is burnt
- It is a recycle process, but it is very costly.

Common plastics and uses

Polypropylene (PP) – Bottle caps, drinking straws, yogurt containers, appliances, car fenders (bumpers), plastic pressure pipe systems

Polystyrene (PS) – Foam peanuts, food containers, plastic tableware, disposable cups, plates, cutlery, compact-disc (CD) and cassette boxes

High impact polystyrene (HIPS) – Refrigerator liners, food packaging, vending cups

Polyamides (PA) (Nylons) – Fibers, toothbrush bristles, tubing, fishing line, low-strength machine parts such as engine parts or gun frames

Acrylonitrile butadiene styrene (ABS) – Electronic equipment cases (e.g. computer monitors, printers, keyboards), drainage pipe

Polyethylene/Acrylonitrile Butadiene Styrene (PE/ABS) – A slippery blend of PE and ABS used in low-duty dry bearings

Polycarbonate (PC) – Compact discs, eyeglasses, riot shields, security windows, traffic lights, lenses

Some of these plastics main uses in the construction industry are:

- Cladding panels.

- Cables.
- Pipes and gutters.
- Windows and doors.
- Shuttering
- Wall linings
- Floor covering
- Ceiling panels.
- Roof coverings.
- Sinks, basins, baths, and showers.
- Worktops
- Insulation materials.
- Membranes & Handrails.

Polyethylene or Polythene

Polyethylene sheeting has a big role in offering plastic protection.

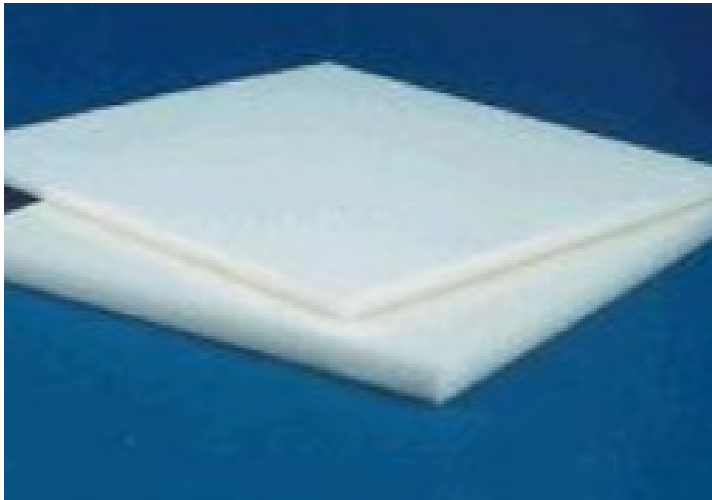
It is used in **construction as vapor retarders, window films, flooring and** counter top protection, and even in roofing.

A **vapor barrier (or vapour barrier)** is any material used for damp proofing, typically a plastic or foil sheet, that resists diffusion of moisture through wall, ceiling and floor assemblies of buildings to prevent interstitial condensation and of packaging.

Technically, many of these materials are only **vapor retarders as they have varying degrees** of permeability



Polystyrene



In-situ concrete flooring on 300mm of Expanded Polystyrene insulation.

PVC



Multi-Lock Industrial Warehouse Floor Tile Made Using PVC



PVC Vinyl Floor Tile



Geomembranes Made Using Polypropylene



Acrylic Shower Base, Screen and Door



Polypropylene Pipe Fittings



FRP
Ventilators



FRP Windows



FRP Pipes



2 Panel Arch
Woodgrain Finish



3 Panel Arch
Woodgrain Finish



3 Panel Square
Woodgrain Finish



4 Panel
Woodgrain Finish



4 Panel Arch
Woodgrain Finish

FRP Doors

Use of Plastics in Different Aspects of the Construction Industry

Flooring

Plastic materials like polyvinyl chloride (PVC) and polyethylene are used to make flooring less prone to wear and tear. It also decreases the sound pollution level and can be cleaned easily.

Roofing

To protect the outer surface of the roof from damage, two layers of different plastic materials are required. The upper part is made of colored thermoplastic olefin or vinyl while the lower part consists of polyurethane foam which consumes less energy and keeps the interior of a house cooler.

Insulation

Polyurethane spray is frequently used for insulation when constructing green or low energy buildings. Rigid polyurethane foam is known for its high thermal resistance which promotes temperature consistency. Polyurethane foam is also popular because it is lightweight, chemical resistant, and flame retardant. Due to its closed cell nature, polyurethane insulation performs as an air barrier, resulting in significant energy savings.

Wall

A structural insulated panel (SIP) is a sandwich of expanded polystyrene amidst two slim layers of oriented strand board. This type of pre-fab, composite wall board can be transferred to the work place easily for a particular task and provide good support to columns and other associated essentials during renovation.

Pipes

Commonly made up of polyvinyl chloride (PVC), CPVC, acrylonitrile butadiene styrene (ABS) or polyethylene, plastic pipes are flexible and very light in weight, making them easy to install. All of these plastic materials are also highly chemical and water resistant, making them suitable for many extreme environments.

Windows

Polycarbonate is used to manufacture building windows. This plastic material is strong, clear and very light in weight. Polycarbonate windows are considered more burglar-proof than regular glass windows. Two plastics materials, vinyl and fiberglass, are used commonly in the production of window frames. Fiberglass is extremely strong while vinyl is quite durable and also inexpensive.

Doors

Some construction projects use doors made from a stiff polyurethane foam core with a fiber reinforced plastic (FRP) coating. The sandwich structure of these doors makes them incredibly strong.

❑ *Plastic as a Roofing Systems:*

- Corrugated plastic sheeting has been used for roofing in conservatories and buildings where transparent panels have been required. However, in more recent times double and triple walled polycarbonate sheeting has become increasingly used, since this provides not only diffuse daylight for illumination but also heat insulation and hence reduced heating costs.



❑ *Twin or triple walled polycarbonate:*

- Provides a number of advantages during installation since it can be cut with conventional tools, is rigid to handle, does not require closely spaced supports, is light in weight and can be easily fitted. In addition, it can be cold formed or thermoformed into a variety of shapes to provide attractive and functional curved surfaces. Edges and joints can be sealed to prevent draughts. Another major advantage is its resistance to breakage.



❑ *Sound Insulation:*

- Sound within buildings may be general noise transmitted through walls and floors or a specific noise from vibrating machinery. The latter can be dealt with by using vibration mounts as mentioned above. Air-borne noise can also present problems and must be taken into account when designing sound insulation systems.
- With general noise, the traditional method was to build very thick and heavy walls and floors. However, as buildings have become lighter, other methods of sound reduction have become necessary. As a general principle, sound insulation can be provided by either a simple and heavy or a light and complex construction, which is now replaced by the rubber and plastics materials.



❑ *Thermal Insulation:*

- As well as sound insulation, buildings need thermal insulation also. This can be met by using light weight aerated concrete building blocks during the construction of the building or by incorporating foamed plastic sheeting within the structure. Typical foamed plastics include rigid polyurethane foam and expanded polystyrene, although various other foamed plastics may also be used.
- Plasterboard can be readily obtained with a 25 mm foamed polystyrene backing. Other composite sheet building products can be obtained with polyurethane foam cores. They can be kept clean with very little effort.



❑ *Plastic Decorative Laminates:*

- The normal structure of a plastic decorative laminate includes a sheet of decorative paper impregnated (saturated) with one or more resins.
- Plastic decorative laminates have a wide range of uses, they can be used in the furniture industry for kitchen cabinet counters, bookshelves and door linings, among many other things. In the building industry they can be used for partitions screens in order to divide space in offices, houses, etc...

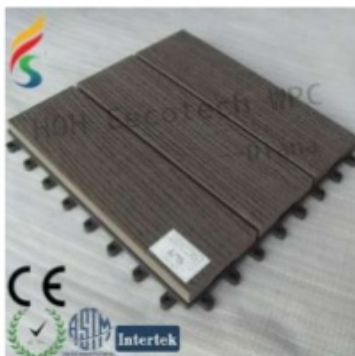


❑ *Plastic Adhesives & Sealants:*

- There are also water-based versions that can provide better heat resistance.
- Generally solvent-based, these cost effective, gap-filling adhesives are suitable for bonding sheet flooring, adhering skirtings and architraves, signs and wall panels.
- They have good adhesion to most substrates (especially porous materials such as wood, concrete, brick and plasterboard).
- Sealants- create a flexible, durable bond which is vibration- and shock-resistant.



**PLASTIC FLOORING
LIKE WOOD FINISH**



**WOOD PLASTIC
COMPOSITE DECKOING**



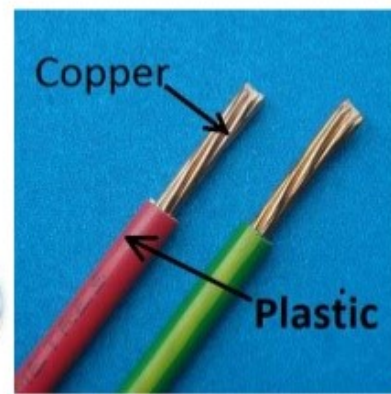
Pipes : Electrical Conduits, Rain Water & Sewage pipes, Plumbing, Gas Distributions.

Cables : PVC Insulation on cables, Insulation Tapes .

Floorings : Flooring tiles & Rolls .

Domes / sky lights : Opaque as well as transparent.

Roofing : Coloured or Double skinned for insulation.

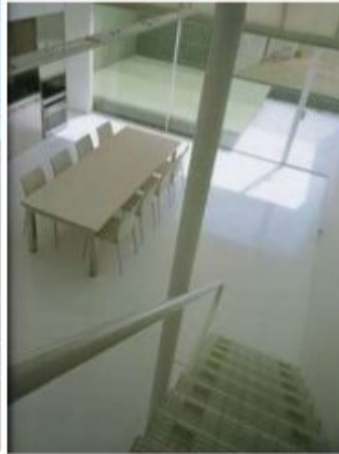


The building's form is inspired by the natural formation of soap bubbles.

Ethyl tetrafluoroethylene (ETFE) was chosen for the façade. This material weighs just 1% of glass and is a better thermal insulator. Around 20% of solar energy is trapped and used for heating.

Water Cube; The National Aquatic Centre in Beijing China





Plastic house by Kengo Kuma made entirely of plastic (urethane panels)

Situated in Tokyo, Japan



Construction professionals select plastic materials based on the following criteria:

1. Durability

Many plastic materials are as strong as if not stronger than certain metals. Plastic hardware is also frequently corrosion resistant, allowing it to survive outside in inclement weather indefinitely.

2. Cost Effectiveness

As is the case in most industries these days, cost is an important factor in any construction project. Many plastic materials are very economical.

3. Recycling

Unlike metals, some plastics can be recycled without losing any chemical properties and hence can be used over and over again.

4. Energy Saving

Plastic consumes less heat than metal. The insulating effects of some plastics can also decrease sound pollution level.

5. Safety

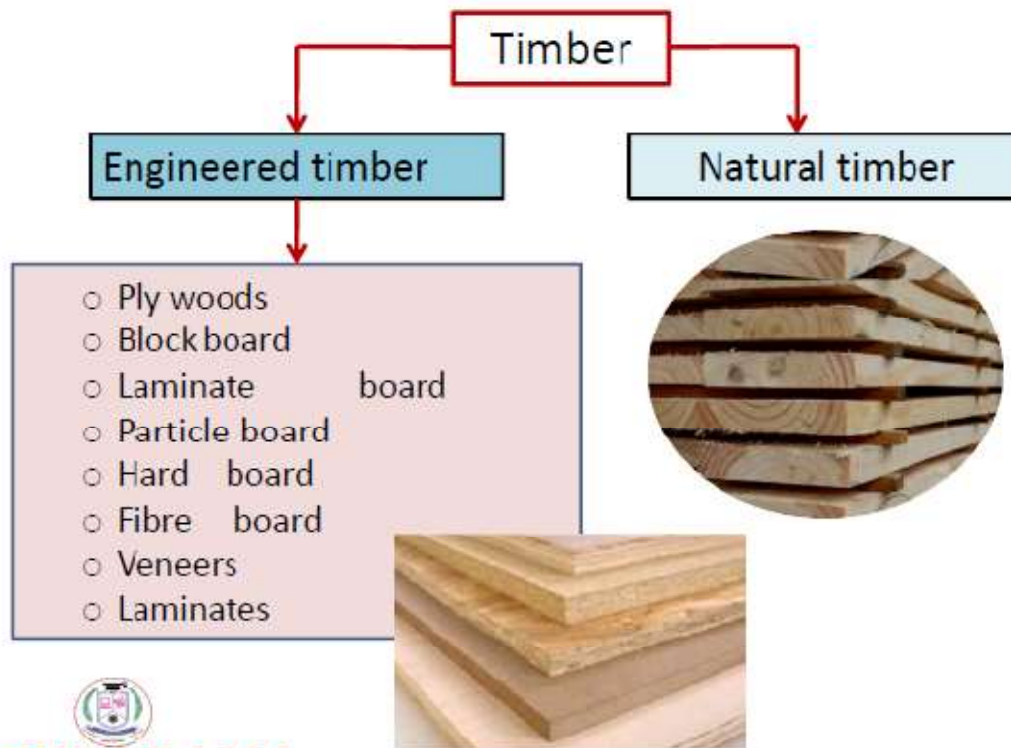
Plastic materials are typically much lighter than metals. The lightness of the material makes it easier to carry and lift into place.

6. Easy to install

A while back we posted about an FRP bridge that was installed in just a few days. The lightweight of plastic materials allows for quick and easy installation.

TIMBER IN BUILDING CONSTRUCTION

PART OF STRUCTURE



Plywood

Plywood is a composite material, made of timber, although we often consider it as a traditional working material. It is composed of individual plies/ veneers of wood.



CHARACTERISTICS

- It is very strong due to the way the plies are put together.
- Plywood is less likely to warp or split.
- Manmade boards of this type are supplied in a range of sizes and thicknesses.
- This is an advantage compared to natural woods, as manmade boards can be manufactured so that they are extremely wide.

This makes plywood a popular material in the construction industry.



Plywood Structure

Individual layers of plywood are called **plies**.

Each ply has its grain running at **ninety degrees to the next layer**, as indicated by the arrows. (Panel strength and stiffness in both directions are maximized)

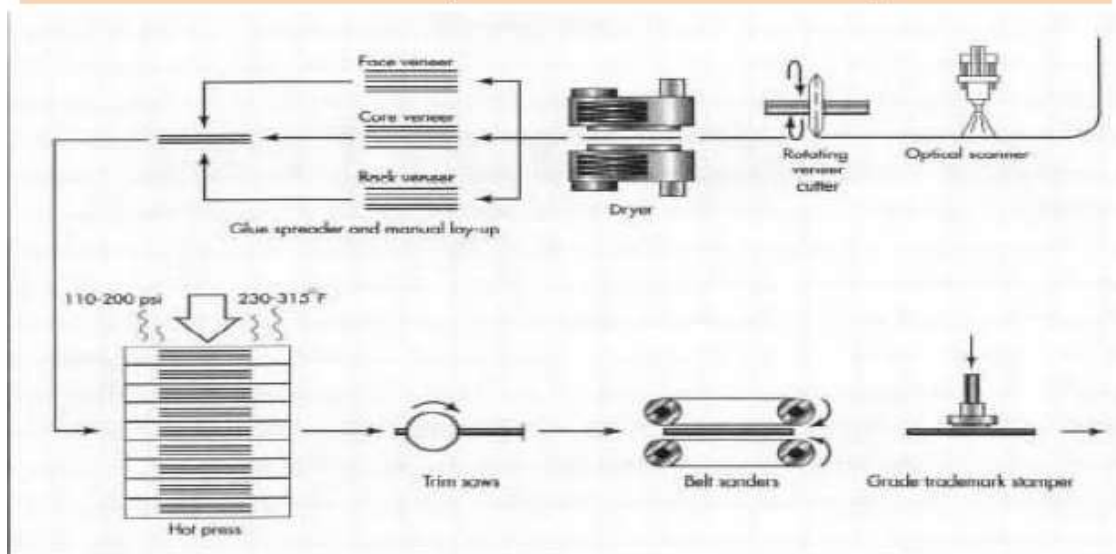
The **plies are glued** together with synthetic resin, making a very strong composite material.

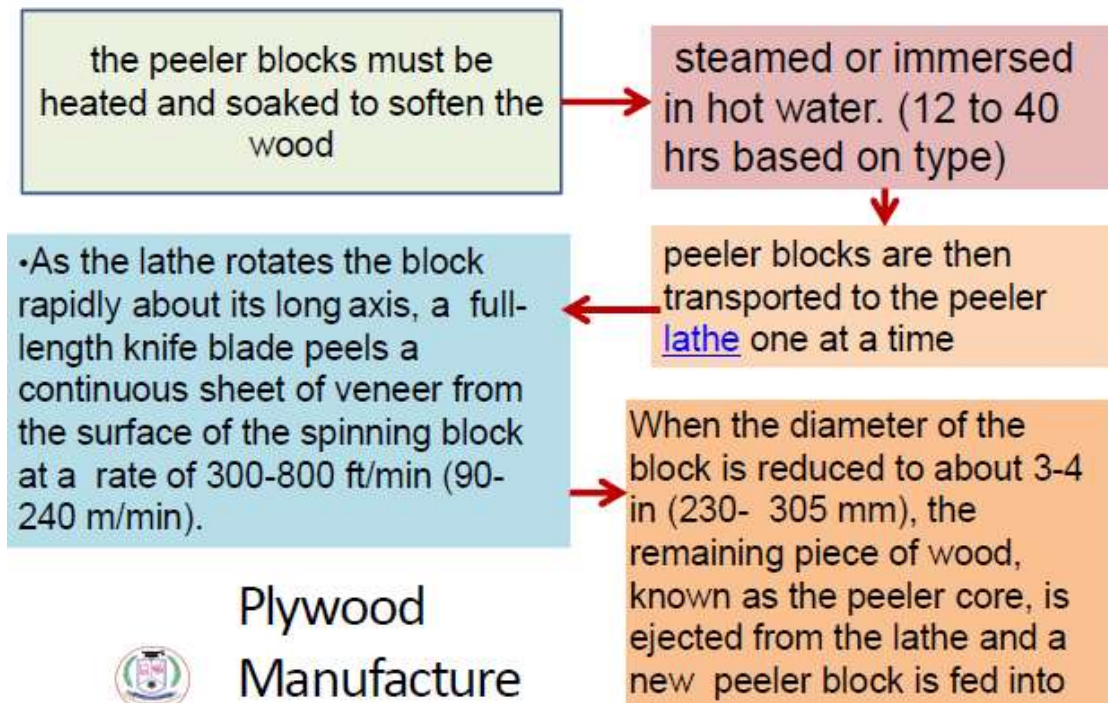
Bonded under heat and pressure with durable, moisture-resistant adhesives

Plywood is usually constructed so that an **odd number of plies** are used.



Plywood : Manufacture process





- The long sheet of veneer emerging from / the peeler lathe may be processed immediately, or it may be stored in long, **multiple-level trays** or **wound onto rolls**.
- In any case, the next process involves cutting the veneer into usable widths, usually **about 4 ft-6 in** (1.4 m), for making standard 4 ft (1.2 m) wide plywood sheets.
- At the same time, optical scanners look for sections with unacceptable defects, and these are clipped out, leaving less than standard width pieces of veneer.

The wet strips of veneer are wound into a roll, while an optical scanner detects any unacceptable defects in the wood. Once dried the veneer is graded and stacked.

Selected sections of veneer are glued together. A hot press is used to seal the veneer into one solid piece of plywood, which will be trimmed and sanded before being stamped with its appropriate grade.

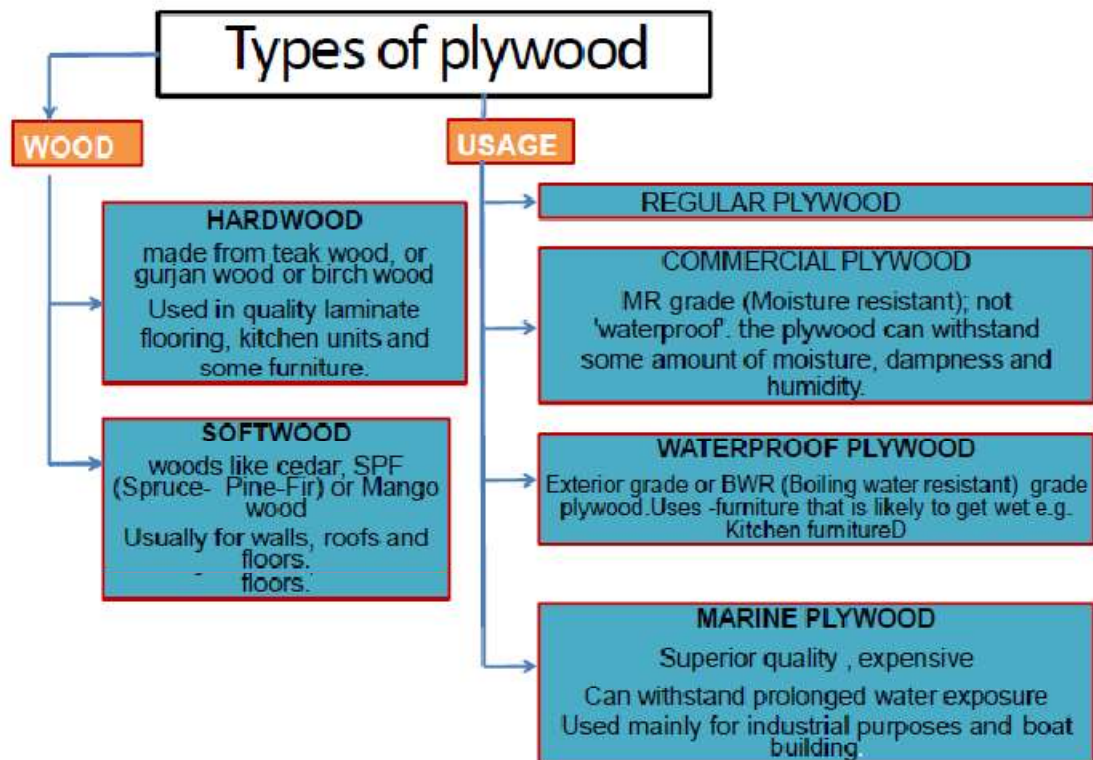
The sections of veneer are then sorted and stacked according to grade. This may be done manually, or it may be done automatically using optical scanners.

The sorted sections are fed into a dryer to reduce their moisture content and allow them to shrink before they are glued together.

- The glued sheets are loaded into a multiple-opening hot press. presses can handle 20-40 sheets at a time, with each sheet loaded in a separate slot.
- When all the sheets are loaded, the press squeezes them together under a pressure of about 110-200 psi (7.6-13.8 bar), while at the same time heating them to a temperature of about 230-315° F (109.9-157.2° C).
- The pressure assures good contact between the layers of veneer, and the heat causes the glue to cure properly for maximum strength. After a period of 2-7 minutes, the press is opened and the sheets are unloaded.

- The plies are arranged in perpendicular fashion, according to the size and thickness of plywood needed.
 - Then the adhesive is applied in between each layers either by hand or use of machines.
 - The whole arrangement undergoes thru a hot press.
 - The machine presses the different layers together under heat; where the separate layers get bonded with each other and form a monolithic composite material.
 - The almost finished plywood then undergoes through sawing machine to get its edges straight cut to have a sharp, straight and square edges with the desired size as well.
 - Then a sanding machine which sands the top and bottom layers to achieve a even surface.
 - Now the plywood piece is ready and can be used in a wide range of applications.
- Can be finished of with a decorative layer of veneer or laminates etc for aesthetical purposes.
 - If it's a pre decorated board (one eg pre-lam boards), the decorative finish of laminate is placed on the top and inserted along with the other veneer layers into the hot press. So the plywood which comes as the end product doesn't require any additional finish.

Different types of plywood



Plywood: Special Types



FLEXIBLE PLYWOOD

- Also called as flexi ply
- Can easily be rolled up
- Used for creating round and curved shaped furniture



FR GRADE: FIRE RETARDANT

- Used in places where fire risks have to be reduced
- Surface is treated with fire resisting chemicals



TERMITE-RESISTANT AND BORER-PROOF

- Offers protection from external pests that can destroy the wood



STRUCTURAL PLYWOOD

- Suitable for construction applications where structural stability is required

Plywood Sizes & Thickness

THICKNESS AVAILABLE

MR grade (Moisture Resistant)	3, 4, 6, 8, 12, 15, 18, 21, 25 mm
BWR grade (Boiling Water Resistant)	4, 6, 9, 12, 16, 19, 25 mm
Shuttering plywood	6, 12, 15, 18, 21, 25 mm



Can you tell
how these
sizes are
derived??



SIZES AVAILABLE (in feet)

8x4
8x3
7x4
7x3
6x4
6x3

SAR1406

Plywood

LEADING BRANDS OF PLYWOOD IN INDIA

Century Plyboards (India) Ltd. Greenply Industries Ltd.

National Plywood Industries Ltd.

Sarda Plywood Industries Ltd.

Mayur Plywood

Kitply Industries Ltd.

INDIAN STANDARDS SPECIFICATIONS FOR PLYWOODS

IS: 303 - MR Plywood, BWP/BWR Plywood, Flexi Ply IS: 710 - Marine Plywood

IS: 10701 - Structural plywood

IS: 5509-1980 - Fire Retardant Plywood IS: 4990 - Shuttering Plywood

Plywood Future

- Even though plywood makes fairly efficient use of trees— essentially taking them apart and putting them back together in a stronger, more usable configuration—there is still considerable **waste inherent in the manufacturing process.**
- In most cases, only about **50-75% of the usable volume of wood in a tree is converted into plywood.** To improve this figure, several new products are under development.

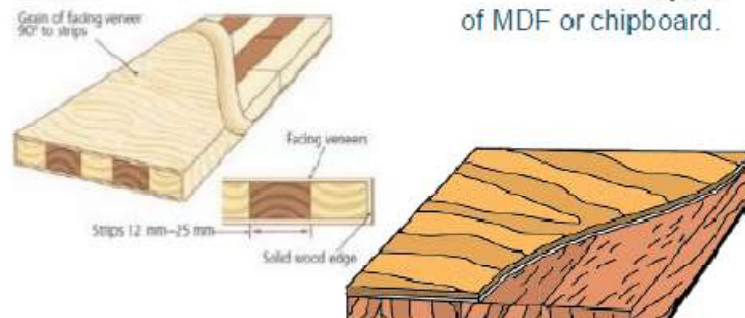
New product : **ORIENTED STRAND BOARD**

- which is made by shredding the entire log into strands, rather than peeling a veneer from the log and discarding the core.
- The strands are mixed with an adhesive and compressed into layers with the grain running in one direction.
- These compressed layers are then oriented at right angles to each other, like plywood, and are bonded together.
- Oriented strand board is as strong as plywood and costs slightly less.



Structure

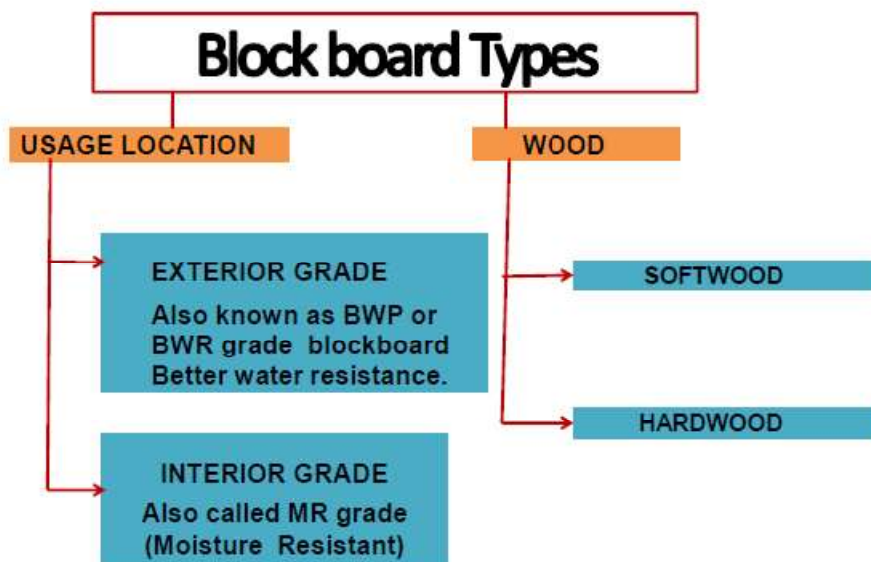
Strips of softwood glued together and faced with veneers.
Softwood strips are 12 – 25mm wide
Does not split
Alternating growth rings



Blockboards

This is built up with a core of solid elongated blocks of softwood bonded together with adhesive and covered with a sheet of plywood on either side. Alternative facing materials include thin layers of MDF or chipboard.

Difference Between Plywood & Blockboard



Block board : Properties and uses

ADVANTAGES

- Lighter in weight (use of softwood)
- Very strong due to different directions of veneer
- Does not split easily
- Comes in large sizes and also large thicknesses
- Lesser tendency to sag or bend
- Costs Less
- Can screw into the edges
- Better than Particle Board and even MDF
- Resistance to attack from water, heat, chemical, fungi and insect attack.

DISADVANTAGES

- Not as strong as plywood or good quality solid wood
- The nails may sometimes enter the gaps
- Edges need to be covered

USES/APPLICATION

- Furniture
 - long book shelves
 - tables and benches
- Kitchen storage
- Interior finishing – shop fittings
- Blockboard Doors and Solid core flush doors
- Wall cladding – lengthy wall panels
- Ship interiors
- Theater stages

This is made up of small chips of wood bonded together with resin (urea formaldehyde) and formed into sheets by compression in a hot press. It is not as strong as plywood and block board but it is not expensive.

Chipboard is often covered with a plastic laminate or wood veneer and used in furniture.

Also called **CHIPBOARD**

Particle boards



particle board

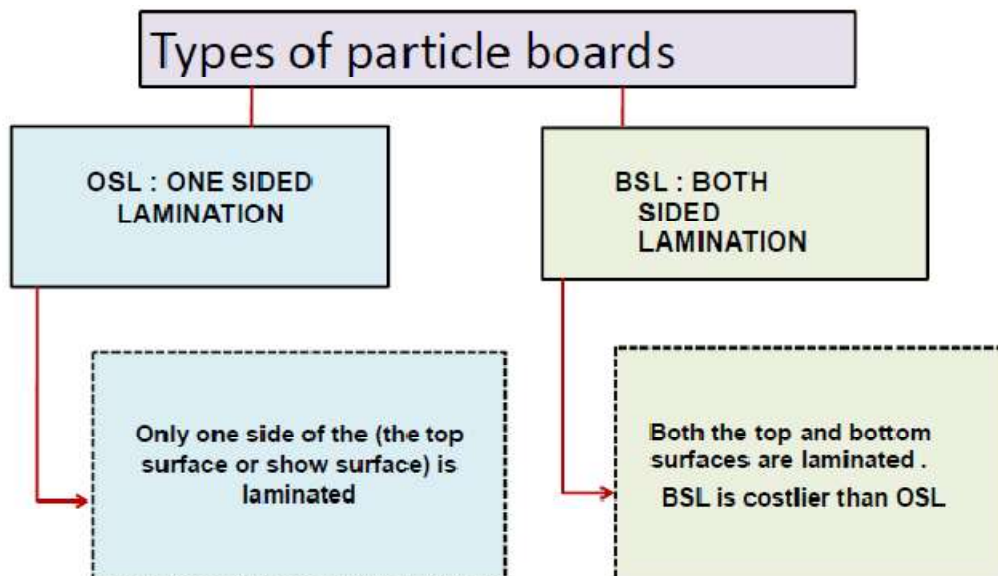
Properties & Uses

ADVANTAGES

- Uniform thickness
- Very light weight
- Eco-friendly as it is made up to waste wood particles

DISADVANTAGES

- Age usually not more than 5yrs
- Very sensitive to water and moisture. Swells if comes in contact.



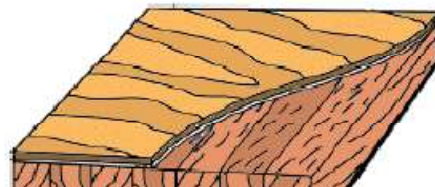


lamin boards

A compound wood board consisting of thin strips of softwood placed side by side and sandwiched between veneer panels, often of hardwood. Considered to be of higher quality than blockboard.

Structure

The central core consists of 5mm wide strips with vertically arranged growth rings, individually interlocked. This results in a particularly even surface and high material stability.



hard boards

This is made from wood fibres that have been pulped. It is not as strong as the other boards.

Manufacture

- Hardboard is made up from wood pulp
- Water is added to the pulp
- The mixture is then pressed under high temperatures and the water is removed
- Sheets are smooth on one side and textured on the other
- 3-9mm thick

PROPERTIES

- Available in thin sheets
- One face smooth, one textured
- Often faced with plastic laminate
- Back of cabinets, base of drawers
- Only used indoors

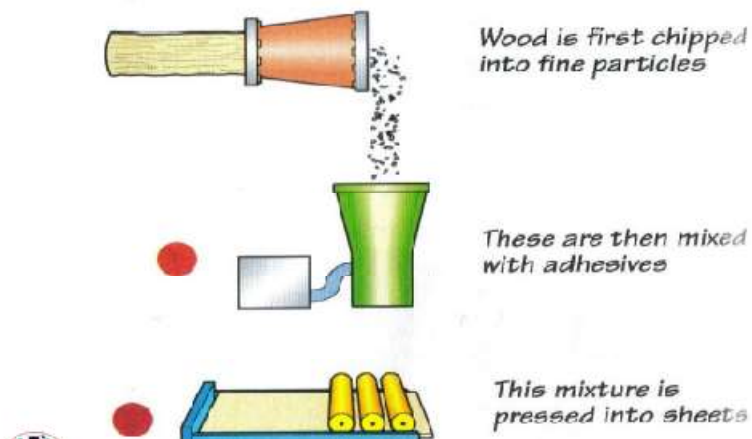


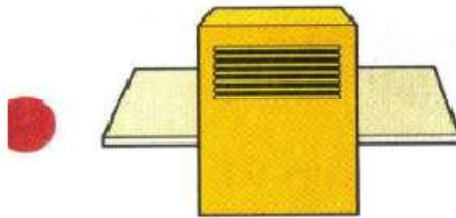
A quality board, relatively cheap. This board is composed of fine wood dust and resin pressed into a board. This material can be worked, shaped and machined easily. Paint can be applied to it without the need for an undercoat or primer. Used in the building and furniture trades

fibre boards

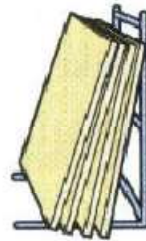
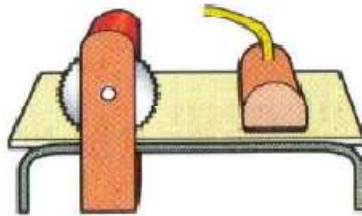


Fibre board Manufacture

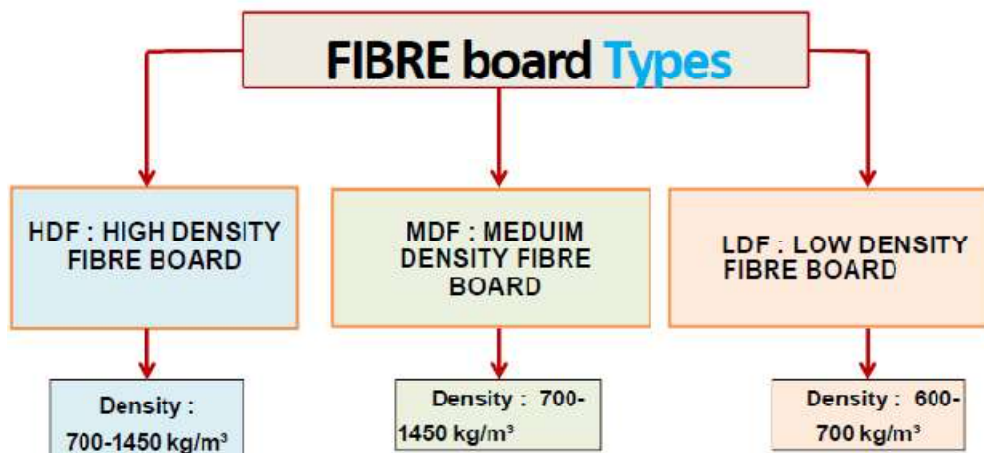




The sheets are sanded



...then cut into standard sizes



MDF FIBRE boards

ADVANTAGES OF USING

- Isotropic (properties same in all directions) ,so no tendency to split
- Consistent in strength and size
- Flexible. Can be used for curved walls or surfaces.
- Shapes well.
- Stable dimensions (won't expand or contract like wood)
- Easy to finish (i.e. paint)
- MDF boards are stronger, and hence costlier than plywood,particle boards and block boards.

DISADVANTAGES OF USING MDF

- Low grade MDF may swell and break when saturated with water.
- May warp or expand if not sealed.
- Dulls blades more quickly than many woods
- Weaker compared to plywood,

VENEER

Veneer is a thin sheet/layer of natural wood, usually a similar thickness to cardboard. It is produced from a tree trunk in a number of ways

CHARACTERISTICS

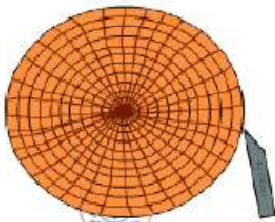
- Thinner than 3mm
- Available in standard sizes same as laminates
- Gives wood finish using much lesser solid wood
- Is usually glued onto the surface of a cheaper manmade board, giving the illusion of expensive natural wood.
- Due to its flexibility wooden finished furniture can be made in all (curved) shapes and sizes which were not possible using solid wood



Veneer Manufacture –METHODS

ROTATORY CUT VENEERS –ROLL VENEERS

Logs are horizontally
rotated and peeled



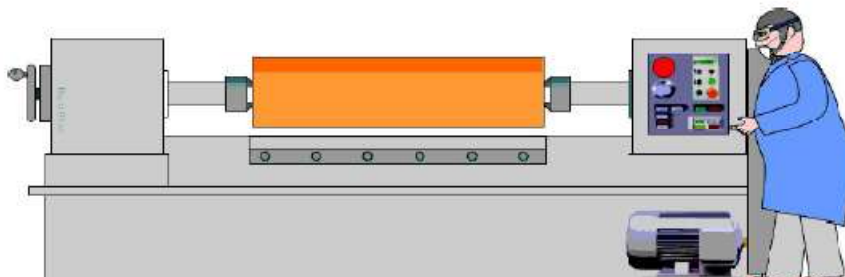
SLICED OR SHEET VENEERS

logs are sliced
More expensive
better quality veneer

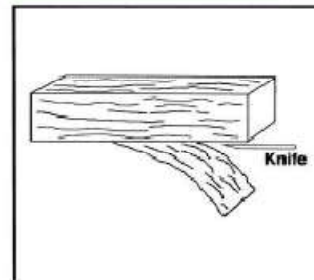
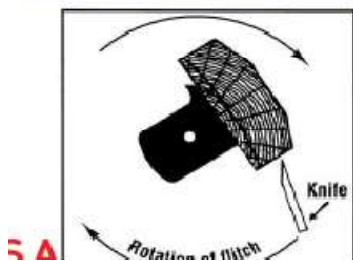


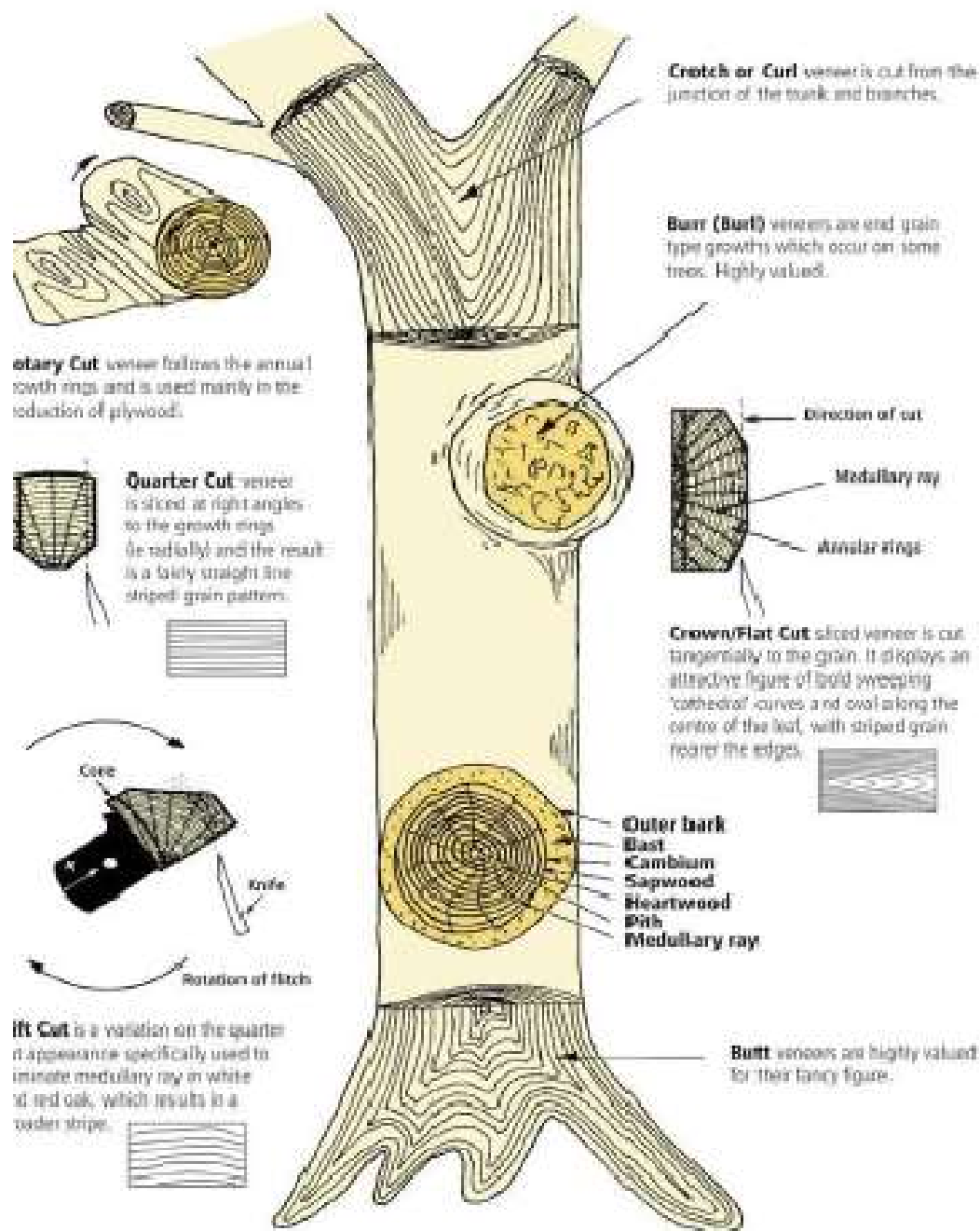
Veneer Manufacture –ROLL VENEERS

The most popular method is to 'peel' a layer of thin wood (veneer) with a cutter, whilst the tree trunk revolves on a large lathe.



Veneer Manufacture—SHEET VENEERS





Veneer slicing pattern

'Iron on' veneer is purchased in the form of rolls. It is supplied in a range of widths, lengths and woods. One side is natural wood and the other is a layer of glue/adhesive.

veneer

Iron on Veneer

TO USE

A strip of veneer is cut slightly longer than the edge of the board. It is positioned on the edge of the manmade board, natural wood side facing upwards. A 'hot' iron is placed on top of the veneer. This warms and melts the glue. As the iron is pushed along the strip, the veneer is glued to the edge of the manmade board. A craft knife is used to trim the veneer to the exact size.

In its simplest form, a roll of 'iron on' veneer can be used to glue along the edge of a board (eg: particle board, lamin board) providing a quality finish and hiding the cheaper board beneath.



A wood laminate is a thin sheet of material used to cover the core of a wood project in order to change the appearance of the material.

CHARACTERISTICS

- The **advantage** to a laminate is that they help to lower the overall construction cost while still providing the same sort of aesthetic beauty as solid hardwood cabinets.
- A **disadvantage** is that a laminated cabinet is slightly more difficult to refinish in the future and the overall cabinet lacks the strength of the hardwood it is being made to resemble.

laminates



INGREDIENTS

Brown paper (also known as Kraft paper)

Phenolic resin (which is made from phenol and is the basic material used for making plastic)

Decorative printed paper (this will have the printed decorative design for the face of the sunmica/laminate sheet)

Melamine resin (A clear transparent resin for treating the decorative paper)

Clear translucent paper (which forms the topmost overlay of the decorative laminated sheet)

laminate Manufacture

STEP 1: SOAKING THE PAPER IN RESINS

STEP 2: DRYING THE PAPERS STEP

3: CUTTING

STEP 4: HIGH-PRESSURE PRESSING AND BONDING

STEP 5: SANDING THE NON-DECORATIVE SIDE

STEP 6: TESTING, PACKING, SHIPPING

laminate Manufacture

STEP 1: SOAKING THE PAPER IN RESINS

The brown paper that is going to form the bottom side or base of the laminate is soaked in a bath tub that is filled with phenolic resin. On soaking, the brown paper absorbs the resin and is saturated with it. This soaking process is also known as impregnation.

The decorative printed paper and the translucent paper is similarly soaked and saturated with the melamine resin. The resin helps to make these surfaces harder, stiffer and better at resisting scratches and wear and tear.

Step 2: Drying the papers

The soaked papers are allowed to dry. After the drying is complete, the paper which earlier was easy to tear acquires new physical properties. It becomes stiff and brittle.

Step 3: Cutting

The hardened rolls of paper are then cut to the desired sizes by the cutting machines (called cutters). In India, the standard or most common size for laminate sheets is 8'x4' (8 feet by 4 feet). So the machines accordingly cut the papers to this size.

laminate Manufacture

Step 4: High-pressure pressing and bonding

The next step in the laminate manufacturing process is to hard press these papers together under high pressure and temperature.

This is done using hydraulic presses. The papers or sheets are stacked upon each other. The brown paper forms the bottom sheet followed by the decorative sheet, and the topmost layer is of the clear translucent paper.

The huge hydraulic presses are designed to press large number of laminate sheets at a single go. So all the laminates that are to be pressed are placed one upon another with steel separator plates interspersed between them (so that the separate laminate sheets do not stick with each other while being pressed).

The steel sheets also serve another purpose. They are designed to carry textures or patterns on them that get etched on to the surface of the sunmica/laminate sheet while being pressed. The pressing is one of the most important processes in the manufacturing of laminate sheets and is the reason why decorative laminates are often referred to as HPL and HPDL (High-pressure decorative laminates).

laminate Manufacture

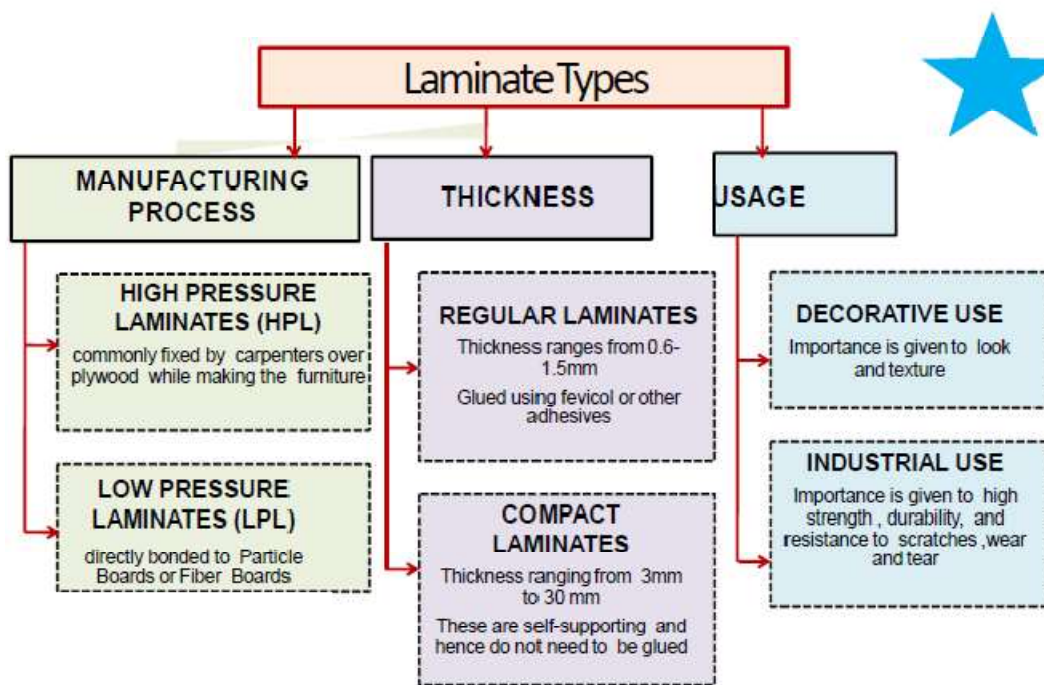
Step 5: Sanding the non-decorative side

In the final step of the process, the bottom side (non-decorative side) is uniformly sanded by a sanding machine. The sanding process makes this surface better suited for adhesion to surfaces. This sanded surface is the one on which carpenters apply Fevicol (or other adhesives) while glueing these sunmica/laminate sheets over plywood or other base substrate materials.

Step 6: Testing, Packing, Shipping

Samples of the finished products may be subjected to standard quality tests for laminates as per norms, and these sheets are then packaged and shipped to the regular distribution channels of the laminate companies.

So this is how sunmica and other laminate sheets are made.



Laminates Sizes..Facts

FEW LEADING LAMINATE BRANDS IN INDIA

Unmica, Formica, Greenlam
Laminates, Century, Sundek, Delta
Laminates, Kitvista

Laminates, Merino
Asis, Virgo, Durian,

The market rates of laminates ranges from Rs.28 – Rs.390 per sq.ft



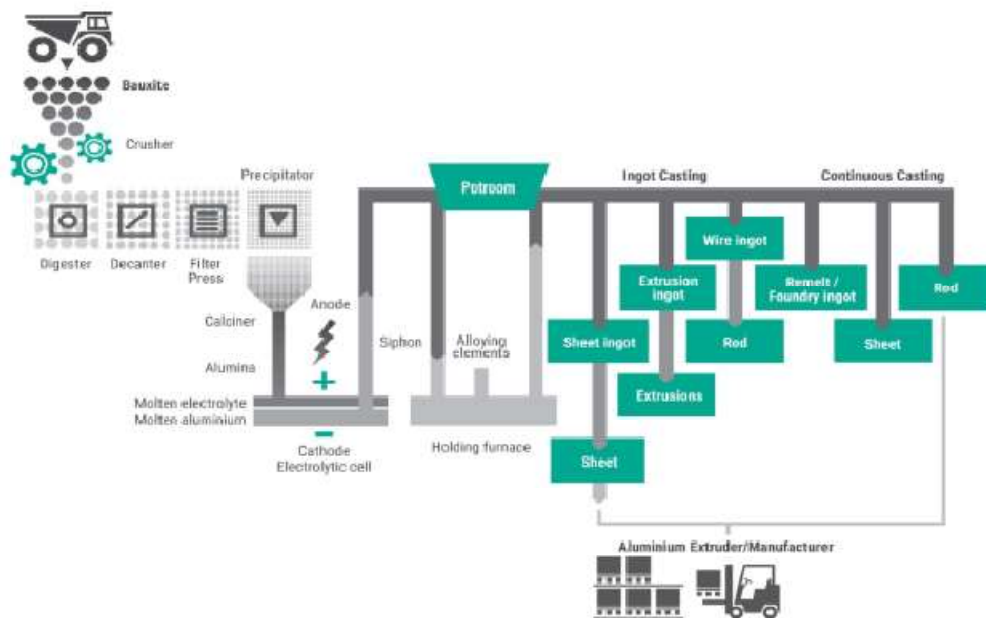
DID YOU KNOW !!
Laminates are also called MICA boards.

SIZES AVAILABLE
(in feet)

Standard size : 8'x 4' Special

Aluminium

- Aluminium is a silvery-white metal, the 13 element in the periodic table.
- One surprising fact about aluminium is that it's the most widespread metal on Earth, making up more than 8% of the Earth's core mass.
- It's also the third most common chemical element on our planet after oxygen and silicon.



- **Bauxite mining** : Bauxite is used as the main raw material in the manufacture of aluminium. About 4-5 tonnes of bauxites are required for 1 tonne of aluminium.
- **Bauxite grinding**: The bauxite mineral is transported to refineries where the clay is washed off and the bauxite passes through a grinder to produce a more consistent material.
- **Bauxite crushing and digesting – producing sodium aluminate** : The ground mineral is pumped into large pressure tanks with a caustic soda or [sodium hydroxide](#) solution, and a steam heat is applied. The caustic soda reacts with the aluminium compounds in the bauxite material to produce a solution of sodium aluminate (also known as **slurry**).
- **Settling**: The sodium aluminate solution is then passed through into lower pressure settling tanks. The solution at the top of the tanks is directed downwards through a series of filters to remove excess red mud. The remaining alumina is then passed through huge “leaves” or cloth filters to remove any solids in the solution
- **Precipitation**: The sodium aluminate solution is then cooled and pumped into large **precipitators** (sometimes as tall as a 6-story building). Aluminium hydroxide seed crystals added to the solution to start the precipitation process. At this point, large aluminium crystals are formed.
- **Calcination**: he crystals are then heated in rotary kilns to temperatures over 960°C. This extracts the last impurities and creates a white powder, known as alumina or aluminium oxide.
- **Smelting process**: The alumina is poured into a reduction cell with 950°C molten cryolite. 400kA electrical currents are passed through the mixture to break the bond between the aluminium and oxygen. The result is 99.8% pure aluminium



ALUMINIUM

USES

The uses that aluminium gives to nowadays are **MULTIPLE** and we can divide them by sectors:

- Electricity and communication
- Transport
- Building and construction
- Packings

RECYCLING

- It takes between 200 and 500 years to deteriorate
- Any product of aluminium can be recycled infinite times without losing his properties
- the material can be re-used

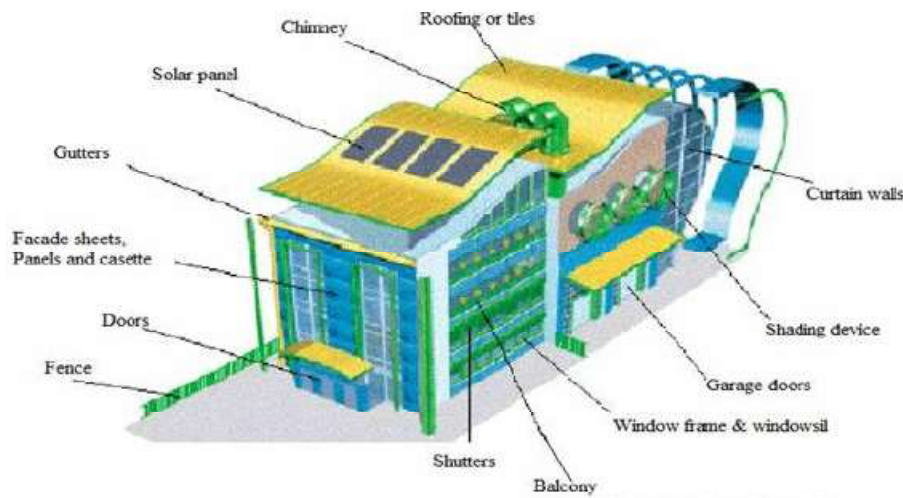


Fig 3.1 Aluminium used in construction

Properties of aluminium

Density of Aluminium

- Aluminium has a density around one third that of steel or copper making it one of the lightest commercially available metals. The resultant high strength to weight ratio makes it an important structural material allowing increased payloads or fuel savings for transport industries in particular.

Strength of Aluminium

- Pure aluminium doesn't have a high tensile strength. However, the addition of alloying elements like manganese, silicon, copper and magnesium can increase the strength properties of aluminium and produce an alloy with properties tailored to particular applications.
- Aluminium is well suited to cold environments. It has the advantage over steel in that its tensile strength increases with decreasing temperature while retaining its toughness. Steel on the other hand becomes brittle at low temperatures.

Corrosion Resistance of Aluminium

- When exposed to air, a layer of aluminium oxide forms almost instantaneously on the surface of aluminium. This layer has excellent resistance to corrosion. It is fairly resistant to most acids but less resistant to alkalis.

Thermal Conductivity of Aluminium

- The thermal conductivity of aluminium is about three times greater than that of steel. This makes aluminium an important material for both cooling and heating applications such as heat-exchangers. Combined with it being non-toxic this property means aluminium is used extensively in cooking utensils and kitchenware.

Electrical Conductivity of Aluminium

- Along with copper, aluminium has an electrical conductivity high enough for use as an electrical conductor. Although the conductivity of the commonly used conducting alloy (1350) is only around 62% of annealed copper, it is only one third the weight and can therefore conduct twice as much electricity when compared with copper of the same weight.

Reflectivity of Aluminium

- From UV to infra-red, aluminium is an excellent reflector of radiant energy. Visible light reflectivity of around 80% means it is widely used in light fixtures. The same properties of reflectivity makes [aluminium](#) ideal as an insulating material to protect against the sun's rays in summer, while insulating against heat loss in winter.

Mechanical Properties of Aluminium

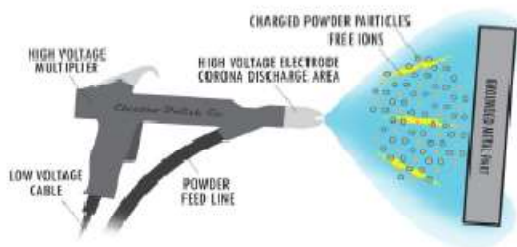
- Aluminium can be severely deformed without failure. This allows aluminium to be formed by **rolling, extruding, drawing, machining and other mechanical processes**. It can also be cast to a high tolerance.
- Alloying, cold working and heat-treating can all be utilised to tailor the properties of aluminium.
- The tensile strength of pure aluminium is around 90 MPa but this can be increased to over 690 MPa for some heat-treatable alloys.

Powder coated aluminium



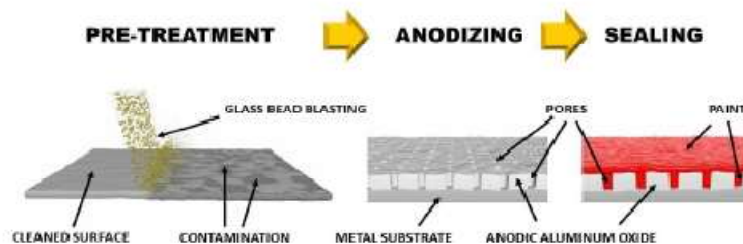
Powder coating process

Powder coating is a dry finishing process that uses finely ground particles of pigment and resin that are electrostatically charged and sprayed onto electrically grounded parts. The charged powder particles adhere to the part and are held there until melted and fused into a uniform coating in a curing oven.



Anodizing of aluminium

Anodizing is an electrochemical process that converts the metal surface into a decorative, durable, corrosion-resistant, anodic oxide finish. This aluminum oxide is not applied to the surface like paint or plating, but is fully integrated with the underlying aluminum substrate, so it cannot chip or peel.



copper alloys: Properties and uses of bronze

- Copper and copper alloys offer a suite of **infinitely recyclable materials** providing many property combinations suited to a wide range of applications that facilitate and enhance our daily lives.
 - Copper's performance can be expanded to suit many industrial applications by alloying: making a solid material out of two or more different metals.
 - Good electrical and thermal conductivity, strength, ductility and excellent corrosion resistance are just some of the properties that copper and its alloys offer. Copper alloys are grouped into families, based on their composition.
- There are more than 100 copper alloys, each with a unique combination of properties, to suit many applications, manufacturing

- **Pure copper** has the best electrical and thermal conductivity of any commercial metal. Today, over half of the copper produced is used in electrical and electronic applications and this leads to a convenient classification of the types of copper into electrical (high conductivity) and non-electrical (engineering).
 - Copper forms alloys more freely than most metals and with a wide range of alloying elements to produce the following alloys:
 - **Brass** is the generic term for a range of copper-zinc alloys with differing combinations of properties, including strength, machinability, ductility, wear-resistance, hardness, colour, hygienic, electrical and thermal conductivity, and corrosion-resistance.
 - **Bronze** alloys are made from copper and tin, and were the first to be developed, about four thousand years ago. They were so important that they led to a period in time being named the Bronze Age
-
- **Gunmetals** are alloys of copper with tin, zinc and lead and have been used for at least 2000 years due to their ease of casting and good strength and corrosion resistance.
 - **Copper-nickel alloys** have excellent resistance to marine corrosion, high thermal conductivity and low susceptibility to attachment of marine macro-organisms. The addition of nickel to copper improves strength and corrosion resistance, but good ductility is retained.
 - **Nickel silver** alloys are made from copper, nickel and zinc, and can be regarded as special brasses. They have an attractive silvery appearance rather than the typical brassy colour.
 - **Beryllium-copper** is the hardest and strongest of any copper alloy, in the fully heat treated and cold worked condition. It is similar in mechanical properties to many high strength alloy steels but, compared to steels, it has better corrosion resistance.

Bronze

- Highly **ductile**.
- Bronze exhibits low **friction** against other metals.
- Many bronze alloys display the unusual property of expanding a small amount when solidifying from a liquid into a solid
- Brittle, but less so than cast **iron**.
- Upon exposure to air, bronze oxidizes, but only on its outer layer.

Brass



Handrails



Covering for the columns

Applications



Bronze cladding



- It is a substitutional alloy: atoms of the two constituents may replace each other within the same crystal structure.

Applications...





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SCHOOL OF BUILDING AND ENVIRONMENT

DEPARTMENT OF ARCHITECTURE

UNIT – II Materials and construction IV – SAR1304

ALUMIMIMIUM DOORS AND WINDOWS





INTRODUCTION

- ▶ Aluminium is a conductive material
- ▶ Heat transmission can be reduced by separating the ALU profile in 2 parts using an insulating material to reduce the thermal transmission.
- ▶ Conductivity of Aluminium: 160 W/mK



INTRODUCTION

- ▶ The aluminium doors and window frames made from extruded aluminium sections.
- ▶ The channels and box sections have flanges and grooves for double glazing and weather-stripping.
- ▶ The glazed doors are commonly advertised as 'patio doors'.



COMPARISON B/W STEEL, ALUMINUM AND PVC

STEEL	ALUMINUM	PVC
LESS EXPENSIVE	MORE EXPENSIVE	ECONOMICAL
EASY TO WELD	DIFFICULT TO WELD	DOES NOT WELD
NOT 100% RECYCLABLE	100% RECYCLABLE	NOT 100% RECYCLABLE
HEAVY THAN ALUMINUM	60% LIGHTER THAN STEEL	VERY LIGHT WEIGHT
CORROSION RESISTANT	HIGHLY CORROSION RESISTANT	RUST OR CORROSION FREE
REQUIRE PAINTING	DOES NOT REQUIRE PAINTING	DOES NOT REQUIRE PAINTING
MELTING TEMP. - 1500°C	MELTING TEMP. - 660°C	MELTING TEMP. - 260°C
CONDUCTOR	CONDUCTOR	INSULATOR

Aluminium Doors



Advantages of Aluminium Doors

However, if you need a customized door, the entire process of making it would take a bit longer. In the case of regular and common designs, a supplier will always have them readily available in different sizes. Regular doors will only require delivery and installation upon ordering.

- ▶ A great advantage to most property owners who use these doors is that they will not have to maintain them often. Aluminium resists rust and this is good news since it makes them ideal for use in any weather condition, even in areas near the ocean.
- ▶ Salty air around coastal regions damages many metallic products due to rust. You can always find these doors from most dealers. This is a big advantage. You will not have to struggle looking for them since most door suppliers worldwide stock them in plenty.

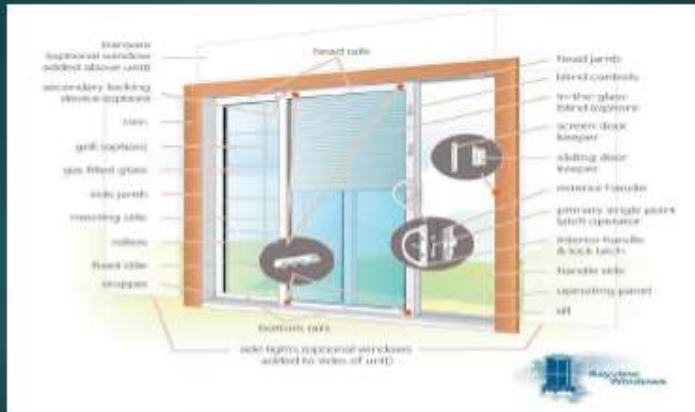


Disadvantages

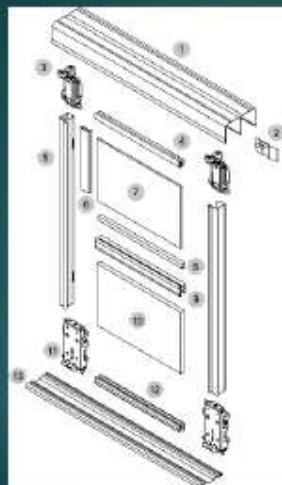
- ▶ The marks may increase in size and number over time. Although they don't rust, these marks look unsightly. Hence, consider this shortcoming before making your final decision.
- ▶ These doors are also relatively more expensive than those made of other materials. Aluminium is expensive and metal prices fluctuate often. This makes it challenging to budget much in advance.
- ▶ They require expert installers since their quality demands the highest installation standards.



Features Of Fixing Doors



DOORS

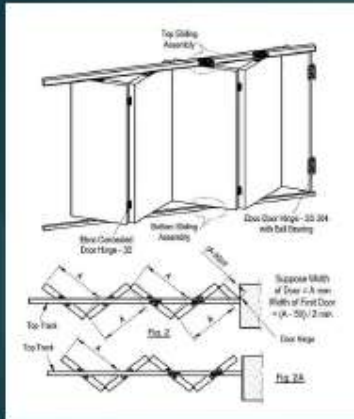


1. Double top track (Aluminum)
2. Door positioner
3. Twin wheel top guide
4. Top rail (Aluminum)
5. Stile (Aluminum)
6. Stile spacer
7. 4mm glass pane
8. H-bar spacer
9. H-bar (Aluminum)
10. 8mm Melamine Faced Chipboard (MFC) panel
11. Bottom running gear
12. Bottom rail (Aluminum)
13. Bottom track (Aluminum)

ELEMENTS OF DOOR

Aluminium Slide & Fold Doors

These doors are one of the best choices when it comes to choosing aluminium doors for home renovation. The slide and fold doors are folding, sliding varieties among the many different types that are available in the market today. Opening these doors really gives the homeowners a feeling of being out in the open porch without actually stepping out.



Aluminium Sliding Doors

Aluminium Sliding Doors

These doors are great for patios and areas where you want an unobstructed view of the outdoors. Aluminium sliding doors could also be opened easily through sliding the desired side. The state-of-the-art sliding mechanism of a good brand of such products offers the desired ease and convenience.



SLIDING DOORS



Aluminium Casement Doors

If you are looking for a design that would make a stunning entrance to your home, you can definitely choose aluminium casement doors. These doors generally come with huge, clear glass panels that are attached to the main frame with hinges

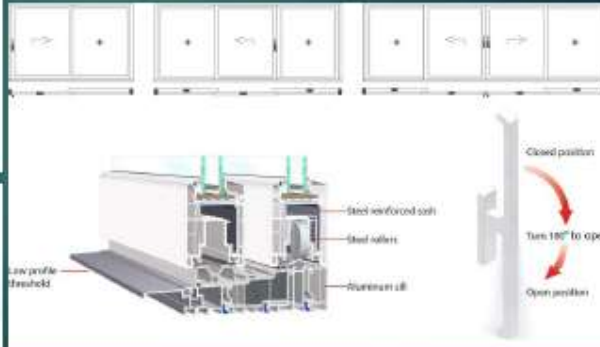
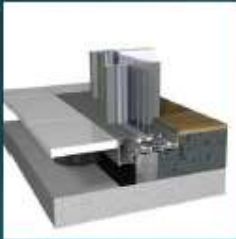


Aluminium Lift & Slide Doors

The aluminium lift & slide doors can be used where there is less space to install something large and it is space-consuming. This type of design is used in many modern homes. The doors have high quality mechanism that makes it easier for the doors to operate.



Aluminium Lift & Slide Doors



ALUMINIUM WINDOWS



TYPES OF ALUMINIUM WINDOWS



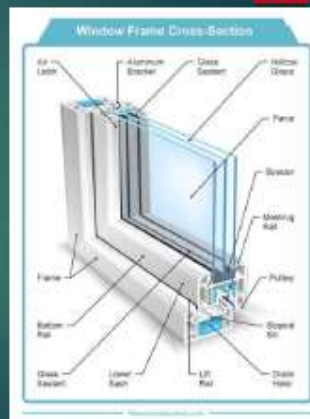
WINDOW SIZES CHART

TABLE 2 – RECOMMENDED OPENING SIZES – WINDOWS

S. No.	Type	Location	Sill Height	Masonry Opening Size
1	W1	Habitable Room	750	1800 x 1200
2	W2	Habitable Room	900	1800 x 1200
3	W3	Habitable Room	750	1500 x 1350
4	W4	Habitable Room	900	1500 x 1200
5	W5	Habitable Room	750	1200 x 1350
6	W6	Habitable Room	900	1200 x 1200
7	W7	Habitable Room	750	900 x 1350
8	W8	Habitable Room	900	900 x 1200
9	W9	Habitable Room	750	600 x 1350
10	W10	Habitable Room	900	600 x 1200
11	W11	Habitable Room	750	450 x 1350
12	W12	Habitable Room	900	450 x 1200
13	W13	Kitchen	1050	900 x 1050
14	W14	Toilet	1050	600 x 1050
15	W15	Toilet	1050	450 x 1050

Fixed pane windows.

Remember that there are areas of your home that may not need an actual opening window. You can have fixed pane windows installed anywhere on the outer envelopes of your house where there is a view or natural surroundings. This immediately adds a modern aesthetic to your home. You can also have large fixed-pane windows installed for indoor dividers between rooms.



Top-lights and sidelights

A perfect way to compliment windows and doors, that you may not know about, is to use top-lights and sidelights. Top-lights refer to the glass inserts above a window or door. Sidelights refer to the glass sections installed directly next to your door,

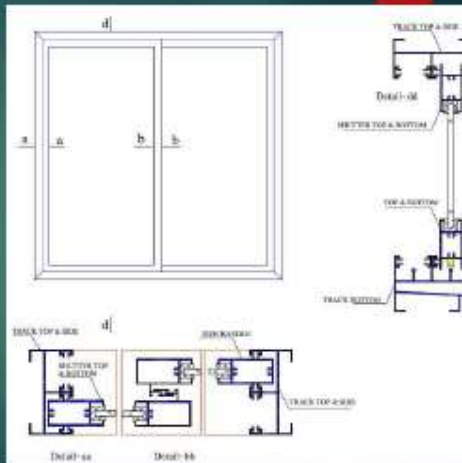
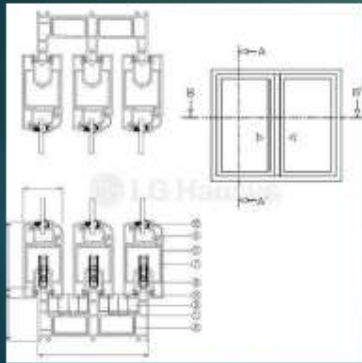




Sliding windows

Sliding windows have an unobtrusive design, especially in cases where space does not allow for sashes to project outwards. Horizontal sliding windows come in 2, 3 or 4 pane, depending on the width of the window. They are available in range of standard sizes, up to 3m in width, and up to 1.5m in height, but larger custom sizes are also possible.

SLIDING WINDOW



Stacking windows

The lesser known "stacking" windows, are also sometimes referred to as folding windows, folding-sliding windows, or concertina windows. These modern innovative windows open up extremely wide spaces, can let Stacking windows are manufactured exactly like stacking doors, but are made to the dimensions of a window.



Casement windows

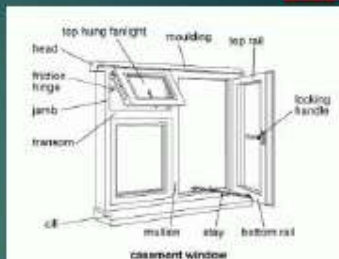
Casement windows are also called projected windows or sash windows. The sashes refer to the opening sections which swing out from the window outer frame. Casement windows can take two forms: side hung and top hung. The sashes of top hung windows are attached to the top of the outer frame and open upwards. Whereas with the side-hung windows, the sashes open to the left or right. The beauty of casement windows is that their design provides optimal control over wind, rain and ventilation to the exact degree.

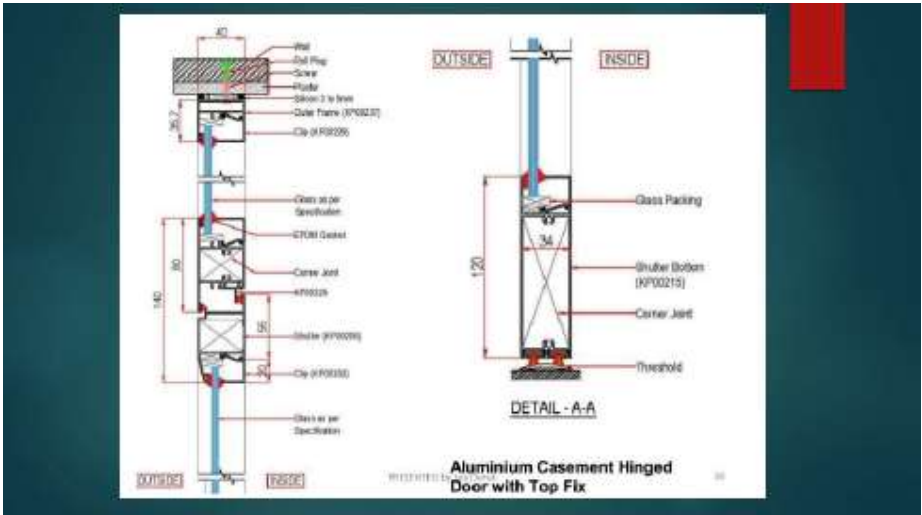


SLIDE AND STACK WINDOW



CASEMENT WINDOWS





ELEVATIONS AND DETAILS

WINDOW ELEVATION

RECOMMENDED ELEVATION OF WINDOWS FOR FIXING COOLER/AC

Fig. 26 : Opening Size 1200 x 1350

A

Fig. 27 : Opening Size 1500 x 1350

B



Fig. 26 : Opening Size 1200 x 1350

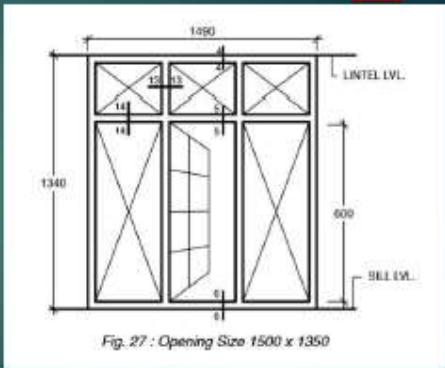
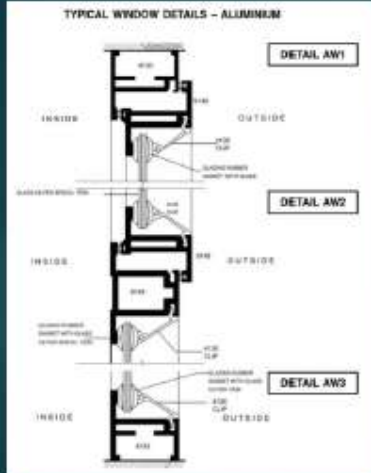
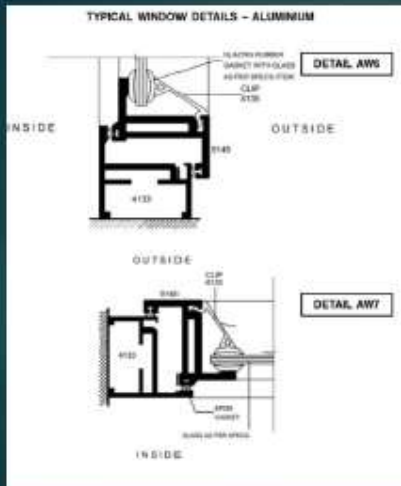
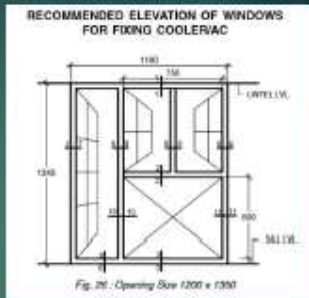
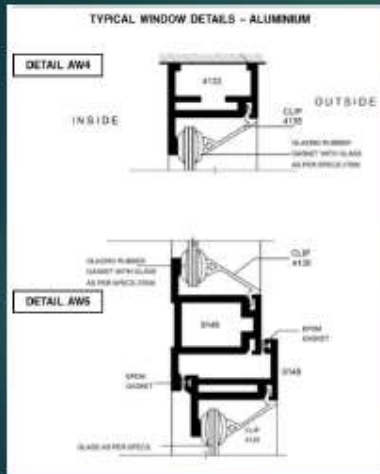


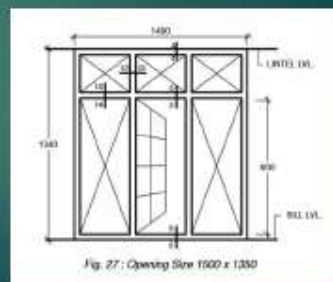
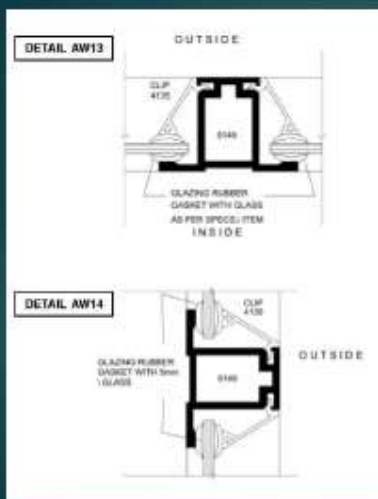
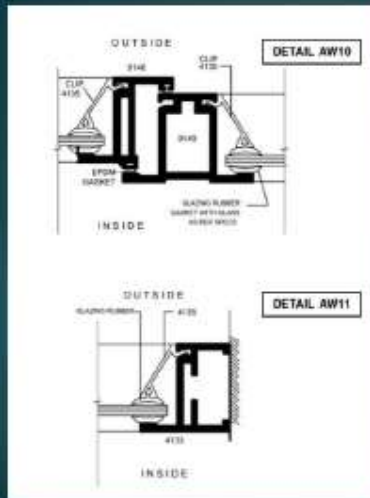
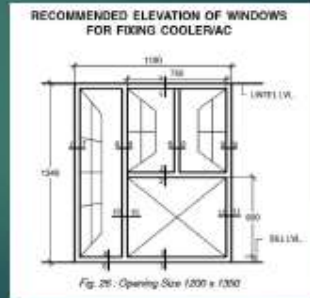
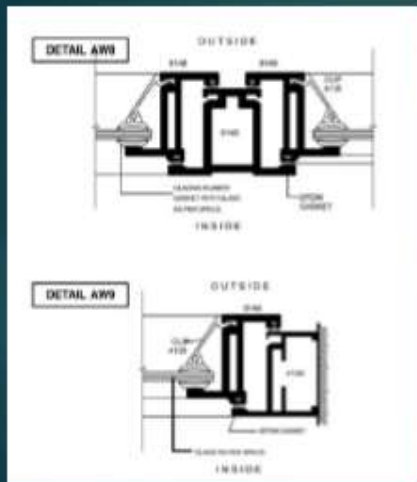
Fig. 27 : Opening Size 1500 x 1350



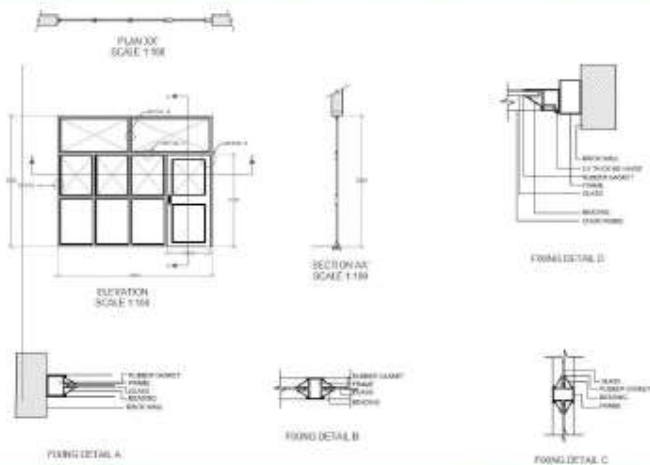
DETAILS

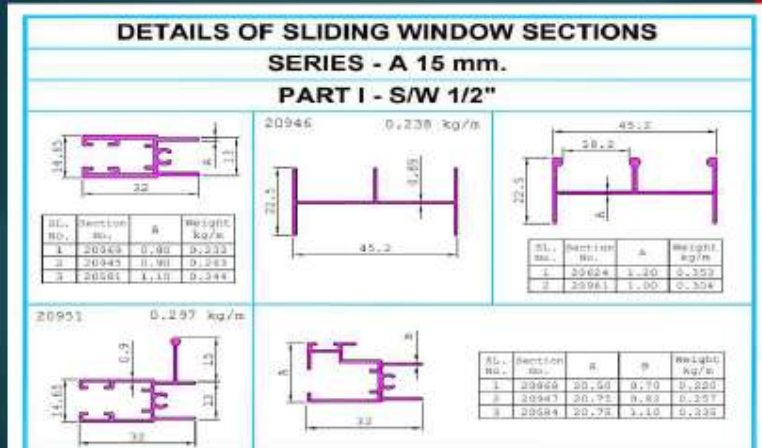


DETAILS



DETAILS





aUPVC

Unplasticised polyvinyl chloride (uPVC)



uPVC or **PVCu** is a form of plastic and stands for **unplasticised polyvinyl chloride**.

It is also known as **rigid PVC** due to the fact that it is hard and not flexible.

It is a **resistant form of PVC** that is often used for pipework and window frames.

UPVC is a low-maintenance building material used as a substitute for painted wood.



This composition varies according to climate

- **Good dimension stability**
- durable and strong, easy to maintain, high in insulation and environmental friendly
- **100% termite proof when compared to timber windows**
- uPVC profiles are corrosion free, pollution free and self extinguishing in case of fire
- **Manufactured and then brought to site**
- Quick to install at site



- **Installation done after wall plastering (geometry is crucial/ fenestration to be 6mm bigger in all the sides to fix the joinery & seal it with exterior grade SILICON sealant)**
- Security grills can be fixed in the joinery itself

- Friction stay hinges holds the casement shutter in any required position without the need of a stay hook
- Life cycle of uPVC is good.

The quality of a uPVC window can be determined by the quality of following Four main components:

The uPVC Profile:

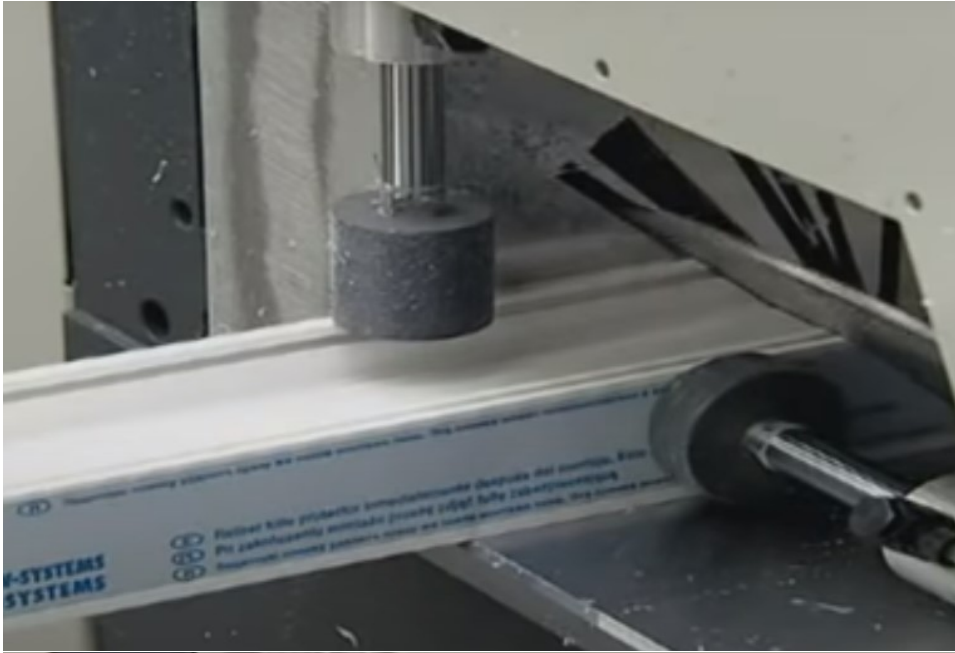
The uPVC Profile is basically an extruded section of a mixture of PVC with certain additives to make it suitable for making uPVC Windows and Doors. So, this very formulation technology is the key to make a Quality profile to make the Premium Windows. This formulation varies according to the climates. That's why the formulation for High UV Sensitive India requires a formulation combination of:

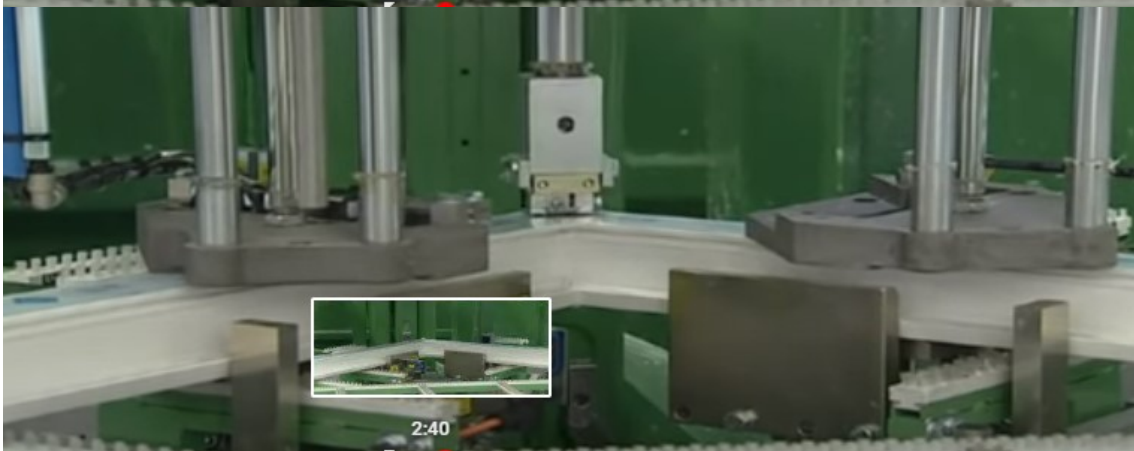
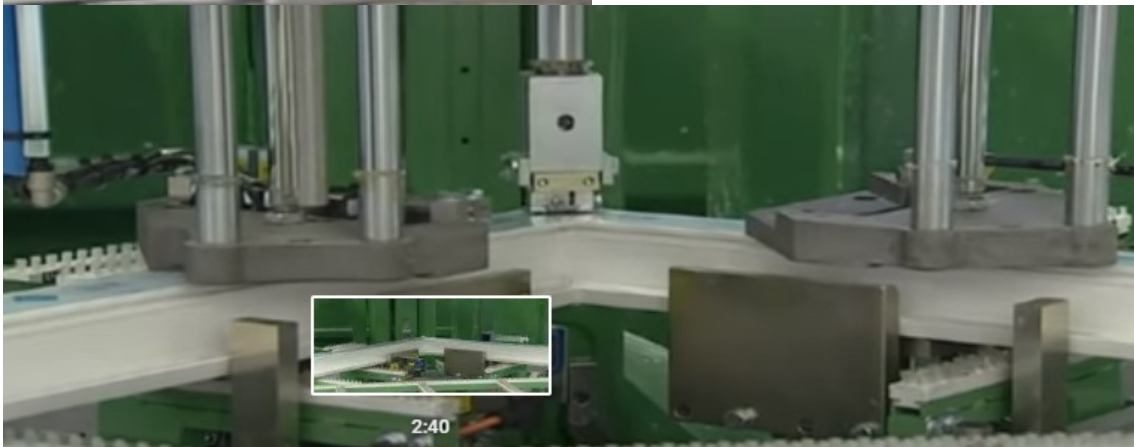
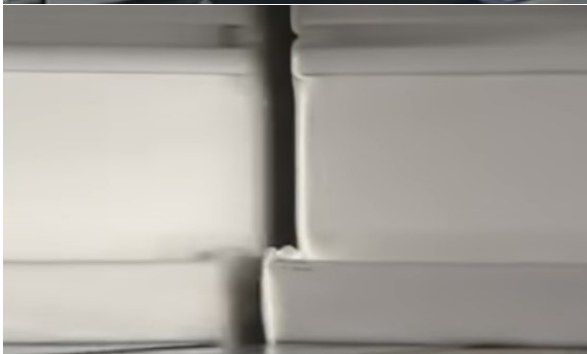
**2.5 mm. wall thickness
& 8 Parts of
Titanium Dioxide.**

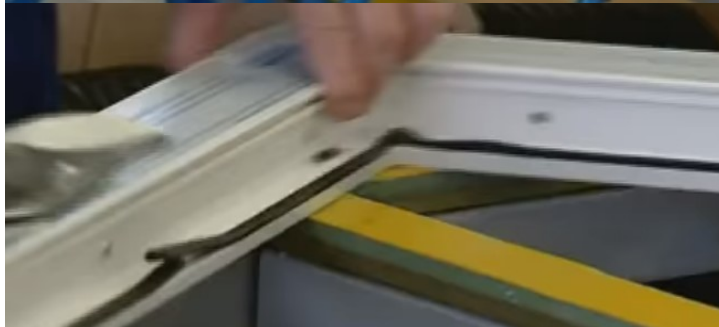


- uPVC is a **synthetic plastic polymer**, it is still safer and more environment-friendly than other materials used to make doors and **windows**.
- During the manufacturing process, **chemical compounds** are added to **prevent any toxic substances to be released**.
- **PVC windows** are **toxic** and not ecological.
- **How to Select Good Quality uPVC Doors & Windows**
- **uPVC profiles** are **multi-chambered sections that are reinforced with steel for strength**. These sections form the frame in which the glass panes are fitted. Here is how you can check the quality of a uPVC profile:
 -
 - Only go for uPVC profiles that are **lead-free**.
 - For stability of the door and window, the **width of each section of the uPVC profile** should range between **2.2 and 3 millimetres**.
 - The uPVC profiles should be **resistant to cracking and flaking**.
 - Additionally, check that the material is **flame-retardant** and resistant to sustained exposure to fire.
 - Make sure that the profile is **designed with a rain-track which allows the rain water to flow outwards**.
- **Reinforcement (steel / aluminium)**
- Provide **rigidity to frame sections** over a certain size and also provide an **enhanced control of rate of expansion** in these products.
- - The material used for **steel reinforcements** within the multi-chambers of the uPVC profiles should be **corrosion-resistant galvanised steel**.
- The **thickness of the reinforcements** should range between **1 & 3mm**.
- **‘U’ or ‘L’** profiles that are fitted in pieces so as not to hinder the welding process.
- **UV resistance**
 - The uPVC doors and windows should be **resistant to UV** (ultraviolet) radiation so that the windows **do not discolour** and get a yellowish tinge due to prolonged exposure to sunlight.
- **Titanium dioxide** is the key ingredient that **ensures colour stability** to the white uPVC profiles. **It should be present in the proportion of 2.5 per cent by weight of the uPVC profile**.
- **Specifications of glass**
 - Glass is available in thicknesses of **4-6 millimetres for doors and windows**. These are the different types of glass that are used in uPVC doors and windows:

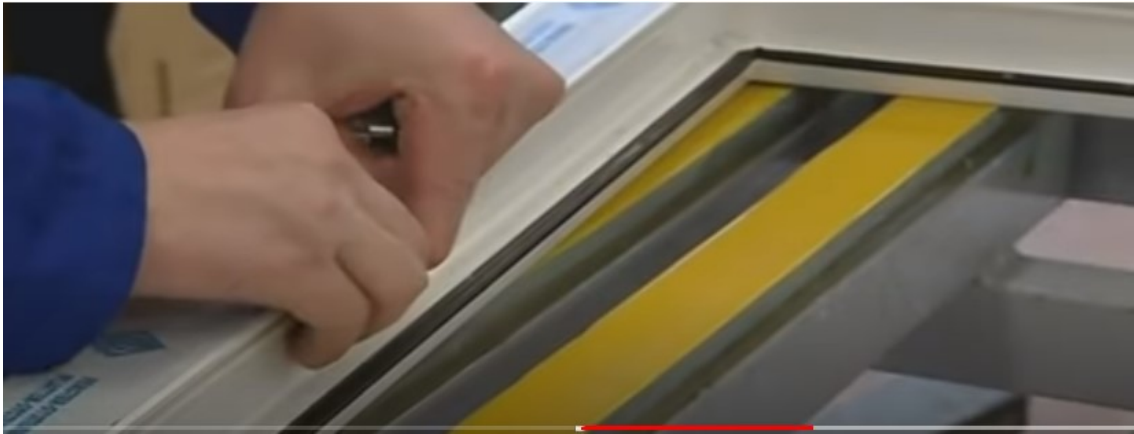
- **Float glass** is a transparent glass that is widely used as it **allows clear views** of the outdoors.
- **Toughened glass** is stronger than float glass; when damaged it **breaks into very small fragments** instead of sharp shards of glass.
- **Laminated glass is a safety glass.** It comprises a resin sandwiched between two layers of glass. In case of breakage, the glass pieces are stuck to the resin and do not fall off.
- For **thermal efficiency** choose **thermal glass coating**. It is a liquid the coating works as a poor conductor of heat, and prevents heat gain into the interiors of the building and heat loss from it.
- **Double-glazed windows**
- These windows comprise two sheets of glass between which is filled an inert gas such as **argon, krypton or neon**. It is sealed at the edges to form a single unit. The **thickness** of the complete double-glazed units should be at least **28 mm**.
- **Sound proofing**
- To improve the acoustics of your home, consider **double- or triple-glazed windows** that significantly cut down noise from the outdoors.
- The manufacturer should use **silicone sealants and rubber gaskets** to make the windows **airtight and watertight**.
- First of all, they must be **durable enough to withstand the climate**
- secondly, have a **low solar heat gain coefficient** (filtering out infrared and ultraviolet light).
- Special double glazing or triple glazing with the relevant coating can additionally help **minimise unwanted heating and loss of cool air**.
- uPVC is ideal in coastal areas

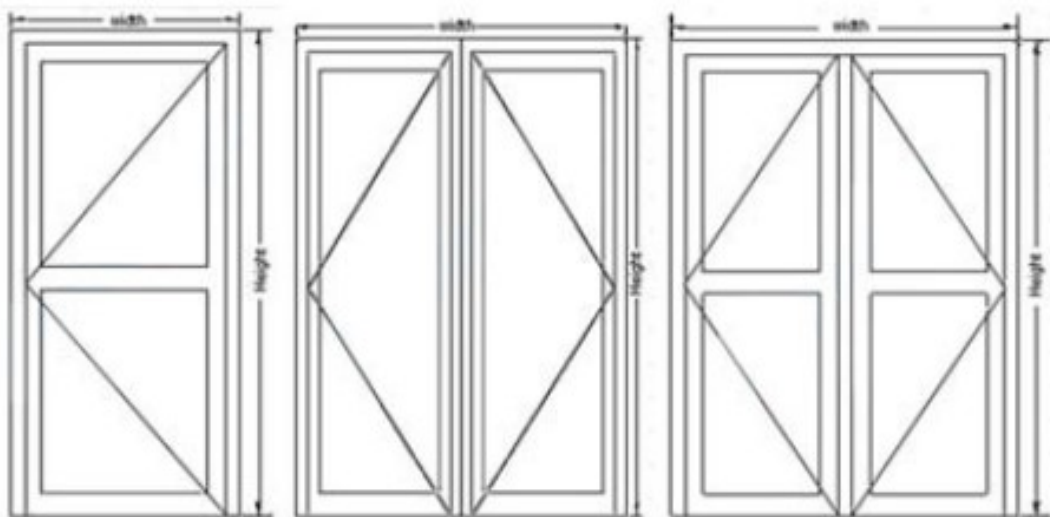




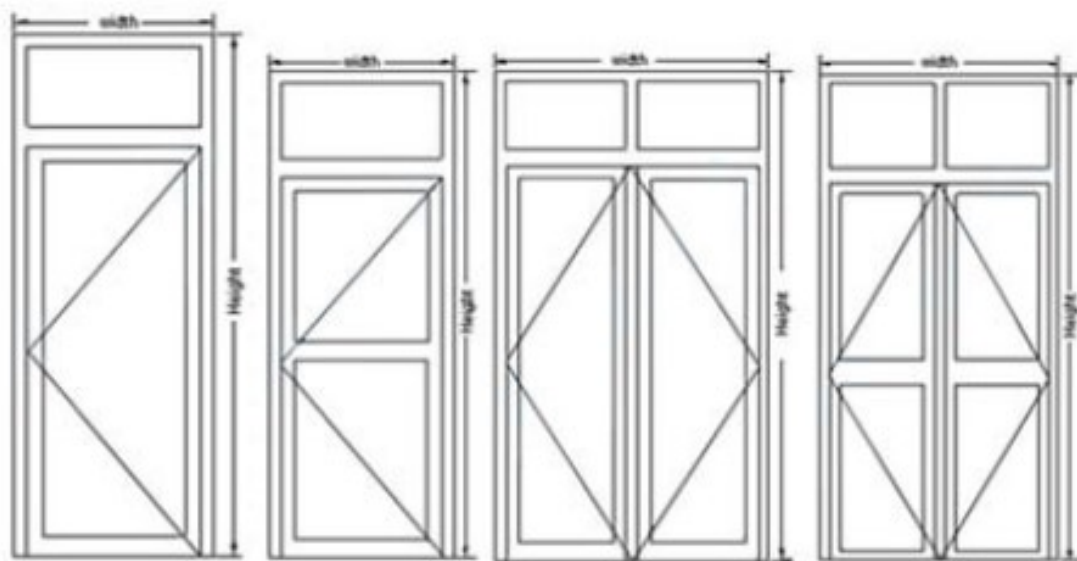






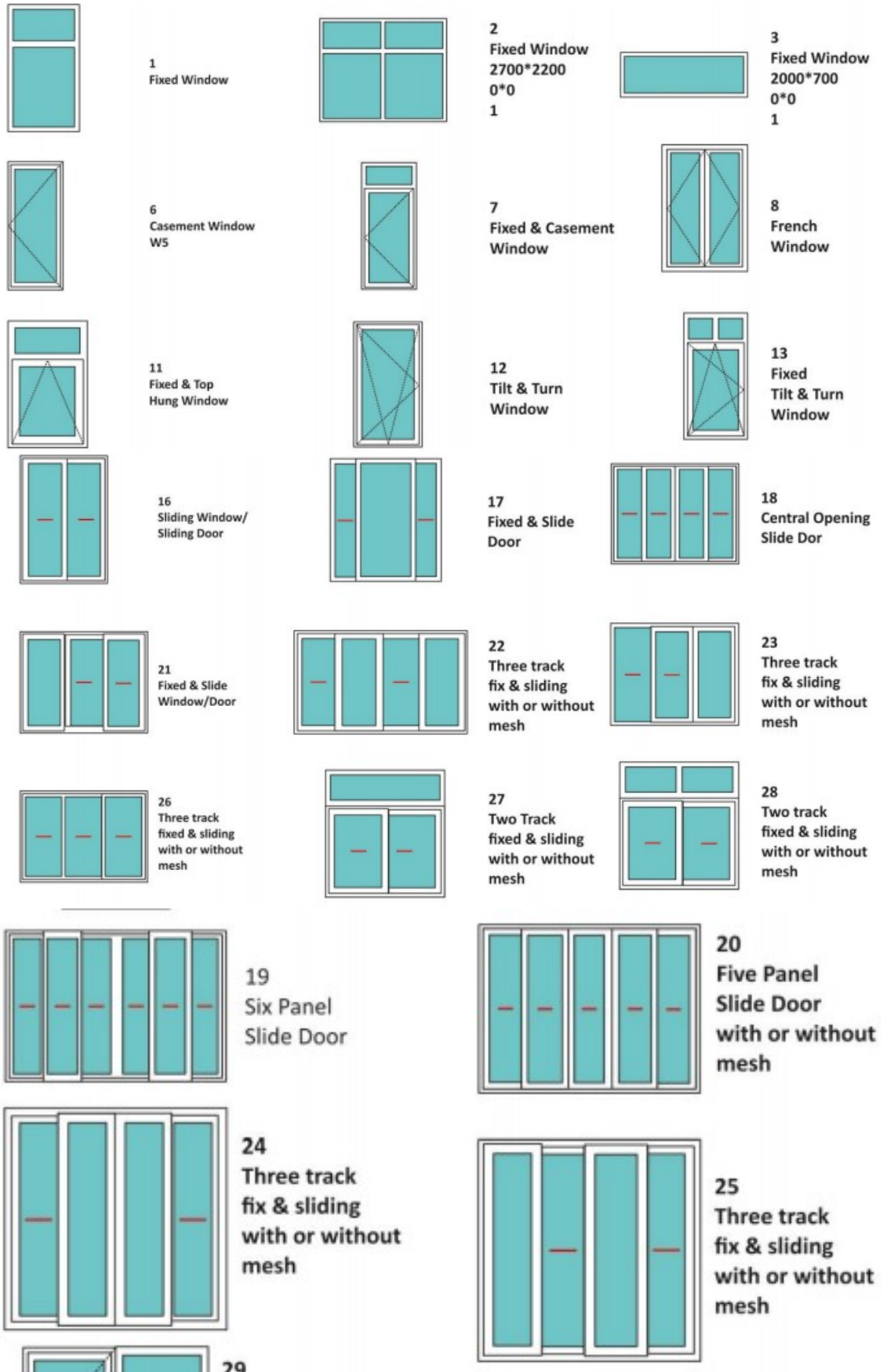


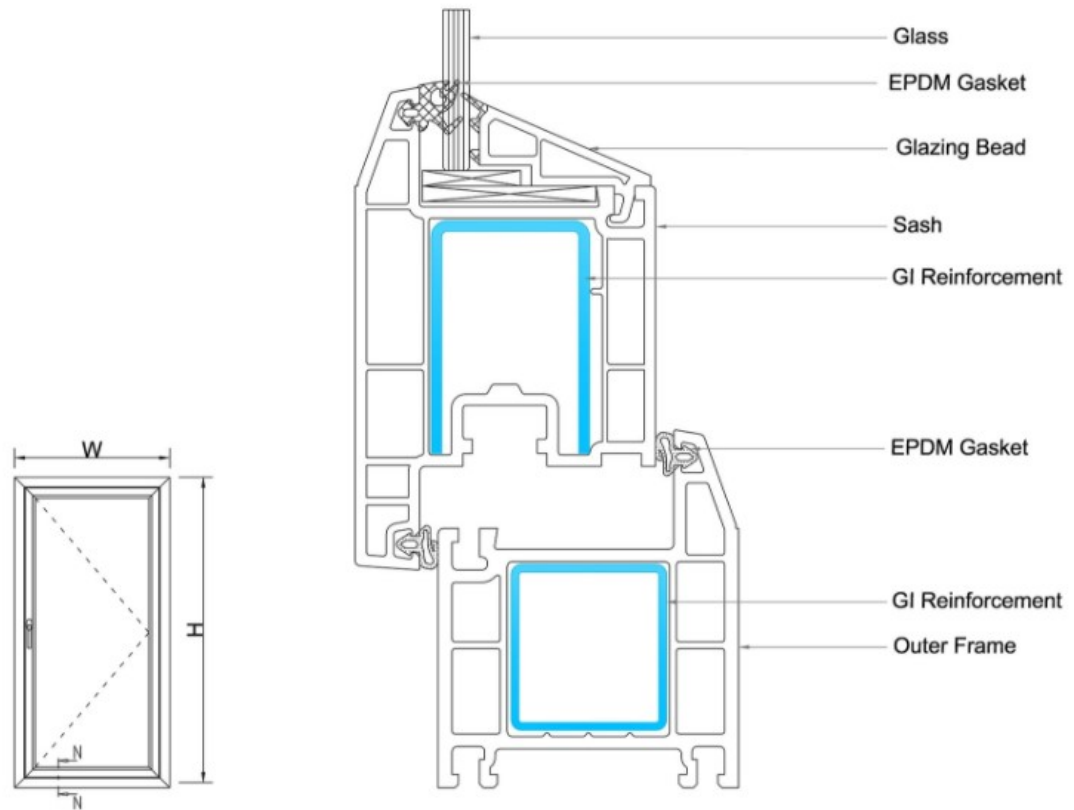
Single Glass



Double Glass



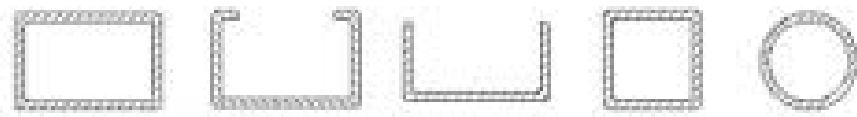


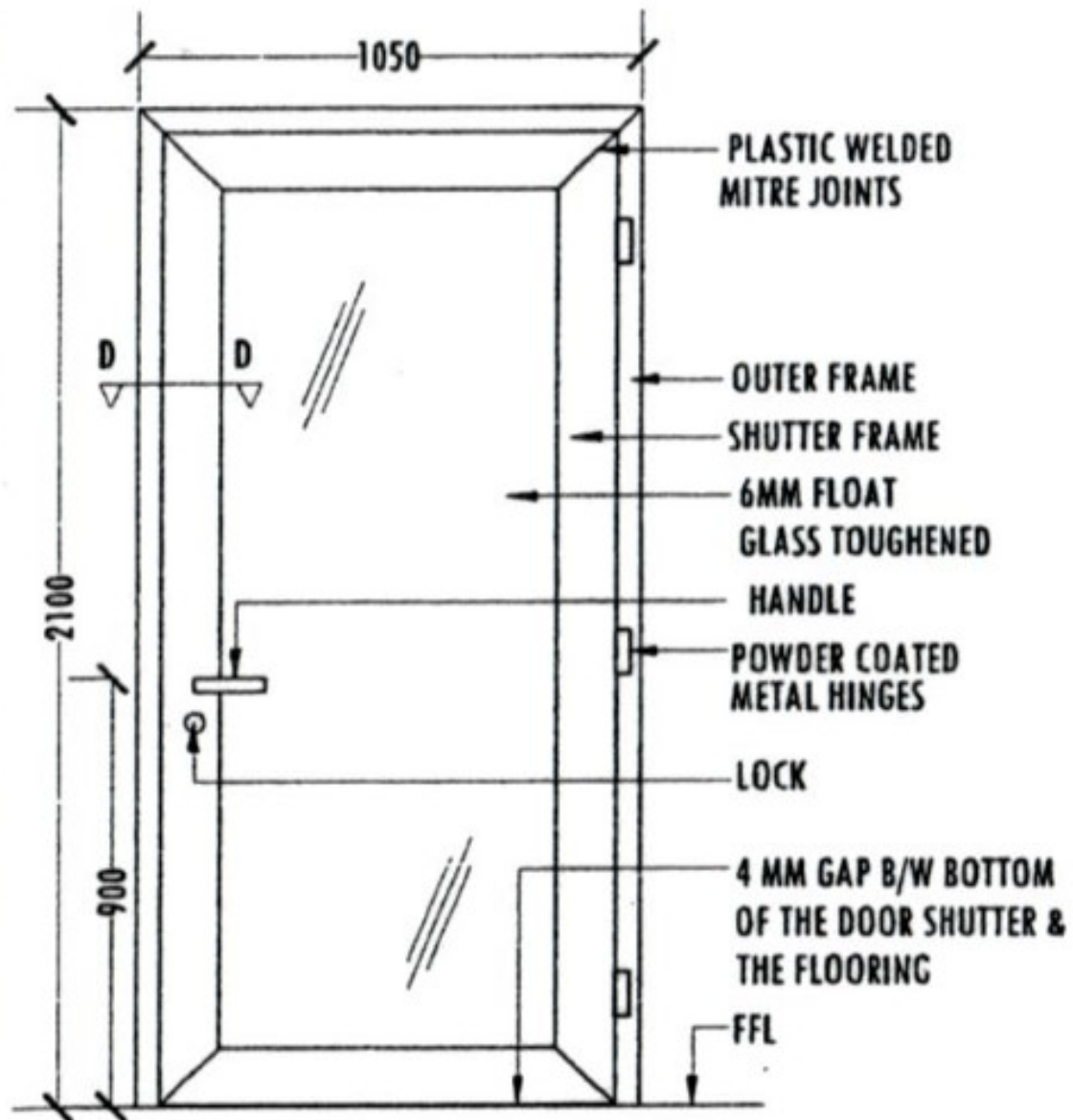


Cross Section of Outward Opening Door (System Gold Asea)

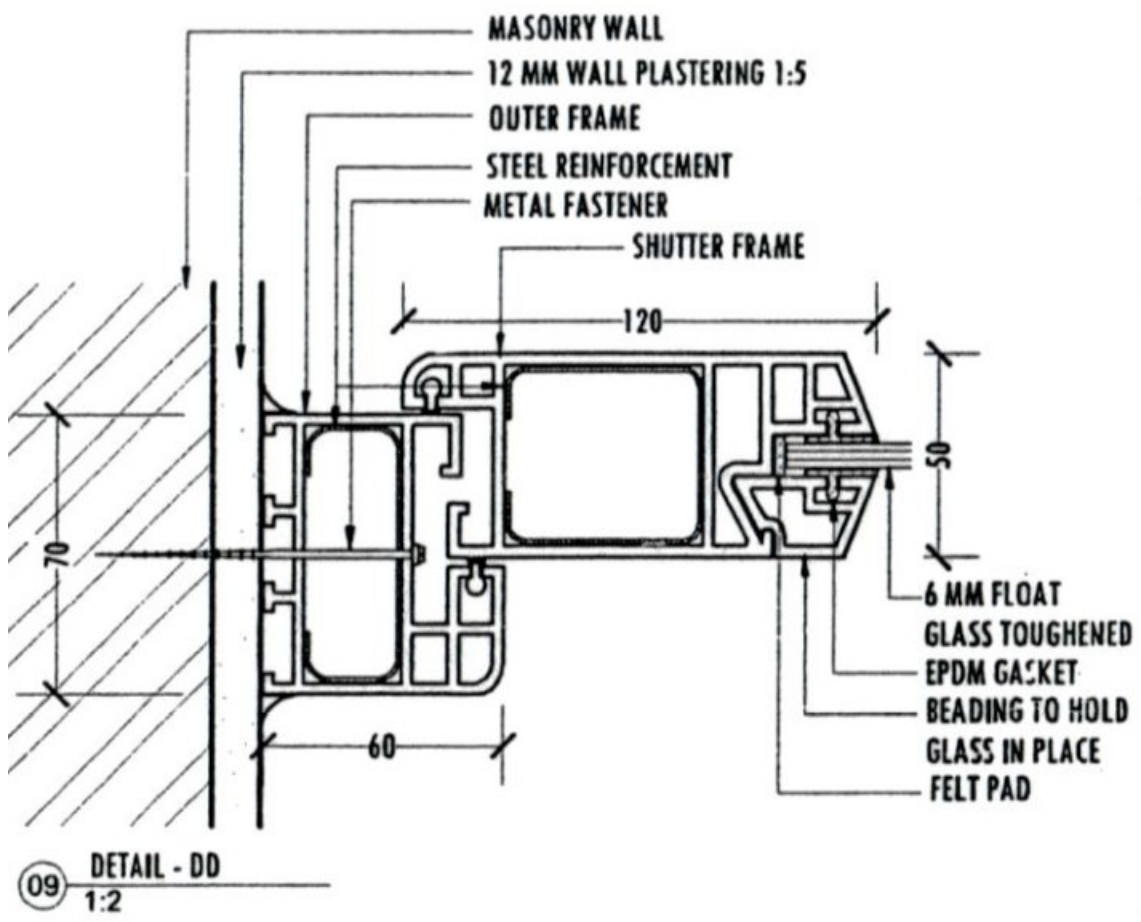
The purpose of **reinforcing uPVC** window and door frames is **to control the rate of expansion** and to **provide rigidity to frame sections** over a certain size.

- It is also used to provide **rigidity for hardware**, particularly where door locking mechanisms are fitted.



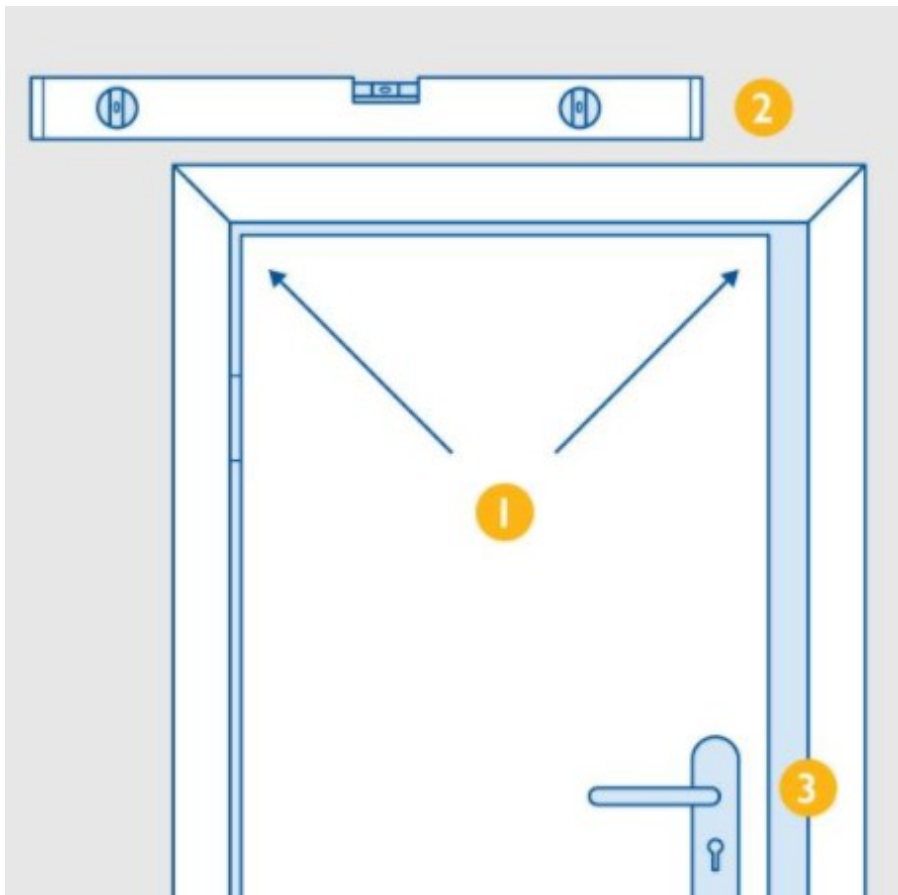


02 CASEMENT DOOR ELEVATION
1:20



How

to adjust a uPVC door and hinges



How to check if your door is out of alignment

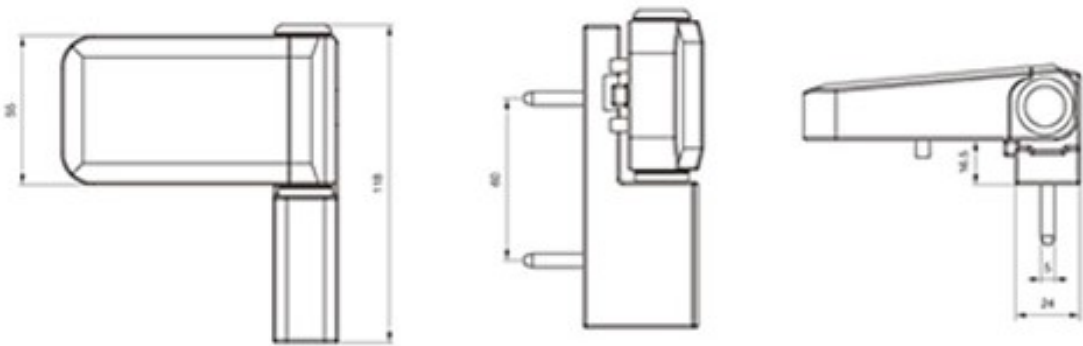
First of all, check where your door is misaligned.

- 1 Look at the corners of the door, are the mitres lined up with the mitres of the door frame?
- 2 Check the level of the door, use a spirit level on the top of the door.
- 3 Check the gap between the door and the frame - open the door slightly and at the lock side, see if the gap is consistent all the way up and down the door and frame.

Types of hinges for uPVC doors



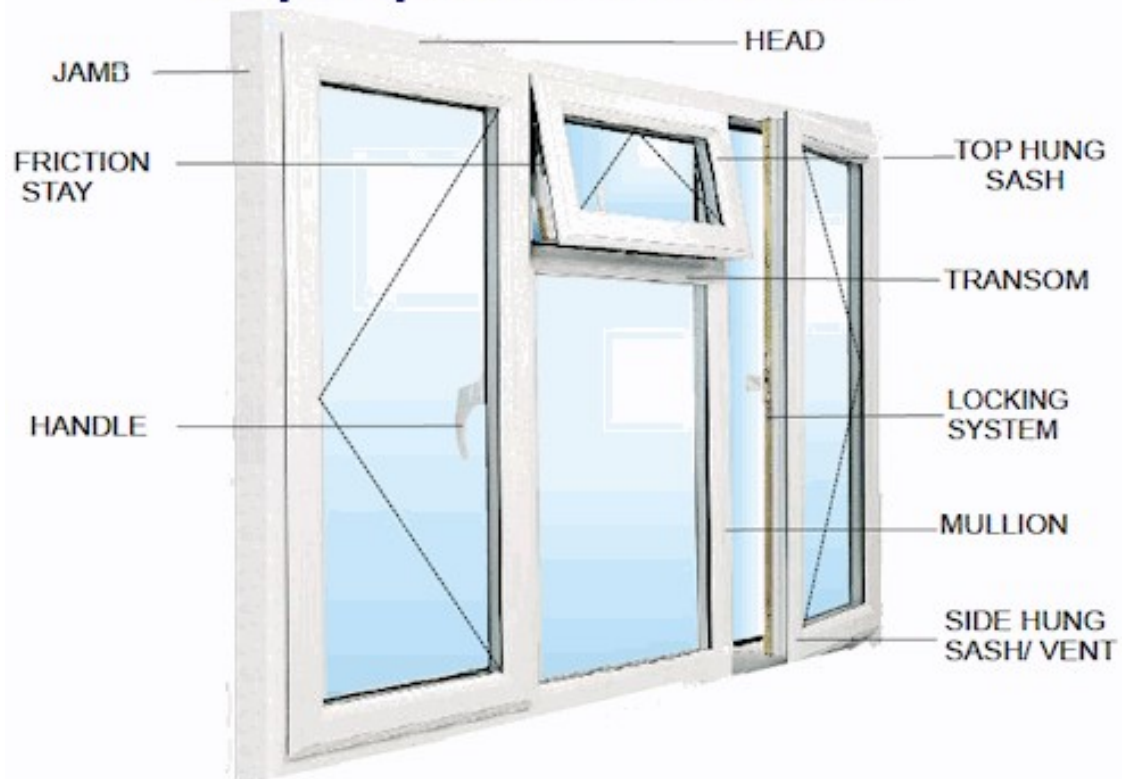
Flag hinge



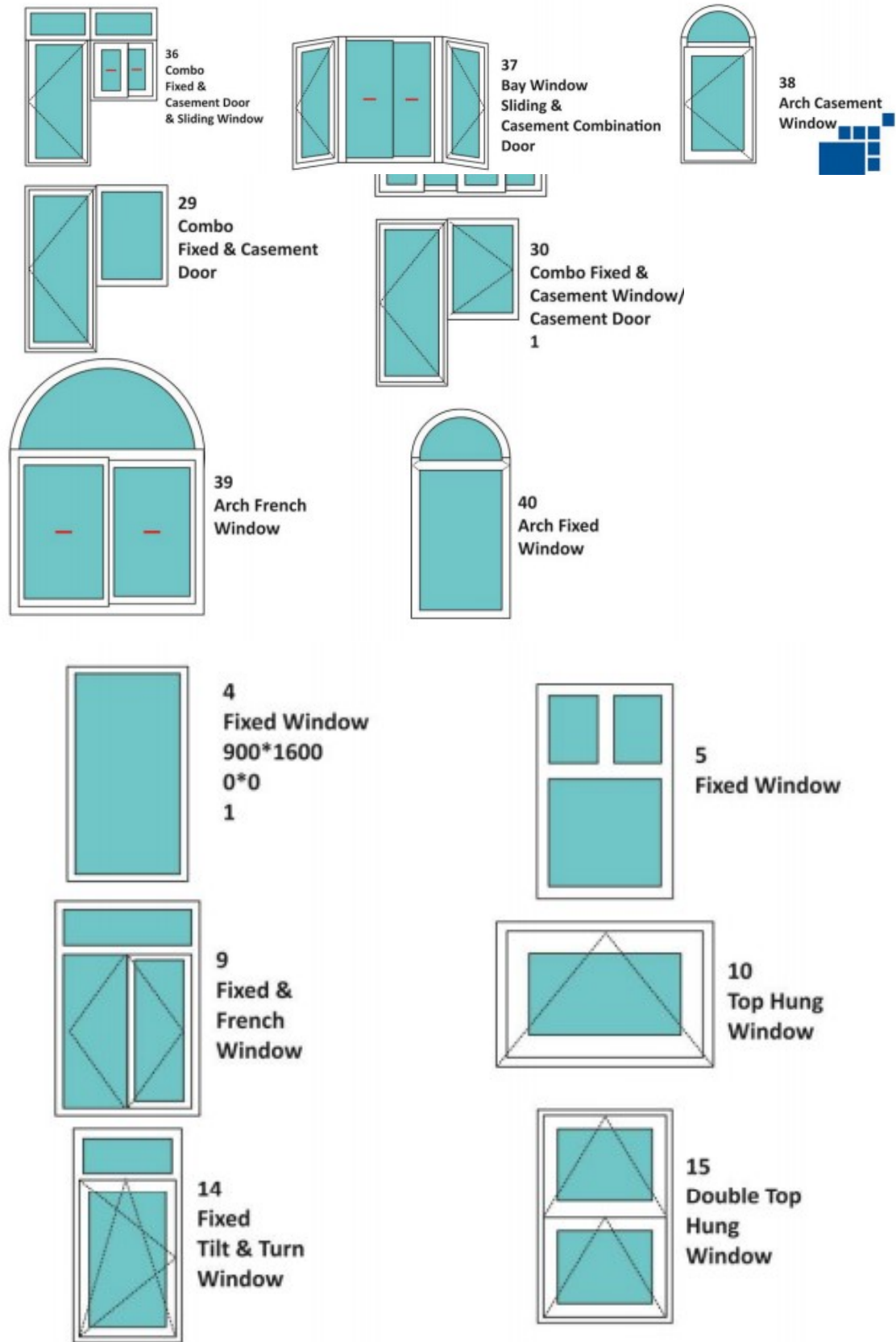
performance adjustable heavy duty hinge

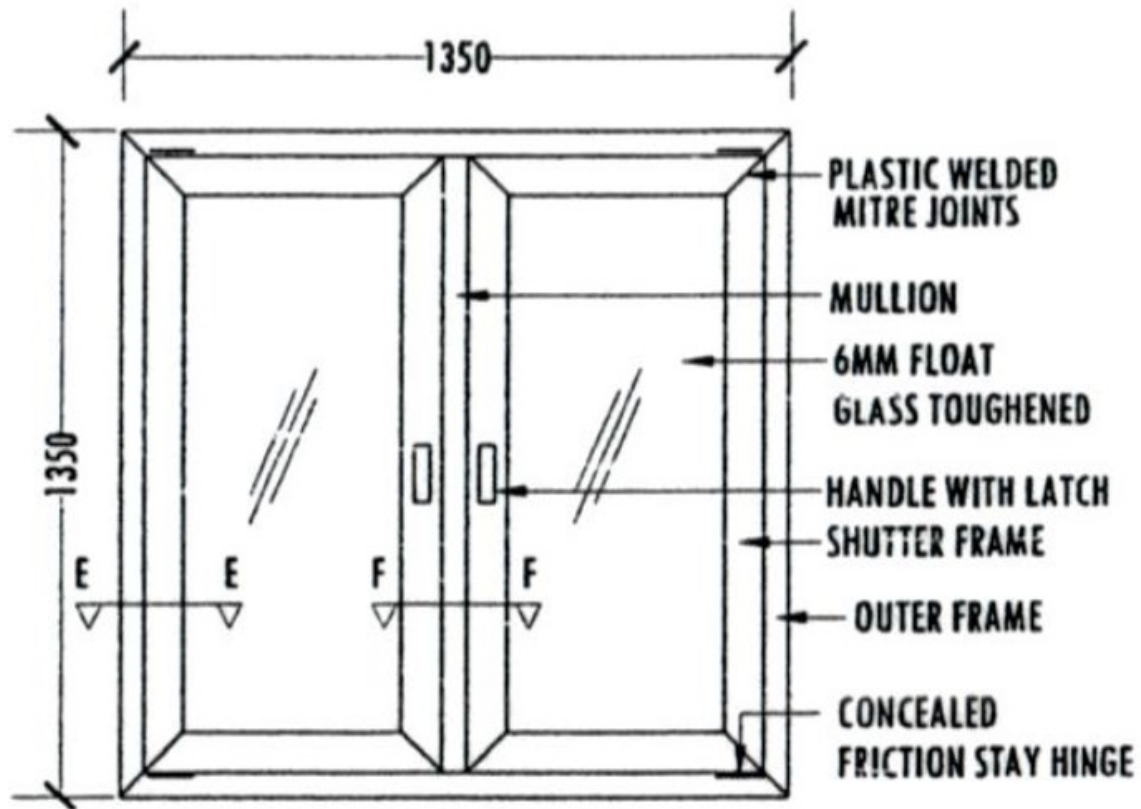
High

<http://spikerwindows.com/>

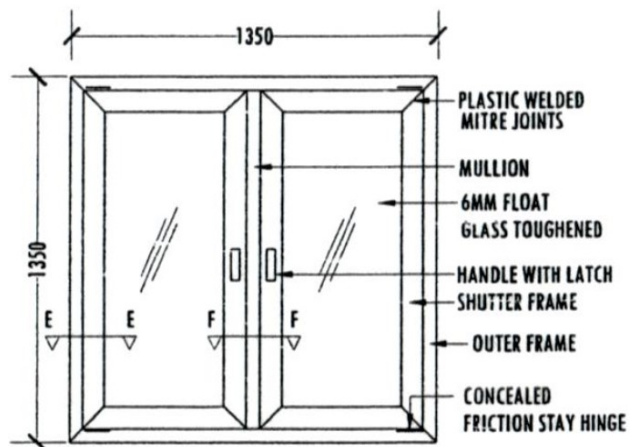


Transom is a transverse horizontal structural beam or bar, or a crosspiece separating a door from a **window** above it.





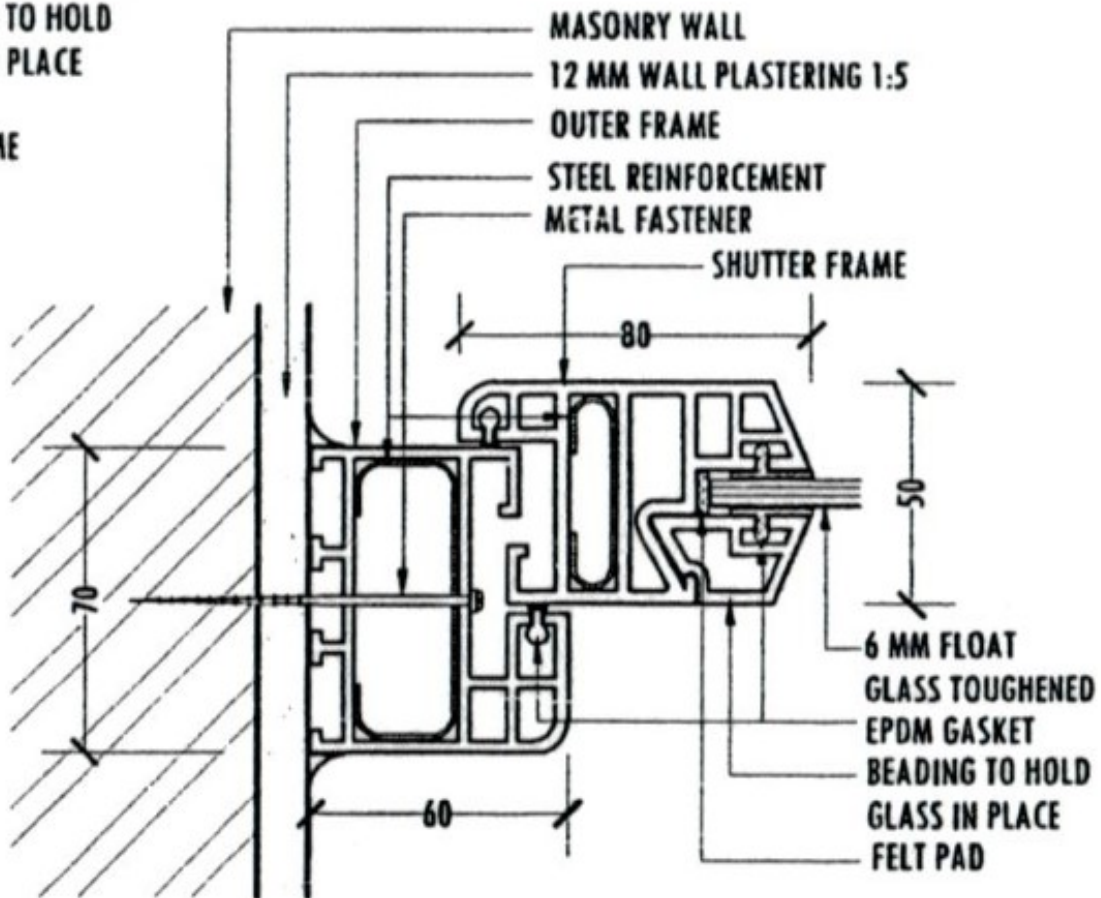
03 CASEMENT WINDOW ELEVATION
1:20



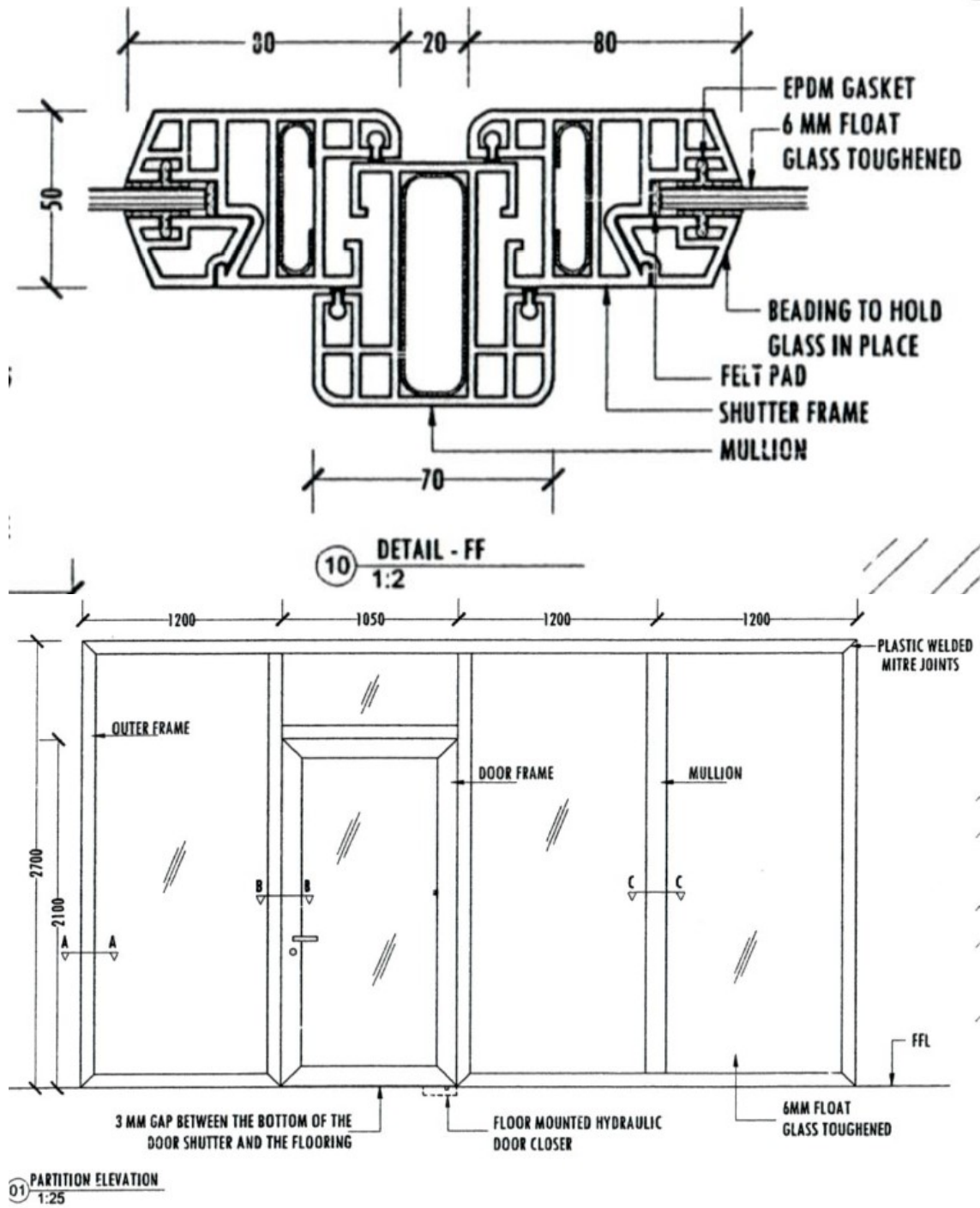
03 CASEMENT WINDOW ELEVATION
1:20

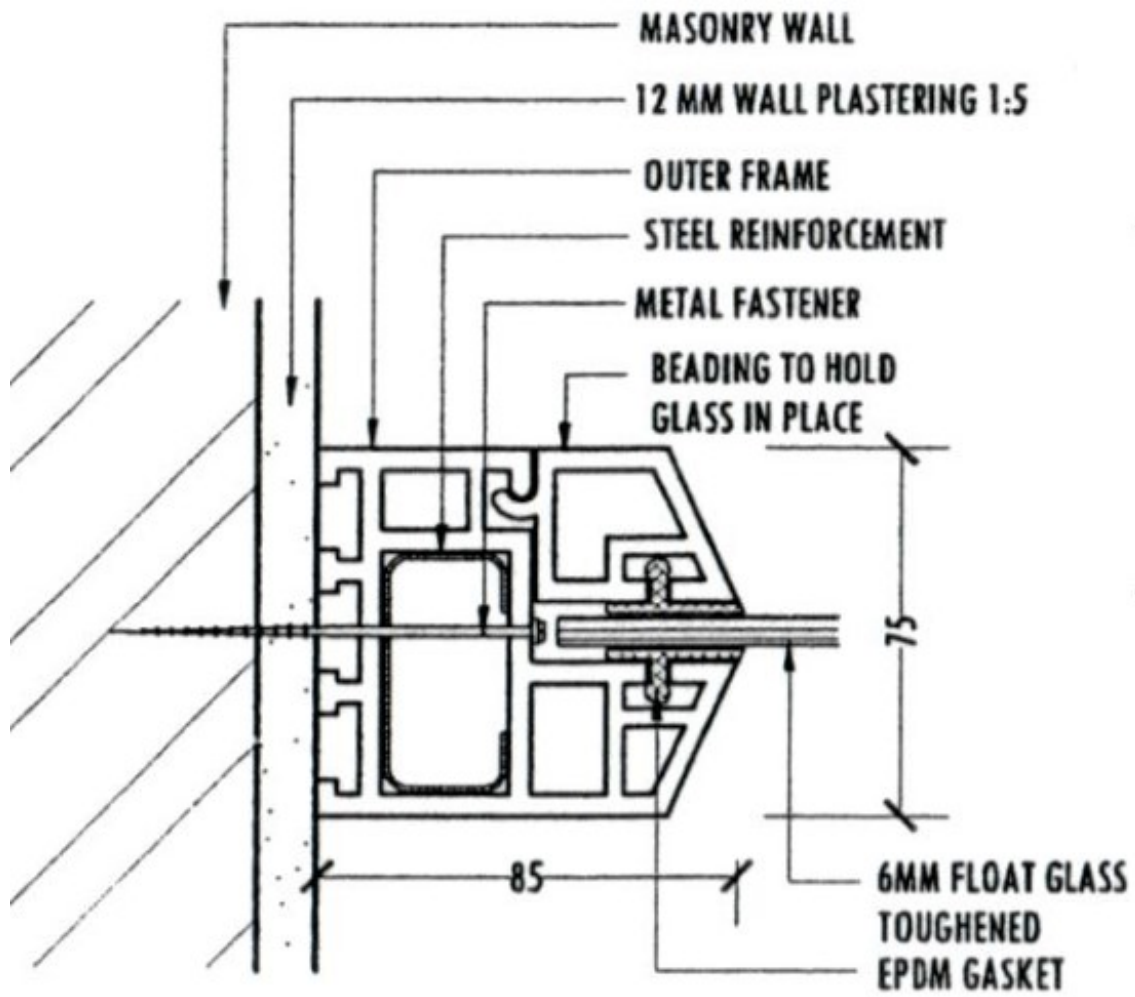
TO HOLD
IN PLACE

ME

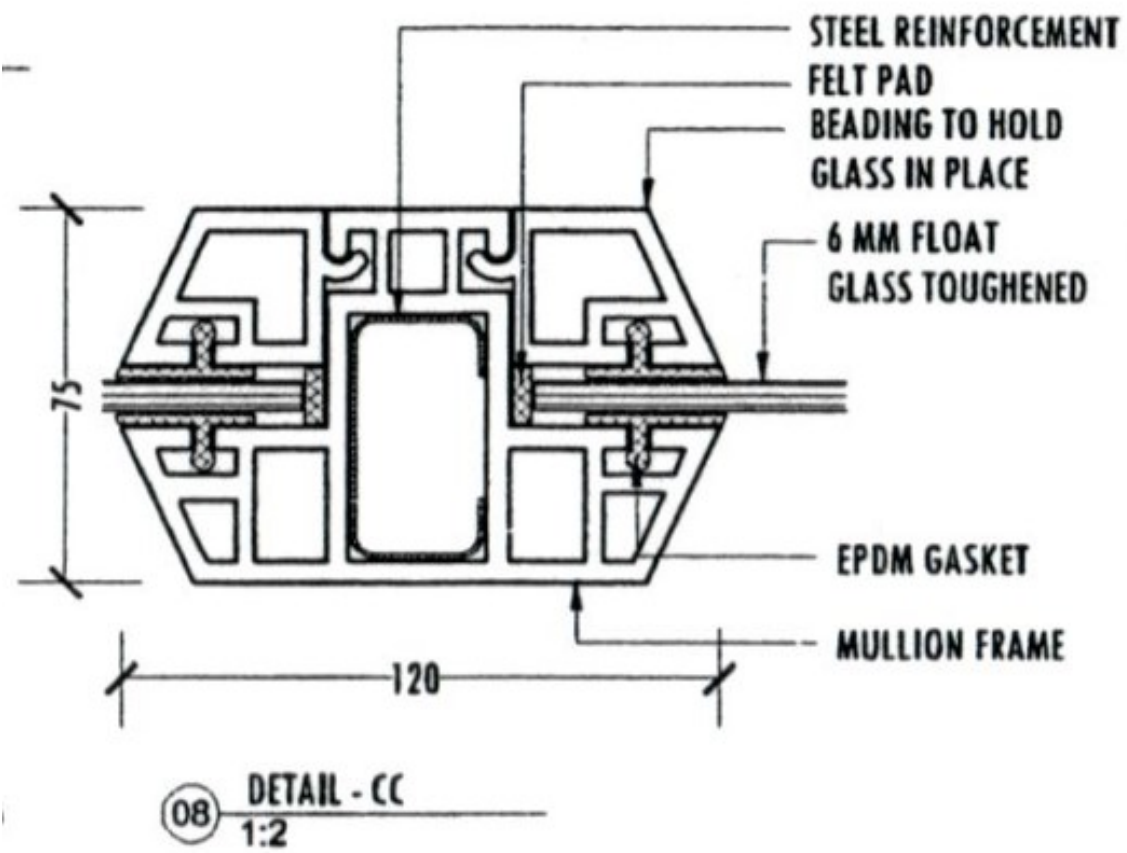
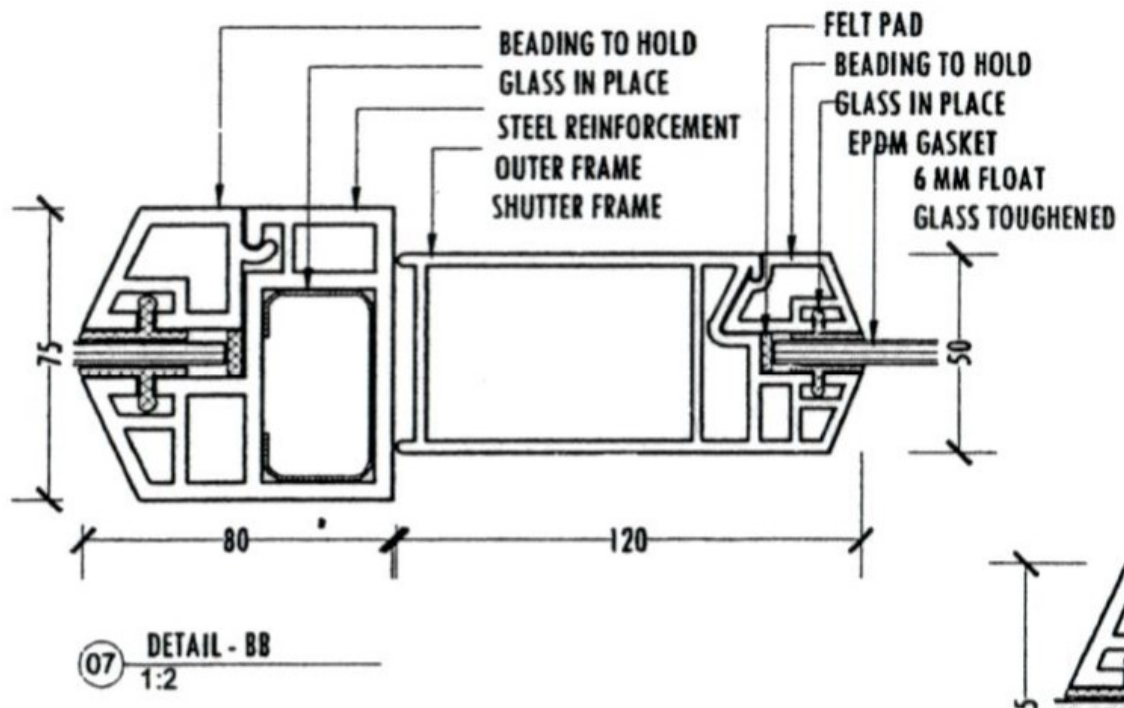


11 **DETAIL - EE**
1:2



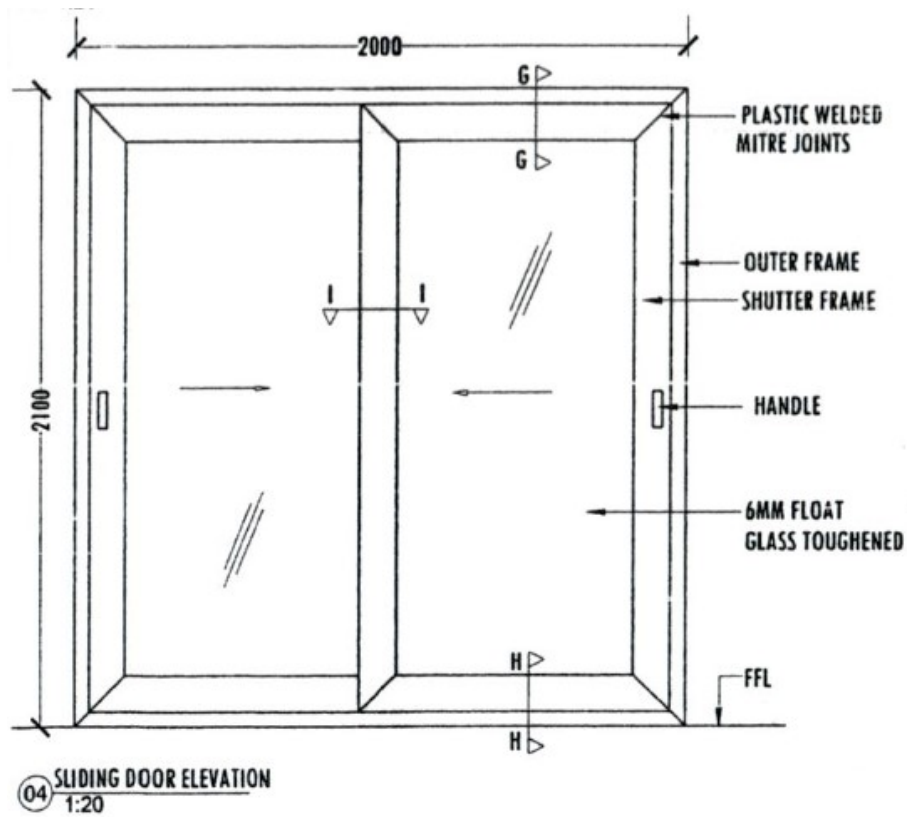


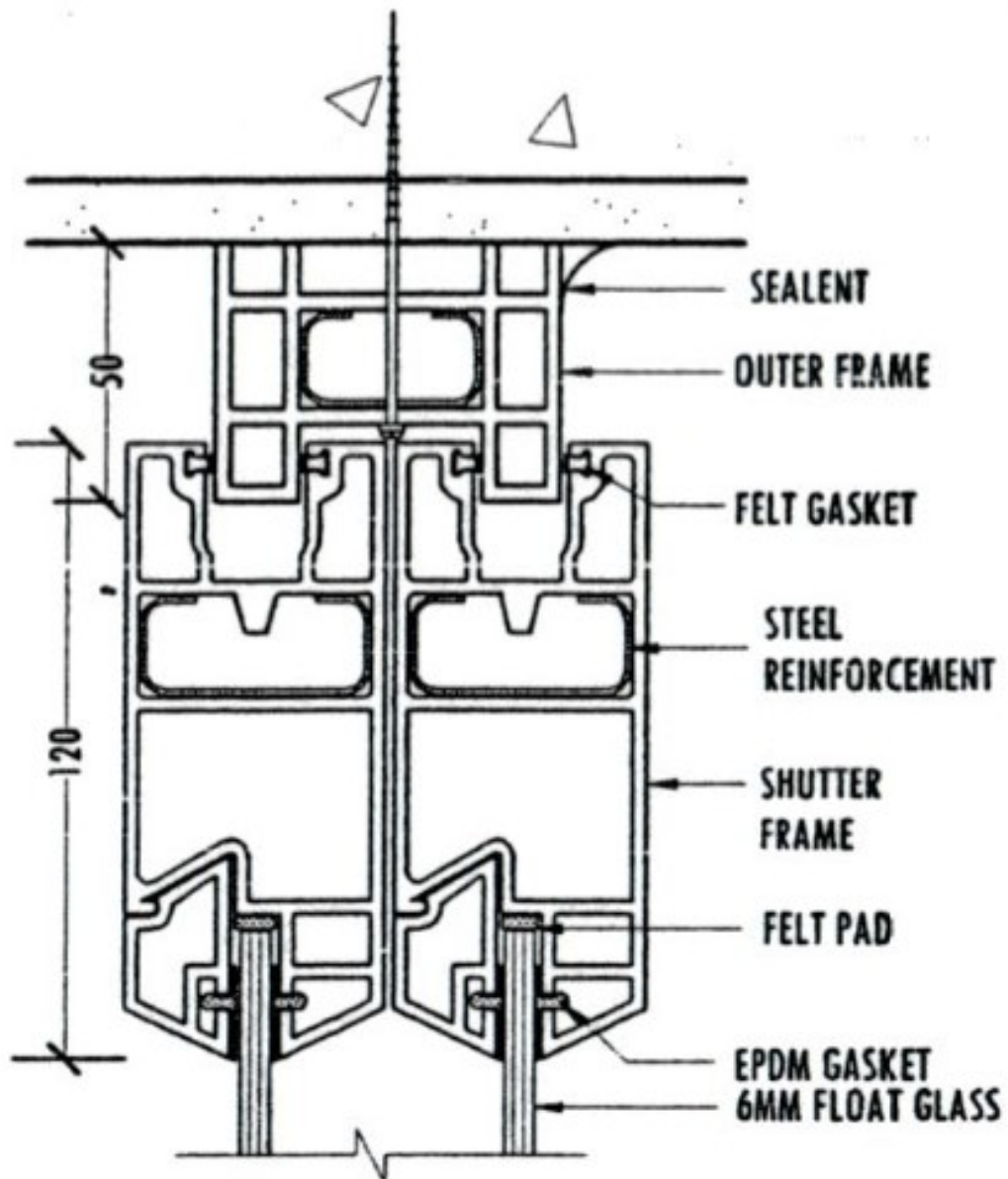
06 DETAIL - AA
1:2



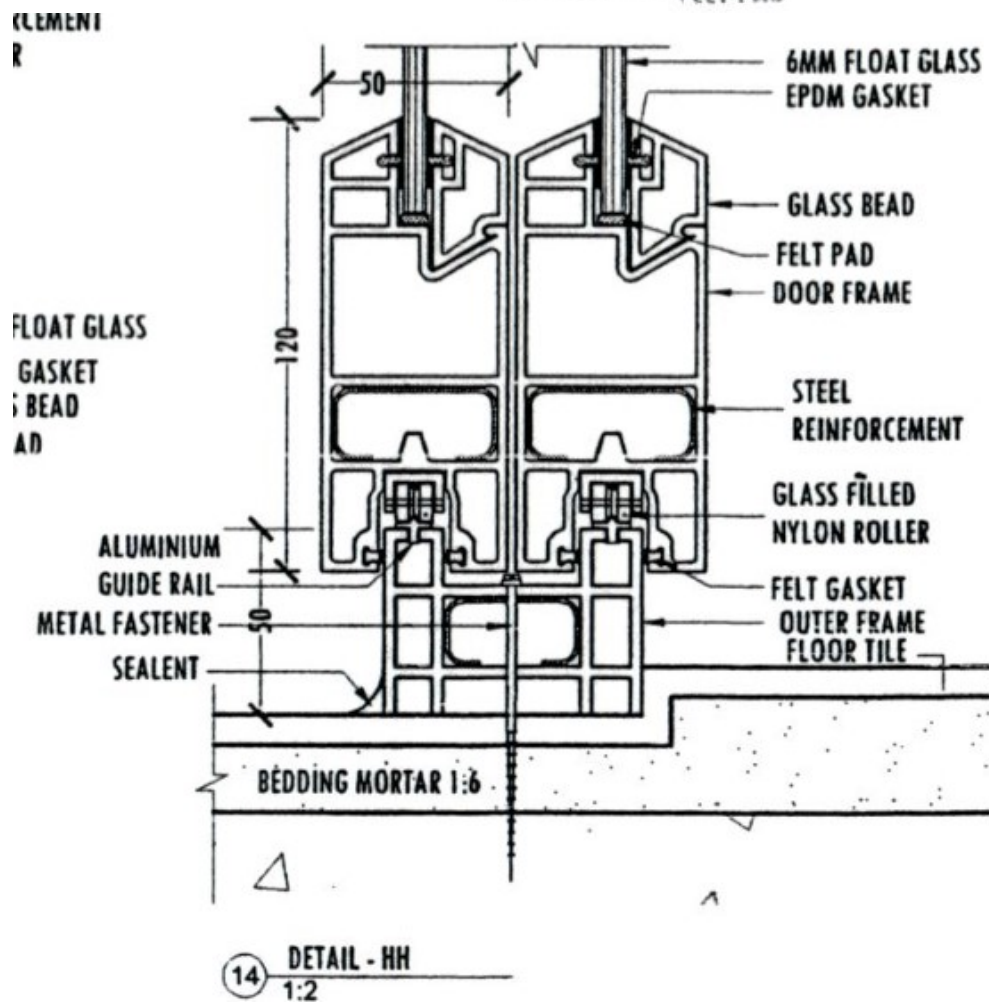
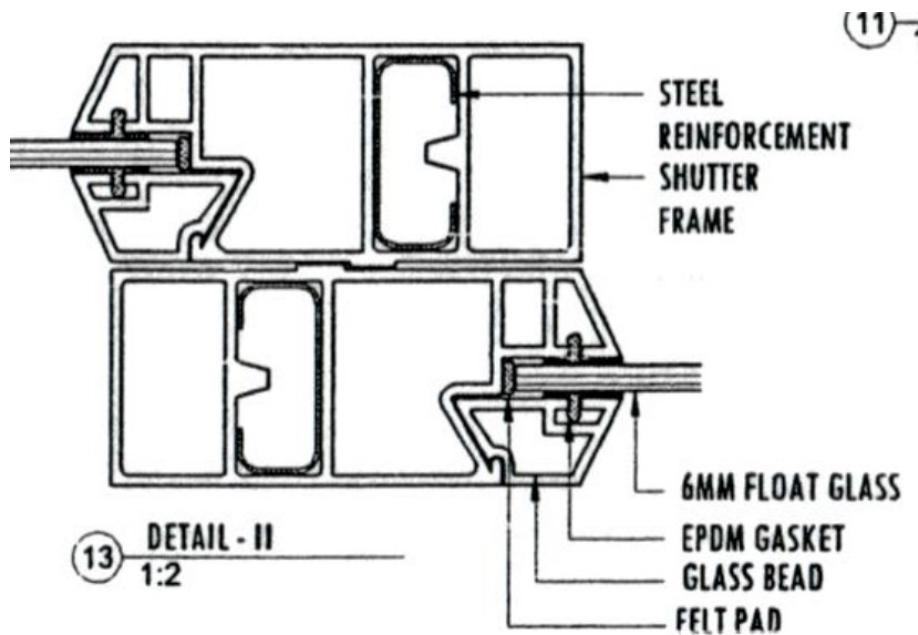


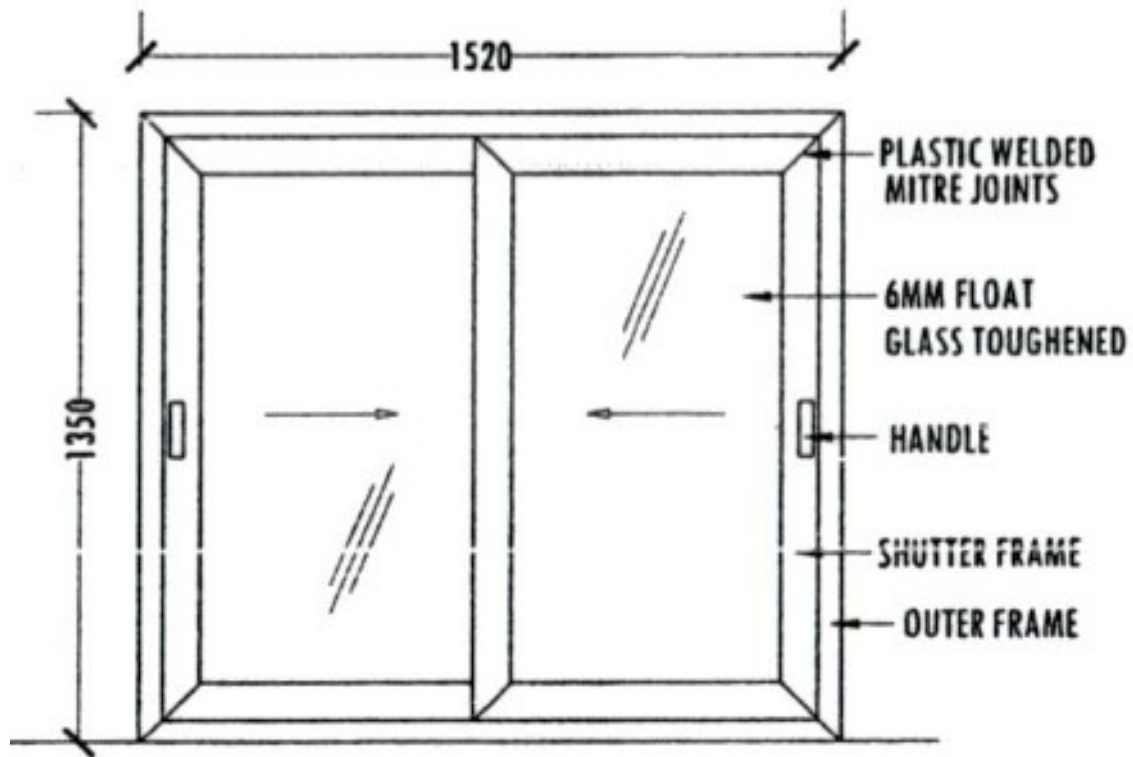
Two and three track sliding windows



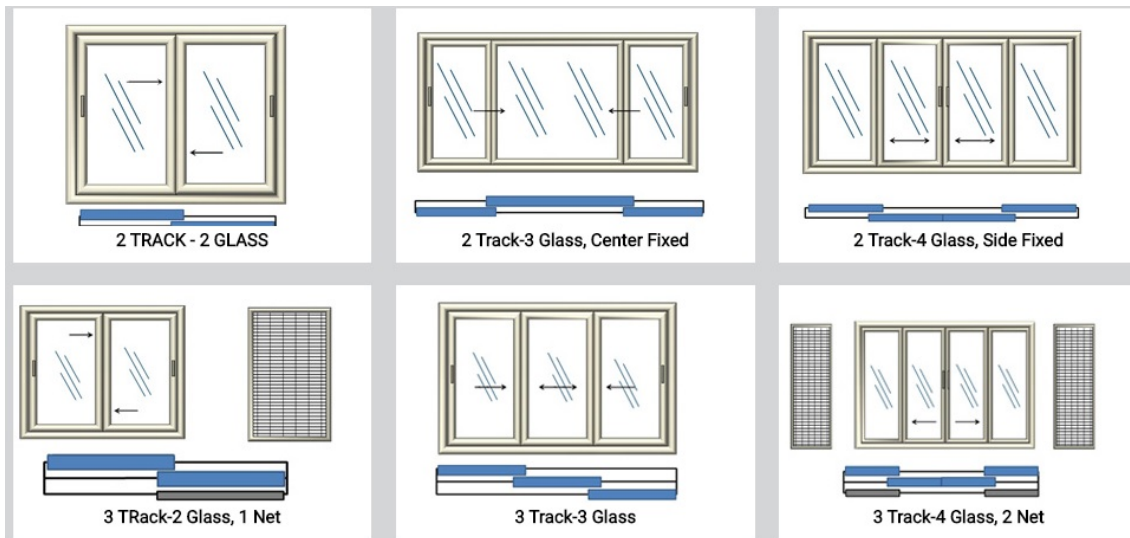


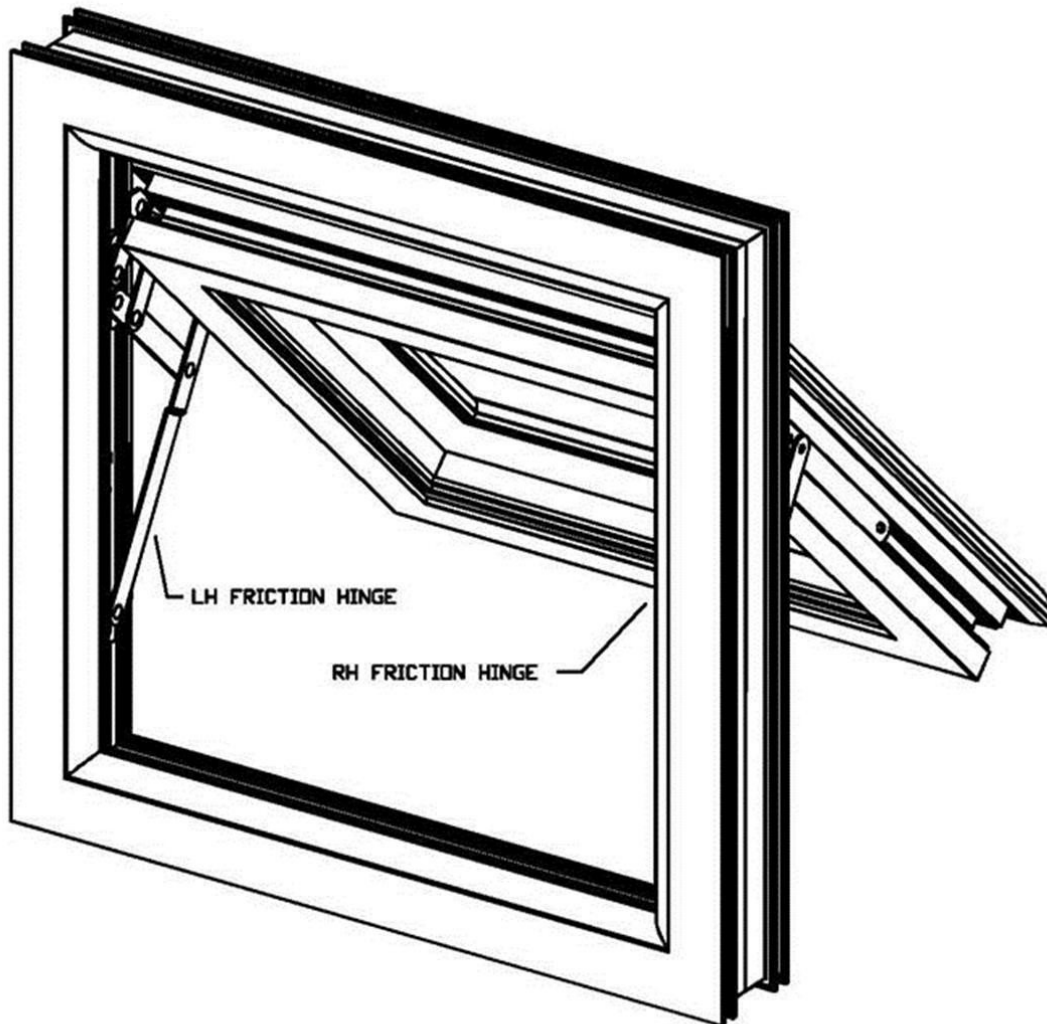
12 DETAIL - GG
1:2



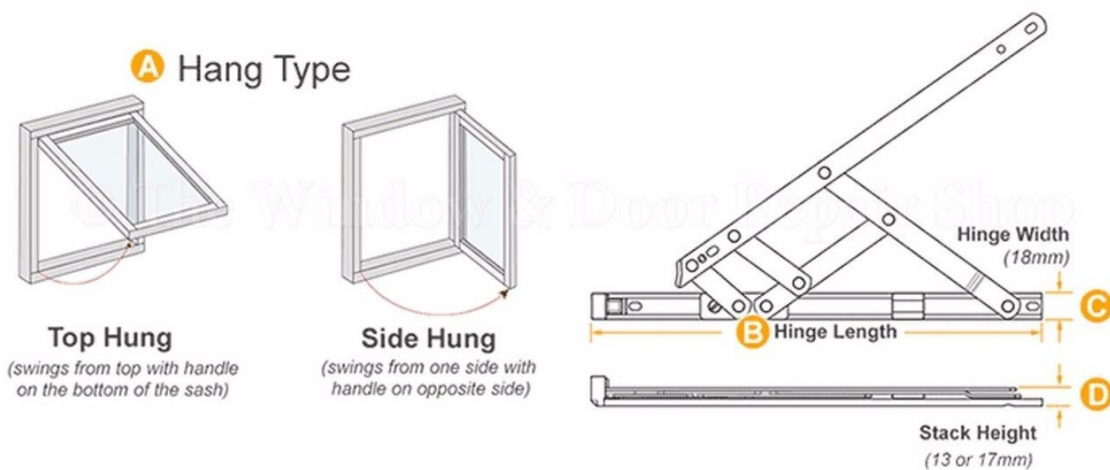


05 SLIDING WINDOW ELEVATION
1:20





TOP HUNG SASH



Durability:

In comparison to conventional doors and windows UPVC windows and doors have **better life cycle**.

Advantages Of UPVC Window

Since these products are **temperature and termite resistant** they outlast the traditional doors by almost a complete lifetime of the wooden or aluminum doors used in traditional buildings.

Ease of use and maintenance:

UPVC windows come with **negligible maintenance**. Since UPVC is **not biodegradable**, the doors and windows will **not have any fungal attacks**. They are also very **light in weight** so they are easy to carry and transport making it easy to use.

Sound Insulation:

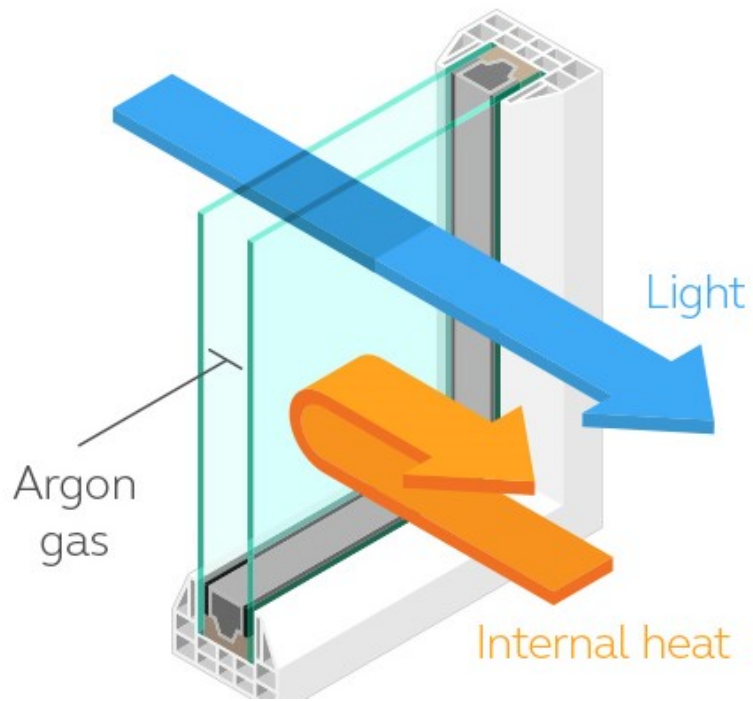
UPVC windows provide very **good sound insulation against noise pollution**. It is advisable to use UPVC windows for houses which are near Airports, Highways, temples, mosques etc., for sound insulation.

Thermal Insulation:

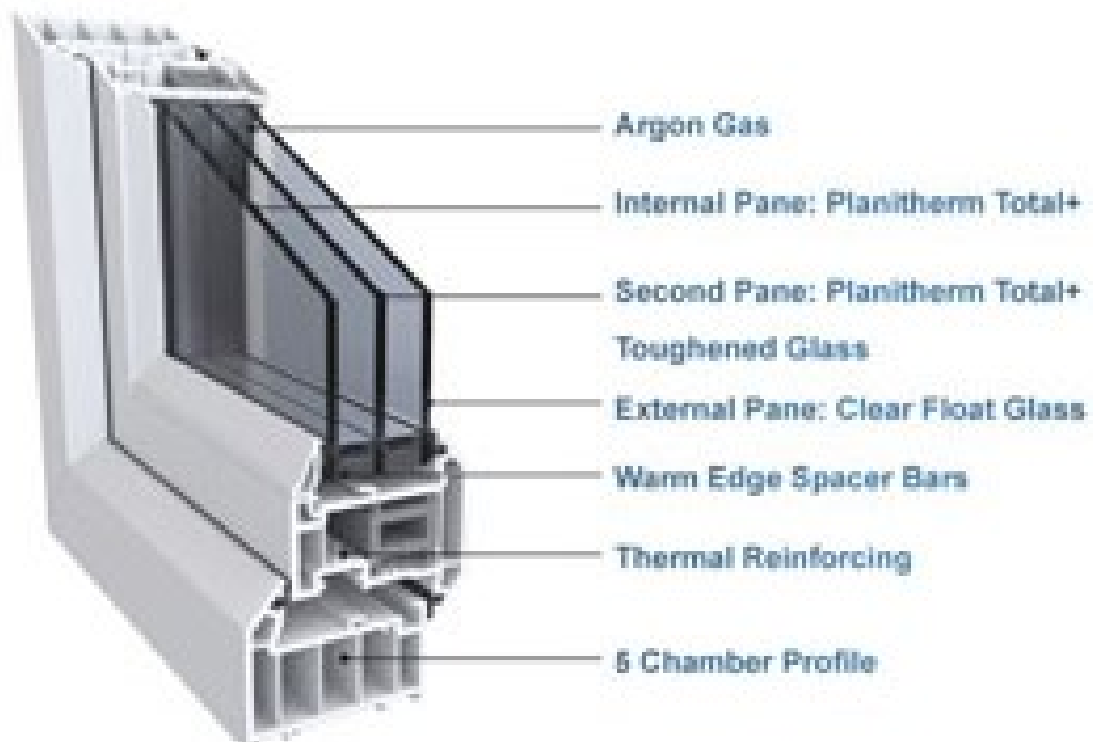
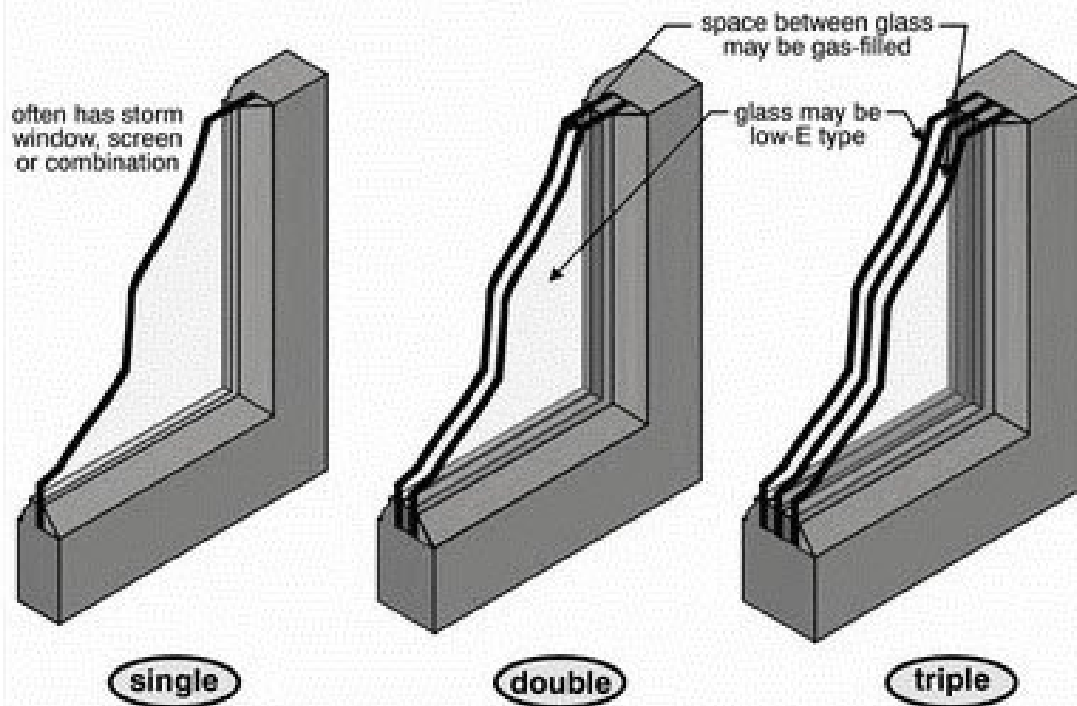
UPVC windows provide very **good thermal Insulation** which leaves no space for increased consumption of energy, be it for air conditioners or for heating machines.

Disadvantages of UPVC Windows

- **safe and non toxic material as long as it is not burnt**
- production is highly regulated to make sure that it does not cause any **harm** or toxicity. However, the **burning of PVC can result in the release of dioxins**
- Sliding UPVC windows and doors are **very expensive** than traditional windows/doors.
- uPVC windows are **not easily available in market** as compare to traditional windows.



Glazing types



Sl.No: 11 - 65 mm Series

Descriptions: The DELUXE QUALITY inside Opening

- Outer wall 2.7 mm. with 5 Chambers
- for More Energy Saving & More acoustic Values, suitable for properties near to the Noisy areas, Farm Houses & Bungalow.
- 8000 hrs. Xenon tested.
- in Golden Oak Lamination



Sl.No: 13 - 65 mm.

Descriptions: The PREMIUM QUALITY

Descriptions: The PREMIUM QUALITY



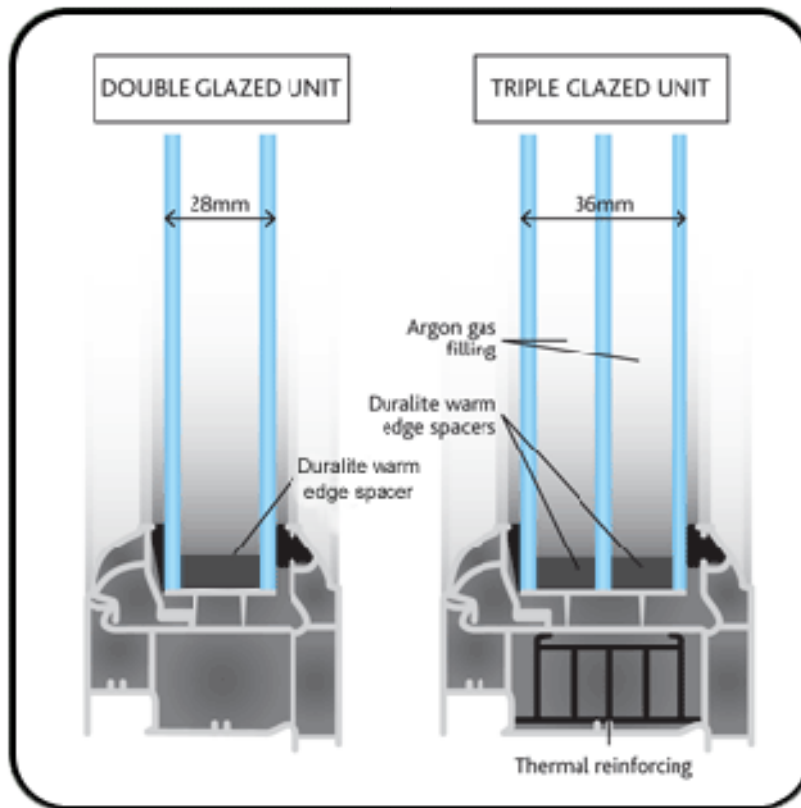
Sl.No: 12 - 65 mm.

Descriptions: The PREMIUM QUALITY Door Cross Section with Black EPDM opening

- Outer wall 2.7 mm. with 5 Chambers
- for More Energy Saving & More suitable for properties near to Farm Houses & Bungalow.
- High UV Formulation with 8 Parts Titanium Dioxide.
- 8000 hrs. Xenon tested.
- in White or various colours



THERMALLY SEPARATED PROFILES



Eco-Friendly



Fire Resistant



Sound Proof



Energy Saving



Termite Proof



Water Resistant



High UV Resistant



SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)

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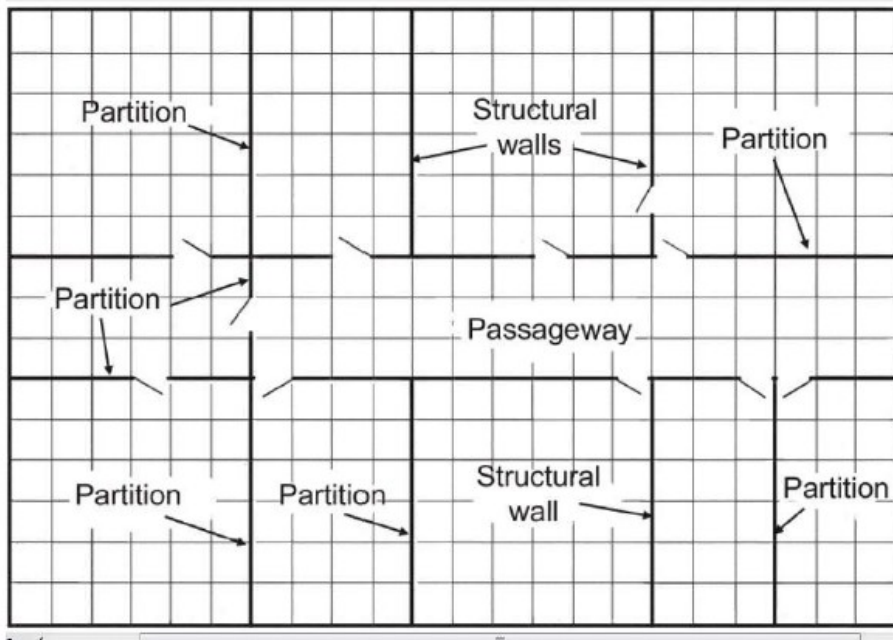
SCHOOL OF BUILDING AND ENVIRONMENT

DEPARTMENT OF ARCHITECTURE

UNIT – III–Materials and construction IV– SAR1304

aPARTITIONS

A structure dividing a space into two parts, especially a light interior wall..



1.Visual Barrier.

2.Physical Barrier.

3.Light Barrier.

4.Ventilation / air flow barrier

ALUMINIUM PARTITION

It is a light weight wall made with aluminium frames and does not support any load other than its own weight.

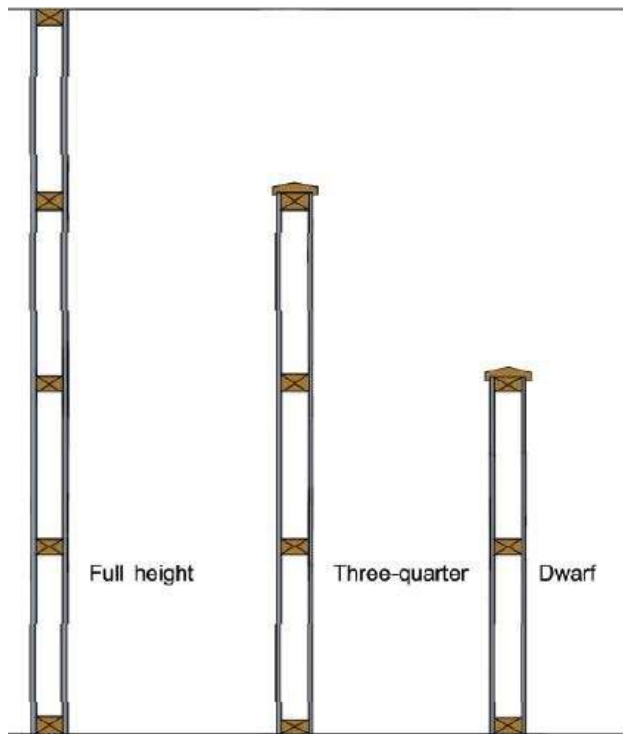
ALUMINIUM PANELLING

It is made up of series of panels joined to form a continuous surface. It does not support any load other than its own weight.

TYPES OF PARTITION

MOVABLE/ (Sliding/ Folding

FIXED



PANELS IN PARTITION

PRELAMINATED PANELS

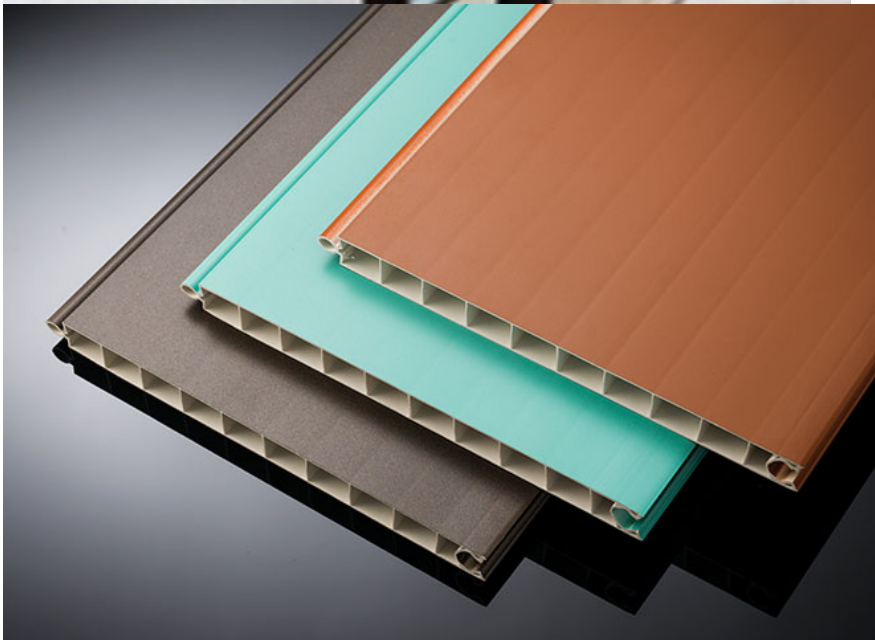
Pre laminated particle board is a particle **board laminated** on both surfaces by synthetic resin impregnated base papers

FABRIC UPHOLSTERED PANELS

A **panel** of wood that is **padded** with foam and batting and then covered over with **fabric**.

ALUMINIUM COMPOSITE PANELS

Aluminium composite panels (ACP), made of **aluminium composite** material (ACM), are flat **panels** consisting of two thin coil-coated **aluminium** sheets bonded to a non-**aluminium** core. ACPs are frequently used for external **cladding** or facades of buildings, insulation, and signage.



SINGLE SKIN PARTITIONS

Aluminium frame work are exposed in a single skin partition.

Ideal for enclosing work area be multi- tiered to improve security and keep working areas dust free. Panels can also be cut to accommodate an existing structure to provide an aesthetic finish.

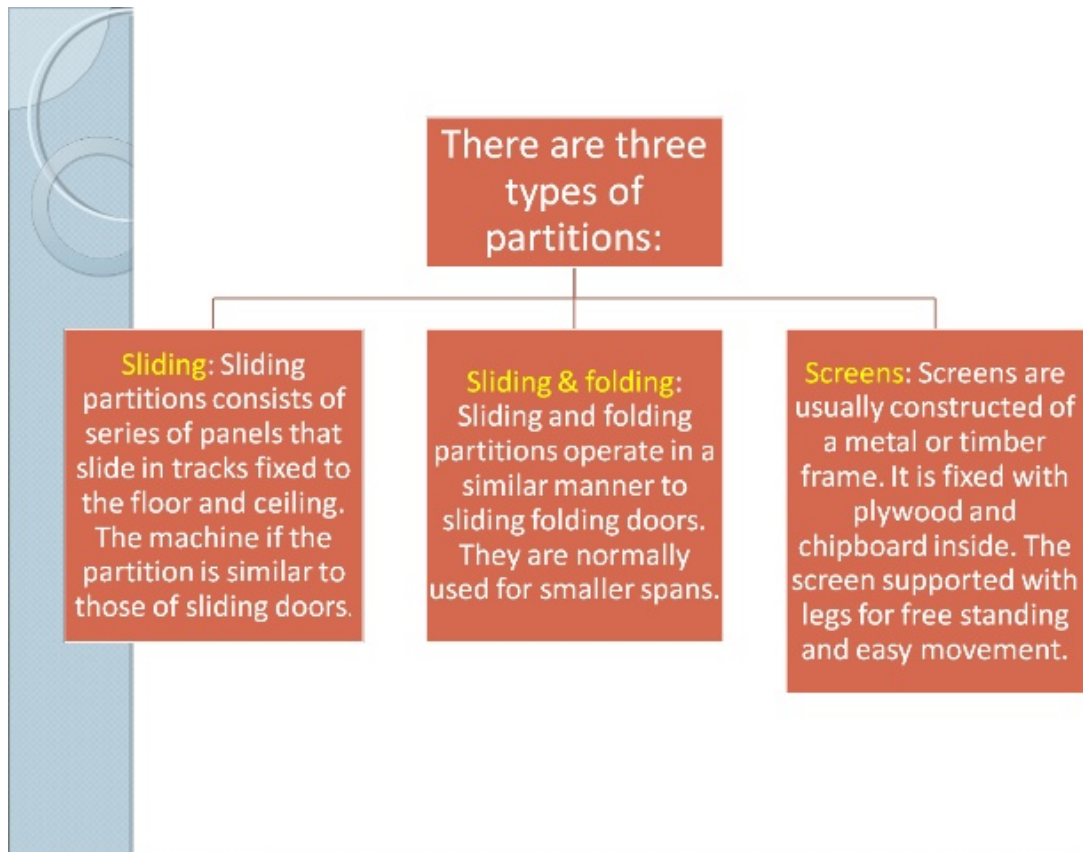
Double skin partitions

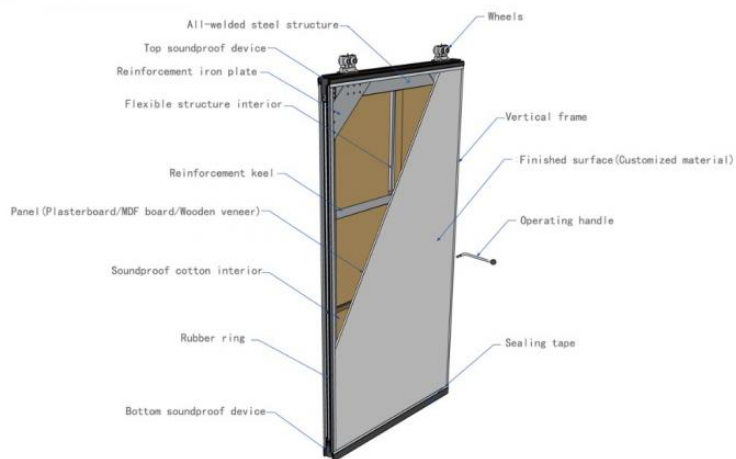
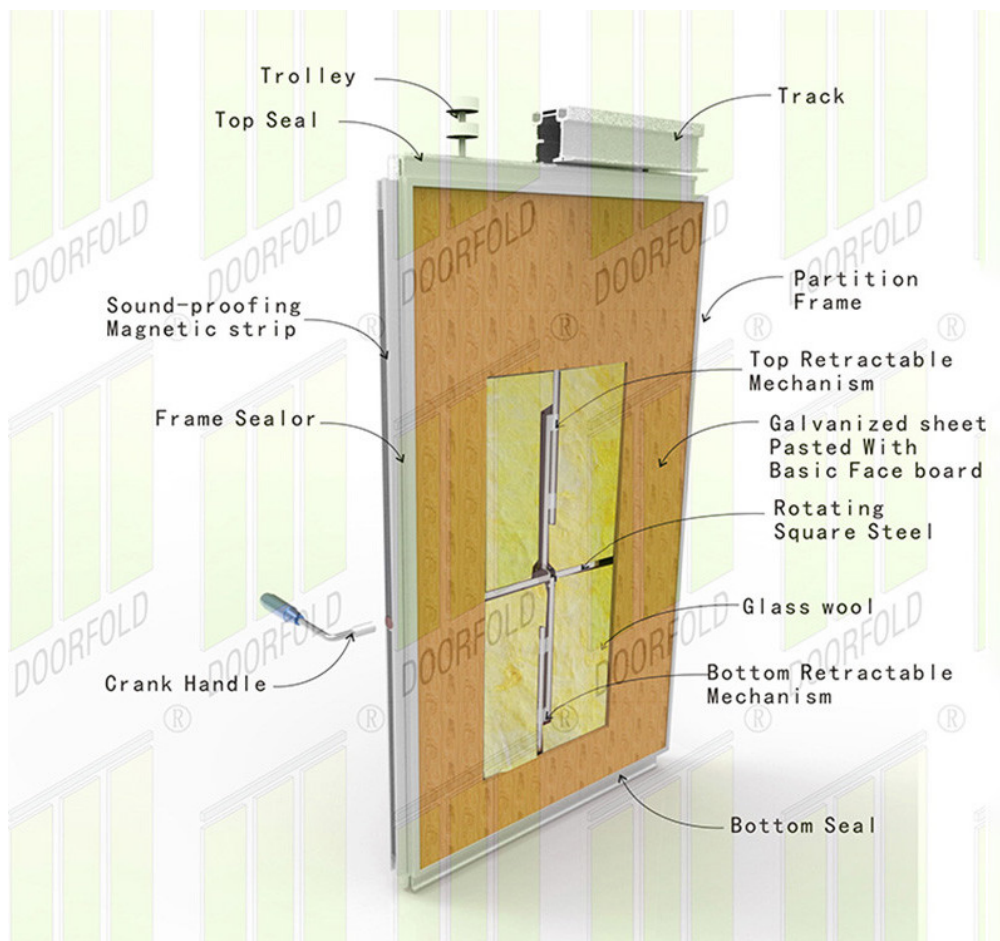
The conduits, wiring, switch boxes can be concealed and they are aesthetically pleasing too.

REQUIREMENTS OF GOOD PARTITION

- Cross section thin

- Sight and sound
- Acoustic
- Economical construction
- Resistant
- Vibrations
- Supportive feature

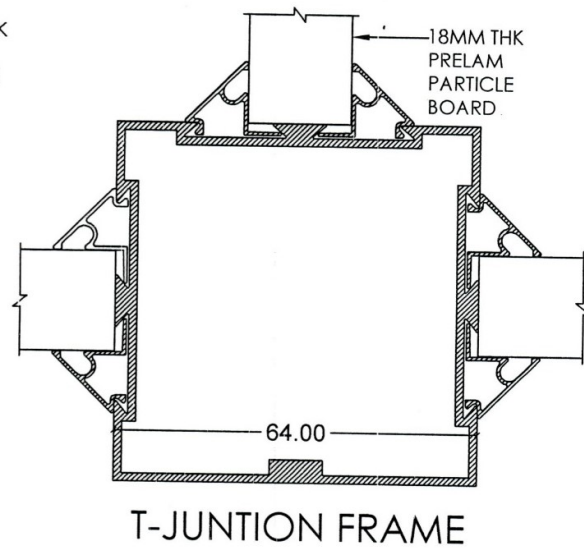
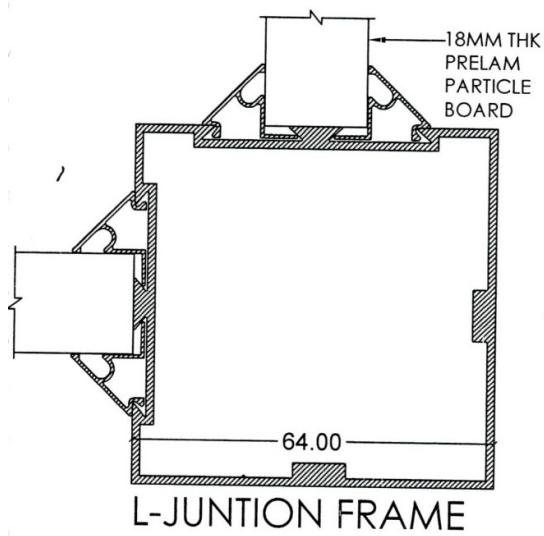
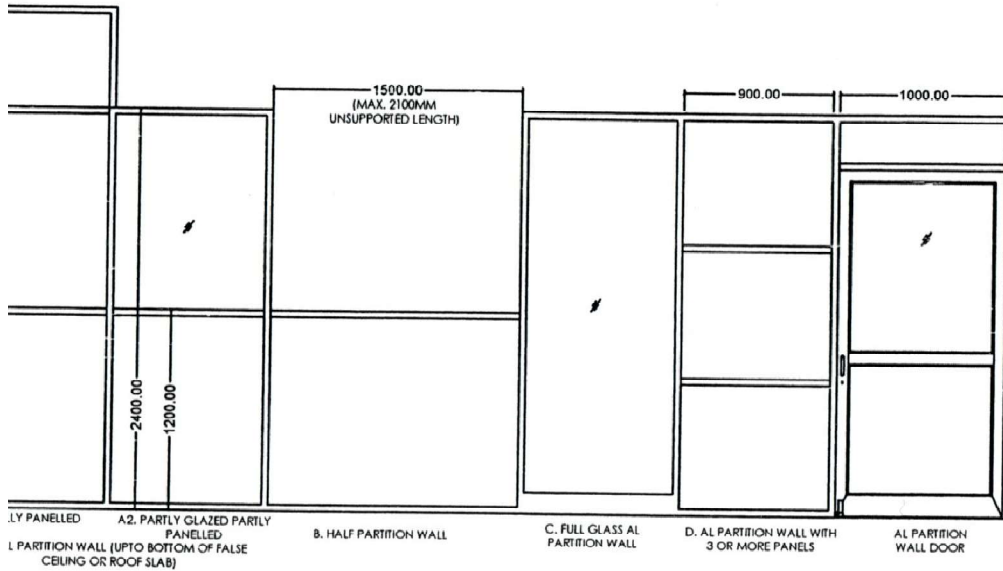


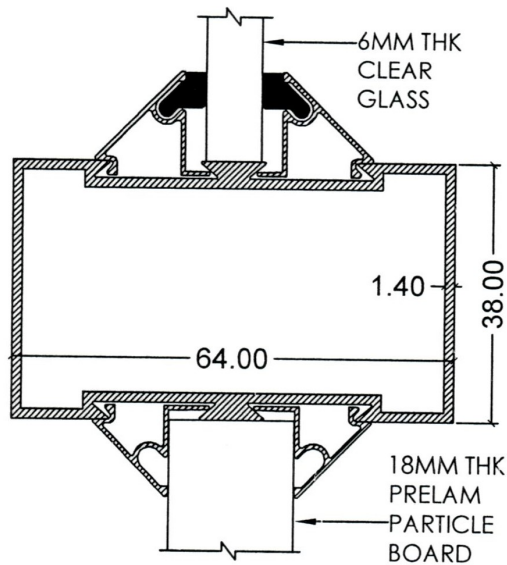


Portable Partitions

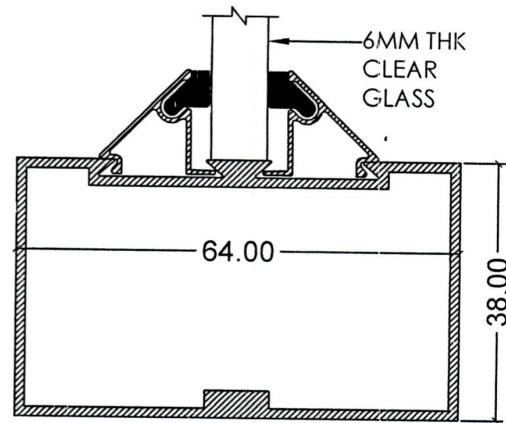
- Rolling mobile folding partitions which provide temporary walls
- The portable wall partition has two full panel end members which provide support, rigidity, privacy, and noise reduction.
- They fold and are on wheels enabling mobility and ease of storage.







DOUBLE GROOVE
FRAME

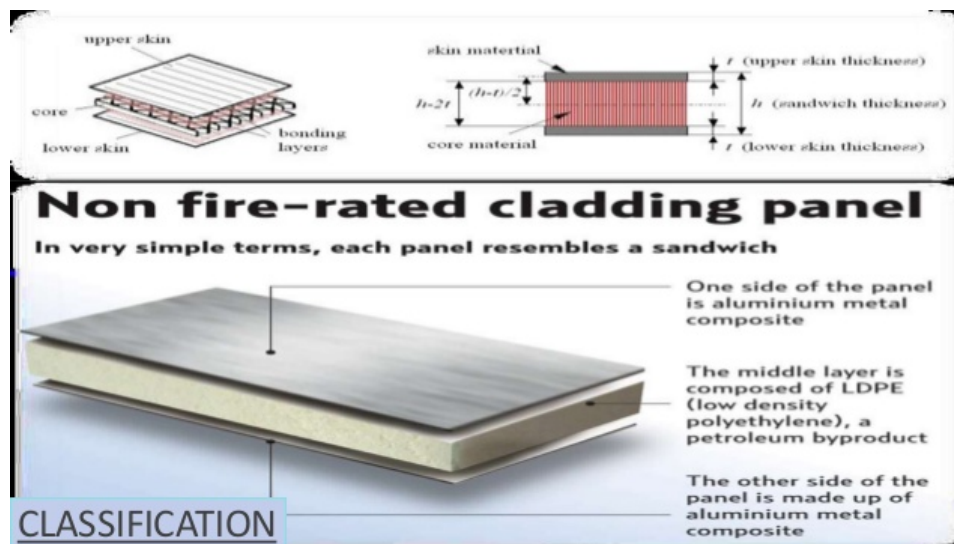


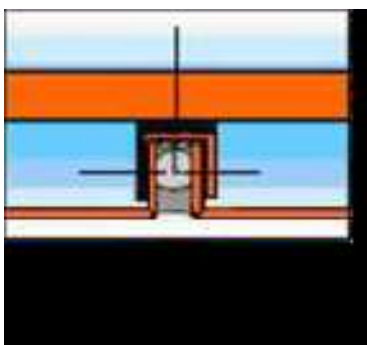
SINGLE GROOVE
FRAME

ALUMINIUM COMPOSITE PANELS SHEETS

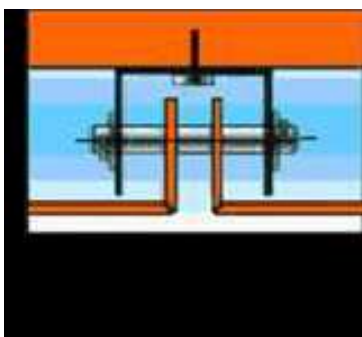
Aluminium paneling is done using aluminium frame work which can be concealed with aluminium composite panels, PVC panels, prelaminated boards, Fabric upholstered panels and glass panels.

Panelling is generally done to a permanent wall, Columns, Beams, Ceilings, etc





Tray system



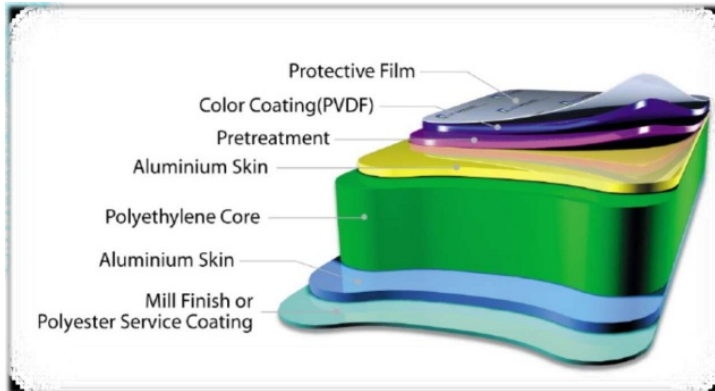
Cassette system

Panel thickness	Units	3mm	4mm	6mm
-----------------	-------	-----	-----	-----

1. PANEL DIMENSIONS				
1.1 Aluminium thickness	mm	0.25	0.50	0.50
1.2 EUROBOND weight	kg/m ²	3.8	5.6	7.4
1.3 Max. standard width	mm	1220, 1550		
1.4 Standard length	mm	2440, 3050, 3660		

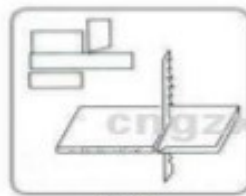
2. PANEL DIMENSION TOLERANCES		
2.1 Panel thickness	mm	±0.20
2.2 Panel width	mm	±2.0
2.3 Panel length	mm	±4.0
2.4 Diagonal difference	mm	±3.0

3 MECHANICAL CHARACTERISTICS OF ALUMINIUM COVER SHEETS (0.50mm)				
3.1 Tensile strength tolerances (Rm)	N/mm ²	145		
3.2 Yield strength [Rp0.2)	N/mm ²	120		
3.3 Elongation (AS)	%	5%		
3.4 Modulus of elasticity	N/mm ²	70000		
3.5 Rigidity (E)	KN m ² /m	0.11	0.25	0.60



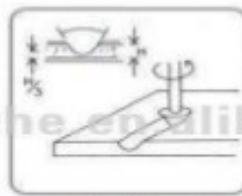
INSTALLATION OF ACP

- Aluminium composite panel are installed on aluminium by rivet or screw Or Cutting.
Panel can be cut by suitable kinds of saws and lathes.



Cutting

Cutting: electronic saw, hand saw, disc scissor.



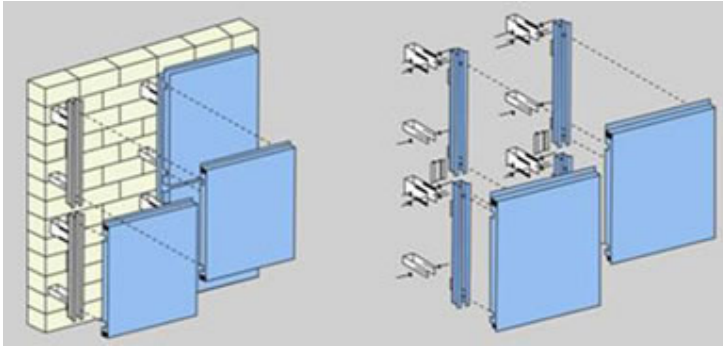
Slotting

After machining by electronic milling machine or portable milling machine, panel bendable to all kinds of arches by hand

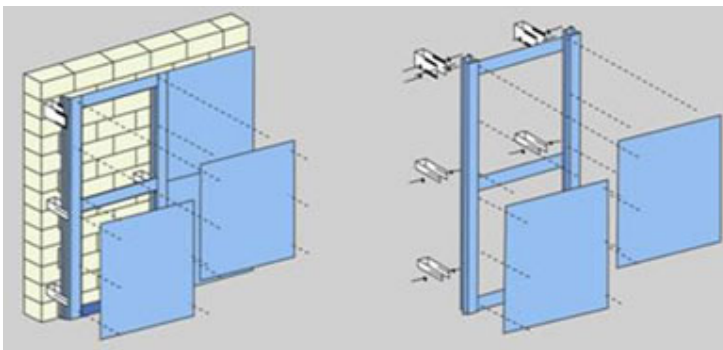


Chamfering

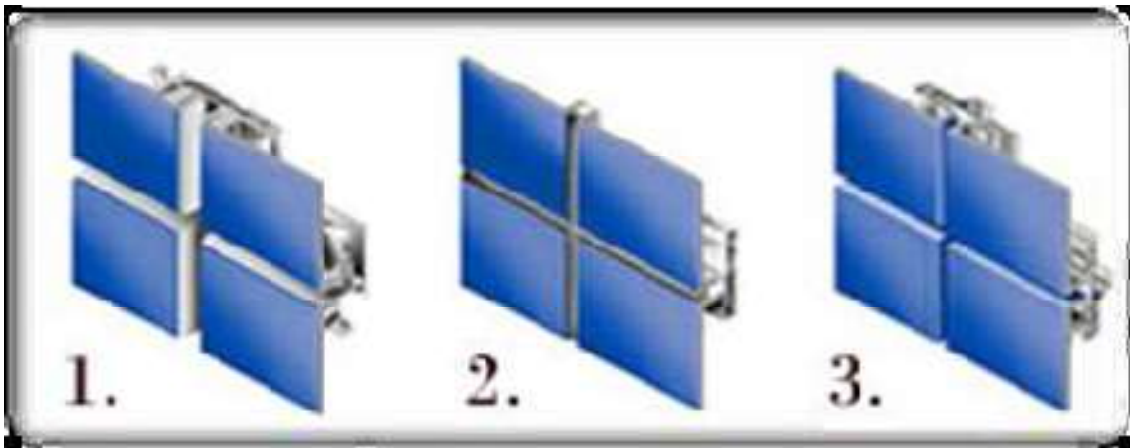
Fold into a carton after machining of punch machine and chamfer

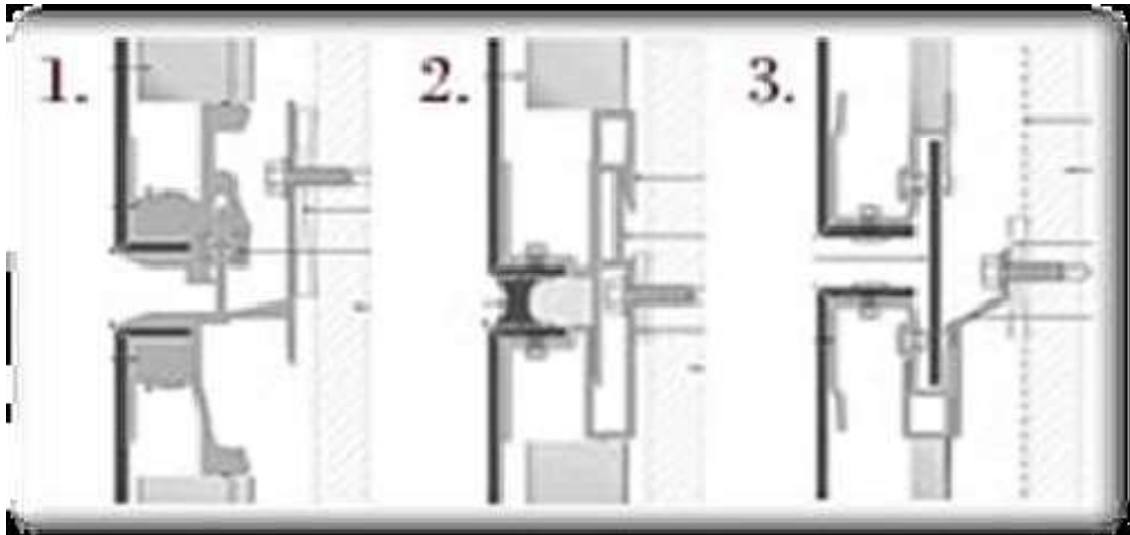


Cassette-Hanging Fixing System



Rivet-Screw Fixing System

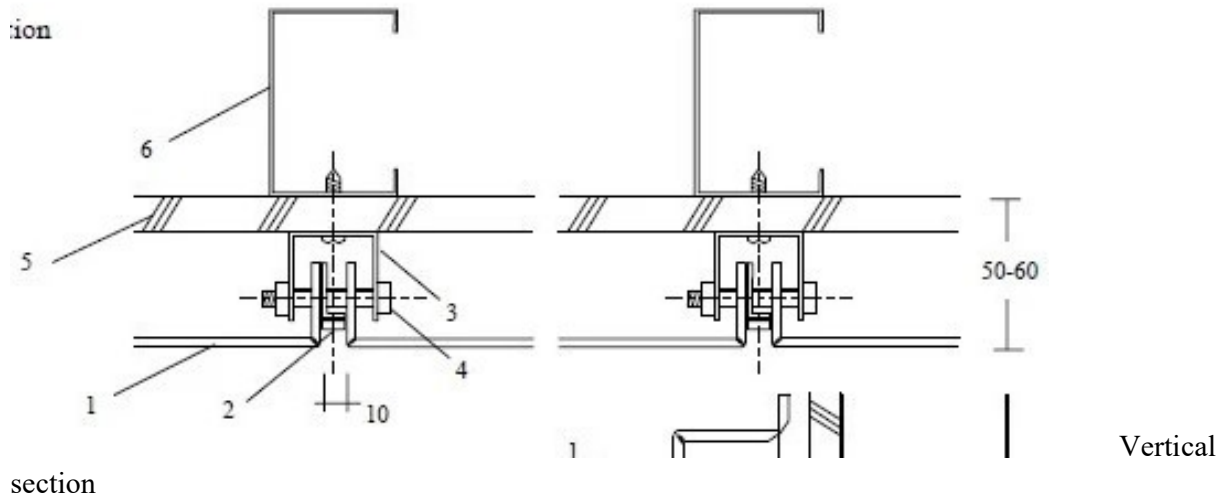


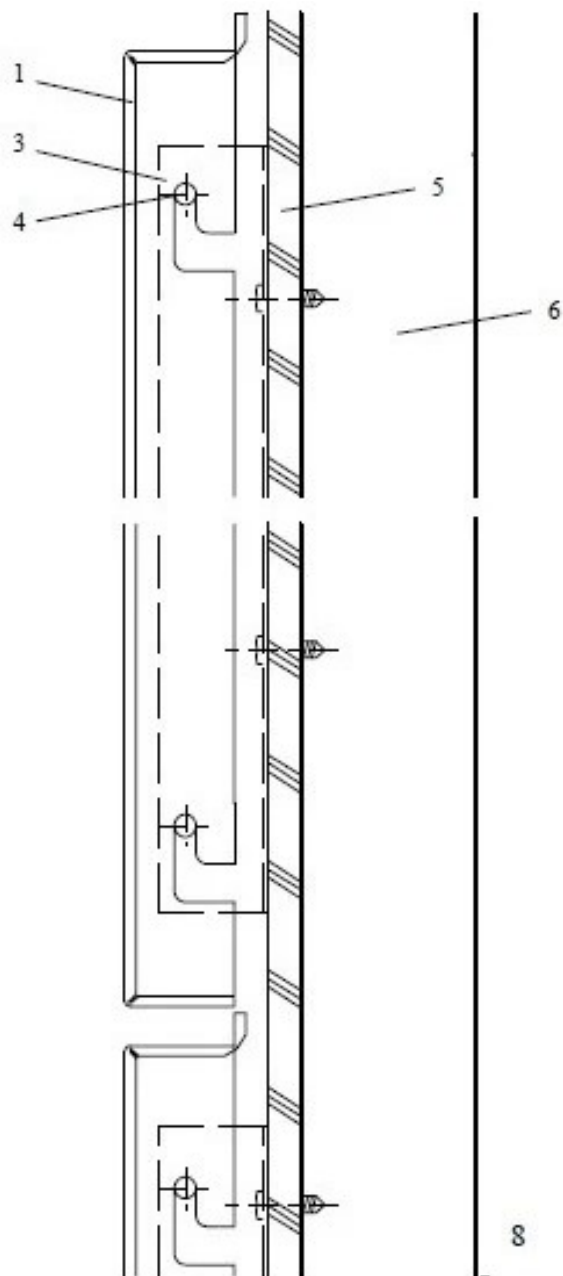


WALL CLADDING TYPE

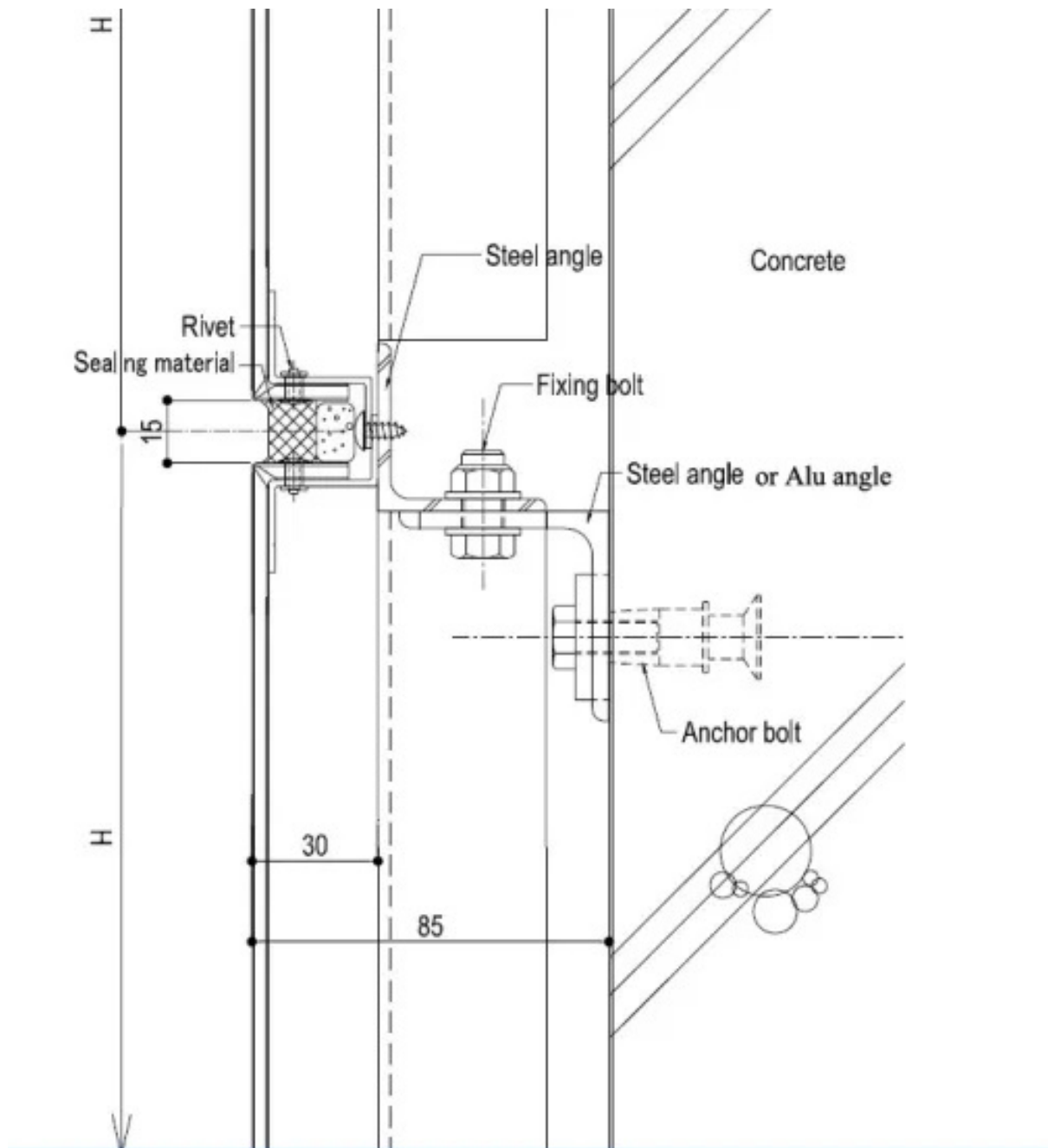
1. Narrow open joint
2. Wet sealant joint
3. Hanging method

1. ALPOLIC/fr LT 3mm
2. Joint cover, ALPOLIC/fr LT strip adhered on aluminum L-9×20 with VHB tape
3. Holder, aluminum C-30×30
4. Hanging bolt, M5, covered with rubber tube
5. Gypsum board
6. Stud

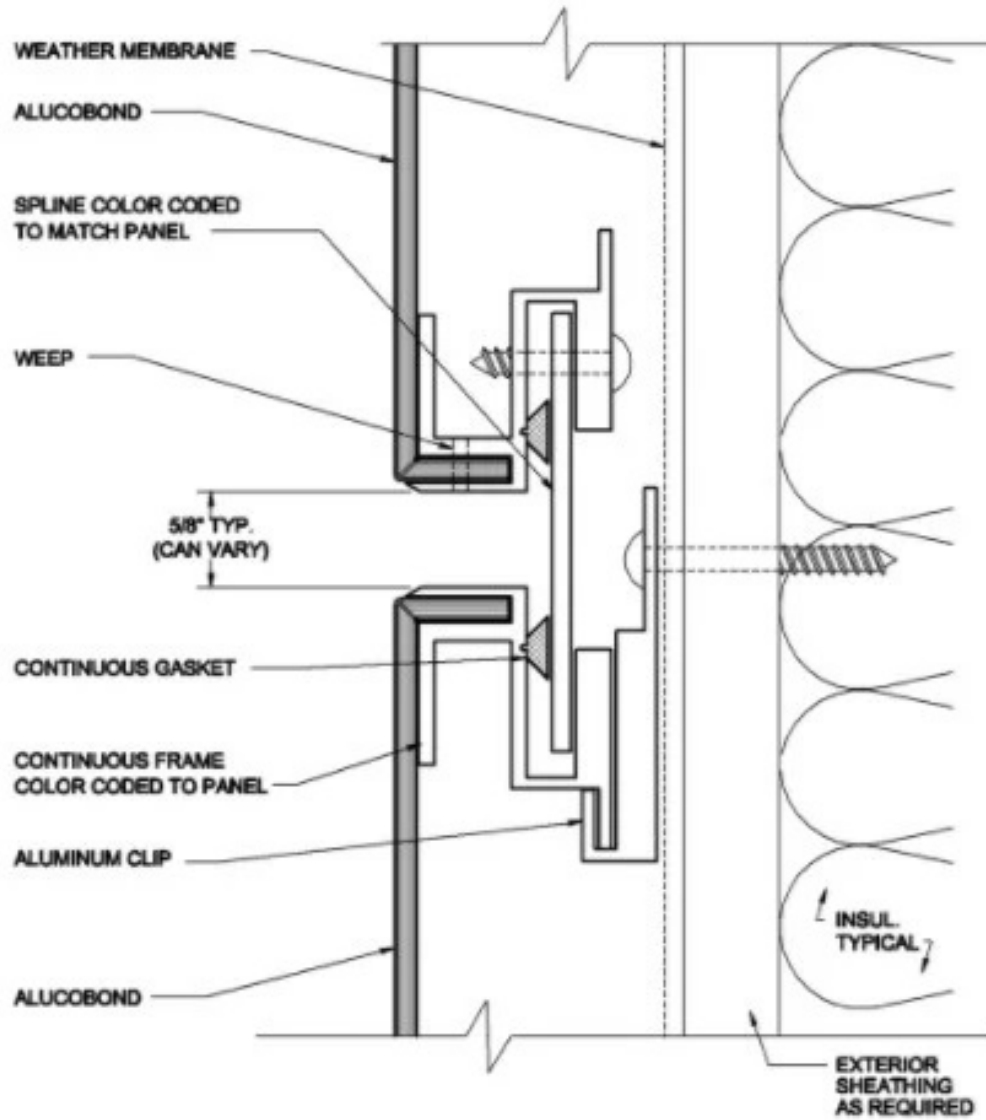




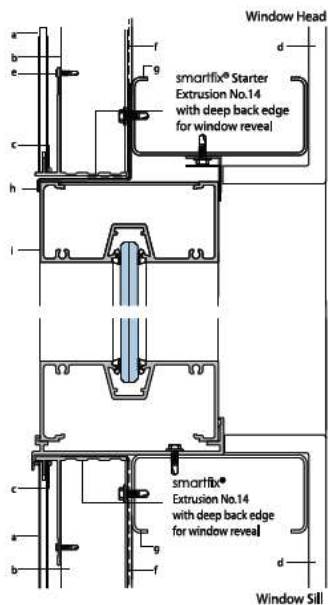
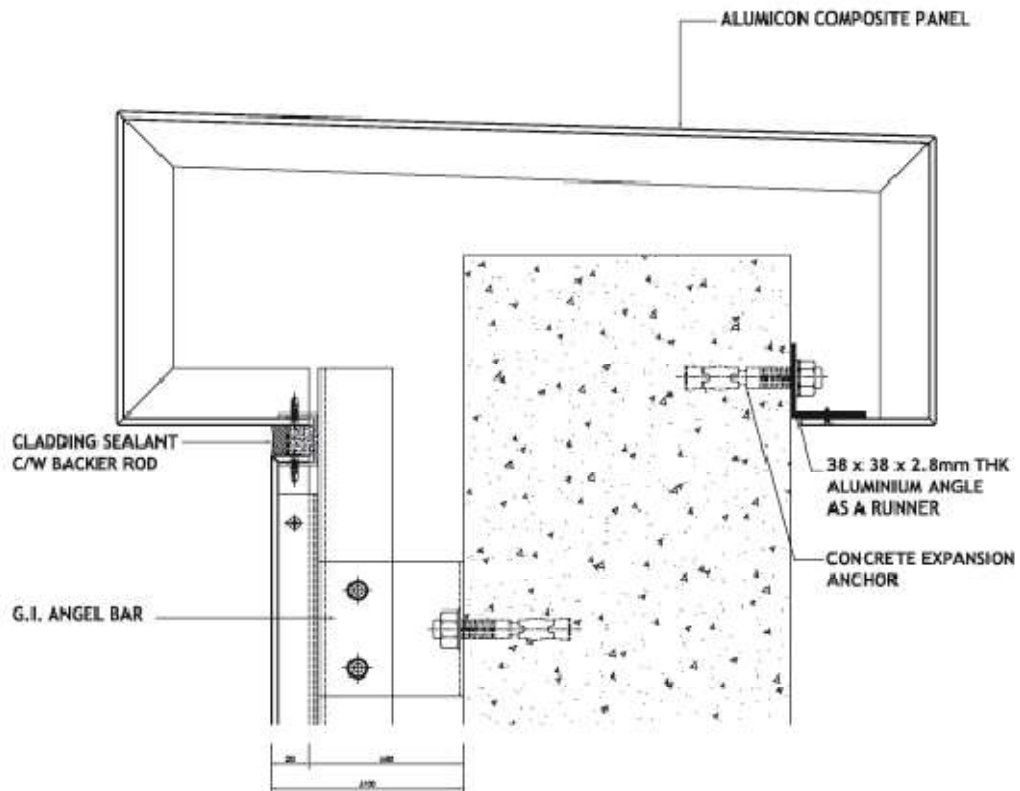
Horizontal section



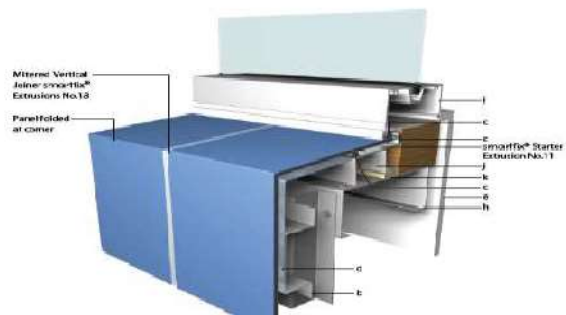
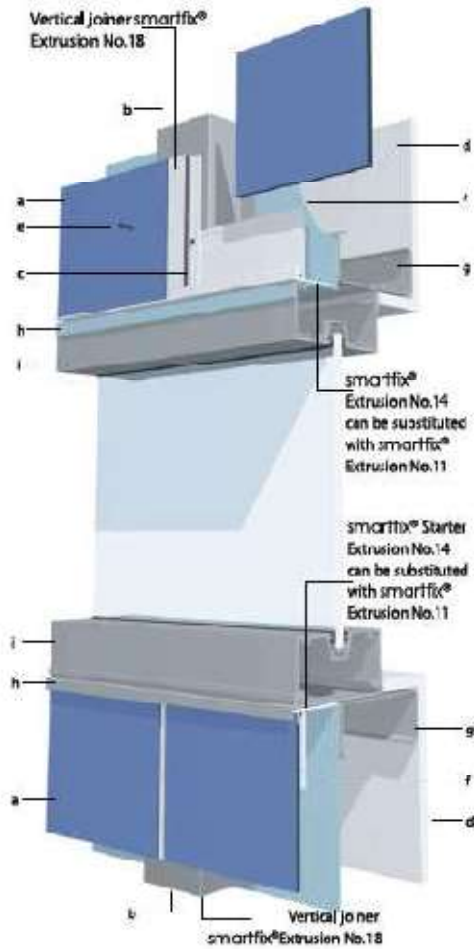
WALL CLADDING DETAIL WITH SEALANT



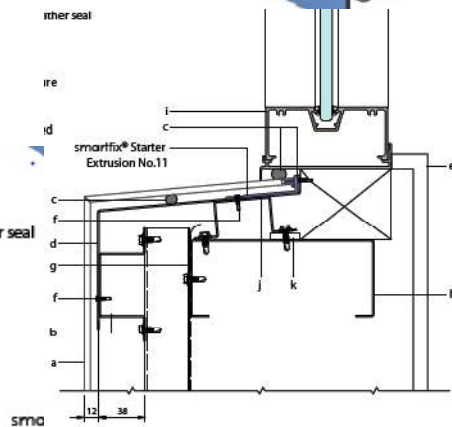
WALL CLADDING DETAIL HANGING METHOD

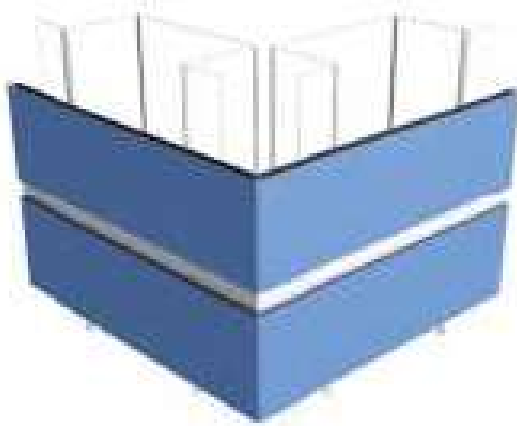


- a. 5mm Aluminium Composite Panel
- b. 50x35x1.1mm top hat section or structure as required
- c. EPDM gasket or appropriate sealant for concealed weather seal
- d. Internal lining
- e. Wafer head tek screws
- f. Vapour barrier between top hat and support structure
- g. Main support structure
- h. Vapour barrier flashing
- i. Glazing head & sill frame fixed using smartfix® Extrusion No.14
- j. Extrusion No.14 - Head and Sill



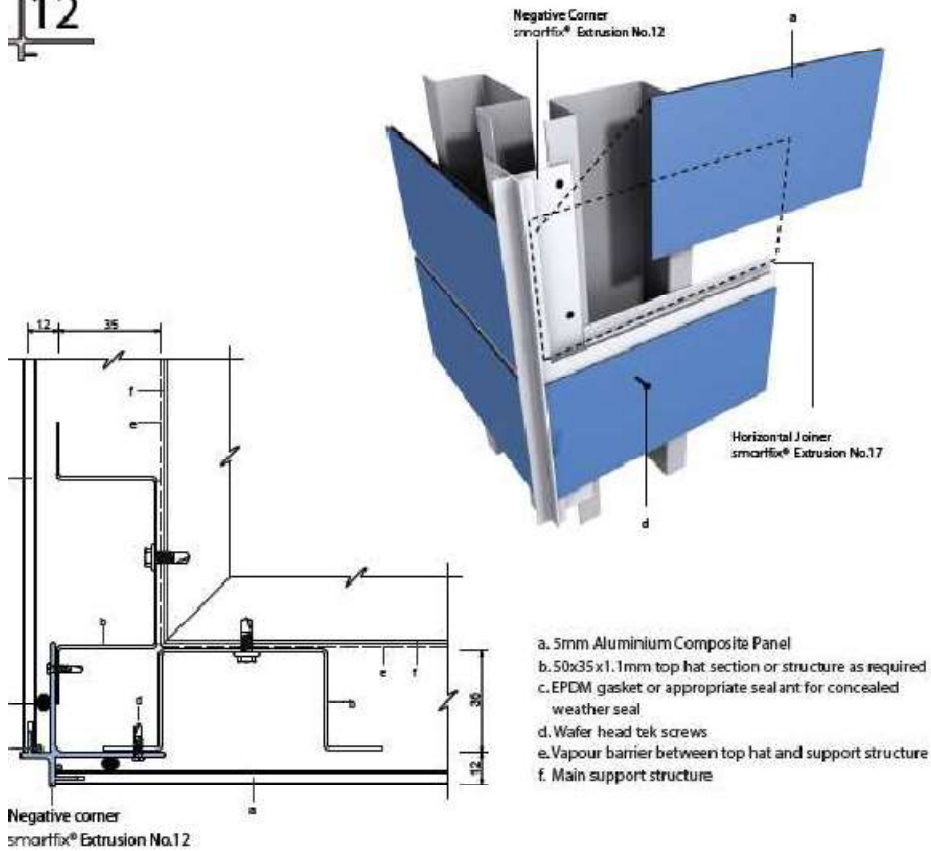
- a. 5mm Aluminium Composite Panel
- b. 50x35x1.1mm top hat section or structure as required
- c. EPDM gasket or appropriate sealant for concealed weather seal
- d. Steel angle
- e. Internal lining
- f. Wafer head tek screws
- g. Vapour barrier between top hat and support structure
- h. Main support structure
- i. Glazing head & sill frame
- j. 50 x 25 x 1.2mm top hat section or structure as required
- k. Plastic packer

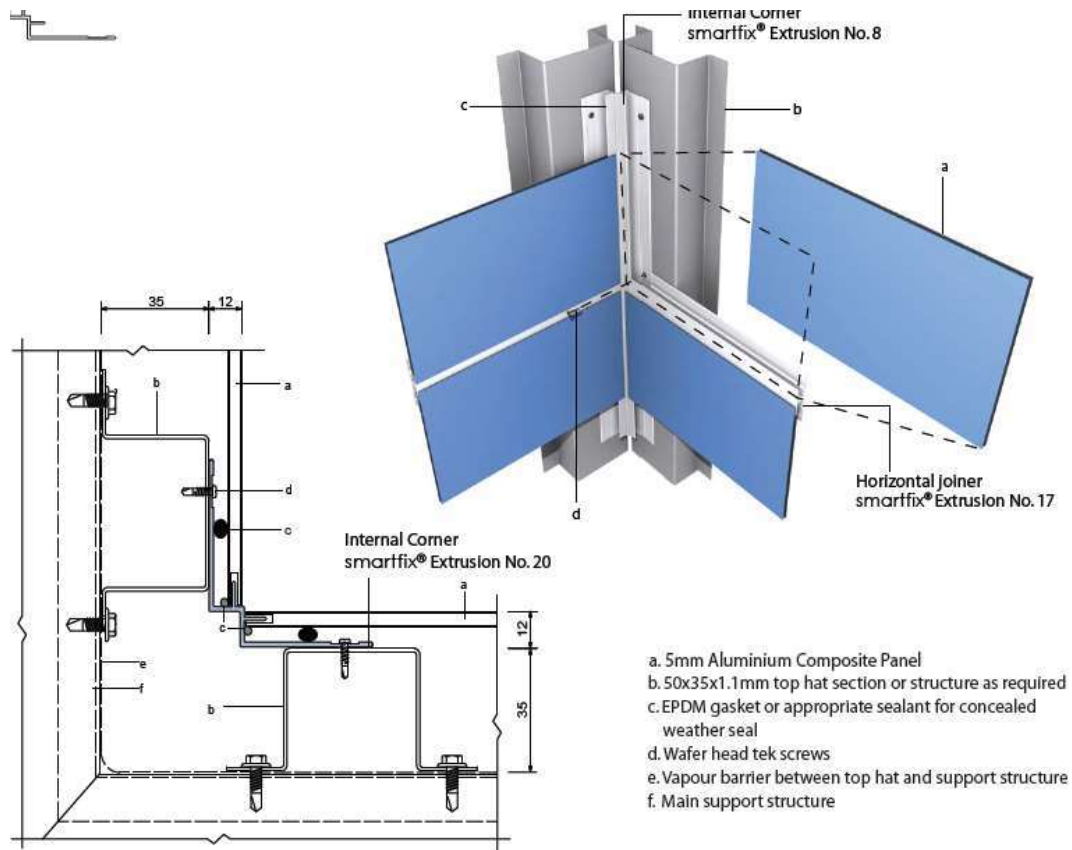




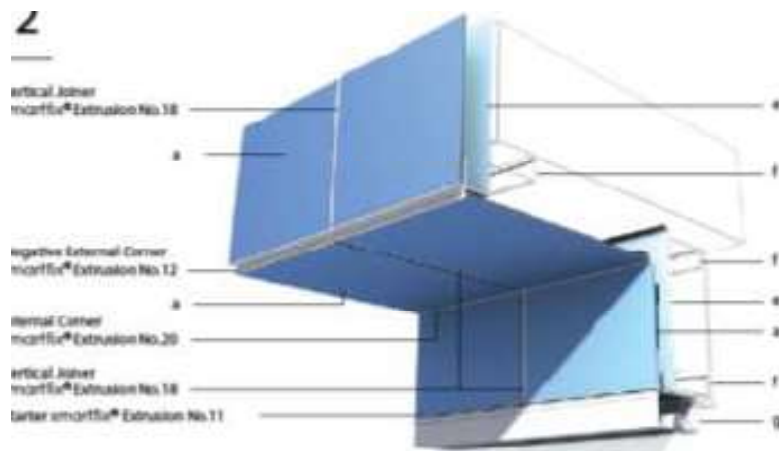
External corner detail

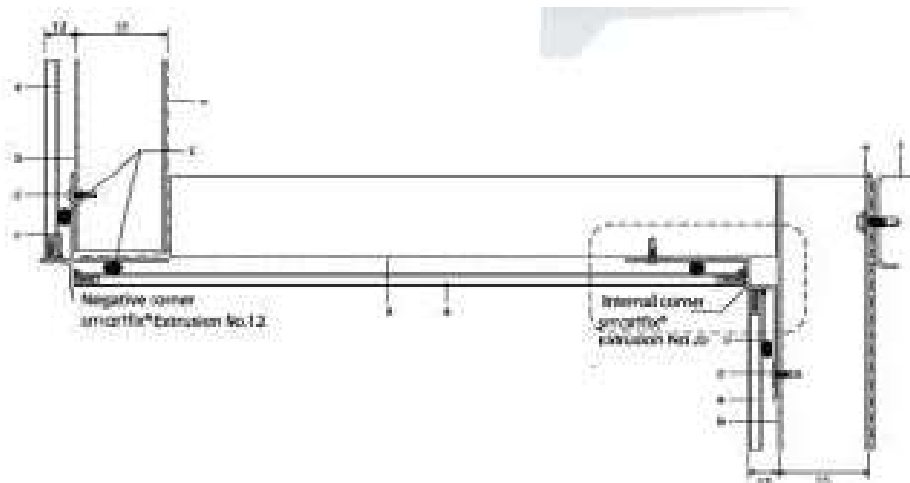
12



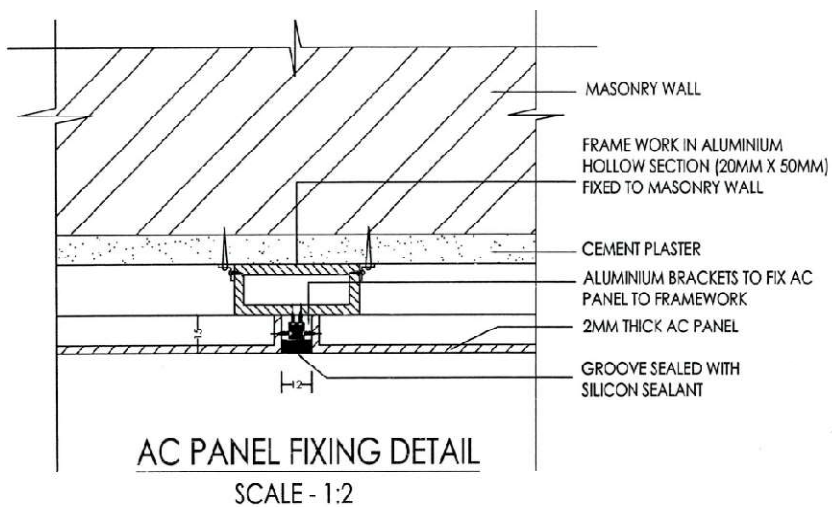
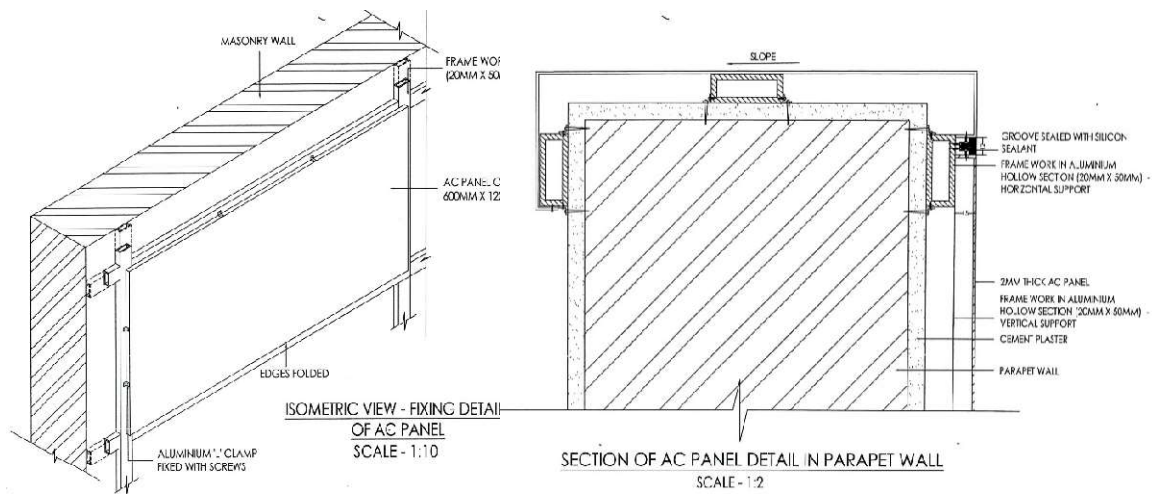


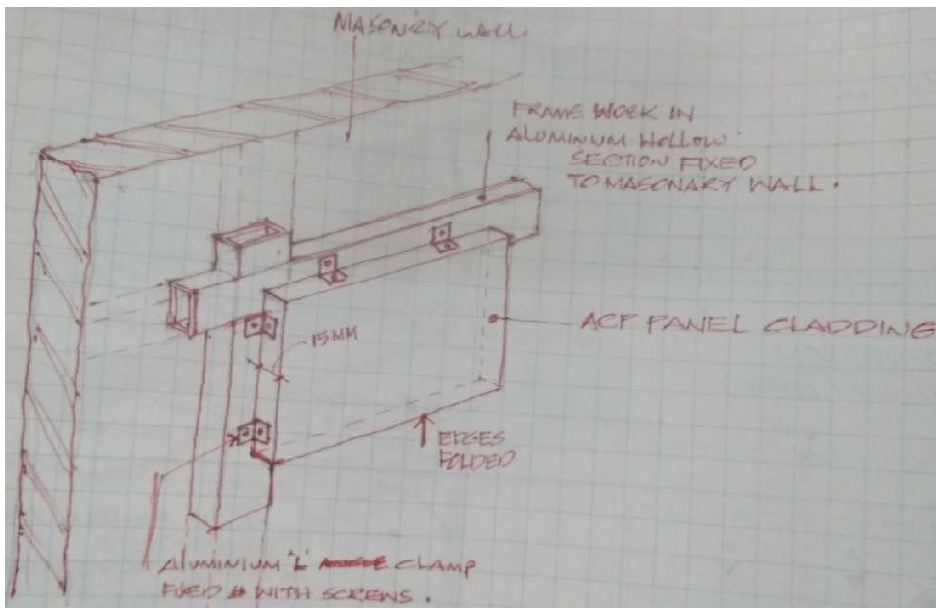
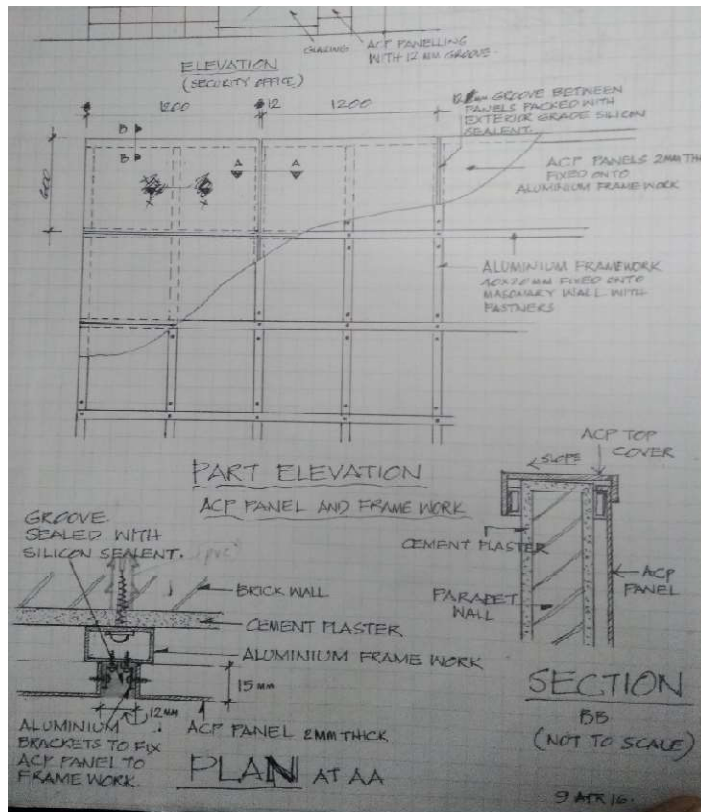
SOFFIT DETAIL

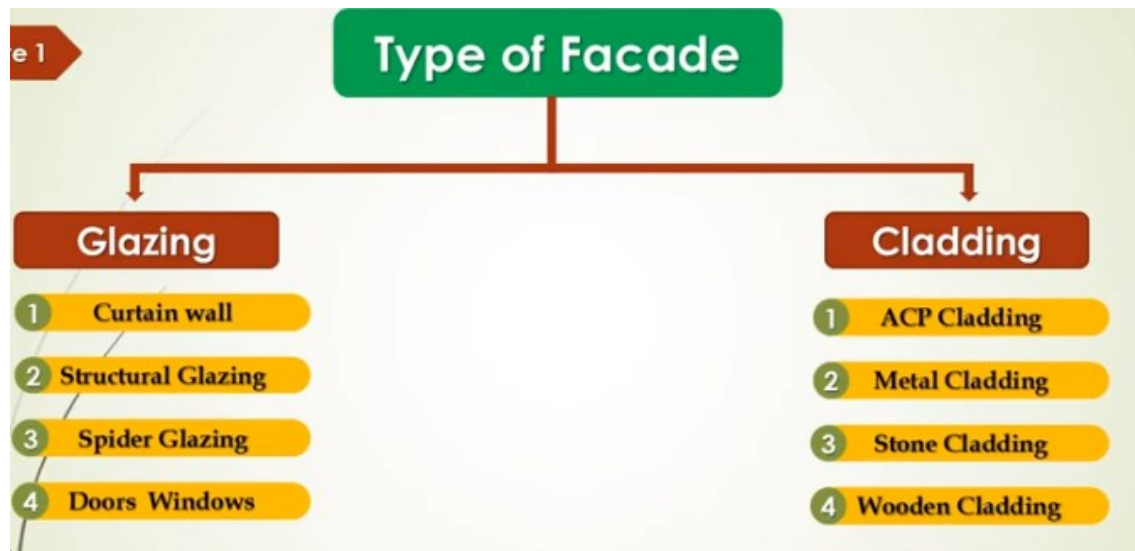




- a. 5mm Aluminium Composite Panel
- b. 50x35x1.1mm top hat section or structure as required
- c. EPDM gasket or appropriate sealant for concealed weather seal
- d. Wafer head tek screws
- e. Vapour barrier between top hat and support structure
- f. Main support structure
- g. Glazing frame. Refer to Window Details for further details



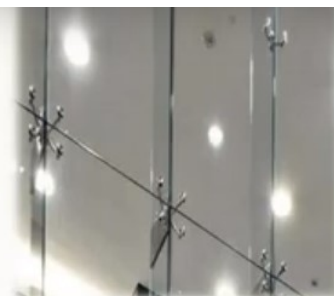




Curtain Wall



Structure Glazing



Spider Glazing



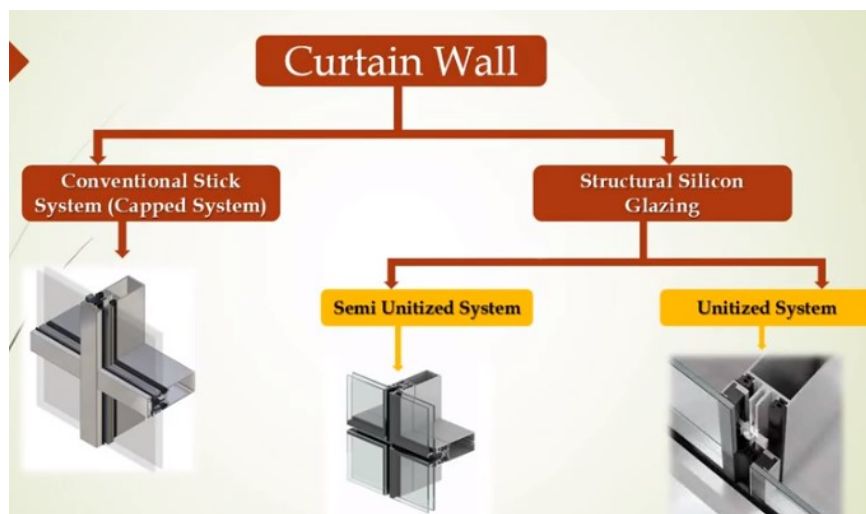
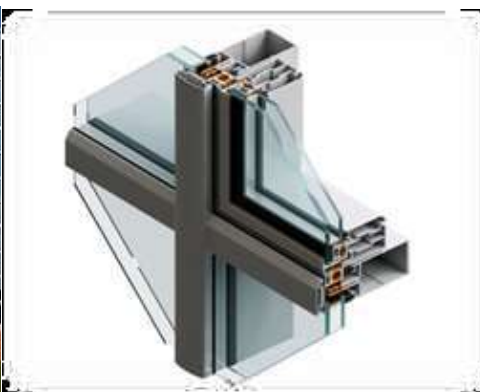
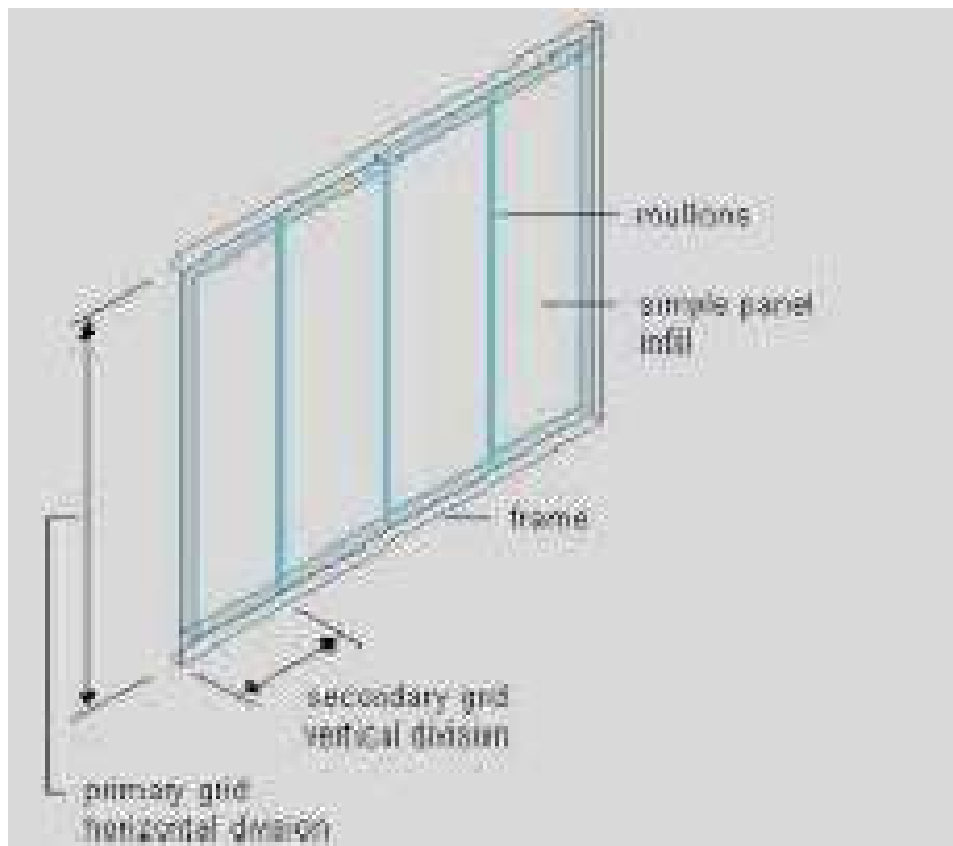
Sliding Door

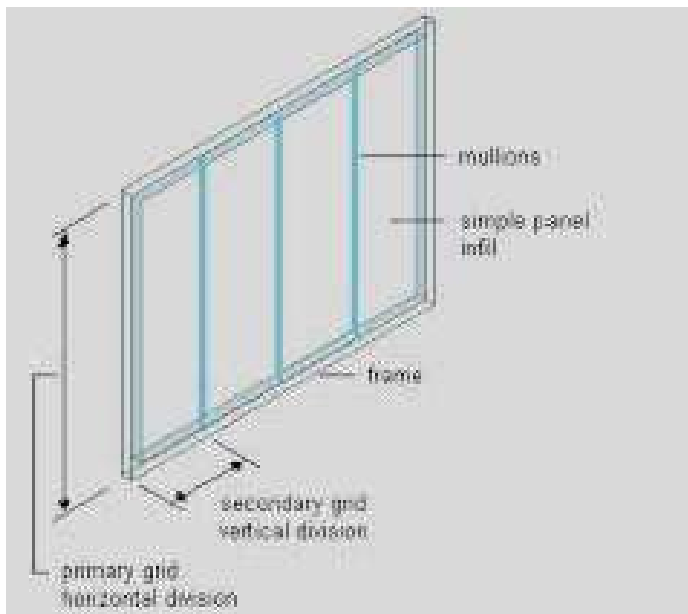


Casement Window



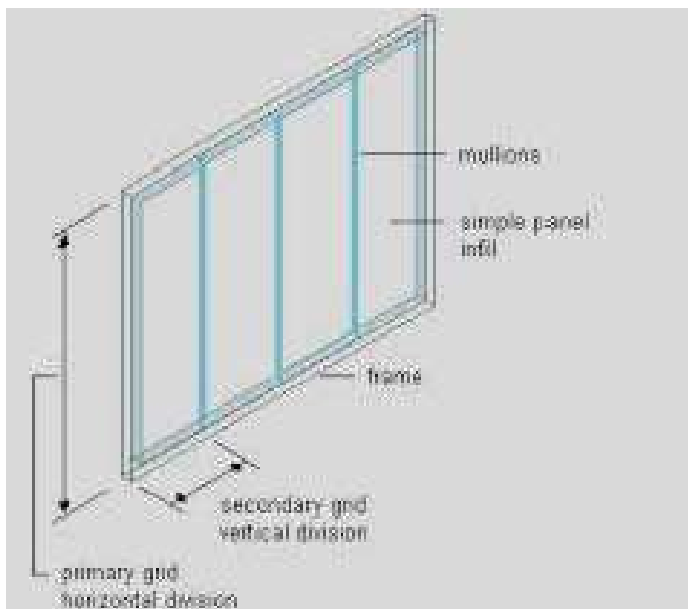
Skylight

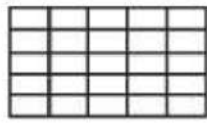




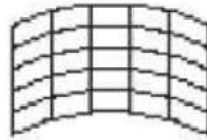
What is Unitized system?

In this system MS/SS/ Aluminium brackets are anchored to the columns/Slabs. After detailed site survey. The complete unit spanning floor height fully fabricate At the factory is installed on the brackets.
 This system 10% of the work can be done at site

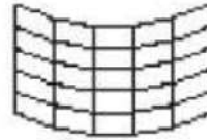




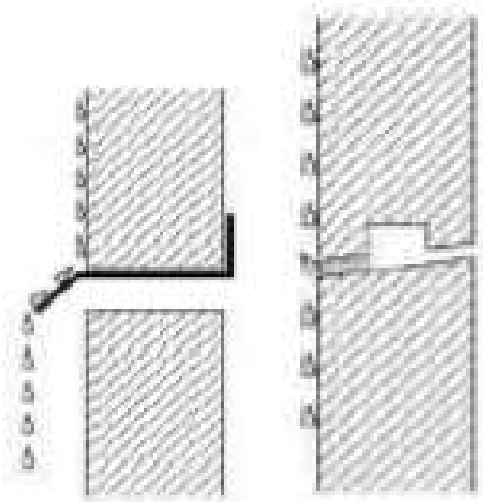
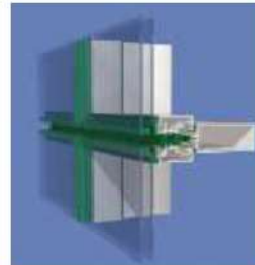
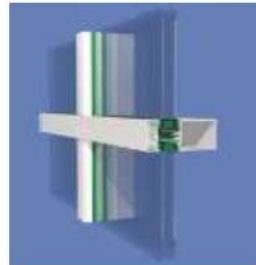
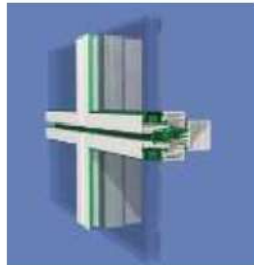
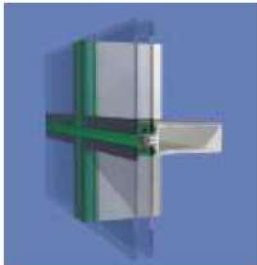
Vertical curtain wall



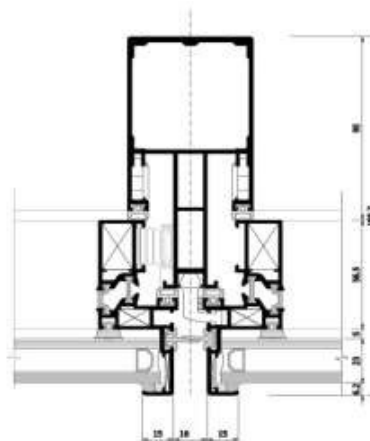
Convex contoured
Curtain wall

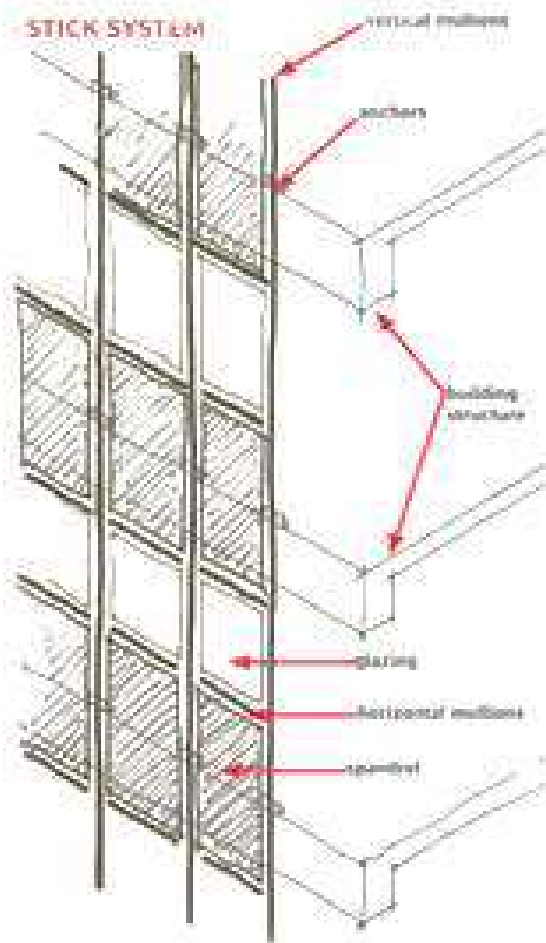


Concave contoured curtain
Curtain wall

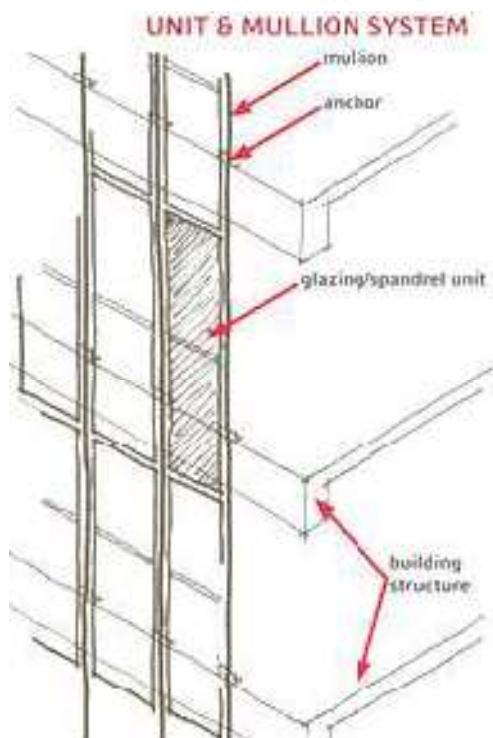


RAIN SCREEN PRINCIPLE

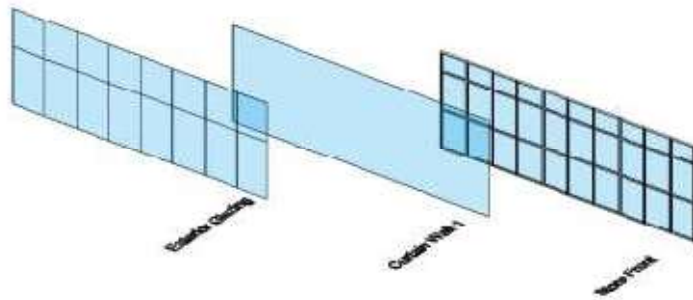




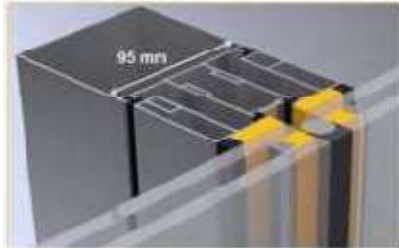
UNI



UNITIZED SYSTE

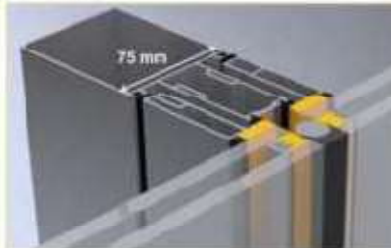


Old System



IG sealant dimension: 17 * 12 mm
 SG joint dimension: 30 * 9.5 mm
 Size of spacer tape: 9 * 9.5 mm
 Width of mullion: 95 mm

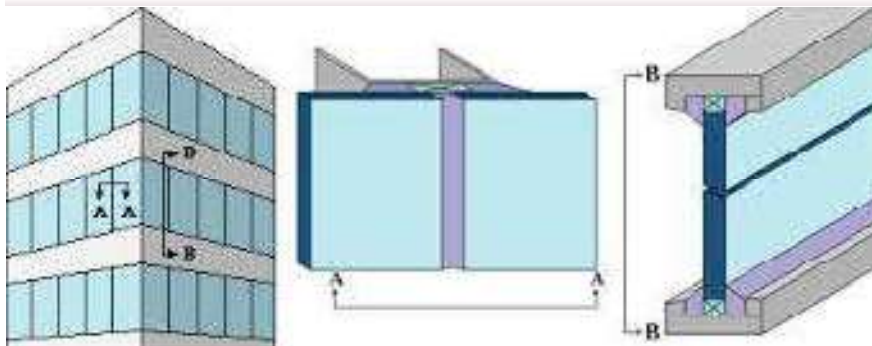
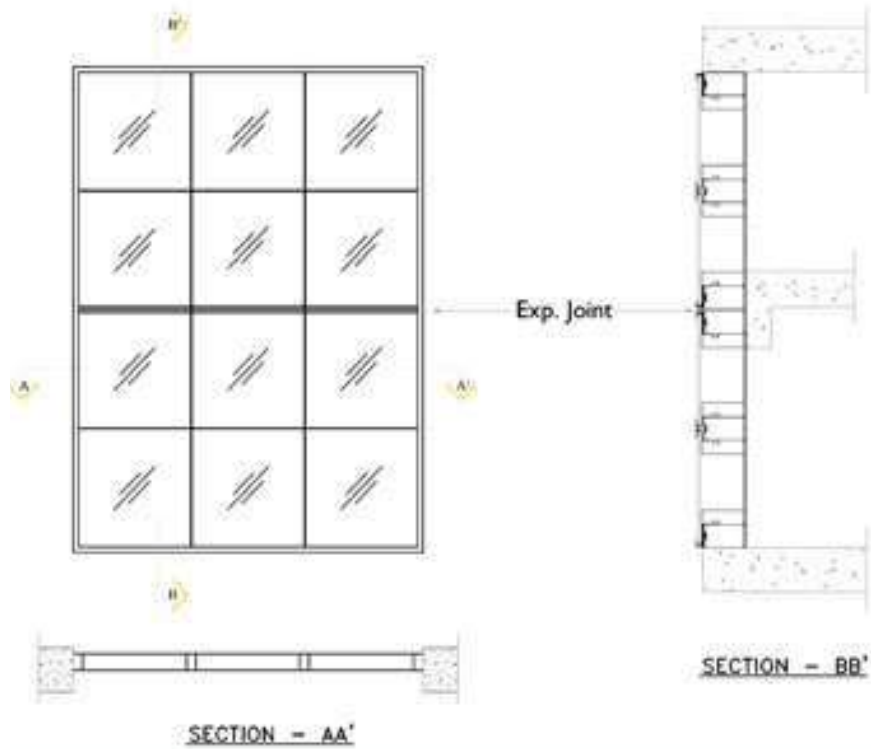
New System



IG sealant dimension: 13 * 12 mm
 SG joint dimension: 21 * 6.4 mm
 Size of spacer tape: 6 * 6.4 mm
 Width of mullion: 75 mm



STRUCTURAL GLAZING





DESIGN COMPONENTS FOR STRUCTURAL GLAZING

A typical structural glazing system is composed of a number of essential components. The specific functions and

relevant concerns relating to each of these components are:

1. STRUCTURAL FRAMING The design professional specifies the structural framing members in accordance with

design parameters of the building project. The structural framing is normally fabricated from an aluminum alloy

and may be either anodized or finished with an architectural coating. If an architectural coating is applied, it

must be done in-shop by a licensed applicator in strict conformance with the manufacturer's specification and

quality control procedures. Anodized coatings on aluminum tend to be variable, and may create problems for

silicone adhesion if not strictly monitored.

2. GLASS Glass type normally used is clear vision glass, which may be tinted or treated with a reflective coating.

Other types of glass considered by the design professional include: annealed, heat-strengthened, tempered,

laminated, or insulating glass. • Considerations – if the glass is treated with a reflective coating, low E coating, or

anopacifier (as with some spandrel types), structural silicone sealant adhesion to, and compatibility with, this

coating must be verified. If insulating glass is used, it shall be a high quality, dual-seal unit with a silicone

secondary seal in compliance with local specification.

3. STRUCTURAL SILICONE SEALANTS The sealant selection is made based on several factors, including: the type

of System being used, the design parameters to be met and the requirements of the glazing contractors, only

high strength silicone sealants specifically designed tested for structural glazing shall be used. General or multipurpose

silicone sealants not specifically designed for structural glazing should not be used.

4. SPACERS, SETTING BLOCKS AND GASKETS The glass manufacturer shall be consulted for the specific design

requirements of spacers, setting blocks and gaskets. These requirements include factors like size, location and

hardness.

COLD STORAGE

A **cool store** or **cold store** is a large refrigerated room or building designed for storage of goods in an environment below the outdoor temperature. Products needing refrigeration include fruit, vegetables, seafood and meat.

Cold stores are often located near shipping ports used for import/export of produce.

Hypermarket

Meat Market

Mortuarie

Wholesale fruit/Vegetable market

Restaurants/ Hotels

Food manufacturing industries

CLASSIFICATION

Based on operating temperature of cold storage

- ☐ Cold storage maintained above 0 °C
- ☐ Cold storage maintained below 0 °C

Based on construction

- ☐ Constructed cold storage (Stored products)
- ☐ Walk in cold storage (Manufacturing Units)

Based on time duration storage conditions

- ☐ Short term or temporary (7-10 days)
- ☐ Long term (6-8 months)
- ☐ Frozen storage (years)

► To find the capacity of the refrigeration system for the cold storage.

- It is necessary not only to cool the product to the storage temperature but also to meet the cooling load due to various heat infiltrations taking place in the cold storage. Broadly, the total load is divided into two categories as under.

- **1. Sensible heat load**

- 2. Latent heat load**

Heatload Calculation:

Wall / Floor Panel Data:

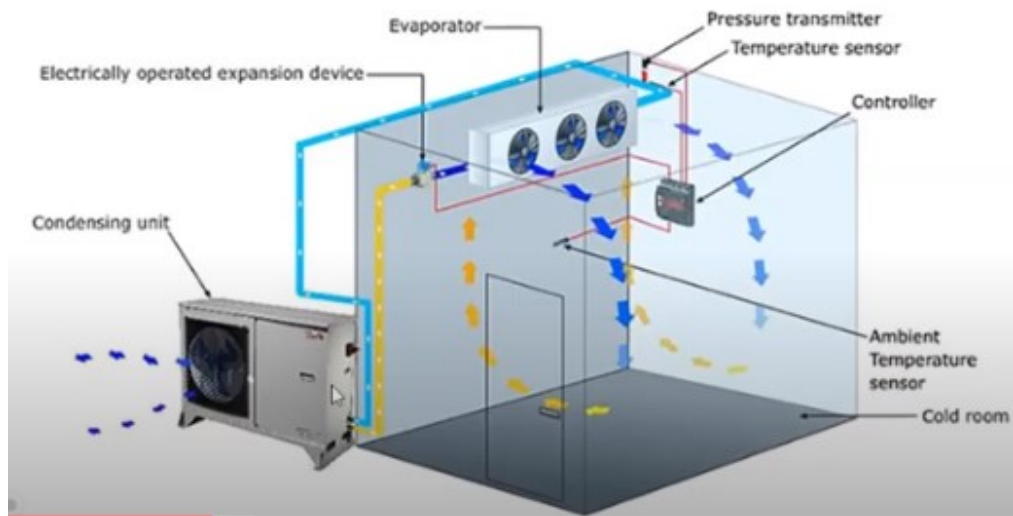
- ⊙ Size of Room
- ⊙ PUF Panel Thickness and Area
- ⊙ Temperature outside Cold Storage

Heatload Calculation:

Product Data:

- ⊙ Product to be stored inside cold storage
- ⊙ Desired Product Temperature
- ⊙ Quantity of Product to be stored
- ⊙ Fresh Load of product on daily basis
- ⊙ Incoming product temperature
- ⊙ Pulldown Time

Components of cold storage



Major Components of Cold Storage

- ⊙ PUF Panels (Walls / Ceiling)
- ⊙ Floor Panels
- ⊙ Doors
- ⊙ Refrigeration Units

PUF Panel Thickness & Temp.

- ⊙ 60 mm : +1 Deg C onwards
- ⊙ 80 mm : 0 Deg C to -5 Deg C
- ⊙ 100 mm: -6 Deg C to -15 Deg C
- ⊙ 120 mm: -16 Deg C to -24 Deg C
- ⊙ 150 mm: -25 Deg C to -40 Deg C

PUF Panel Types

⊙ Camlock Joints

⊙ Continuous Type



FLOORS

- GI Sheets
- Aluminium chequered sheets
- SS – Stainless steel sheets



⊙ Swing Type



⊙ Sliding Type



DISTRIBUTION OF AIR FLOW

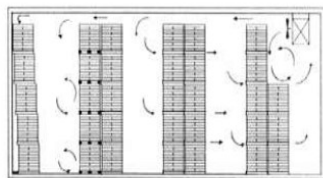


Figure 38 Uneven air distribution in a store with a unit-cooler with fan circulation

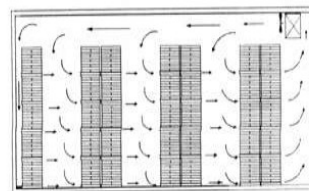


Figure 39 Cold store with suspended unit cooler and head space above pallet stacks

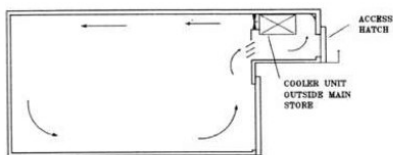


Figure 40 Cold store with cooler unit outside the main store.

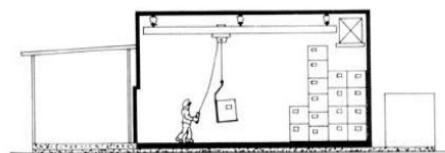


Figure 41 Cross-section of prefabricated cold store.

temperatures

□ Length of air blow and impingement on stored products

□ Uniform

- ☐ Effect of relative humidity
- ☐ Effect of air movement
- ☐ Controlling ventilation systems, if necessary.
- ☐ Product entering temperature
- ☐ Expected duration of storage
- ☐ Required product outdoor temperature
- ☐ Transportation in and storage area

COLD STORAGE DESIGN REQUIREMENTS

1. Selection of site
2. Orientation and building form
3. Size
4. Space requirement
5. Design of building
6. Thermal insulation
7. Refrigeration system for cold store
8. Heat Load calculation

1. Selection of site

Orientation and building form

- ☐ N-S direction
- ☐ W-E walls should have good plantation
- ☐ Surface to volume ratio less

3. Size

- ☐ Volume of product to store
- ☐ Product containers (boxes, hampers, buckets)
- ☐ Volume required per container
- ☐ Space for mechanical or manual operation
- ☐ Lateral and head space

□ Available site space

$$V = v(C+S)$$

Where,

→ V is the total volume needs in cubic feet.

→ v is the volume occupied by one product container in cubic feet.

→ C is the maximum number of containers to be cooled at any one time.

→ S is the maximum number of containers to be stored at any one time

4. Space requirement

Storage space 3.4 m³ / ton suitable for stacking and circulation of cold air (EIRI 2003)

Chamber height -3 to 10 m

For loading and unloading distance between Rack & rack - should not < 75cm Rack & wall - least 20-25 cm

Ceiling & product shelf top - 30 cm

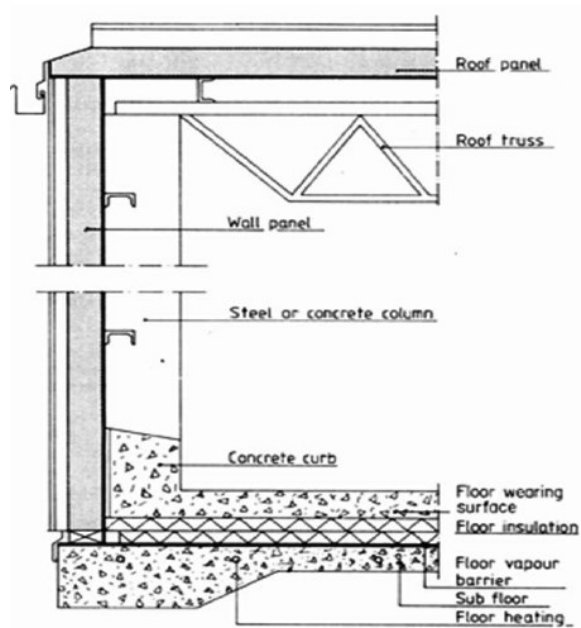
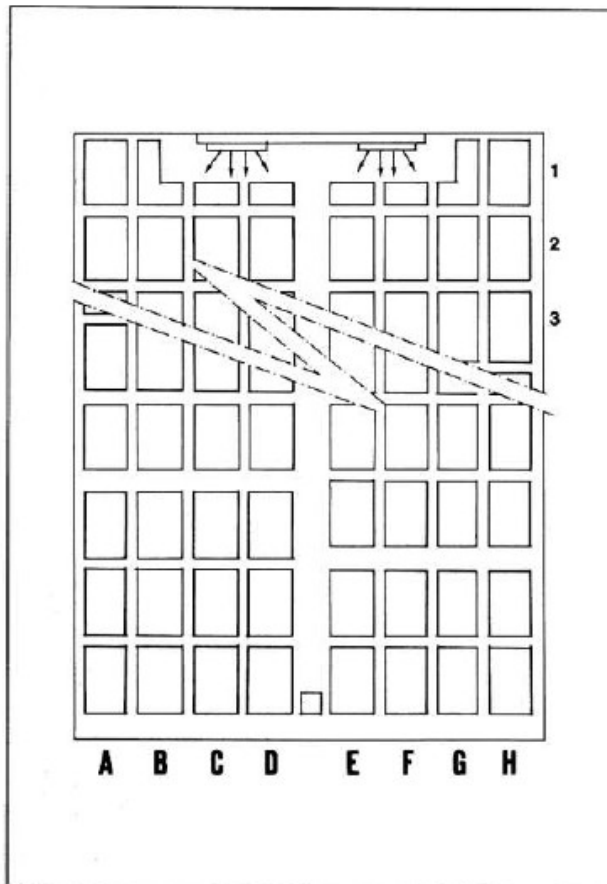
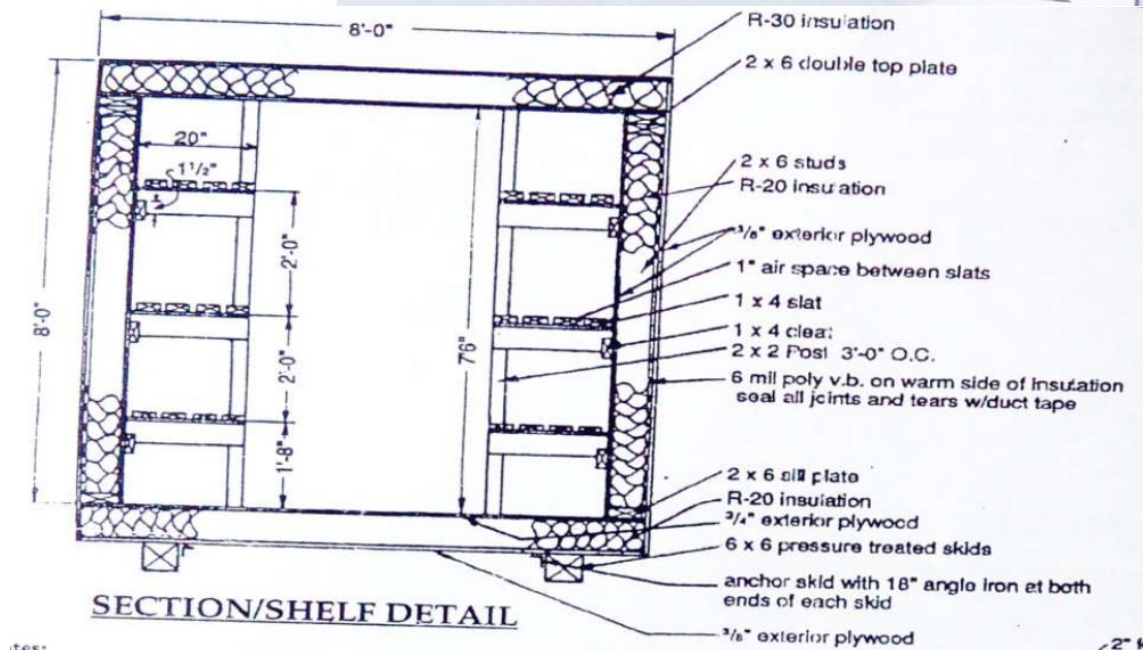
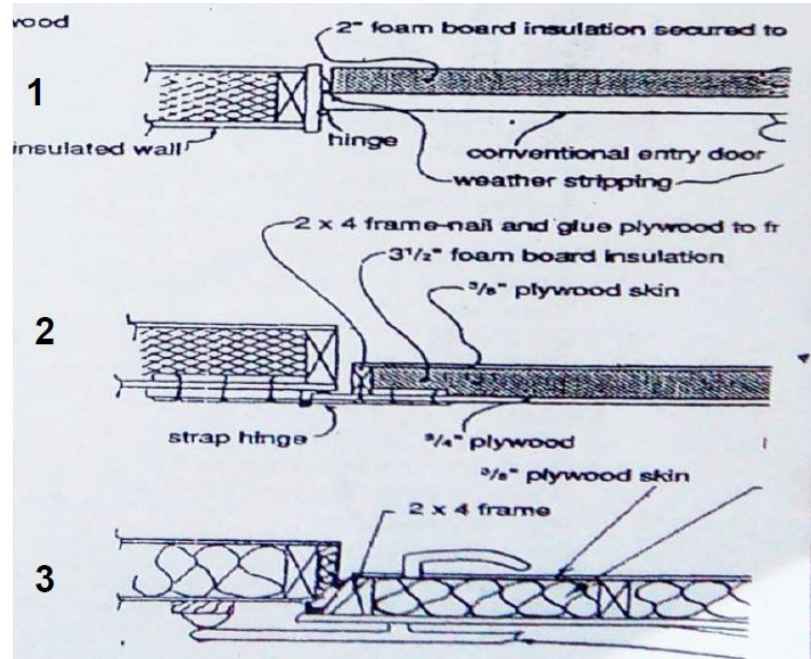


Figure 31 Panel-built cold store with internal structure

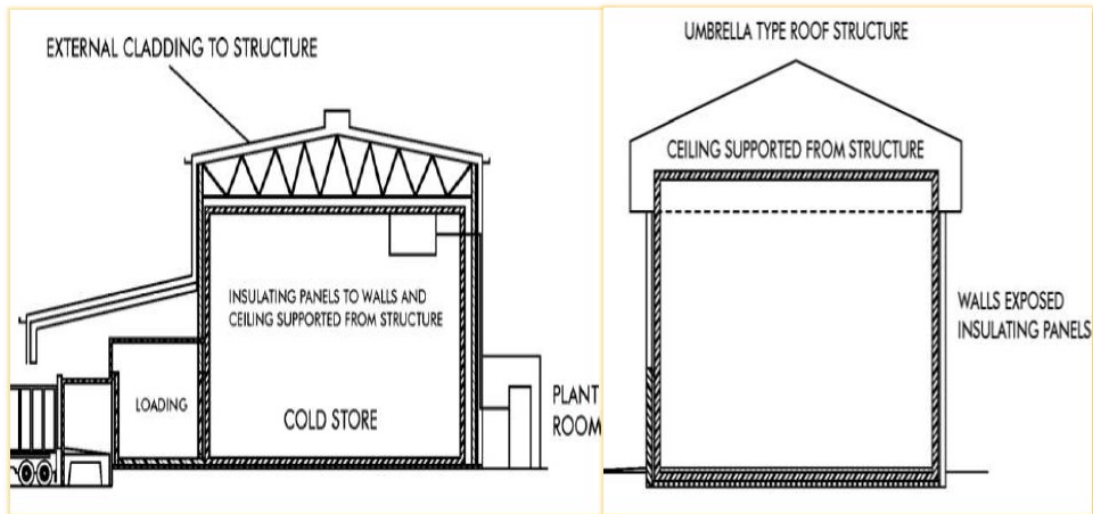
Floor

Ground load 5500-8000 kg/m²
(FAO)

Doors



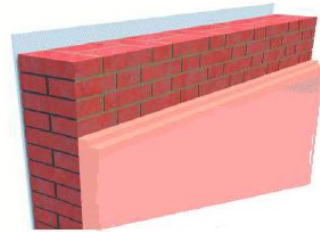
6. Insulation



Insulating materials

Insulation	Calculated thermal conductivity (kcal/m h °C)	Thickness (mm)
Polystyrene	0.033	220
Styrofoam FR	0.030	200
Polyurethane	0.025	170

Polyisocyanurate Foam



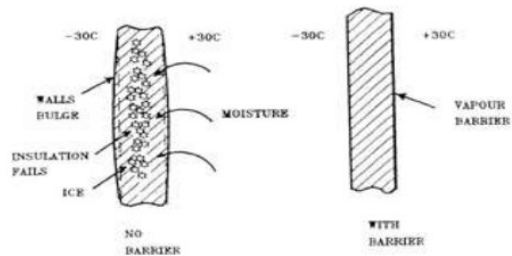


Figure 32 Diagram illustrating the function of a cold store vapour barrier.

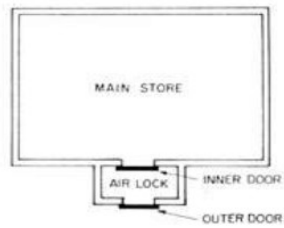


Figure 36 Illustration of a cold store air lock

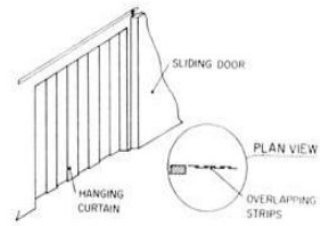


Figure 37 Inner curtain of flexible strips used to reduce air exchange

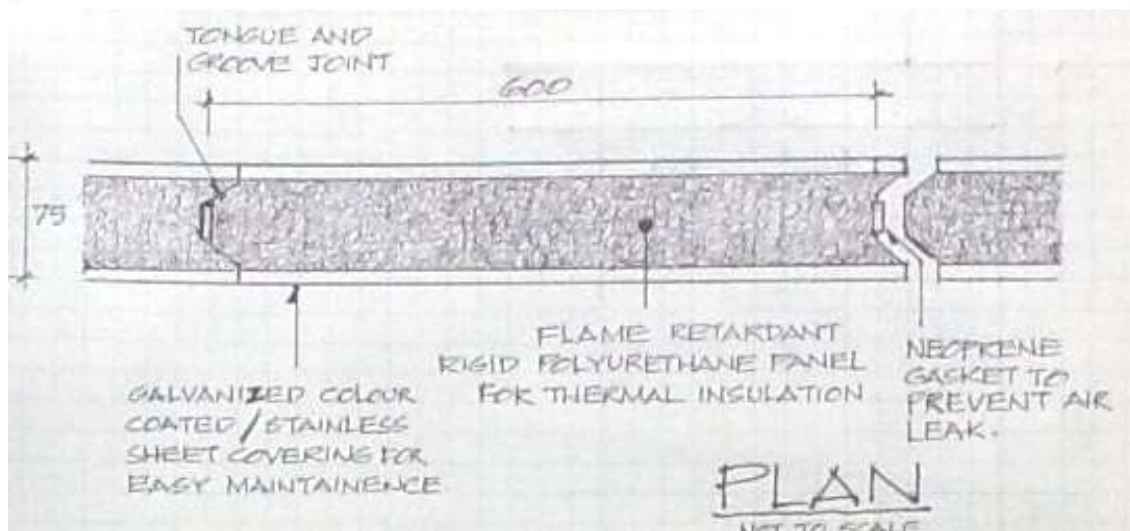
- Refrigerant below -3°C , deposition of frost

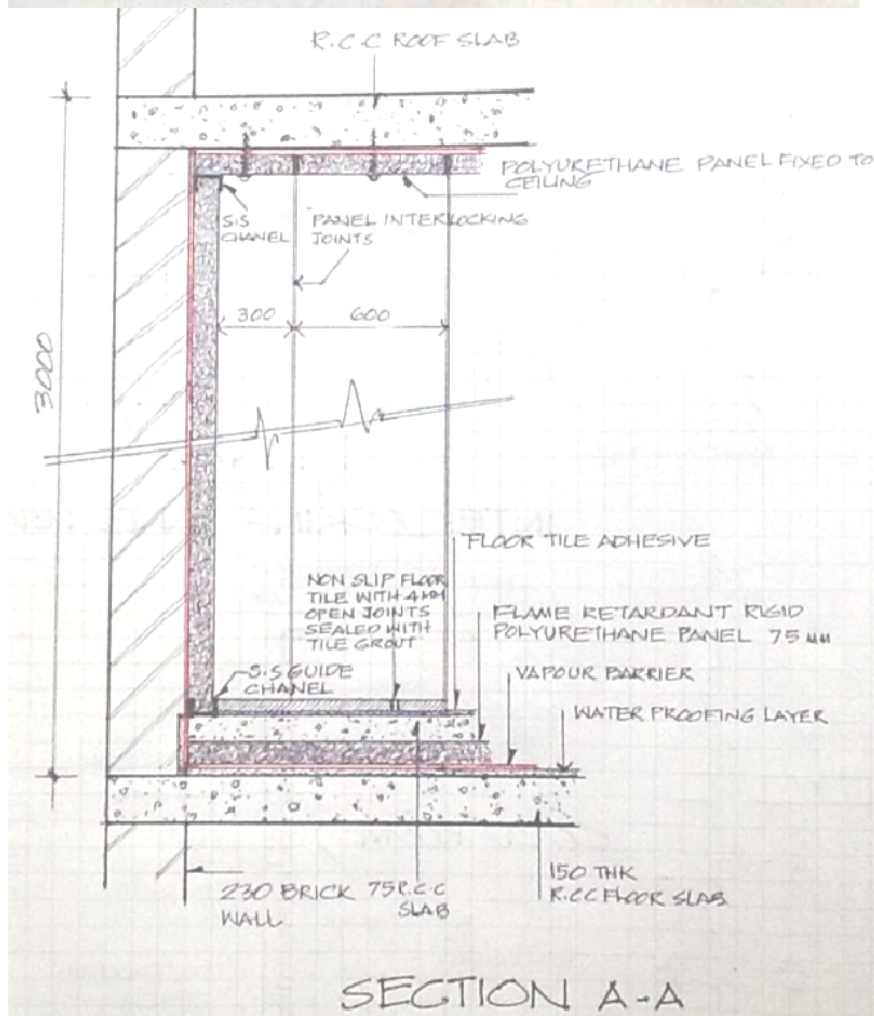
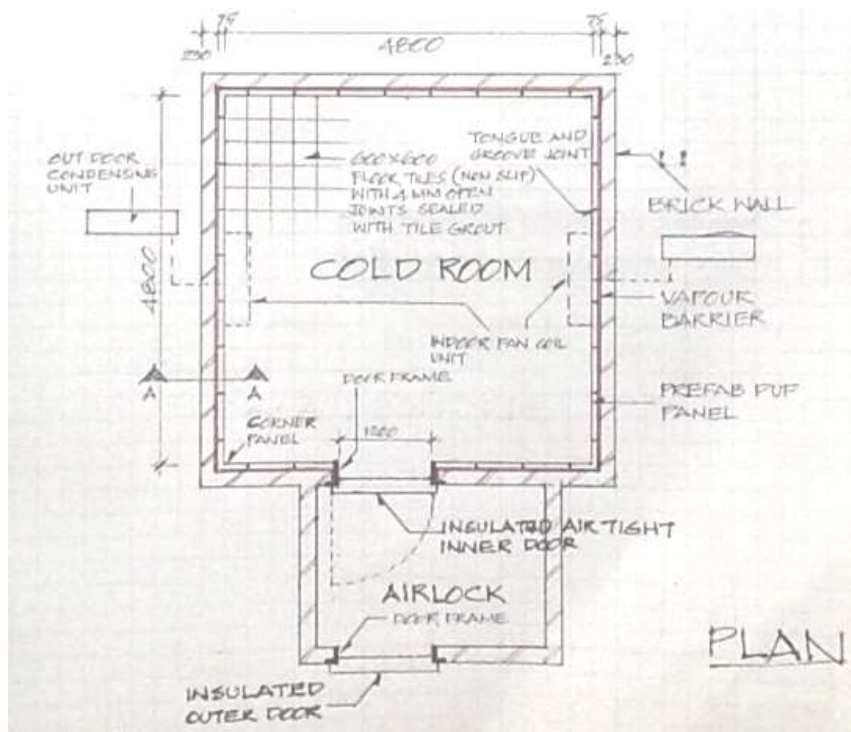


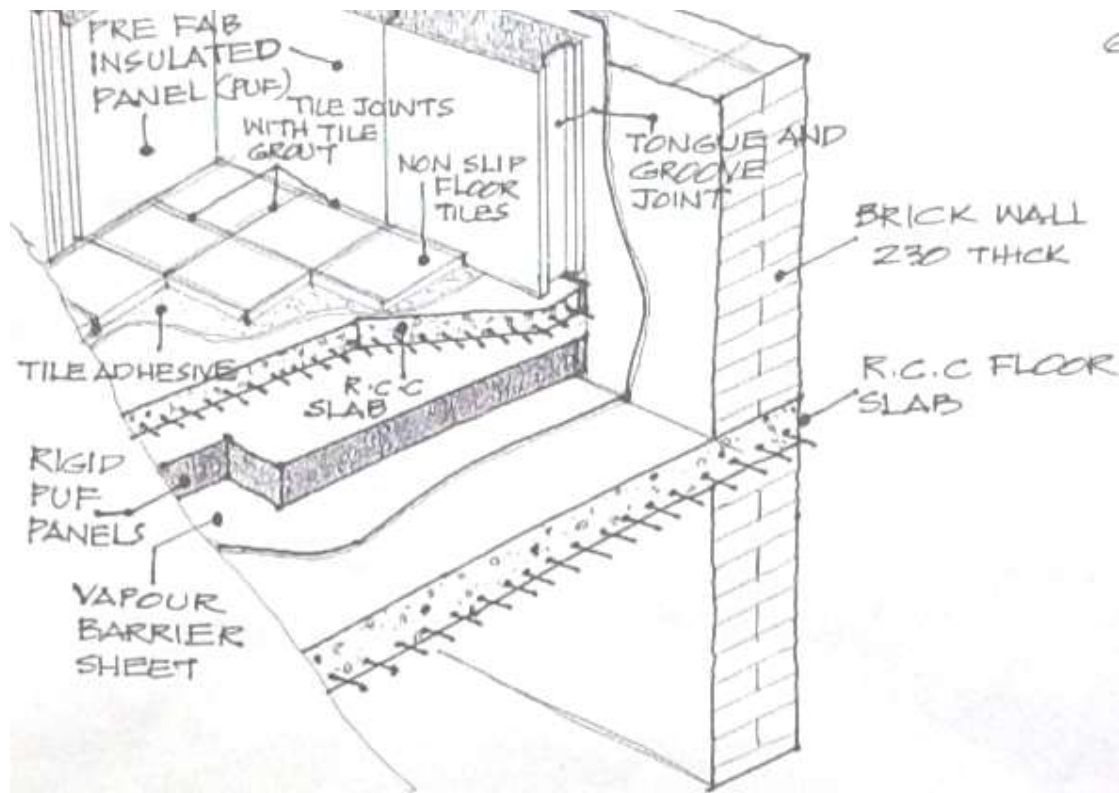
Fig 2. Frost on a duct of a refrigerating unit in a cold store

DESIRED Environmental conditions

Commodity	Temperature (oC)	Relative Humidity (%)
Apple	-1 - 3	90 - 98
Apricots	-0.5 - 0	90 - 95
Avocado	7 - 13	85 - 90
Asparagus	0 - 2	95 - 97
Beans, green	4 - 7	90 - 95
Beet root	0 - 2	95 - 97
Broccoli	0 - 2	90 - 95
Black berry	-0.5 - 0	95 - 97
Cabbage	0 - 2	90 - 95
Carrots	0 - 2	90 - 95
Cauliflower	0 - 2	90 - 95
Cherries	0.5 - 0	90 - 95
Cucumber	7 - 10	90 - 95
Brinjal	0 - 2	90 - 95
Grapes	-1 - 1	85 - 90
Lemons	4 - 15	86 - 88
Lettuce	0 - 1	95 - 98
Lime	3 - 10	85 - 90
Mango	11 - 18	85 - 90
Melon water	2 - 4	85 - 90
Orange	0 - 10	85 - 90
Peach	-1 - 1	88 - 92
Potato	1.5 - 4	90 - 94







COLD ROOM: A ROOM IN WHICH A LOW TEMPERATURE IS MAINTAINED TO CHILL OR FREEZE FOOD STUFFS.

ACOUSTICS

Science that deals with study of all mechanical waves - Acoustics

Scientist who works in the field of acoustics – Acoustician.

Someone working in the field of acoustics technology – Acoustical Engineer.

Word “Acoustic” – Derived from Greek Word (akoustikos) – meaning - of or for hearing, ready to hear.

The study of acoustics revolves around the generation, propagation and reception of mechanical waves and vibrations.

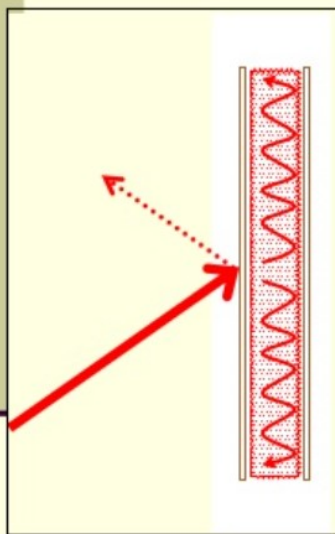
SOUND INSULATION

Sound proofing affects sound in two different ways

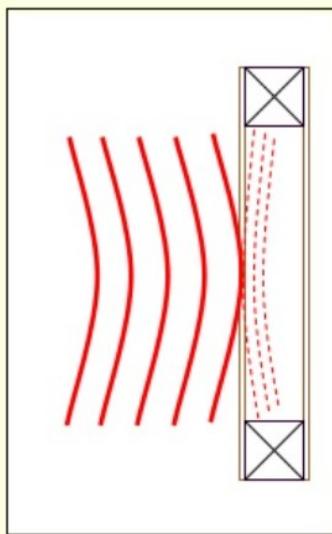
- Noise reduction
- Noise absorption

Sound insulation is any means reducing the intensity of sound w.r.t. a specified source and receptor.

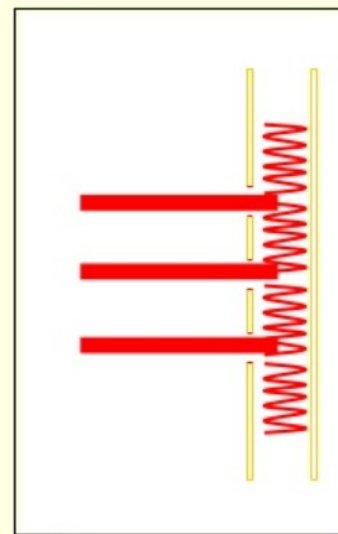
METHODS of ABSORPTION



Frictional



Flexural



Resonating

ACOUSTICAL MATERIALS

General Classifications:

- Porous Materials
- Panel or Membrane Absorbers
- Cavity (Helmholtz) Resonators

POROUS MATERIALS



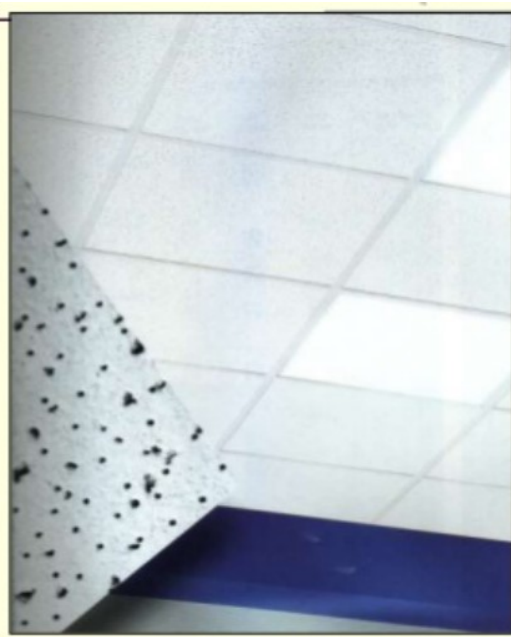
Categories of Commercial Materials:

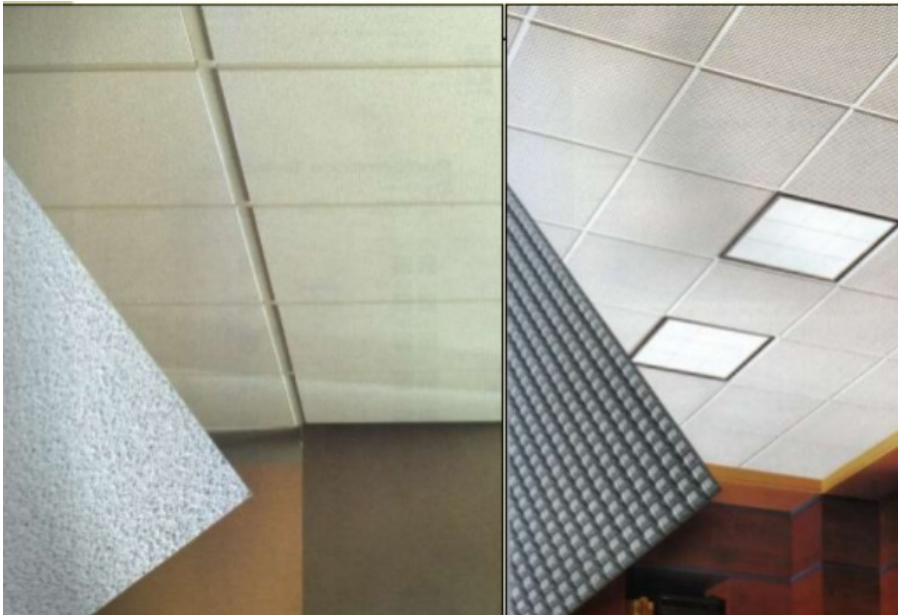
● Pre-fabricated Acoustical Units

Various types of perforated, fissured, or textured materials constitute typical units in this group

Commonly used materials include:

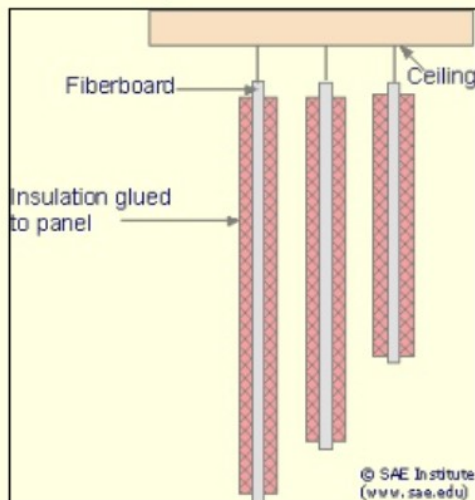
- Acoustical Boards
- Acoustic Hangers
- Geocoustic Tiles
- Diffusers





ACOUSTIC HANGERS

Acoustic Hangers or baffles- a system of fiber-board panels that are wrapped with insulation and are hung freely using wire or rope.



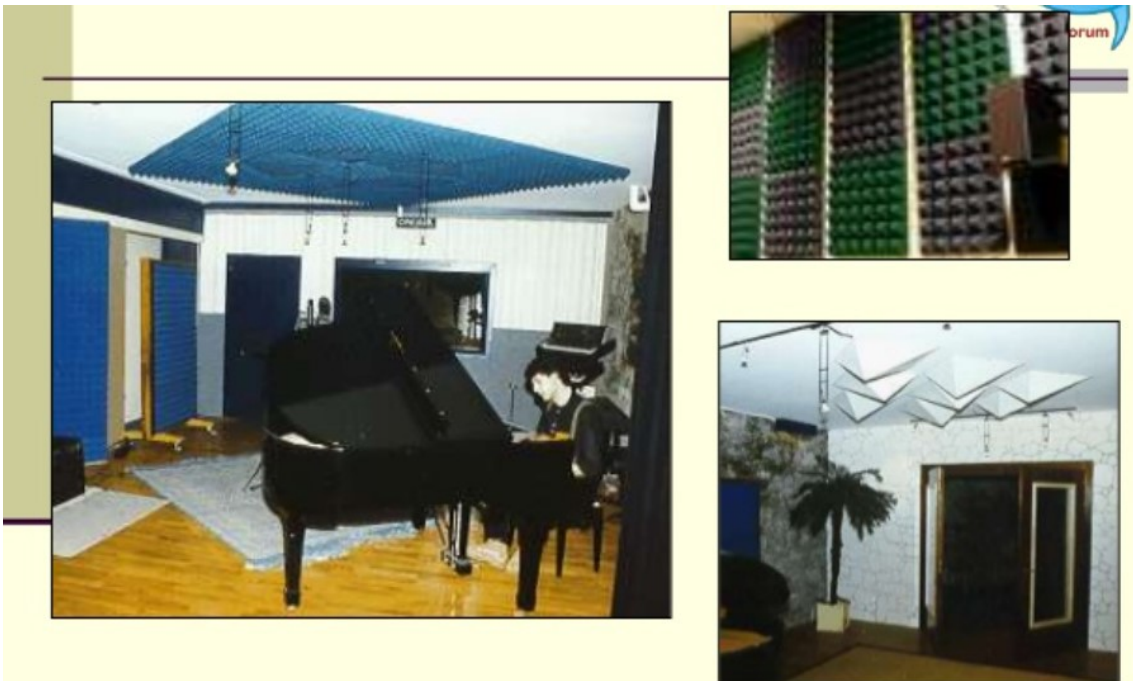
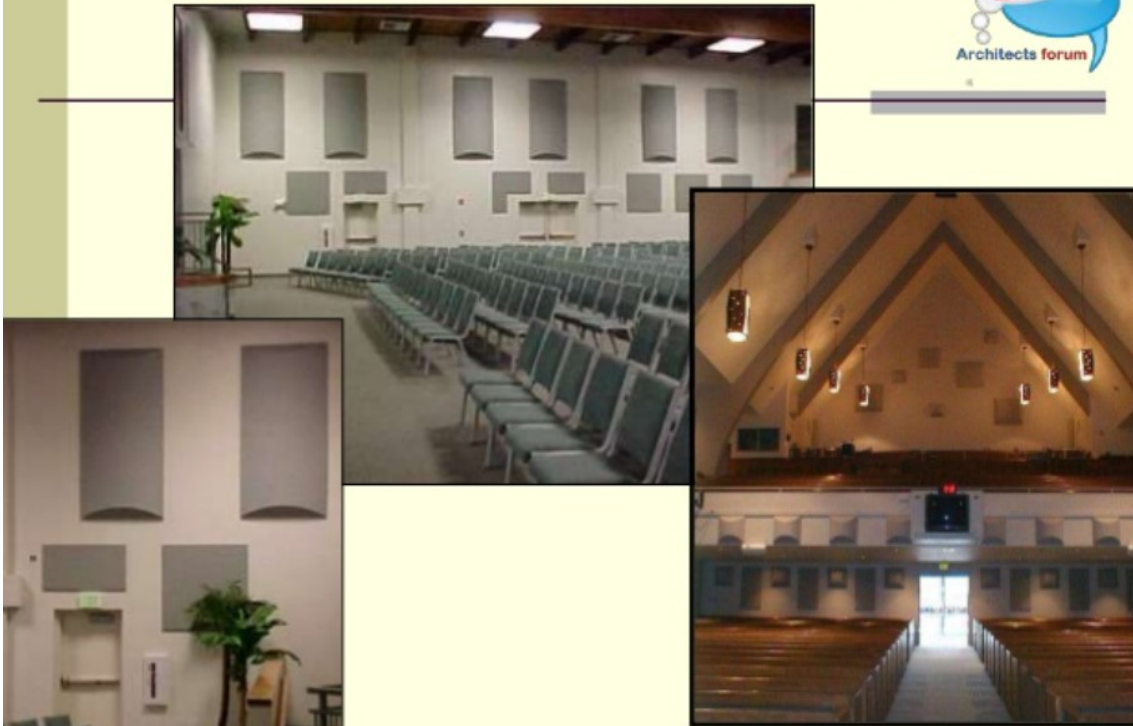
Sample of Acoustic Hangers



Geocoustic Tiles- special prefabricated units for random application on walls and ceilings.



GEOCOUSTIC TILES and PANELS



Acoustical Terms



- **Sound:** a vibration or wave motion that can be heard, reaches the ear through air, the air vibrates back and forth in tiny molecular motions of high and low pressure
- **Decibel:** the unit of measurement used to indicate the loudness or intensity of sound; comparable to the "degree" as a measurement of heat or cold
- **Reverberation Sounds:** airborne sounds which continue after the actual source has ceased, caused by reflections from floors, walls and ceilings
- **Frequency:** rate at which sound energized air molecules vibrate
- **Impact Sounds:** sounds that are carried through the building by the vibrations of the structural materials themselves
- **Masking Sounds:** normal sounds within habitable rooms which tend to "mask" some of the external sounds entering the room

Acoustical Terms



- **Decibels Reduction:** expression used to indicate the sound insulating properties of a wall or floor panel
- **Sound Transmission Loss:** STL, the number of decibels which sound loses when transmitted through a wall or floor
- **Sound Absorption:** capacity of a material or object to reduce sound waves by absorbing them, these sounds are otherwise reflected and cause excessive reverberation and build up of intensity within that area
- **Noise Reduction Coefficient:** NRC, the sound absorption of acoustical materials is expressed as the average percentage absorption at the four frequencies which are representative of most household noises, these frequencies are 250, 500, 1000, and 2000 cycles/second
- **Sound Transmission Class:** STC, single number which represents the minimum performance of a wall or floor at all frequencies, the higher the STC number, the more efficient the wall or floor will be in reducing sound transmission.

NRC : Noise Reduction Coefficient



The Noise Reduction Coefficient (NRC) is a scalar representation of the amount of sound energy absorbed upon striking a particular surface. An NRC of 0 indicates perfect reflection; an NRC of 1 indicates perfect absorption. In particular, it is the average of four sound absorption coefficients of the particular surface at frequencies of 250 Hz, 500 Hz, 1000 Hz, and 2000 Hz. These frequencies encompass the fundamental frequencies and first few overtones of typical human speech, and, therefore, the NRC provides a decent and simple quantification of how well the particular surface will absorb the human voice. A more broad frequency range should be considered for applications such as music or controlling mechanical noise.

Specifications for materials used in sound absorption commonly include an NRC for simplicity, in addition to more detailed frequency vs amplitude charts.

STC – Sound Transmission Class

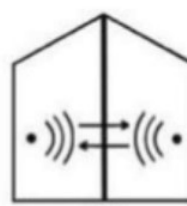


Sound Transmission Class (STC) is an integer rating of how well a building partition attenuates airborne sound. In the USA, it is widely used to rate interior partitions, ceilings/floors, doors, windows and exterior wall configurations

The STC number is derived from sound attenuation values tested at sixteen standard frequencies from 125 Hz to 4000 Hz. These transmission-loss values are then plotted on a sound pressure level graph and the resulting curve is compared to a standard reference contour.



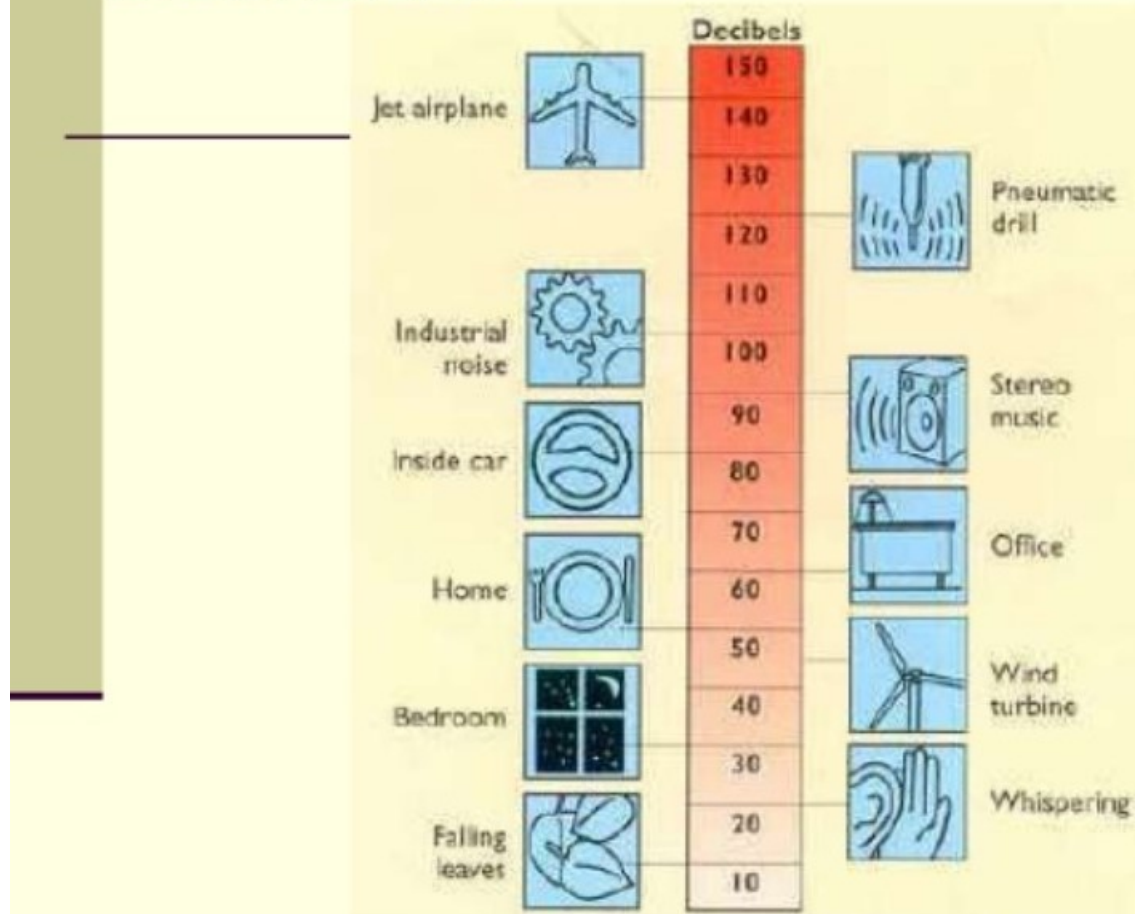
NRC



STC

Build-up of noise within a space Sound transmission between spaces

DECIBELS



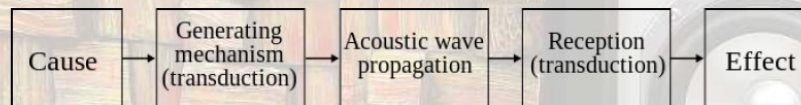
ACOSTICAL MATERIALS

ACOUSTICS

- **Acoustics** is the interdisciplinary science that deals with the study of all mechanical waves in gases, liquids, and solids including vibration, sound, ultrasound and infrasound. A scientist who works in the field of acoustics is an **acoustician** while someone working in the field of acoustics technology may be called an acoustical engineer. The application of acoustics is present in almost all aspects of modern society with the most obvious being the audio and noise control industries.

•The word "acoustic" is derived from the Greek word ἀκουστικός (*akoustikos*), meaning "of or for hearing, ready to hear" and that from ἀκουστός (*akoustos*), "heard, audible", which in turn derives from the verb ἀκούω (*akouo*), "I hear".

The study of acoustics revolves around the generation, propagation and reception of mechanical waves and vibrations.

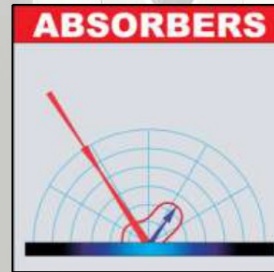


TYPES OF MATERIALS

- SOUND ABSORBERS
- SOUND DIFFUSERS
- NOISE BARRIERS
- SOUND REFLECTORS

SOUND ABSORBERS

- These sound absorbing acoustical panels and soundproofing materials are used to eliminate sound reflections to improve speech intelligibility, reduce standing waves and prevent comb filtering.
- Typical materials are open cell polyurethane foam, cellular melamine, fiberglass, fluffy fabrics and other porous materials. A wide variety of materials can be applied to walls and ceilings depending on your application and environment.
- These materials vary in thickness and in shape to achieve different absorption ratings depending on the specific sound requirements.



TYPES –

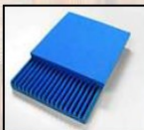
- ☐ Acoustical foam panels
- ☐ White paintable acoustical wall panels
- ☐ Fabric wrapped panels
- ☐ Acoustical wall coverings
- ☐ Ceiling tiles
- ☐ Baffles and banners for ceiling
- ☐ Fibre glass blankets and roll

☐ ACOUSTICAL FOAM PANELS

- These acoustical foam sound absorbers are used in a wide variety of applications ranging from Recording and Broadcast Studios to Commercial and Industrial Facilities. Available in Polyurethane or in a [Class 1 Fire Rated foam](#). These products can be applied directly to walls, hung as baffles or used as freestanding absorbers.



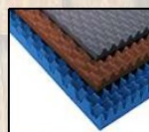
STACKABLE FOAM



CUTTING WEDGE

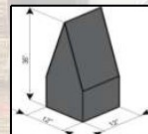
Installs to create seamless absorptive walls, and enhance imaging by reducing unwanted reflections. Available in 1'x1' or 2'x4' sheets.

Design enables you to increase thickness quickly by nesting layers



STANDARD POLYURETHANE FOAM PATTERNS

Standard patterns include wedge, pyramid, max wedge for low frequency absorption, ceiling baffles, bermuda triangle traps for corners, sounds cylinders free standing absorbers



ANECHOIC WEDGE

Anechoic wedges are ideal for controlling low frequency sound to create a room that is perceptually devoid of sound.

Absorbers are lightweight open cell foams used when a Class 1 fire rated foam is required. Standard patterns include Wedge, Pyramid, Max Wedge, Ceiling Baffles and more. These can easily mount to walls or ceilings.

FIRE RATED FOAM

☐ WHITE PAINTABLE PANELS

- It is a white acoustical wall panel with a soft textured appearance. The two foot by one foot dimension provides installers flexibility to mount acoustical panels around existing objects. In addition to reducing echo and reverberation, these acoustical panels are used to create unique designs and patterns. The glass fiber core is faced with a paintable covering. This allows you to match or complement existing wall colors by applying a light coat of flat or matte spray paint. To customize the look even further, many local printing companies now have the capability to produce an image directly to the face of these panels.

- ∞ Quick & Easy acoustical solution
- ∞ Soft drywall texture appearance
- ∞ Create unique patterns
- ∞ Panel size allows for flexible mounting options
- ∞ Paintable & Printable finish



Construction: 1" Fiberglass 6 PCF acoustical core + molded fiberboard + paintable facing. Resin hardened square edges. Paintable finish covers face and exposed edges.

Class A rating per ASTM E 84

Panel Size: 2' x 1' (24 inches by 12 inches)

Thickness: 1-1/8"

Quantity per box: 10 panels

Sustainability

This product bears the Green Cross label for recycled content. The acoustical substrate is certified on average to contain at least 35% recycled glass, with 9% post-consumer and 26% pre-consumer content.

Mounting

Installs using standard impaling clip method. (adhesive by others) Other mounting options shown below.

☐ MOUNT IN CORNERS USING CORNER CLIPS.

☐ MOUNT ON TWO INCH STAND OFF CLIPS

☐ FABRIC WRAPPED PANELS

- Acoustical sound panels utilize 6-7 PCF glass fiber material for maximum absorption. Available as [wall panels](#), [ceiling tiles](#), [hanging baffles](#), [acoustical clouds](#) and [bass traps](#), with more than 50 standard colors to choose from, these materials will look as good as they sound. The standard sizes and configurations best maximize raw materials, however, many of these products can be customized to meet specific requirements should you need material sized to fit or other finishes or coverings.



WALL PANELS

- Used to reduce echo and reverberation in applications, small and large. These panels are manufactured from a rigid high density (6-7 PCF) glass fiber acoustical board and covered with an acoustically transparent fabric.



CEILING CLOUDS

- Ceiling clouds reduce reflected sound in areas such as theaters, restaurants, arenas, shopping malls, convention centers, recording and broadcast rooms, or anywhere absorption is required.



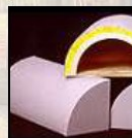
CEILING TILES

- Ceiling Tiles are an excellent choice for many ceiling grid applications requiring high absorption.



CEILING BAFFLES

- All surface faces and edges of the glass fiber core are wrapped in fabric to match or accentuate room décor. Ceiling Baffles absorb sound on all sides and edges.



BROADBAND ABSORBER

- Sculptured sound absorbing modular units used for walls, as corner traps, bass traps and ceiling applications. Available in half-rounds or quarter-rounds.

❑ WALL COVERINGS

- Acoustical wall fabric is a dimensional fabric that offers excellent acoustical properties, unmatched fade resistance, and a fire/smoke retardant class A rating. Sound channels is resistant to moisture, mildew, rot, bacteria, and is non-allergenic. Produced with no voc's (volatile organic compounds), ods's (ozone depleting substances), heavy metals or formaldehyde, it's the perfect acoustic fabric for offices, classrooms, conference centers or any area where speech intelligibility is a critical factor.



Features:

- Lightweight Acoustic Fabric
- Easy to install
- Class A
- Passes Corner Burn Test
- Available in Many Colors
- Durable / Abuse Resistant
- Improves Speech Intelligibility



Applications:

- Conference Rooms
- Theaters
- Hospitals
- Municipal
- Office Partitions
- Schools
- Hallways
- and more...

Installation:

- This material is not factory trimmed. It is necessary for the installer to cut a straight vertical edge
- Following the ribbed pattern. All edges must be butt joined. Do not overcut edges. Cut material to
- Desired lengths, allowing for top and bottom trimming. Wall carpet should be hung
- Straight up. Do not alternately reverse strips.
- Apply a premixed heavy duty adhesive directly to the wall, allowing it to dry to its maximum tackability
- Without it being overly dry. (Important!!! Adhesives are ready mixed. Do not dilute)
- Adhesive and do not apply adhesive to the back of the wall covering).
- Please be sure to follow instructions as provided by the adhesive manufacturer.

❑ CEILING TILES

- Cloudscape® Ceiling Tiles absorb noise and block sound transmission. These ceiling tiles are designed to fit into existing 2' x 2' suspended drop tile ceiling grid systems. They may also retrofit in a 2' x 4' ceiling grid by installing cross tees. Cloudscape® ceiling tiles may also be ordered as a full 24" x 24" size, un-backed for adhesive mounting directly to walls or ceilings.
- Ordinary ceilings take on new levels of visual excitement with these sculptured tiles. They are available in five different patterns plus a non-patterned look to enable you to "mix and match" for your own designs.

Available Sizes:

24" x 24" (nominal)

Specify grid when ordering:
9/16 or 15/16



□ BAFFLES AND BANNERS

- Baffles and Banners are designed to solve acoustical problems economically in any large cubic volume space such as arenas, gymnasiums, theaters, restaurants, and auditoriums. Reverberation times that range from 4 to 9 seconds can be reduced to 1/2 to 2 seconds. Speech intelligibility is greatly improved and sound intensity levels are reduced simultaneously by 3 to 12 decibels.

BAFFLES:

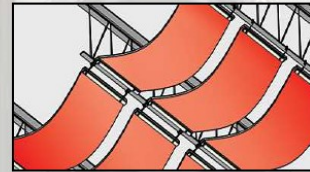
- Baffles are an economical way to reduce sound pressure levels and lower reverberation times in large spaces such as gymnasiums, theaters, restaurants, health and fitness clubs, etc. Reverberation times can be lowered from a RT60 of 4 - 9 seconds down to a RT60 of 0.5 - 2 seconds. Speech intelligibility is greatly improved and sound intensity levels can be simultaneously reduced by 3 to 12 decibels.



- These baffles are easily suspended from existing open truss and pre-engineered suspension systems. They are designed to hang in a vertical fashion, allowing free flow of air and integrate exceptionally well with existing sprinklers, lighting and HVAC systems.

BANNERS:

- Speech intelligibility is greatly improved and sound intensity levels can be simultaneously reduced by 3 to 12 decibels.
- Banners are suspended from ceilings, bar joists or pre-engineered suspension systems. They are designed to hang in a horizontal or in a catenary fashion using edge stiffeners or deck mounted flat with washer plates



□ SOUND DIFFUSERS

- These devices reduce the intensity of sound by scattering it over an expanded area, rather than eliminating the sound reflections as an absorber would. Traditional spatial diffusers, such as the polycylindrical (barrel) shapes also double as low frequency traps. Temporal diffusers, such as binary arrays and quadratics, scatter sound in a manner similar to diffraction of light, where the timing of reflections from an uneven surface of varying depths causes interference which spreads the sound.

QUADRA PYRAMID

DIFFUSER generates a uniform polar response over a broad frequency range using a pre-rotated pyramidal pattern to create 16 angles of reflection.



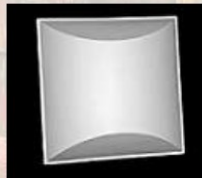
PYRAMIDAL DIFFUSER

- This traditional industry workhorse disperses sound uniformly over a broad frequency range. A quick solution to reduce flutter echo.



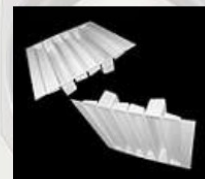
DOUBLE DUTY DIFFUSER

- These Polycylindrical Diffusers do twice the work. They scatter sound and function as a bass trap.



QUADRATIC DIFFUSER

A true quadratic residue diffuser designed for uniform broadband scattering and reducing High-Q reflections.



NOISE BARRIERS

These materials range from dense materials to block the transmission of airborne sound to devices and compounds used to isolate structures from one another and reduce impact noise.

BARRIERS

• Sound barrier materials are used to reduce the transmission of airborne sound. The BlockAid® series of products include the standard one pound per square foot non reinforced barrier, transparent material when observation or supervision is required, reinforced vinyl to create a hanging barrier partition.



COMPOSITES

• Composite materials are manufactured from combinations of various materials from open and closed celled foams to quilted fiberglass and barrier. These products are used to block and absorb sound for machine enclosures as well as blocking airborne sound and impact noise. Some of these products include Composite Foams, StratiQuilt Blankets and Floor Underlayment.



VIBRATION CONTROL

• Vibration control products are used to absorb vibration energy and prevent structural noise transmission. These include vibration damping compounds and vibration pads, isolation hangers, and resilient clips. They improve sound transmission loss.

FABRICS

- Acoustical fabrics are typically used to either absorb sound or as a cover for acoustical panels. Some fabrics can also be used as a speaker grill cloth or as a finish on other types of materials.

SOUND CHANNELS WALL FABRICS

• Acoustical wall fabric is a dimensional fabric that offers excellent acoustical properties, unmatched fade resistance, and a fire/smoke retardant class A rating. Sound channels® is resistant to moisture, mildew, rot, bacteria, and is non-allergenic. Produced with no voc's (volatile organic compounds), ods's (ozone depleting substances), heavy metals or formaldehyde, it's the perfect acoustic fabric for offices, classrooms, conference centers or any area where speech intelligibility is a critical factor.



GUILFORD OF MAINE

• Guilford of Maine® Fabric is an acoustically transparent fabric used to cover many of our products including acoustical wall panels, diffusers, and corner traps. Fabric is also sold separately as speaker grill cloth, wall covering and for other field applications.



LOCATION

LOCATION: N.c.p.a. Marg, South Mumbai.
FOUNDER: DR .Jamshed J Bhabha..
ARCHITECT : Philip Johnson and Patel Batliwala associates
YEAR : 1959
CAPACITY: 1109 person



SITE

- The NCPA complex occupies an area of about 3200m² at Nariman Point on land reclaimed from the sea.
- The site can be accessed through 6 gates , the side is divided into 6 major blocks.
- Apart from these , parking spaces, A.c. plants , staff quarters and electric substations occupy the site.

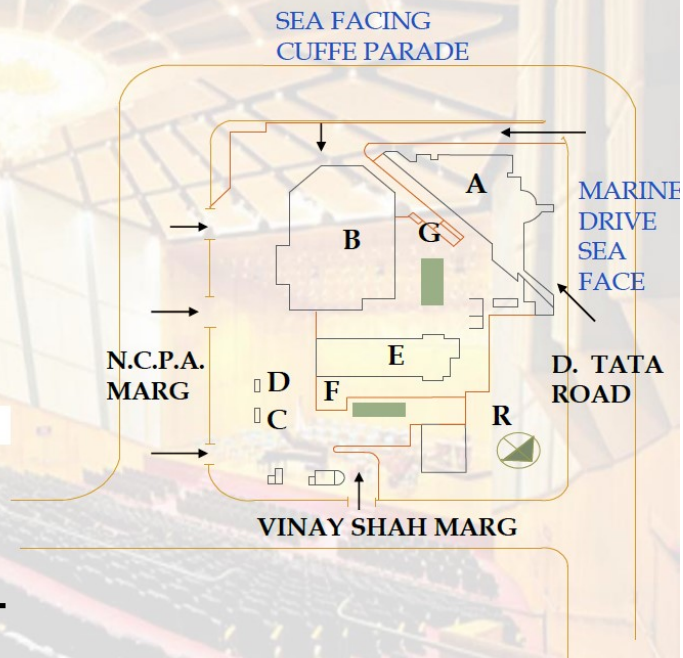


NEIGHBOURHOOD

- This site is located in the commercial area.
- NCPA is surrounded by hotel, malls, offices, etc.
- Oberoi hotel, Nariman hotel, are some nearest landmarks.
- Heritage building of Churchgate station is 1 kms away.
- Other important Landmark is the Mantralaya.

SITE LAYOUT

- A – Tata theatre
 B – Jamshed Bhabha theatre
 C – Main administrative office
 D – Teaching and research block (libraries)
 E – Experimental theatre
 F – Godrej dance academy theatre
 G – Open air plaza
 R – Residences (staff, guest rooms and NCPA apartments)
 - Entry gates



NATIONAL CENTRE FOR PERFORMING ARTS, MUMBAI

DR JAMSHED J BHABHA THEATRE

- SEATING CAPACITY 1109.
- THREE CONFERENCE ROOMS OF 100- 140 SEATING CAPACITY FOR EACH.
- WESTERN MUSIC, FASHION SHOWS, OPERAS ARE SOME OF THE PROGRAMS HELD IN THIS THEATRE.
- CANTEEN, MUSIC LIBRARY, GENERAL LIBRARY ARE THE OTHER FACILITIES PROVIDED IN THIS THEATRE.



TATA THEATRE

- SEATING CAPACITY OF 1010 PERSONS.
- FOYER CAPACITY OF 500 – 600 PERSONS.
- SEA VIEW ROOM CAPACITY OF 50 PERSONS.
- FIVE BLOCKS AND SIX ENTRY SEATINGS.
- ELEVATORS FOR HANDICAPPED.
- ROTATING STAGE WHICH CAN BE USED EVEN THE REAR SIDE.

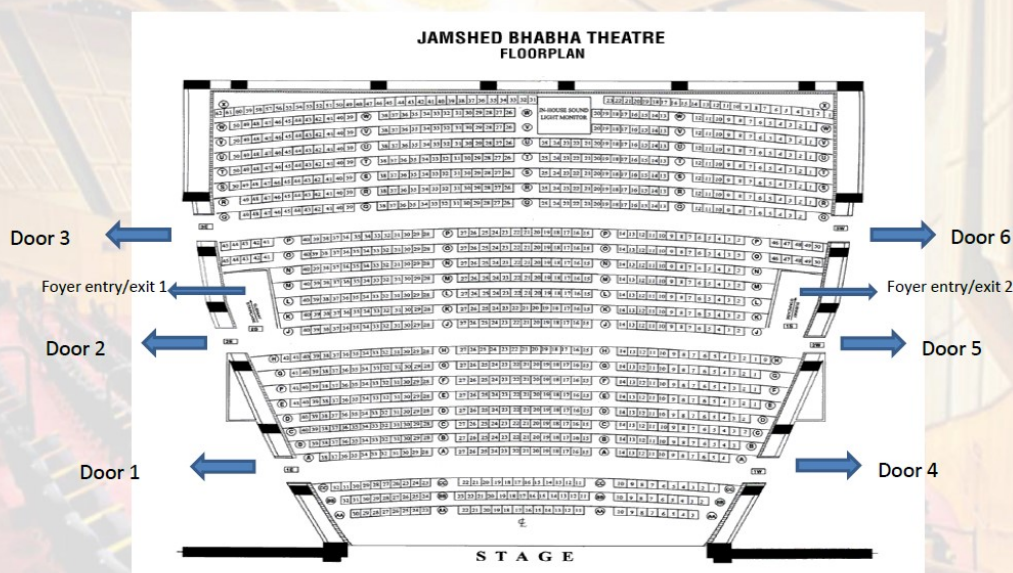


EXPERIMENTAL THEATRE

- CAPACITY OF 114 PERSONS.
- SCREENING, HINDUSTANI VOCAL, DANCE ARE THE PROGRAMS HELD IN THIS THEATRE.
- 3 GREEN ROOMS, 1 ON GROUND FLOOR & 2 ON 1st FLOOR.
- RECORDING STUDIO & MUSIC LIBRARY ARE THE FEATURES OF THIS THEATRE.

Public Entries/Exits

- Total No. of Public Entries/Exit = 8
- 6 on the side aisles (3 on each side) and 2 coming from the foyer (on aisle passages)



DETAILS OF DOORS

- **Dimensions:** Size- 2.4m (wide) x 2.1m (height)
Thickness- 7inch (17.65cm) thick
- **Material:** 2cm leather and thick foam cushioning from the out side to prevent outside noise into the theatre and 15cm dense wood inside.



Backstage Entries/Exits Doors

- Total No. of Backstage Entries/Exits = 4
- 1 entry from lobby inside (for artists/crew members)
- **Dimensions:** Size- 2.4m (wide) x 2.1m (height)
Thickness- 3inch (7.28cm) thick
- **Material:** 1cm leather and foam cushioning outside and remaining dense wood inside.



Backstage Entries/Exits

3 Entries directly from outside (to load/unload the props and instruments)

- **Dimensions:** Size- 3.0m (wide) x 5.6m (height)
- **Types:** 2 Wooden door and other 1 Rolling Shutter



Stage Entries/Exits

- Total No. of Stage Entries/Exits = 6

Types and Dimensions:

- 4 Single Doors- 1.2m (wide) x 2.1m (height)
- 2 Double Doors- 2.4m (wide) x 2.1m (height)
- 3 on each side- 2 Single and 1 Double Door

Material: 2inch thick – 1cm Reflective Wooden Board on Timber frame.

Dimensions: Size- 3.0m (wide) x 5.6m (height)

Types: 1 Wooden door and other 2 Rolling Shutters



Green Rooms

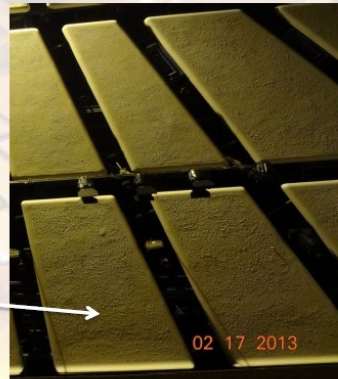
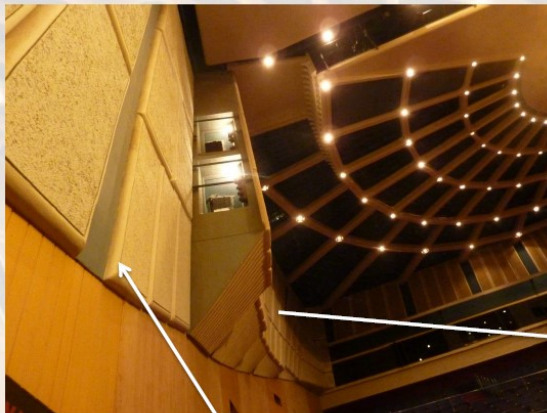
- Total No. of Green Rooms = 10
- No. of Floors = G+2
- 4 Rooms on G; 3 on G+1 and 3 on G+2
- Door Types: Have sound-proof, 3inch thick Door from the backstage for Green Room area.
- The Green Rooms have 2inch thick Wooden doors.



Ramp at entry

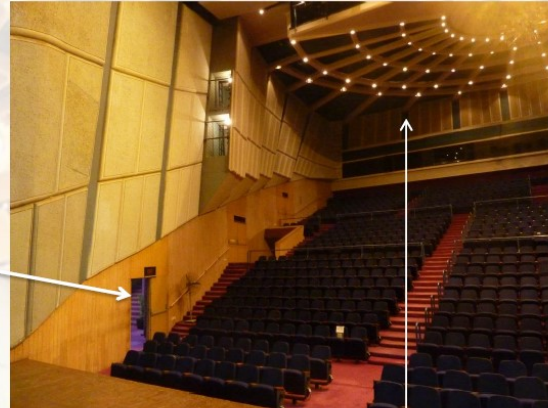
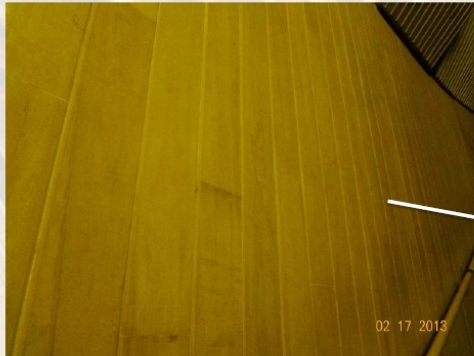


WALLS



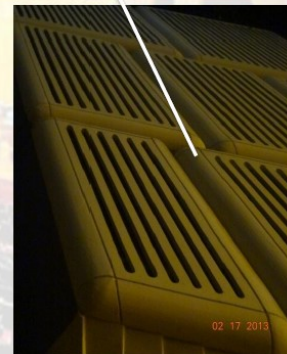
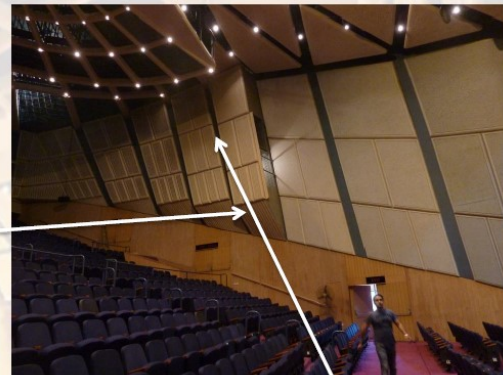
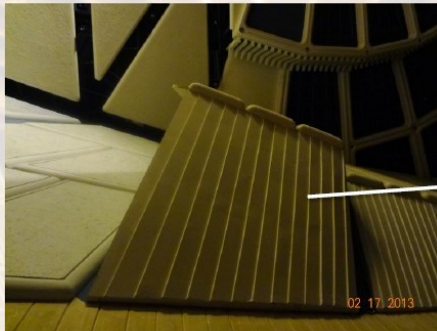
- The panels on the walls around the first three seating rows/the orchestra pit of the auditorium are made of concrete or Plaster of Paris, with a pointed finish plaster.
- Similar types of panels are found to be suspended from the ceiling above the space mentioned before.

WALLS



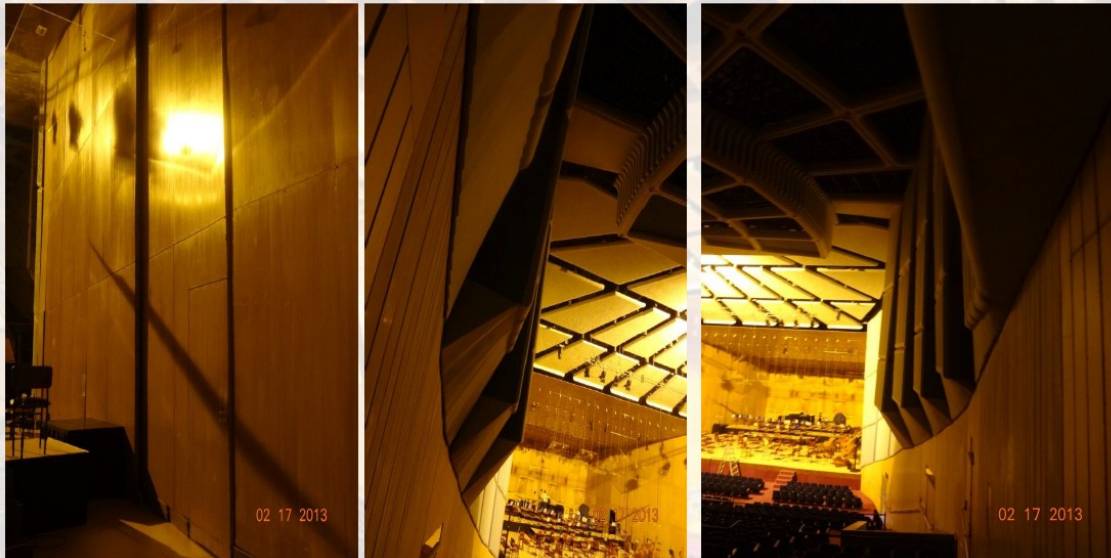
- Marble is used for the panelling of the lower portions of the auditorium.
- Wooden shutters open into electrical ducts in the walls.
- The panels above the control booth at the rear of the auditorium are made of concrete with marble inlays.

WALLS



- There are projections that come out from the side walls of the auditorium. These projections are hollow and may act as resonators.
- They could also be anti focusing surfaces that help in the dispersion of sound.
- These projections are made of concrete or plaster of Paris and have vertical slits on the front faces. They rise all the way up to the ceiling of the auditorium.
- A feature of these groups of projections is that they are arranged in numerical progression, in groups of one, two and three panels, below each other & also groups of two, three and four vertical panels.

WALLS

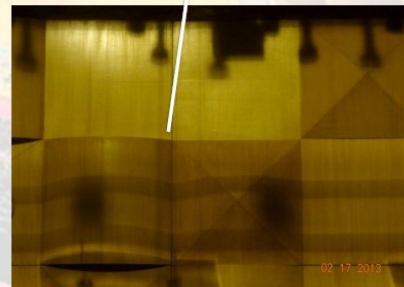


- The wall surfaces of the auditorium are staggered at different angles.
- This is done to avoid the formation of standing waves.
- The panelling of the stage also overlaps.

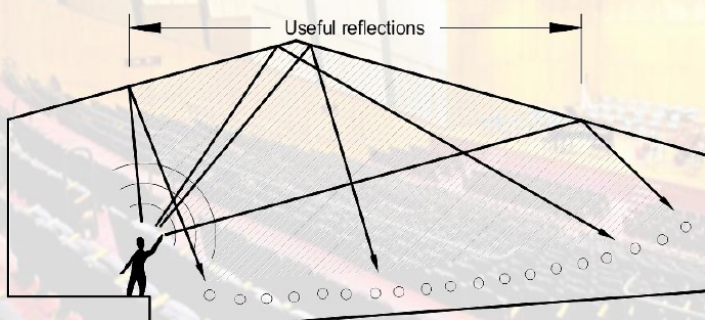
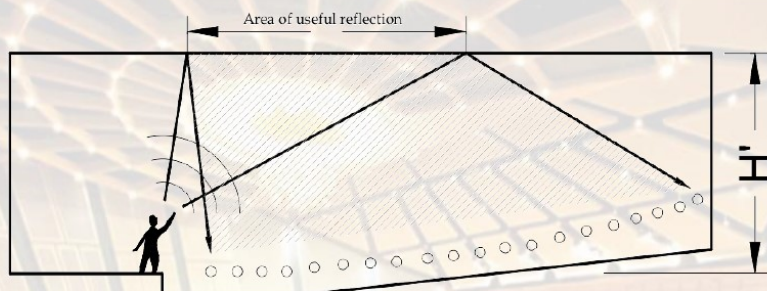
WALLS



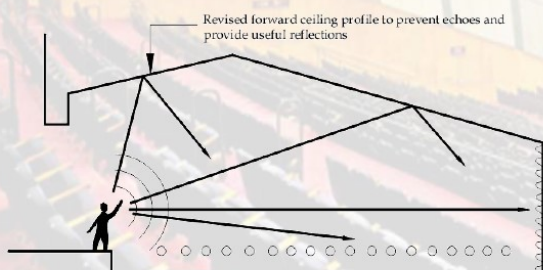
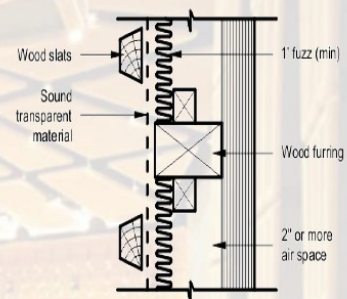
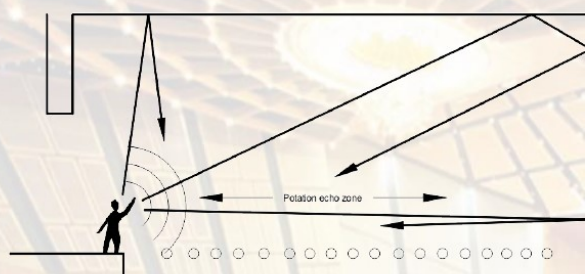
- The rear of the stage has diffusive wooden panels in different shapes.
- This along with the acrylic banners hung on the ceiling help to diffuse and reflect sound appropriately into the auditorium.



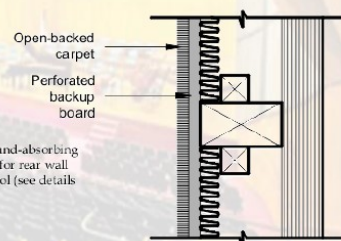
Treatments: for cieling



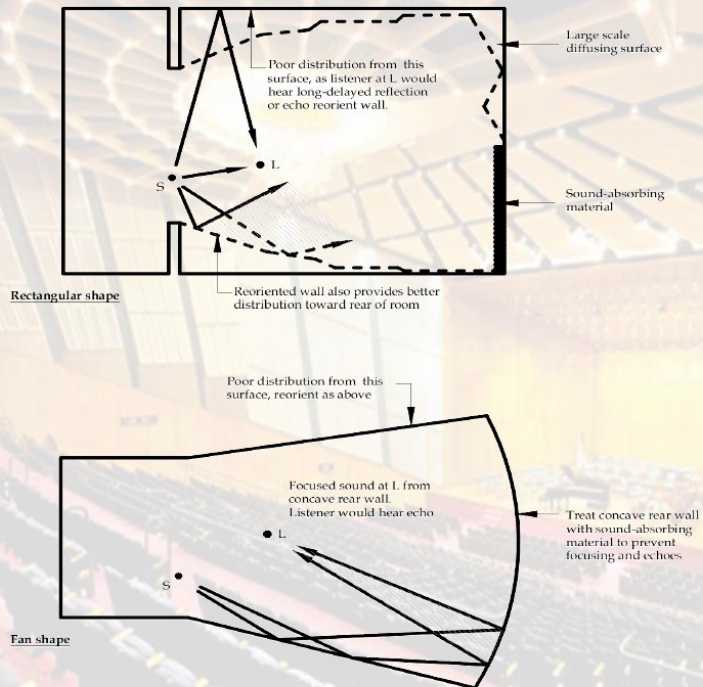
Treatment : to control echo



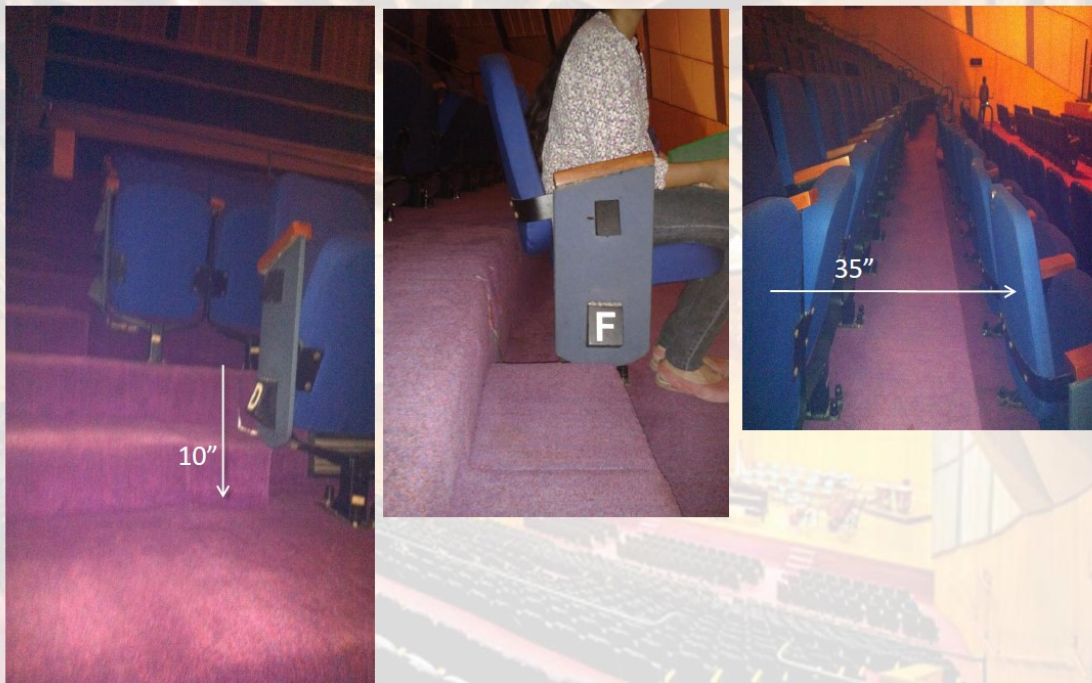
"Deep" sound-absorbing treatment for rear wall echo control (see details below)



Treatment: wall shape



SEATINGS



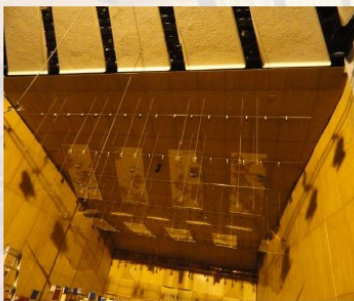
FLOOR



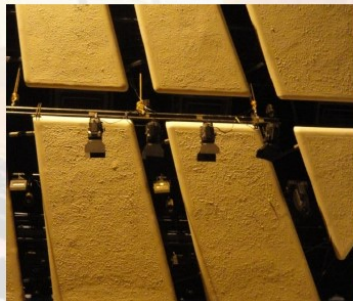
- The material used in Flooring is woollen carpet.
- Woollen carpet is absorptive material
- Carpet is 80% wool and 20% nylon.

LIGHTING FIXTURES

- A good number of lighting fixtures are oriented towards the stage covering all angles possible.
- Other light sources are located on the ceiling of the seating area for the audience.
- These lights are of different types, qualities, intensities, colour etc. for eg. halogen lights, spot lights etc. Depending upon the approximate area to be covered, intensity of light etc. the position of a lighting fixture is fixed.
- These lights can be dimmed or brightened as per requirement.



Lighting fixtures on ceiling



Spot lights



Ceiling with panels

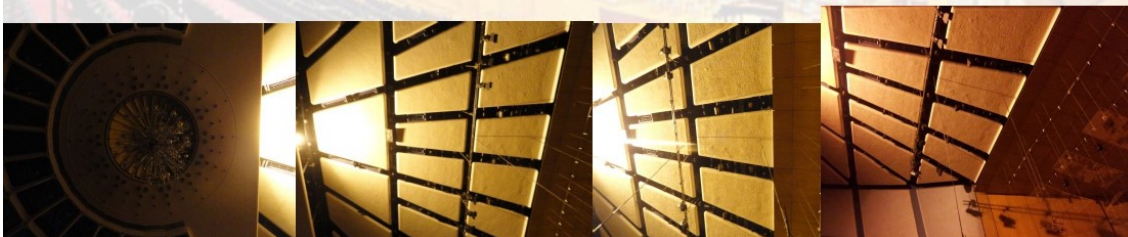


CEILING

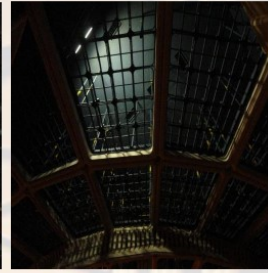
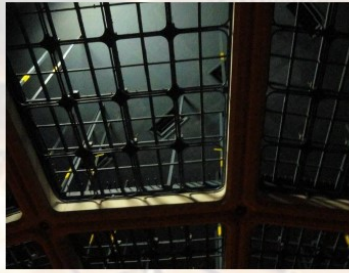
- The ceiling is divided into 3 parts.
- The ceiling in the middle can double up for the extended stage or the audience. It is made up of panels which have hidden lighting fixtures.
- The ceiling of the stage and the adjacent are laid at an angle while the ceiling of the seating area is suspended 2-3M below the actual ceiling surface.
- This ceiling consists of attractive lighting fixtures at the centre which forms the focal point of the auditorium.

View showing the 3 ceilings

Reflected part ceiling plan



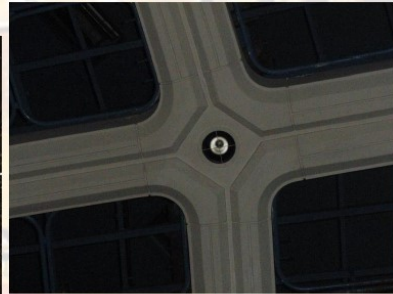
- The remaining grid like ceiling is equipped with centralised air conditioning system and lighting fixtures spread all over covering the entire seating area.
- In between the grid is another framework which holds the false ceiling in place.
- By means of iron members the false ceiling is suspended by 2-3M which may allow a man to repairing the lights etc.



Suspended Ceiling



Grid like false ceiling



Lighting fixture at junction

Lighting (LX)

- Light Bars 6 (Double-barrel 48mm tubular battens)
- Operation Motorised winch (fixed speed)
- Position of first LX bar 4.6m (from the edge of the stage)
- Max. fly height 14m
- Spacing between 350mm adjacent flyset & LX bar
- Maximum loading capacity (SWL) 1000 kg.

Off Stage Lighting Position

- FOH lighting bridge Over row 'G', 11.5m from the edge of stage; at height: 12.5m
- Rear wall lighting bar Over row 'X', 30m from the edge of stage; at height: 4.8m
- Box boom (right) Auditorium right & left walls
- Box boom (left) respectively, in line with row E, 9.5m from the edge of stage; at height 9.5m





SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)

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SCHOOL OF BUILDING AND ENVIRONMENT

DEPARTMENT OF ARCHITECTURE

UNIT – IV–Materials and construction IV– SAR1304

FALSE CEILING

❑ False ceilings are often secondary ceilings that are hung below the main ceiling with the help of suspension cords or struts.

❑ These ceilings are crafted from a wide range of materials such as

POP (plaster of Paris),

gypsum board,

asbestos sheets,

particle board,

aluminium panel,

wood etc.

They are also known as dropped ceiling or suspended ceiling

HISTORY

History of false ceiling started when Dropped ceilings were firstly used in Japan for the purpose of aesthetics in Muromachi period (1337 to 1573) later black friars theatre in London, England, built in 1596, had dropped ceilings to aid acoustics.

On 24th October 1950 Remmen and Bibb designed first fully developed grid system concept.

Modern dropped ceilings were built using interlocking tiles and the only way to provide access for repair or inspection of the area above the tiles was by starting at the edge of the ceiling, or at a specifically designed "key tile", and then removing the tiles one at a time until the desired place of access was reached. Once the repair or inspection was completed, the tiles had to be reinstalled. This process was very time-consuming and expensive. On September 8, 1958 Donald A. Brown of Westlake, Ohio designed *Accessible Suspended Ceiling Construction*. This invention helped suspended ceiling construction in which access is readily obtained at any desired location.

COMPONENTS OF FALSE CEILING

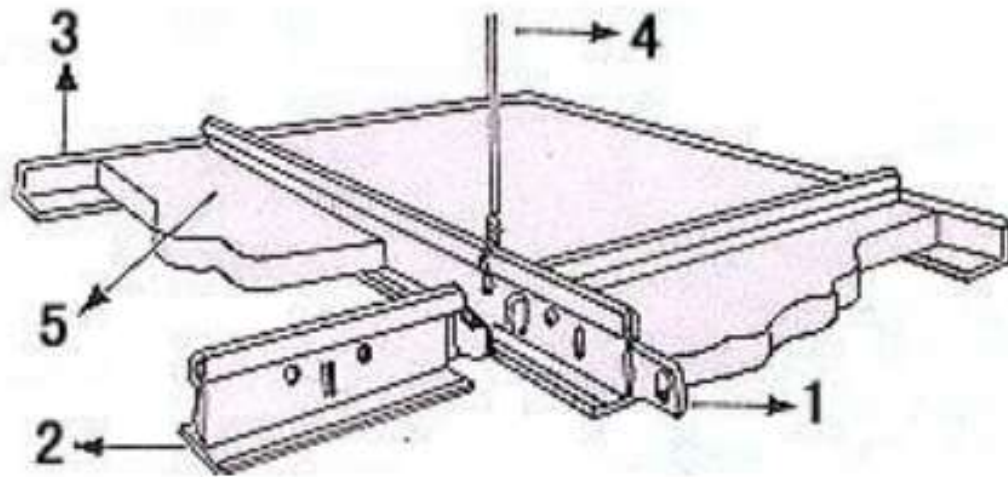
A suspended ceiling system consists of 3 parts:

- Primary Members
- Secondary Members and
- Main Ceiling Material or Tiles (e.g. acoustic boards, cloth etc.)

Suspended ceilings are created using metal grid systems, which are suspended below the ceiling or roof deck using a series of wires. The grid is then filled in with ceiling tiles, which are primarily made from mineral fiber blends. Depending up on the appearance and visibility of the members false ceilings are classified in to two types.

They are :

1. Exposed Grid
2. Concealed grid

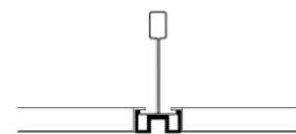
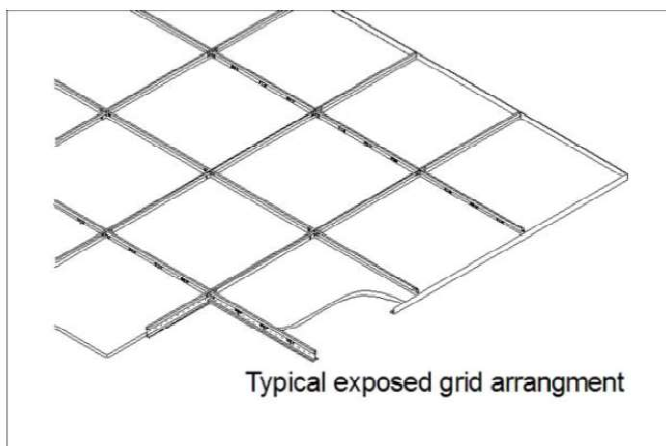


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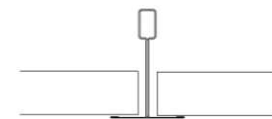
They are :

1. Exposed Grid
2. Concealed grid

EXPOSED GRID SYSTEMS



15mm profiled grid & steel panel
(square edge panels should not be used with 15mm grid)

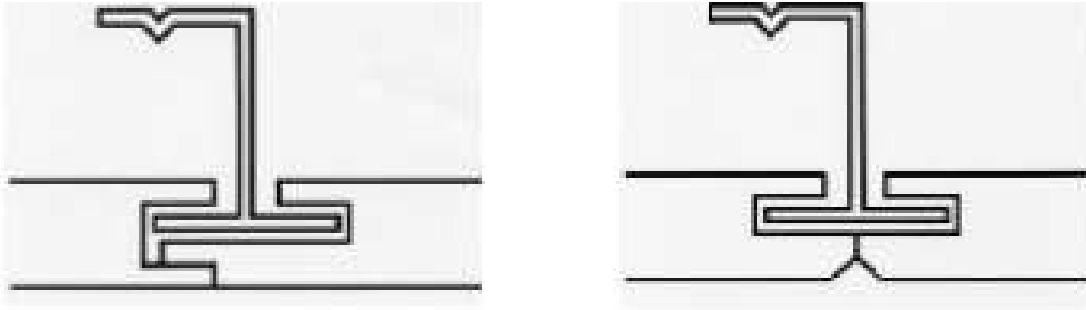


24mm grid & square edge panel

- A system where the grid is visible and into which panels are laid. The grid is finished in colours to harmonise or contrast with the panels is known as exposed grid type ceiling.
- Exposed grid varieties are the most common type of suspended ceiling.

- They consist of long metal strips, called "mains," which are interconnected with shorter metal pieces known as "tees"
- Together, the mains and tees form a grid system, which are then filled with acoustical ceiling tiles.
- Exposed grid suspended ceiling systems can contribute to passive fire protection.
- The system is rapid to install and can provide a high degree of access to the ceiling void.

CONCEALED GRID SYSTEMS



- Concealed grid systems use the acoustical tiles to hide the grid system from view.
- This creates a smooth, clean which is aesthetically pleasing.
- The tile used has a small groove built into it's perimeter, which slides over the mains and tees to cover them.
- Various metal and a few kinds of pop ceilings come under this category
- This type is more expensive than an exposed system.
- This kind of false ceiling system is difficult for maintenance to access areas above the ceiling.

TYPES OF FALSE CEILING

Depending on the place of usage, ambience needed and economy available. The most commonly used false ceiling materials are

- ☐ Gypsum boards
- ☐ Plaster of Paris (POP)

Other materials used are

- ☐ Metal (aluminium, Asbestos)
- ☐ Mineral wool board
- ☐ Poly vinyl chloride (PVC)

- ☐ UPVC
- ☐ Wood
- ☐ Polystyrene
- ☐ Glass
- ☐ Acrylic

GYPSUM BOARD (Gypboard)

Lightweight, flexible and fire and moisture resistant, gypsum is most commonly used for false ceiling. Gypsum board panels are tough, versatile and economical, and are fast replacing other ceiling materials such as POP. Gypsum board can be used while constructing false ceiling. as well as to renovate old ceilings. The material is fire-resistant, waterproof, as well as soundproof, which is why it is the most preferred material for false ceiling.

A gypsum panel could have tapered or square edges. Panels with tapered adage are used for ceiling since the gap between each edge can be filled, to give a smooth surface. Square-edges board can be used. Where visibility of the joints is a requirement. A suspended Gypsum board ceiling can be constructed by nailing Gypsum board panels to each other, or by fixing the panels in a metal grid (usually steel). Generally, gypsum panels of 600 mm×600mm are used.

Gypsum ceiling are popular because:

- ☐ The ‘dry construction’ eliminates the use of extra water while making the ceiling. This also keeps the building clean.
- ☐ Gypsum board is quite flexible. It allows for various shapes and design-such as plain, curved, stepped, coffered, pelmet, drop design, etc.
- ☐ Gypsum board has high impact-resistance and is very strong. It is possible to suspend a load of up to 15 kg from the ceiling without any difficulty.
- ☐ A Gyp board ceiling suspended on a metal grid forms a strong ceiling design.
- ☐ The ceiling can be easily decorated with wallpaper or paint, 24 hours after it is constructed.
- ☐ Glass fibre-reinforced gyp board makes excellent insulation material.
- ☐ Gypsum ceilings are non-resonant which makes then good soundproofing.
- ☐ When exposed to fire, gypsum gives out water, which is converted to steam and helps combat the fire. This is what makes the ceiling fireproof.

Gypsum Board Ceilings : Characteristics

Aesthetics

- **Characteristics:**
- panel has perforations in random pattern and are economical, durable and dimensionally stable.
- pre-painted and coated with special paint which is washable and has anti-mould growth and anti-yellowing properties.
- **Applications :**
- open areas in office spaces
- reception areas
- showrooms

Functional performance

- **Characteristics:**
- ceiling panels has vinyl laminate or PVC film on the face side for a superior maintenance free surface and is available in a granular texture
- **Applications:**
- hospitals
- electronics
- pharmacy companies

Acoustical performance

- **Characteristics:**
- This ceiling panel has square holes in regular pattern and is backed with a special non woven lining.
- This range provides "excellent sound absorption properties with insulation mat.
- **Applications :**
- Multiplexes & cinema halls
- auditoriums
- sound recording studios
- educational institutes

Three Range based on :

METAL CEILING

Metals ceilings are suitable for a large Range of applications. The false ceiling is constructed with metal panels. Which are coupled with insulating materials to make them soundproof? They are ideal for concealing ducts and wiring, since they can be easily installed and maintained.

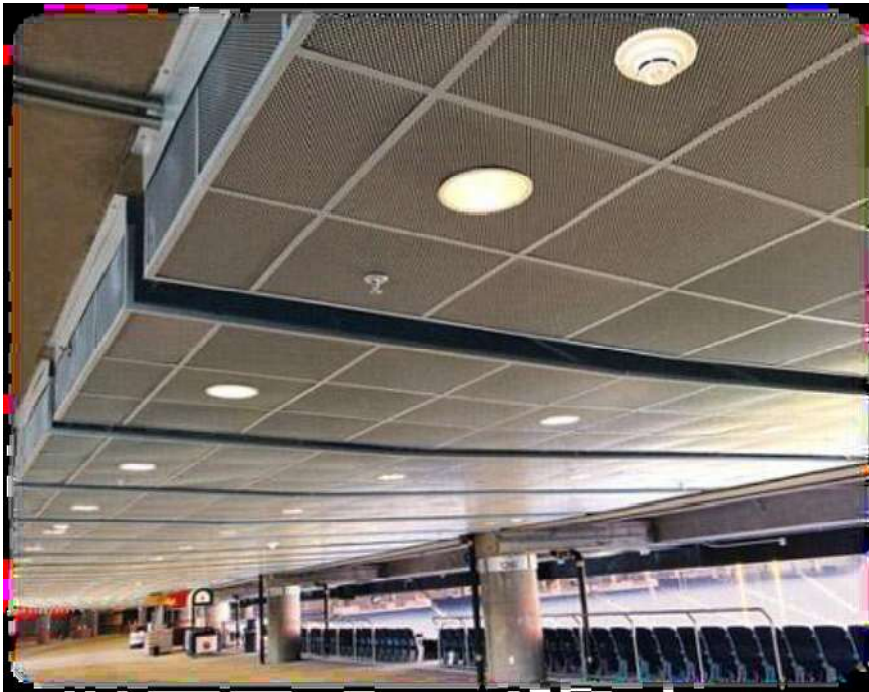
Aluminum or steel panels, 600mm×600mm in size, are generally used. The panels can be laid on a visible steel grid with T-sections or cross-sections that are suspended from the ceiling by rods. This result is strong, long-lasting surface, which is easy to access. The panels can also be clipped to each other or clipping into a suspension system having springs. That method prevents the panel edges from being seen.

The third method is to stretch the metal sheets to form various shapes, which can be suspended from the ceiling. This treatment is ideal for obtaining a variety of shapes in the metal, without changing its soundproofing ability.

Advantages of metal ceiling:

- ☐ They reduce overall cost, since they are easy to install and access.
- ☐ Hidden services can be easily accessed since the panels are removable.
- ☐ They are ideal for workspaces which require clean environments and services that require maintenance such as the machinery rooms, the AHU, etc.
- ☐ They have a monolithic look.

- They give the space a very modern look and blend well with glass.



Plaster of Paris (POP) is commonly used for constructing false ceilings. Gypsum, which gives out water when heated, makes POP. Post-heating, gypsum softens and is then crushed to form a powder. POP hardens instantly when water is added to it. It is applied to fibreboard or a wood base, which is then suspended to form the false ceiling.

Advantages of POP:

- A smooth, uniform finish.
- The surface can be recorded or painted.
- POP false ceiling are easy to construct and maintain.
- The ceilings are really light.

Thickness- 10-15 mm

Labor cost for the pop ceiling is high.



Plywood ceiling are widely used for their visual appeal. These ceilings are created with strips of ply glued or nailed together. The strips are held together and strengthened with ply supports at equal distances. Ply ceiling are generally used in place with cold climates.

Advantage of ply ceilings:

- ☐ They are strong and look appealing.
- ☐ They can be given various finishes, or painted to get the right look.
- ☐ They can be treated to increase their lifespan.

But ply ceiling are difficult to maintain, since these are prone to termite attacks. The room has to be thermally controlled to reduce the humidity in the air. Also, the wood is prone to warping and other physical changes, with time.



SYNTHETIC OR PVC FALSE CEILING:

PVC ceiling system is light in weight, moisture resistant and reduces condensation and subsequent dripping from ceiling onto work surfaces. The cleanable, non-absorbent surface is UV stable and will not discolour.

PVC ceiling systems solves the problem of dirty, unhygienic ceilings that are difficult, and expensive to clean by providing a bright, durable and hygienic surface, which is easily maintained. This extremely practical ceiling system is suitable for any area requiring a fixed, non-porous, non-fibrous and non-absorbent ceiling. they are waterproof, termite proof, fire retardant, economical, maintenance free, being non-porous and non-absorbent, can incorporate flush fitting, lighting, access hatches, air vents and sprinklers easy to install & available in various colours shades & no hassles of painting & polishing.



FIBERBOARD AND FIBER/MINERAL REINFORCED TILES

False ceiling can be made with fiber or mineral reinforced tiles and fiberboard. Fiber reinforced tiles are strengthened with wood vegetable fiber, wood waste, reed paper and agricultural wastes. Mineral tiles are ceramics reinforced with natural stone, wood, vegetable fiber, bitumen and tars. This process increases the insulation capacity of the product.

Advantages

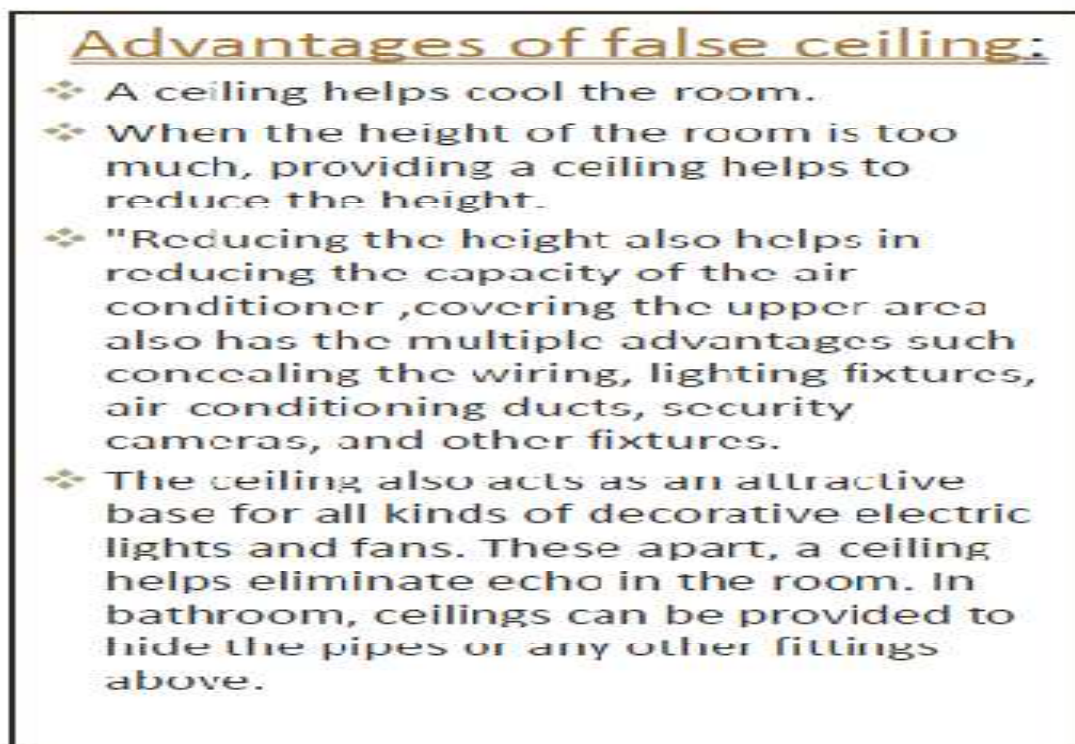
- ☐ They have high insulation against sound and fire.
- ☐ The fiber increases the hardness and the toughness of the material.
- ☐ The material can be decorated with paint or other finishes improving the aesthetics of the room.
- ☐ Water repellents and preservatives can be added to increase the life of the product.

□ If fire safety is a factor, ceiling tiles made from mineral fibers, or fire-rated wood panels can be used within the construction to meet acceptable standards/ratings

FABRIC AND CLOTH:

Fabric is an inexpensive material, may be draped across ceilings, collect dust, these are used for temporary purposes in big churches and function halls. In some places, the light is diffused through the fabric providing a comfortable intensity

This kind of false ceiling is not functional but greatly adds to the aesthetics of the place.



DISADVANTAGES OF FALSE CEILINGS:

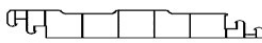


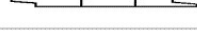



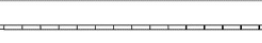

□ The most worrying aspect of having a false ceiling would be pests. They can get through into the space between and can start their own breeding which might lead to a lot of trouble.

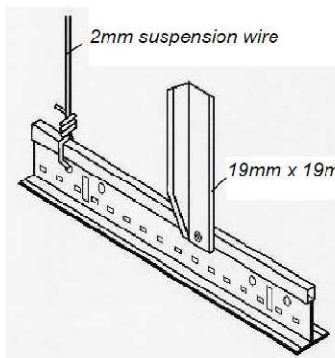
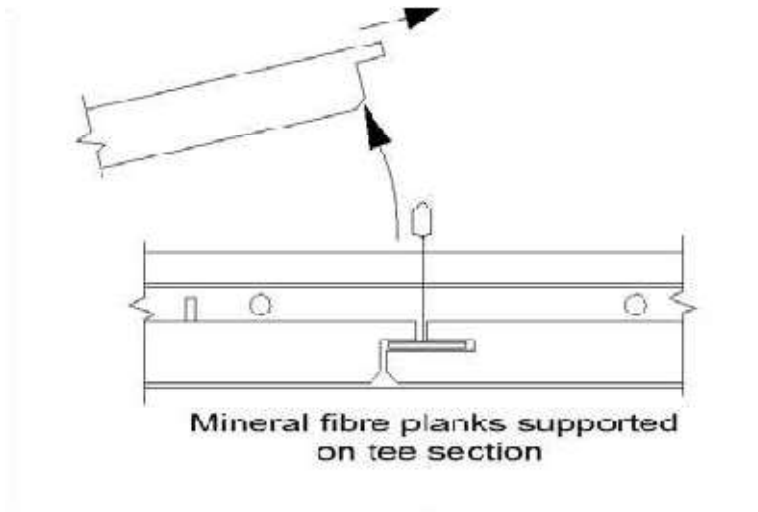
□ Also be careful while putting up decorations or hangings while you have a false ceiling in place. Make sure you know the strength and durability, do's and don'ts with regard to your ceiling.

□ Lastly, the false ceiling would reduce the height of the ceiling considerably and hence do not install false ceiling unless you have a decent ceiling height.

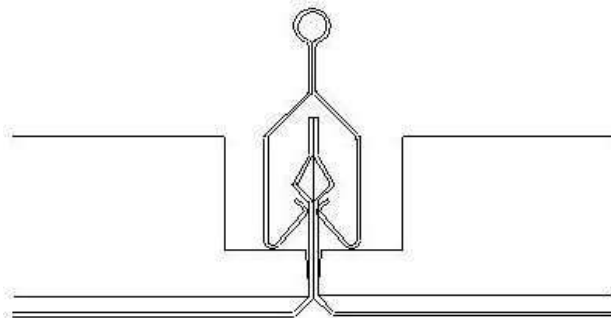
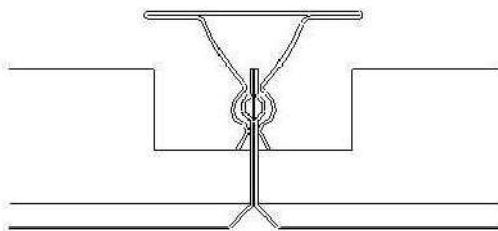
Disadvantages of false ceiling:

- One disadvantage with this ceiling system is reduced headroom. Clearance is required between the grid and any pipes or ductwork above to install the ceiling tiles and light fixtures. In general, a minimum clearance of 100 to 200 millimetres (4 to 8 in) is often needed between the lowest obstruction and the level of the ceiling grid.
- A direct-mount grid may work for those who want the convenience of a dropped ceiling, but have limited headroom. Stretch ceiling supports require less than one inch of vertical space, and no space is required for tiles to be lifted out with a stretch ceiling, but a greater clearance space may be chosen to allow room for MEC or for aesthetic reasons.
- Dropped ceilings generally conceal many of the functional and structural elements of a building, creating an aesthetic paradigm that discourages the use of functional building systems as aesthetic design elements.
- Concealing these elements makes the complexity of today's advanced building technologies more difficult to appreciate. It is also more difficult to perform maintenance on or diagnose problems with the concealed systems.
- As a renovation tool, dropped ceilings are a quick and inexpensive way to repair a ceiling or reduce HVAC costs. Some materials may show their age quickly— for example, mineral fiber sags, is damaged easily when handled, and stains easily, but stretch ceiling, tin and vinyl do not have these characteristics.

PRODUCT NAME PROFILE CODE	SECTION SKETCH	DIMENSIONS		APPLICATION	COLOUR
		THICKNESS	WIDTH		
		mm	mm		
FALSE CEILING, WALL PANELLING & ROOFING SECTIONS					
KINGPAN PS 17540		40	175	ROOFING	1
PLASO LINKER PS 1320		20	13	FALSE CEILINGS & WALL PANELLING AS SUPPL- SECTION TO PS 8719	1
PLASO CEILON PS 8719		19	87	FALSE CEILING WALL PANELLING HOUSES	1
MULTIPAN PS 10015		15	100	FALSE CEILINGS & WALL PANELLING,PORTABLE CABINS/HOUSES & PARTITIONS	1,2
TENPAN PS 25010		10	250	FALSE CEILINGS & WALL PANELLING,PORTABLE CABINS/HOUSES, PAR- TITIONS & KITCHEN CABINETS	1,2,5,6
POLYPAN PS 20010		10	200	FALSE CEILINGS & WALL PANELLING,PORTABLE CABINS/HOUSES & PARTITIONS	1,2,5,6
MULTIDEC PS 15010		10	150	FALSE CEILINGS & WALL PANELLING,PORTABLE CABINS/HOUSES & PARTITIONS	1,2,5,6
WP & FC PL 15010		10	150	FALSE CEILINGS, WALL PANELLING,PORTABLE CABINS/HOUSES & S.I. PARTITIONS	1,2,5,6
TAIPAN PS 25507		7	255	FALSE CEILINGS& WALL PANELLING,PORTABLE CABINS/HOUSES & PARTITIONS	1,5,6
CEILOPAN PS 17507		7	175	FALSE CEILINGS,WALL PANELLING & S.I. PARTITIONS	1,2,5,6



Access to the ceiling void



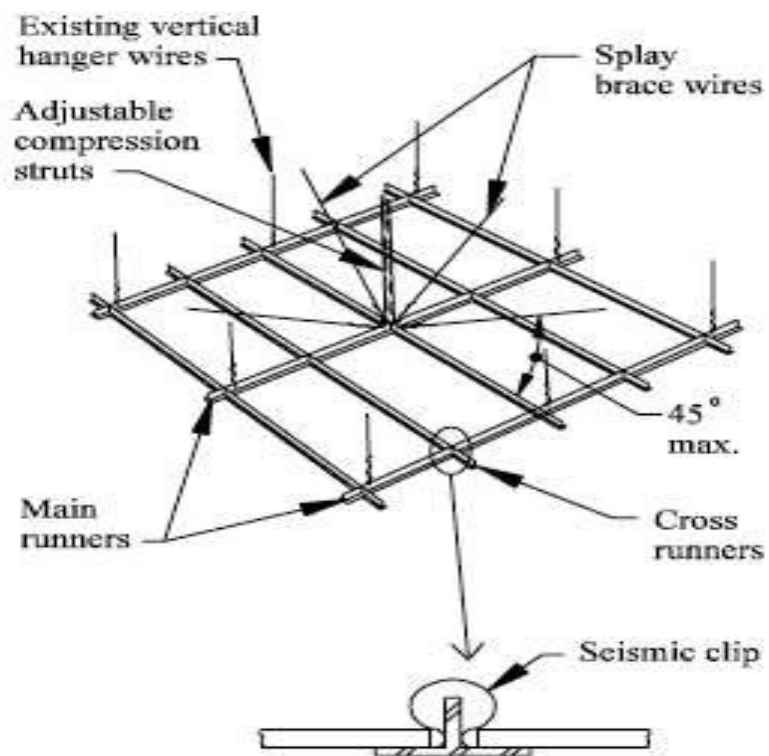
INSTALLATION SEQUENCE

- Marking and drilling in primary ceiling.
- fix the perimeter angle section to the walls at the desired levels.

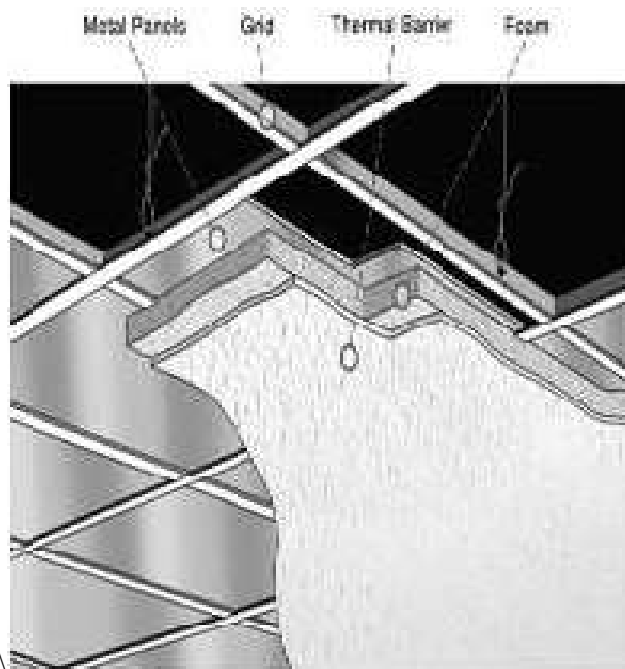
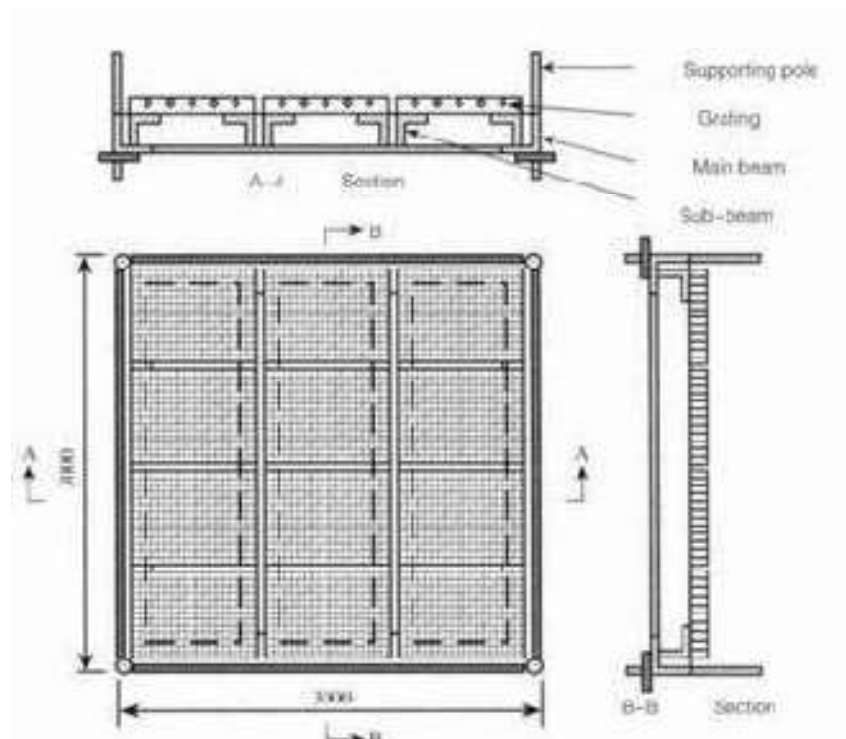
- Suspend the intermediate c channel from the ceiling at the desired height with soffit cleat.(soffit cleat spacing=1200mm, intermediate channel spacing=450/600mm)
- Suspend the main frame ceiling section from the intermediate section with connecting clips at 600mm c/c.
- Screw the panel onto the frame work.
- the electric cables and service ducts ore laid as per design before panels are screwed.
- For final finishing panel can be painted or polished.

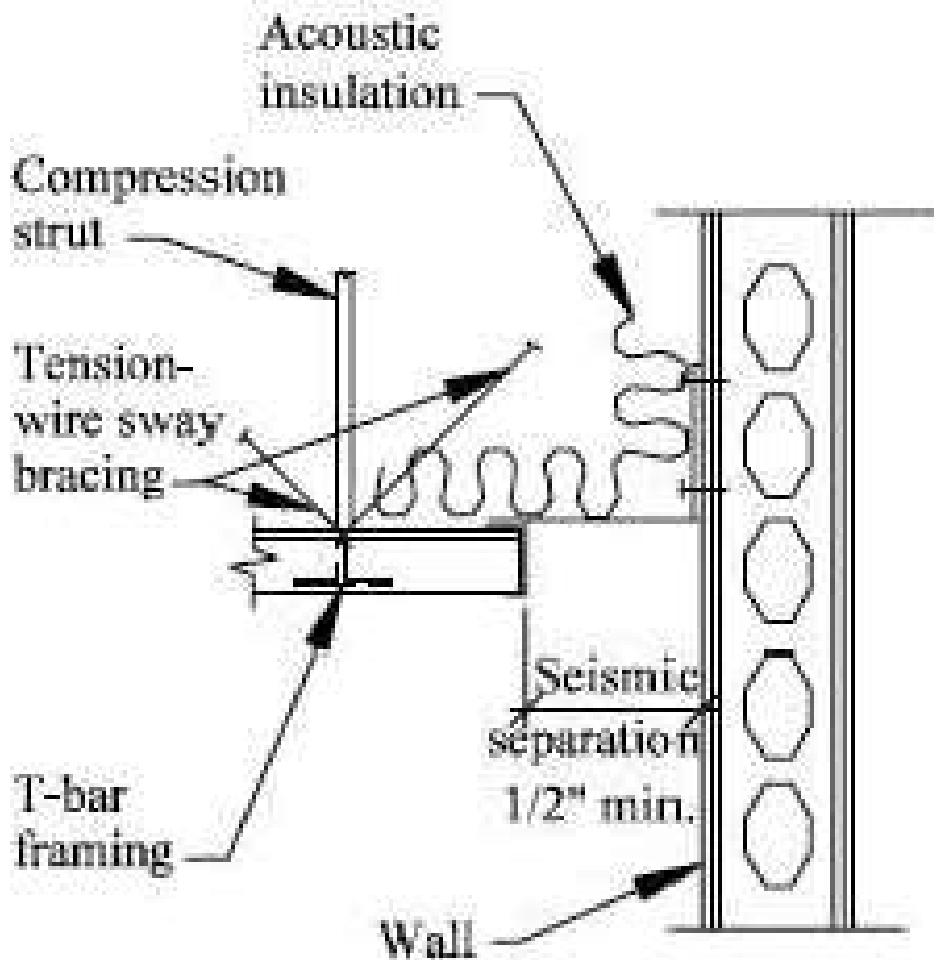
Suspended ceiling is a secondary ceiling which is hung below the main ceiling.

- Also referred as a drop ceiling, Tbarceiling, false ceiling
- Used for concealing the underside of the floor above
- Used to offer acoustic balance and control in a room & improve insulation.



- Consists of a grid work of metal channels in the shape of an upside down "T"
- Grid work are suspended on wires from the overhead structure
- Grids modular size = 600x600mm
- Each cell is filled with lightweight "tiles" or "panels" which simply drop into the grid.
- Tiles can be selected with a variety of materials



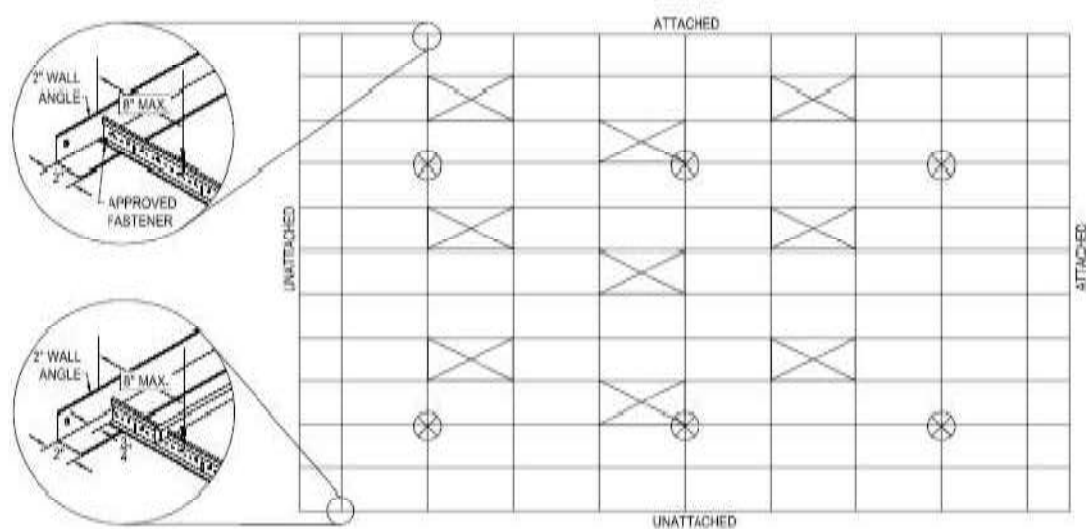
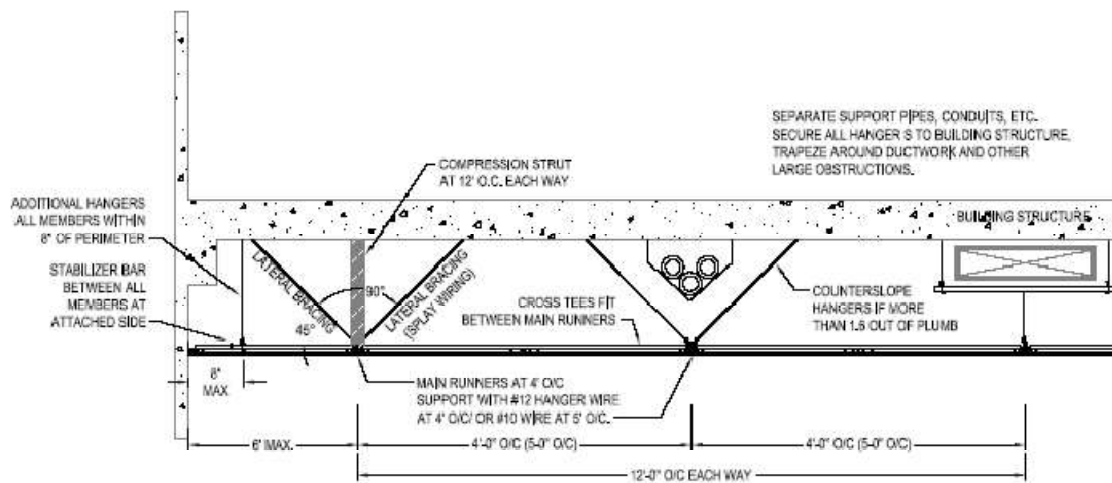


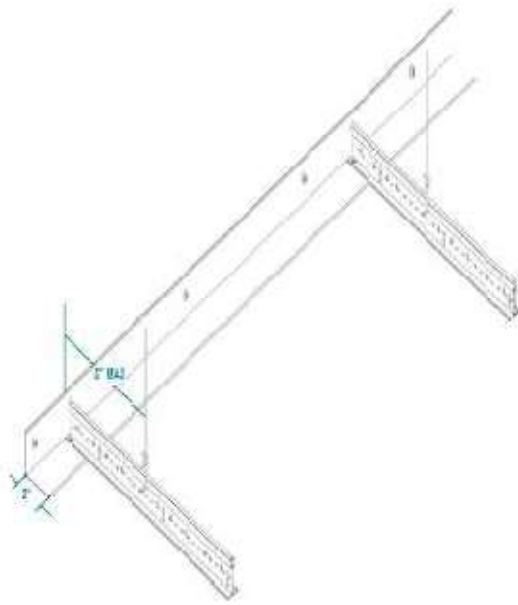
Installation Of Suspended Ceiling:

- Install splayed wires at 3.6m on center in four directions.
- Provide adjustable compression struts, at center of splayed wires, and attach to the structure above.
- Provide ceiling tile clips.
- Provide 25mm minimum separation between the ceiling system and the enclosing walls
- This separation is called seismic separation

Installation Note:

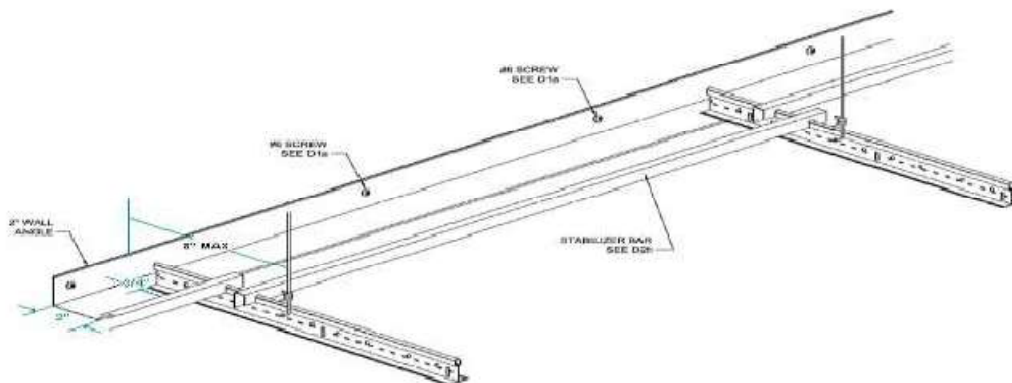
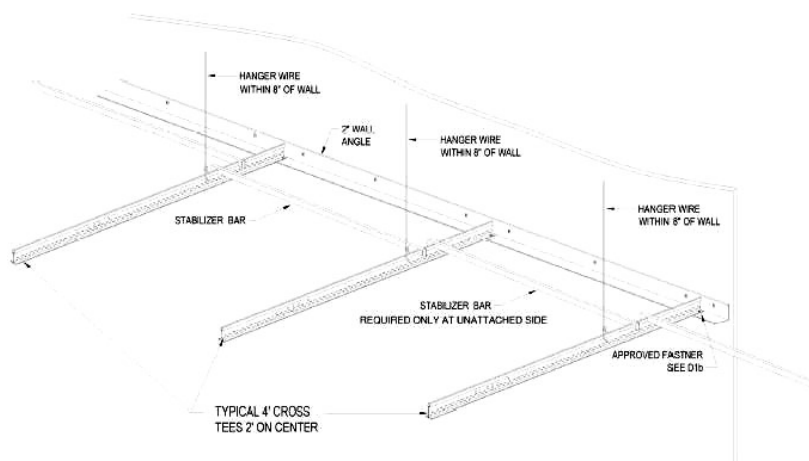
- Standard grid module systems should not be more than 1.5 m in any direction.
- Hanger attachment devices is capable of carrying either 200 pounds or 3 times the ceiling design load
- Members perpendicular to the wall at the unattached sides of the grid shall be tied together with the help of stabilizing bar (stabilized) to prevent their spreading.



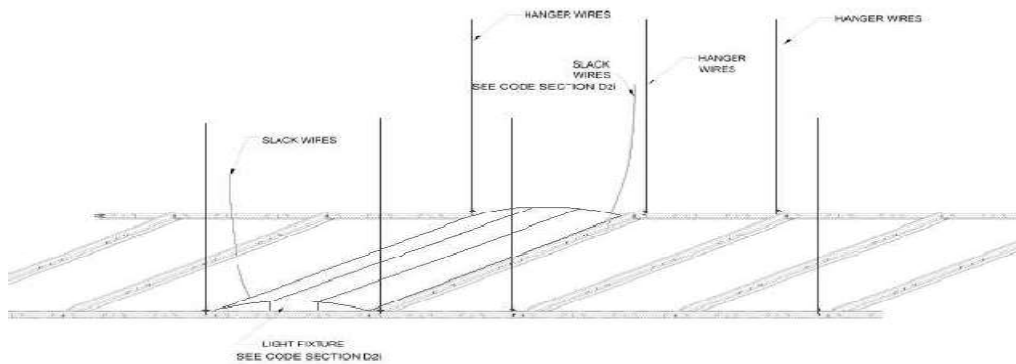


Attached End of Grid

Hanger Wires & Stabilizer Bar



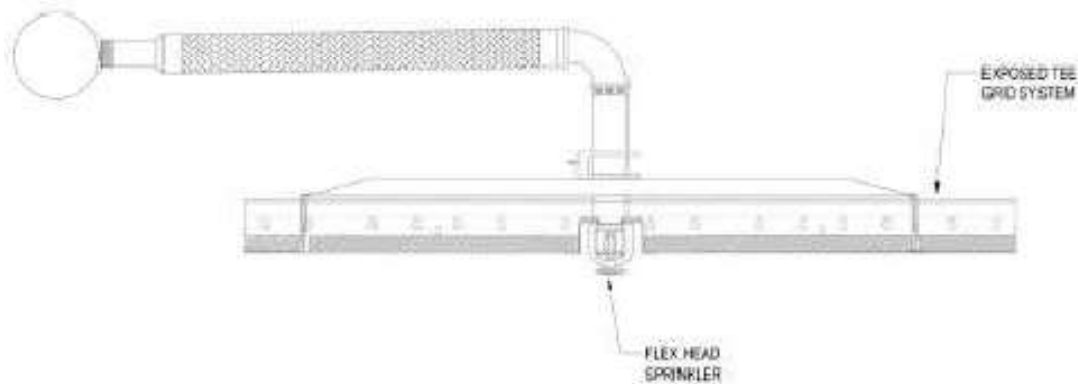
Unattached End of Grid



Fixture Support

Lighting fixtures, egress lighting, speakers, air terminals or mechanical services weighing up to 56 pounds can be supported by suspended ceiling

- Sprinkler heads or other similar ceiling penetrations shall be provided with at least 2.54 cm of clearance in all directions surrounding the sprinkler head or extension.



Sprinkler Penetration

Installation Of Timber Suspended Ceiling:

- Grid system is formed with the help of wooden joists.
- Modular grid size 400x600mm
- Grid system is supported by hanger wire & wooden screws
- Each cell is filled with lightweight "wooden panels" which simply drop into the grid.

Description of the material

1 Cement Board Indoor

2 Insulation material coat

3 Batten and lath framework 400/600 mm

4 Maxi Screw

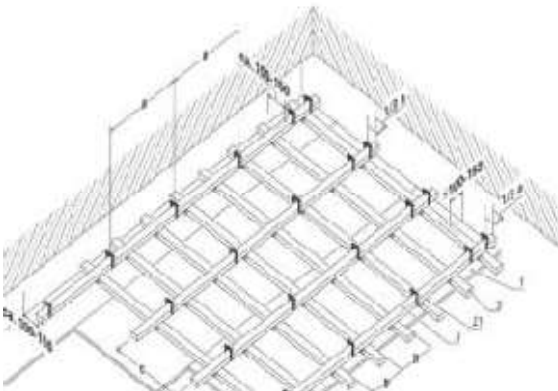
7 Joint Filler –14 fire protection plate GKF, 12.5 mm

21 Direct hanger

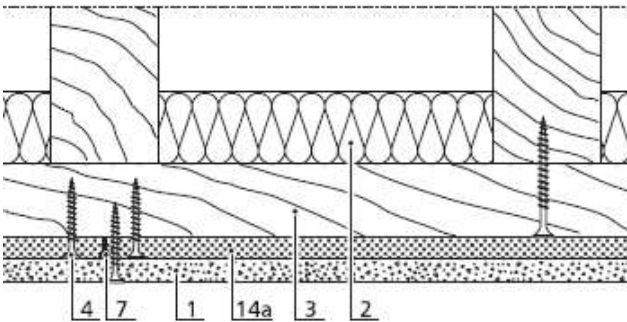
27 Dividing strips

28 Filling

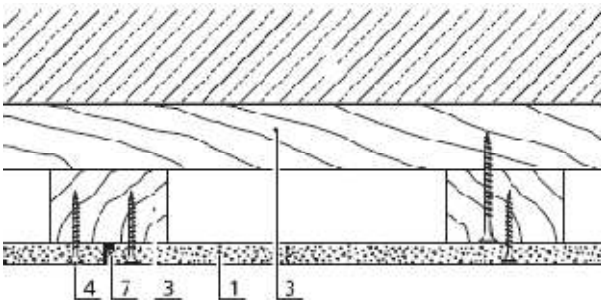
29 Expansion joint (15-20mm gap)



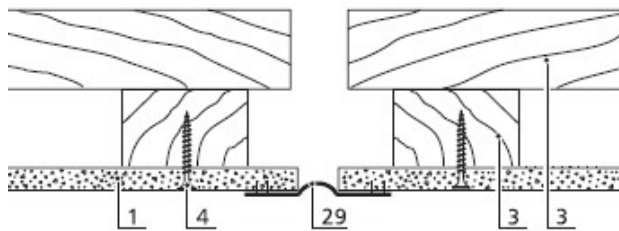
Suspended ceiling with wooden framework



Direct fastening under wooden



Connection to solid walls



Expansion joint

Polyvinyl chloride (P.V.C.) tiles

- Are commonly used floor & suspended ceiling finish
- They are small in size , usually 150mm, 225mm and 305mm
- The tiles are made of a composite of PVC and fiber
- Available in different colors, sizes, designs and patterns
- Are used in residences, offices, and commercial areas
- The main advantages of PVC tiles are:
 - a. Are easy to install & maintenance free
 - b. Offer excellent insulation
 - c. Are water proof and fire retardant.
 - d. Long lasting

Gypsum Board

- Is a panel made of gypsum plaster
- It is pressed between two thick sheets of paper.
- It is used to make interior walls and ceilings.
- The main advantages of gypsum board are:
 - a) Ease of installation
 - b) Fire resistance
 - c) Sound insulation
 - d) Durability , Economy & Versatility Acoustic Board
- Is a special kind of board made of sound absorbing materials.
- Its job is to provide sound insulation.
- Ceiling is porous.

- When sound passes through an acoustic board, the intensity of sound is decreased.
- The loss of sound energy is balanced by producing heat energy.
- Used in auditoriums, halls, seminar rooms, libraries etc

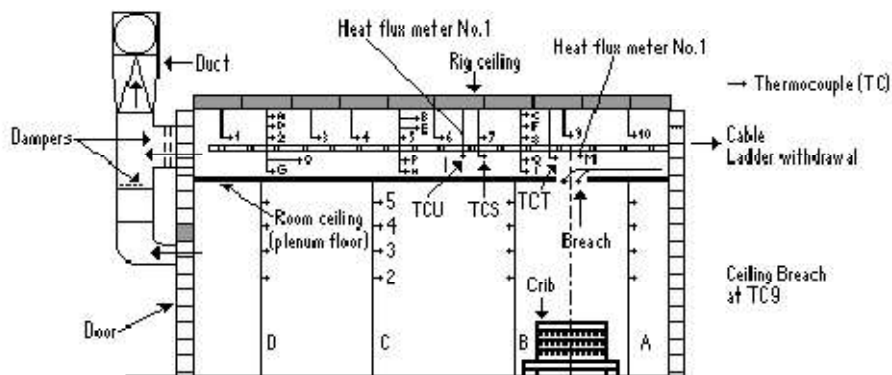
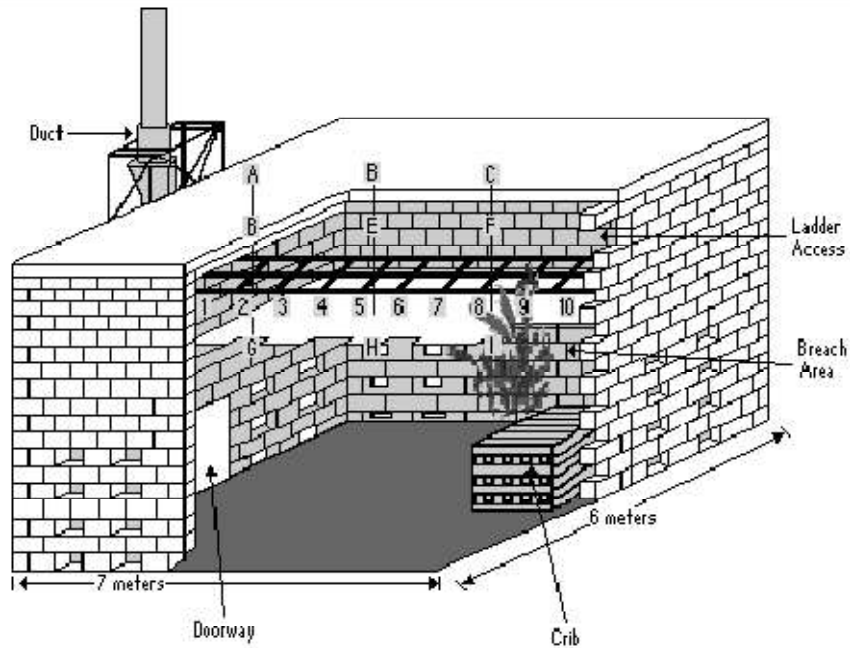
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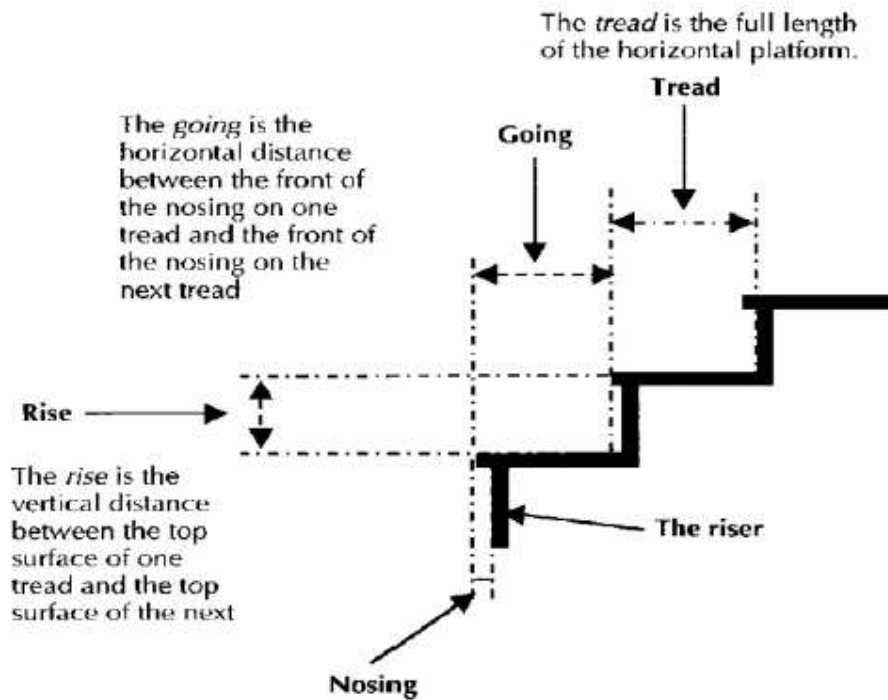
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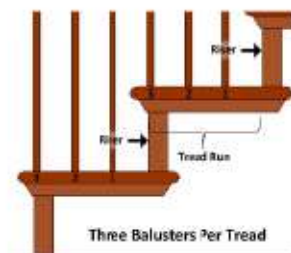
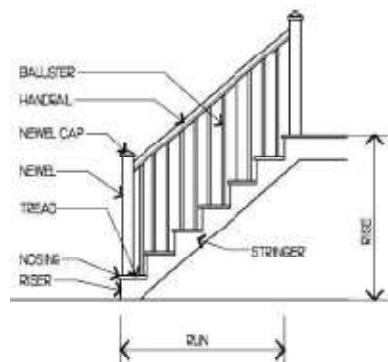
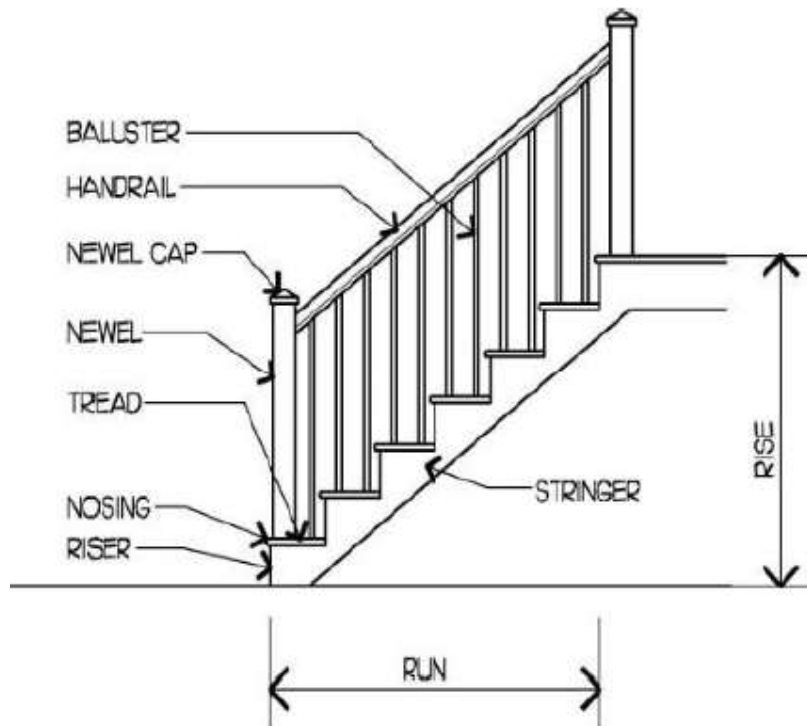
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METAL STAIRCASES



Anatomy of staircase



Riser – A stair riser is the vertical space between one step and another. It may be closed or open, depending on the style of the stairs.

Tread – A stair tread is the horizontal part of the step that a person will stand on, and along with the riser, is an integral part of a staircase.

Newel posts - Newels are the large post found at the foot and at the top of any flight of stairs. They can also be found at key junctures of a staircase, for example where there is a change of direction. They come in a range of styles, including box newels (which are box shape) and turned newels (which are curved).

Newel cap – This is the name for the decorative top section of a newel post. They help provide an attractive finish and can be very simple, such as a square, acorn or ball, or hand carved and highly intricate.

4

Spindles/balusters

This is the term used to describe the smaller posts which can be placed vertically at the side of a staircase to enclose it. They sit underneath the handrail and above the base rail. In contemporary stairs this is now likely to be glass.

Handrail

The handrail sits on top of the balusters and will run the length of the staircase between the newel posts.

Half newel post

These are often found on landings where the staircase meets a wall and are basically a newel post cut in half.

Wall string – This is the side of the staircase which sits flush against the wall, which the treads and risers are housed into.

String Capping – This is a mould that is used to cover the top of the string nearest to the wall.

Landing/Landing return –

This is the area immediately at the top of the staircase (landing), or partway up where a change of direction in the staircase occurs (landing return) which may be either a quarter or a half landing return. Depending on the direction of travel, it may be a parallel landing return that continues back in the direction of the proceeding staircase, or a right angle return that goes off at 90 degrees.

Metal staircases

Steel stairs Design in modern architecture goes nowadays far beyond functional aspects.

- Metal Staircases have increasingly become a creative element of a Unique Interior Design
- Combined with wood or glass components, the Steel Stair gives extraordinary structural soundness and enhances the beauty and elegance of any room.

Why Use Metal Stairs?

- Metal stairs are easy to maintain.
 - They are resistant to extreme stress, fluctuating extreme temperatures and humidity, and thus are suitable both indoor and outdoor use.
- A custom metal stair fabrication will fit into your installation site's profile easily. The result is a seamless integration that will be easy to install and won't require a lot of structural reorganization.
- Metal stairs are tough. They will withstand the test of time under various environments.
 - Offer a better weight to strength ratio making it perfect for commercial or industrial application.
 - A custom metal fabricator can customize the stairs to whichever shape, size or style.

STAIR TYPES

Straight Run consists of either a single flight extending between floors as shown in Figure 2-1 or a series of two or more flights in the same line with intermediate platforms between them as shown in Figure 2-2

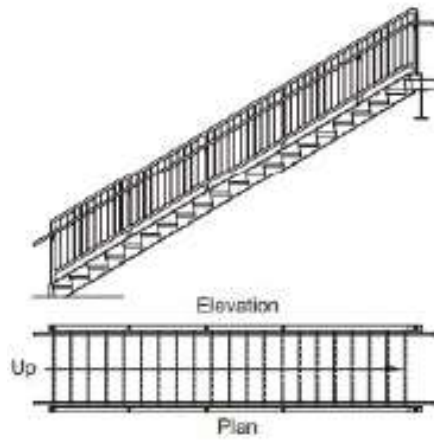


Fig. 2-1. Straight run stair.

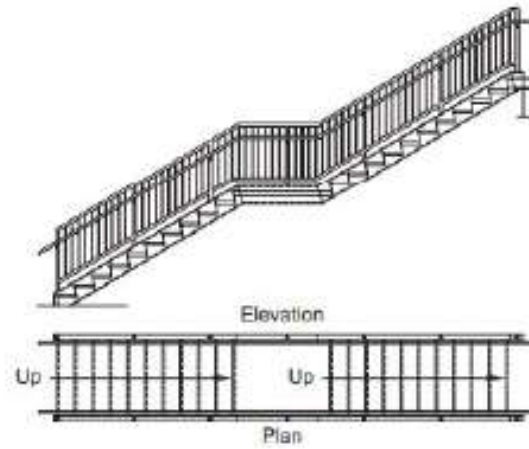


Fig. 2-2. Straight run stair with integrated landing.

Parallel Successive flights which are parallel to each other and are separated by one or more intermediate platforms as shown in Figure 2-3

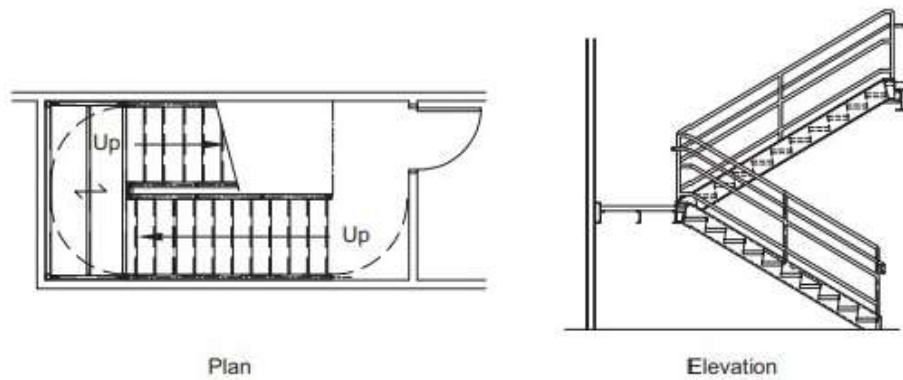


Fig. 2-3. Straight stair—parallel with intermediate landing.

Angled Successive flights

placed at an angle to each other with an intermediate platform between each flight as shown in Figures 2-4 and 2-5. Stairs flights placed at an angle of 180° are classified as parallel as shown in the previous section.

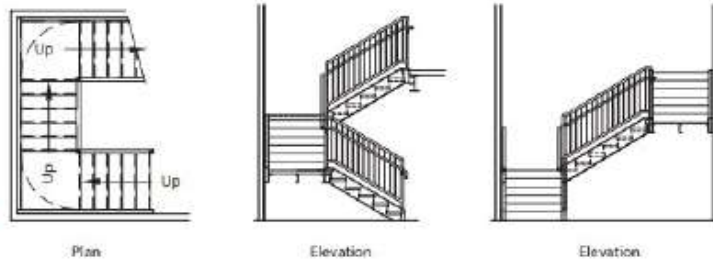


Fig. 2-4. Straight stair—angled.

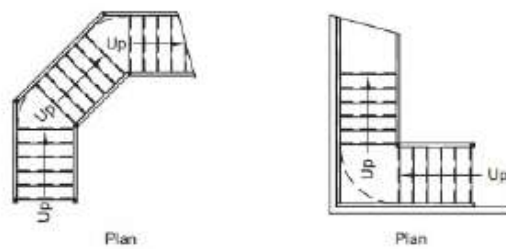


Fig. 2-5. Straight stair—angled.

Scissor A pair of straight run flights paralleling each other in plan in opposite directions on opposite sides of a dividing line as shown in Figure 2-6.

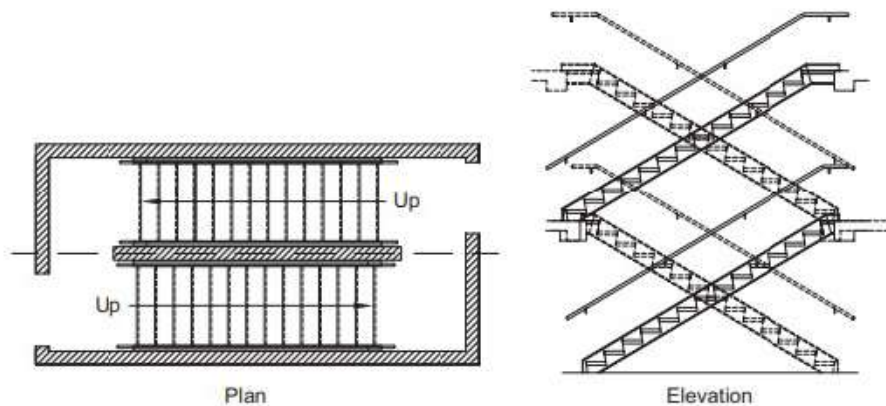


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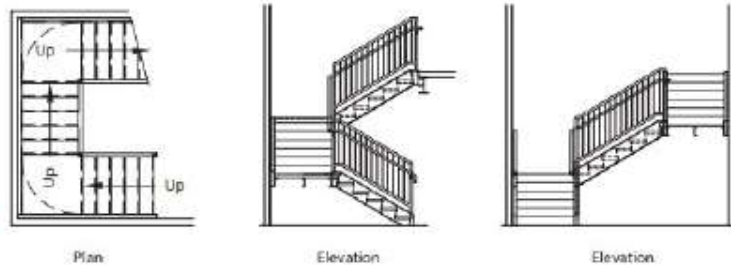


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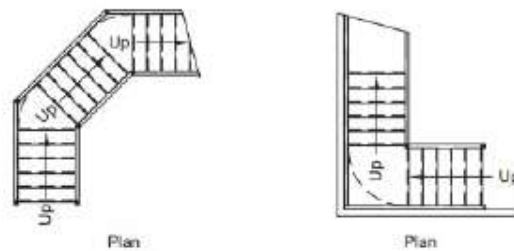


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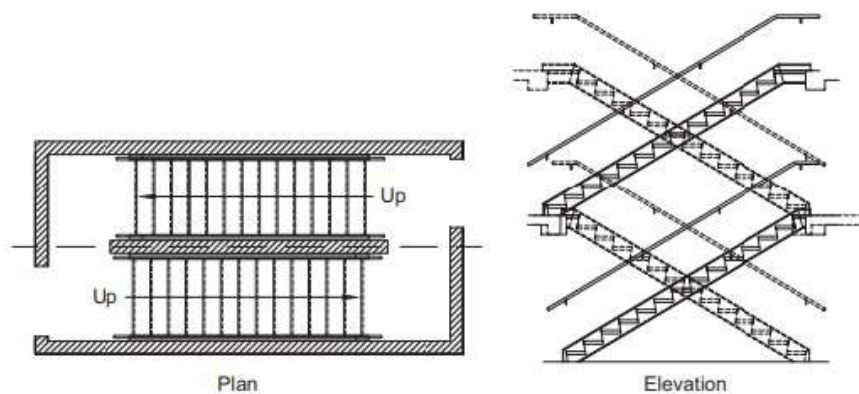


Fig. 2-6. Straight stair—scissor.

Parallel Successive flights which are parallel to each other and are separated by one or more intermediate platforms as shown in Figure 2-3

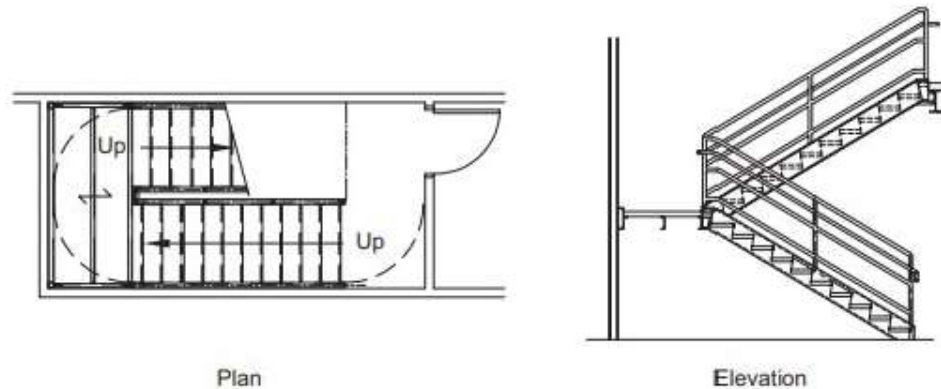


Fig. 2-3. Straight stair—parallel with intermediate landing.

Angled Successive flights placed at an angle to each other with an intermediate platform between each flight as shown in Figures 2-4 and 2-5. Stairs flights placed at an angle of 180° are classified as parallel as shown in the previous section.

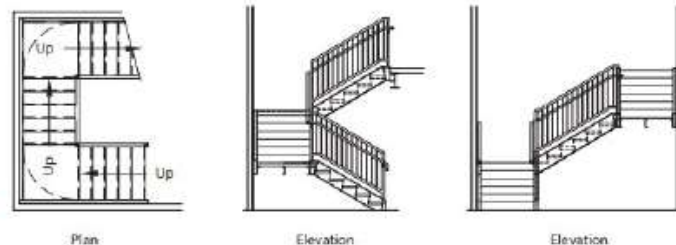


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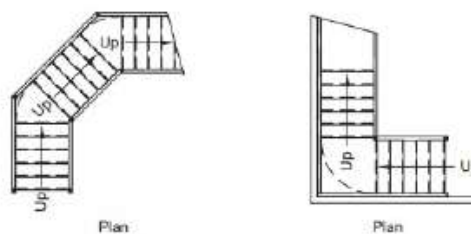


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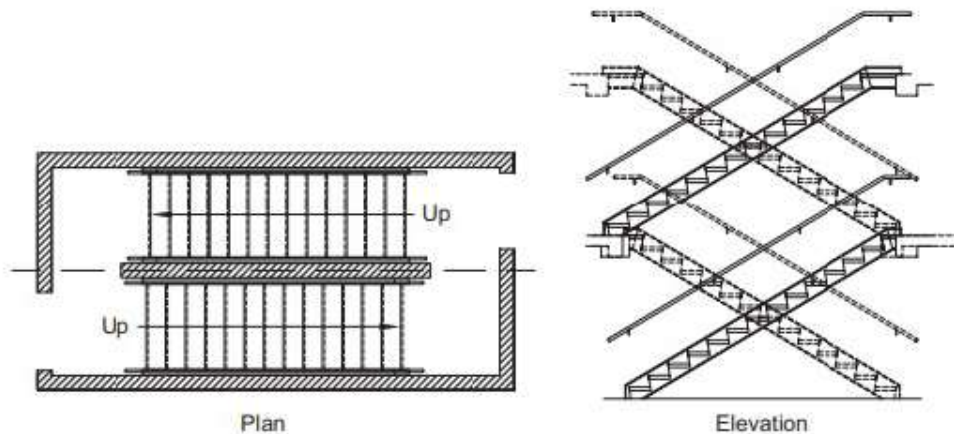
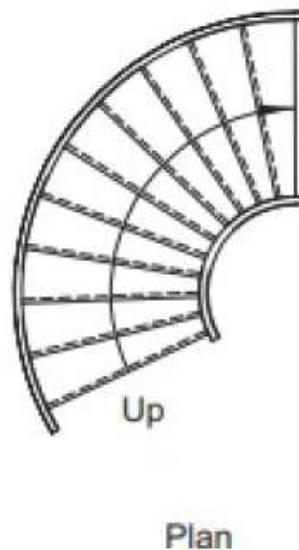


Fig. 2-6. Straight stair—scissor.

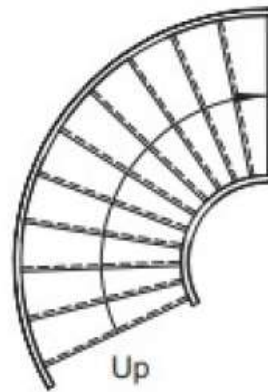
Circular stairs are stairs that, in plan view, have an open circular form with a single center of curvature. They may or may not have intermediate platforms between floors. Refer to Figure 2-7.



Plan

Fig. 2-7. Circular stair.

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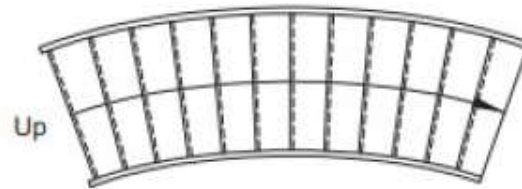


Plan

Fig. 2-7. Circular stair.

14

Curved stairs are stairs that, in plan view, have two or more centers of curvature, being oval, elliptical or some other compound curved form. They also may or may not have one or more intermediate platforms between floors. Refer to Figure 2-8.



Plan

Fig. 2-8. Curved stair.

15

Metal staircases



Metal Stairs Styles

Safety is a key factor in most commercial and industrial settings.

Some of the most common treading options include:

- Plate stair treads
- Bar grate stair treads
- Plank stair treads



Plate stair treads



Bar grate stair treads



Plank stair treads

Composite stairs

- The various components of **stairs** are made of different materials
- in addition, the lightweight materials such as aluminium, plastic etc are also utilized.



A composite material (also called a composition material or shortened to composite) is a material made from two or more constituent materials with significantly different physical or chemical properties that, when combined, produce a material with characteristics different from the individual components.

Composite construction is a generic term to describe any building construction involving multiple dissimilar materials.

Ex:

Reinforced concrete and masonry / composite wood such as plywood/ reinforced plastics, such as fibre-reinforced polymer or fibreglass/ ceramic matrix composites (composite ceramic and metal matrices)/ Metal matrix composites.



How to make metal staircase construction

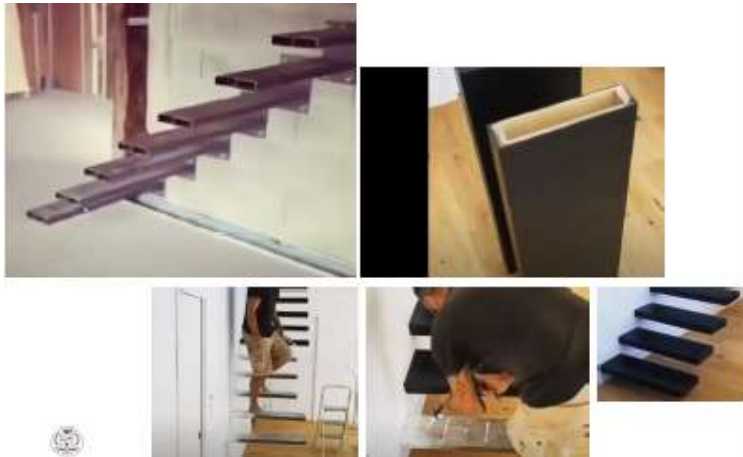




BAMA

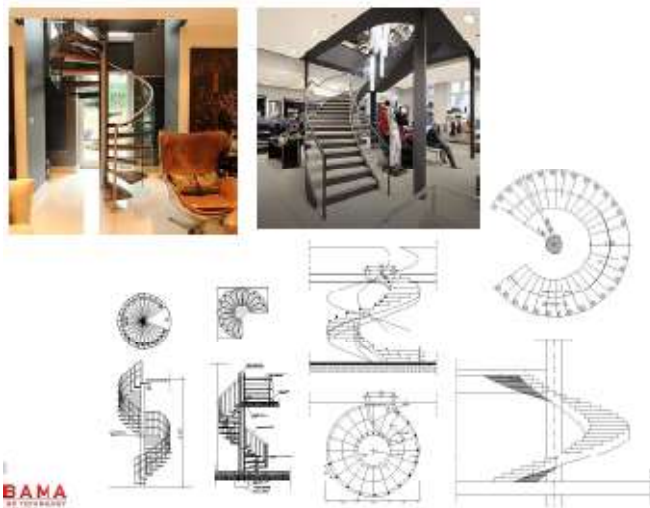
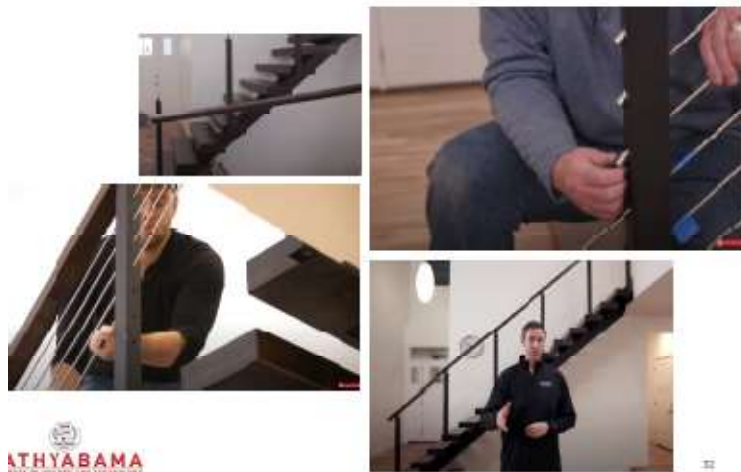
How to install floating staircase | Floating Stair
Design | Latest stair Design interior

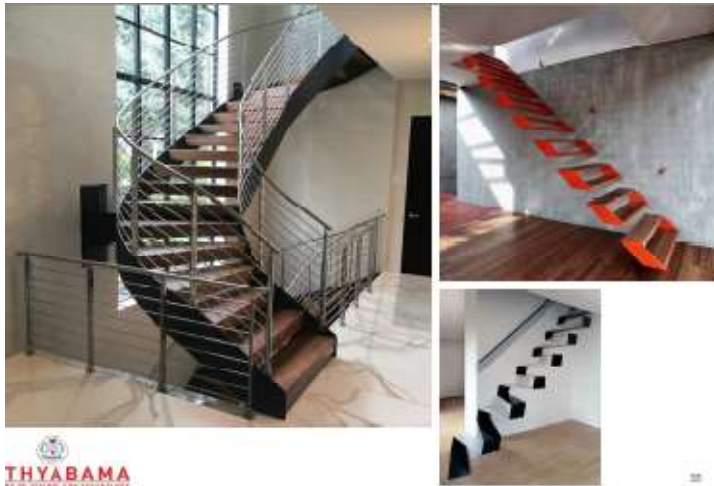




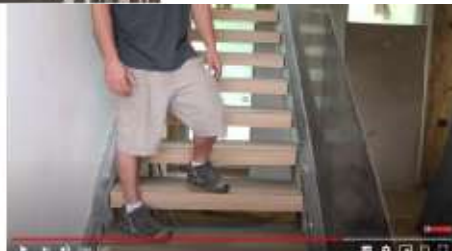
One Day Floating Stairs Install
Guess How Much These Cost!







Modern Steel Stairs
-installation

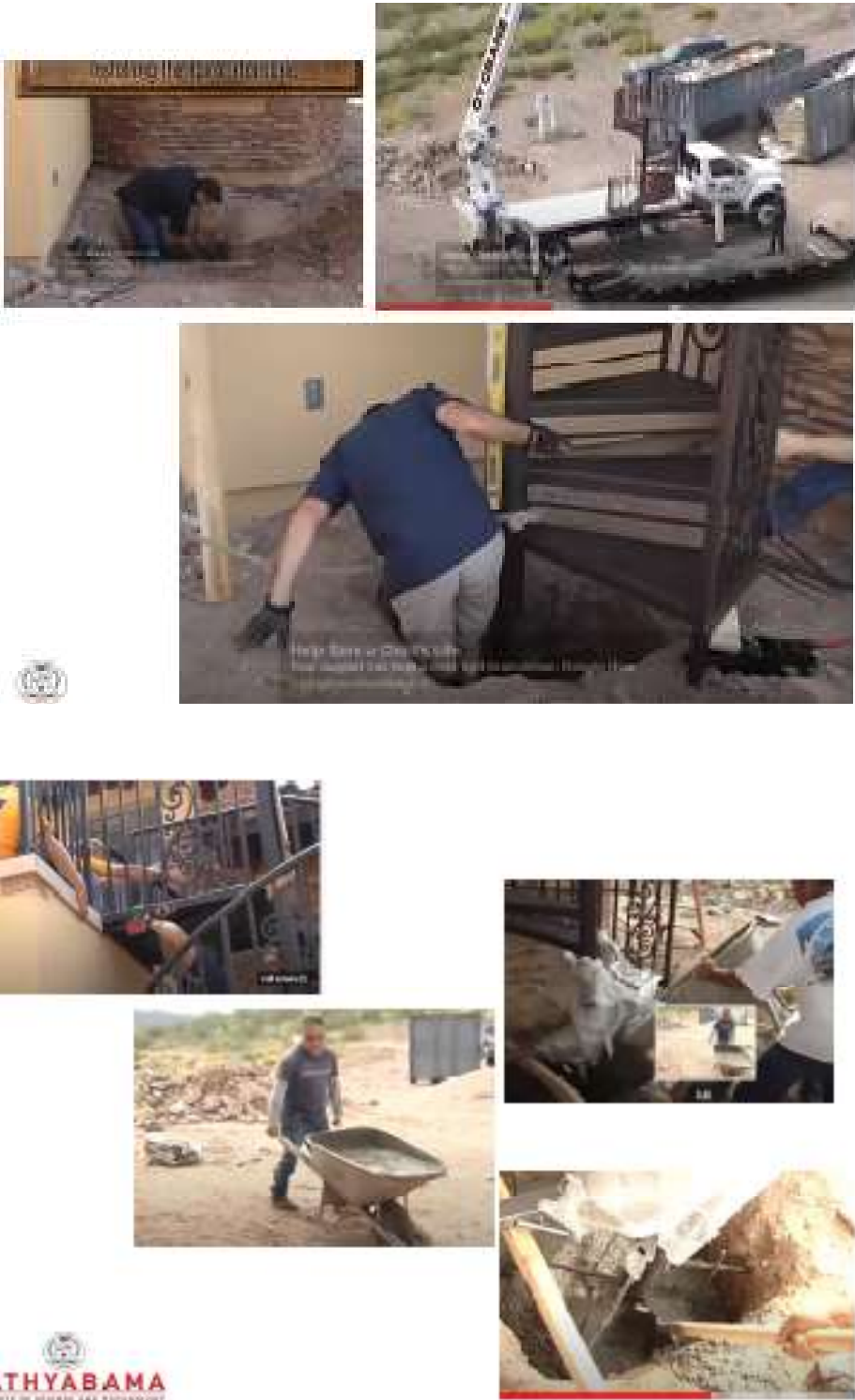




Glass Staircase Design Ideas ! glass stair railing



Iron Spiral Staircase Installation by First Impression Ironworks, Phoenix, AZ



DOLLE Toronto – Mounting video




SATHYABAMA

48



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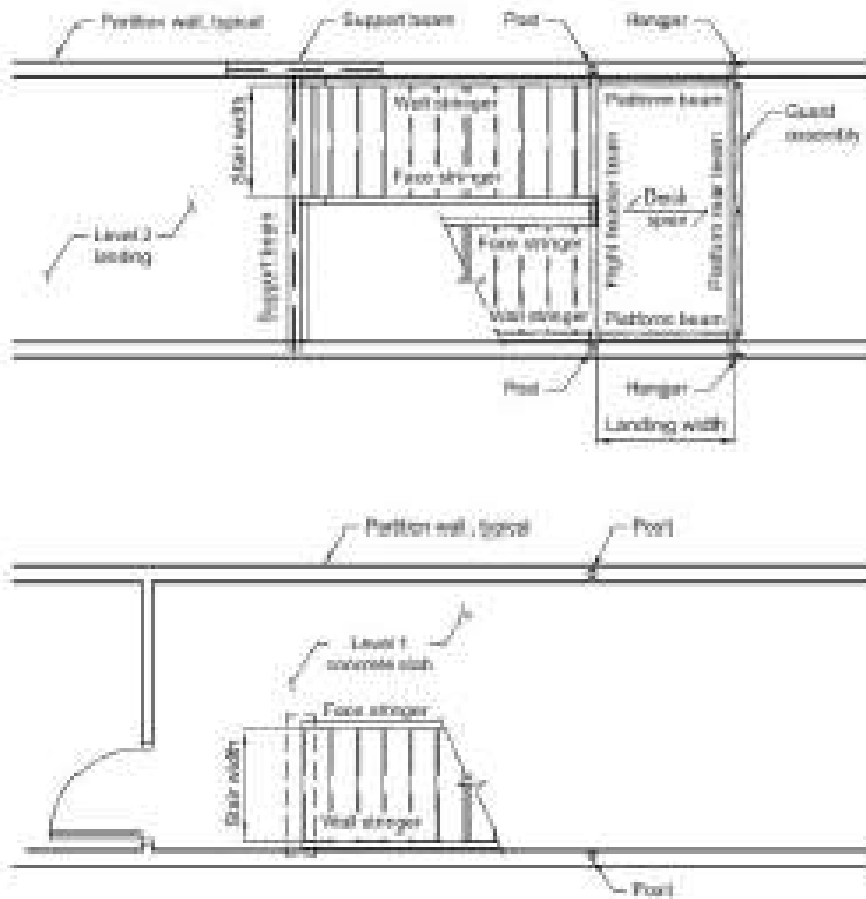


Fig. 3.14 Staircase details – plan views

50

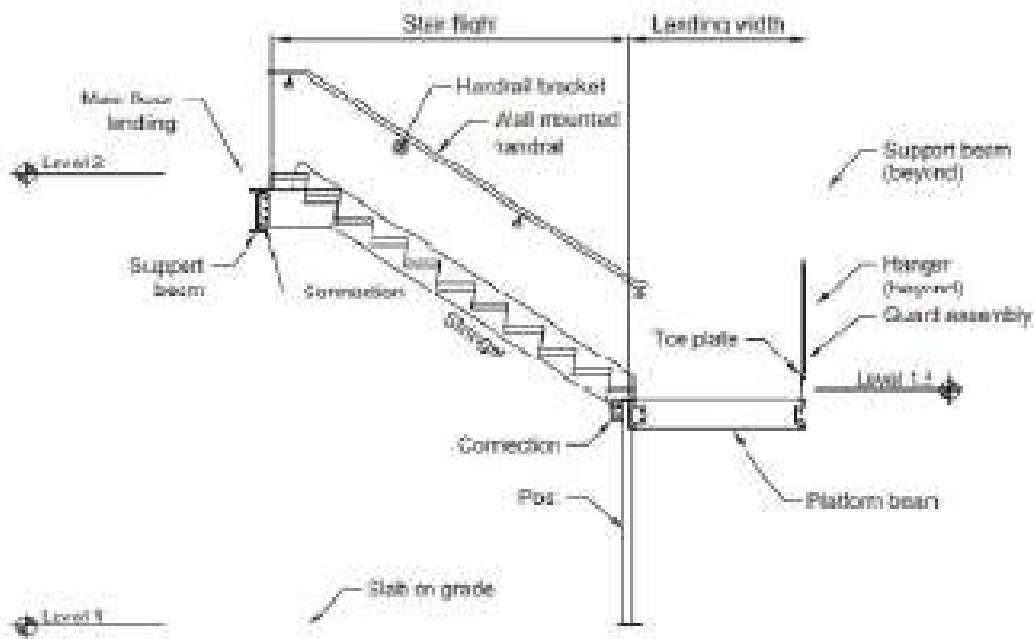
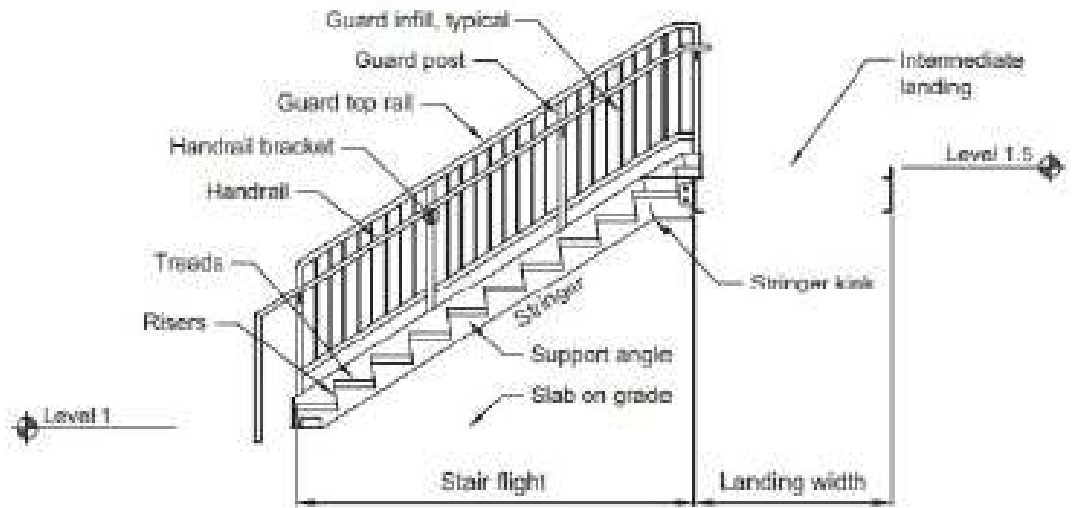


Fig. 2-12. Nomenclature—vertical stairs.

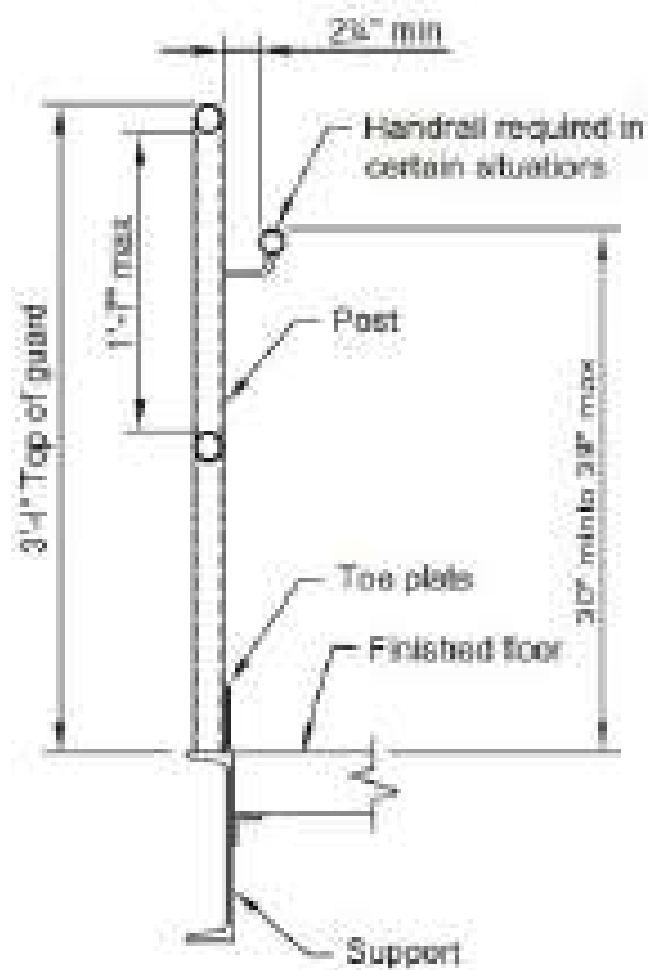


Fig. 7-4. OSHA-style stairway guard, section view.