

BUILDING MATERIALS AND CONSTRUCTION - IV

By – Ar. Jincy Varghese

MODULE IV - GLASS AND GLAZING

Glass products : Types of glass – wired glass, fiber glass, laminated glass, glass building blocks, Heat strengthened glass-toughened glass, laminated glass Special purpose glasses- Low emissivity glass, Solar control glasses and variable transmission glass, Fire resistant glass, Self cleaning glass their properties and uses in buildings

Glazing: Single, double and triple glazing Glazed curtain walls & sky lights.

Sketches : Structural glazing

Glass is an amorphous, hard, brittle, transparent or translucent super cooled liquid of infinite viscosity, having no definite melting point obtained by fusing a mixture of a number of metallic silicates or borates of Sodium, Potassium, Calcium, and Lead.

It possess no definite formula or crystalline structure.

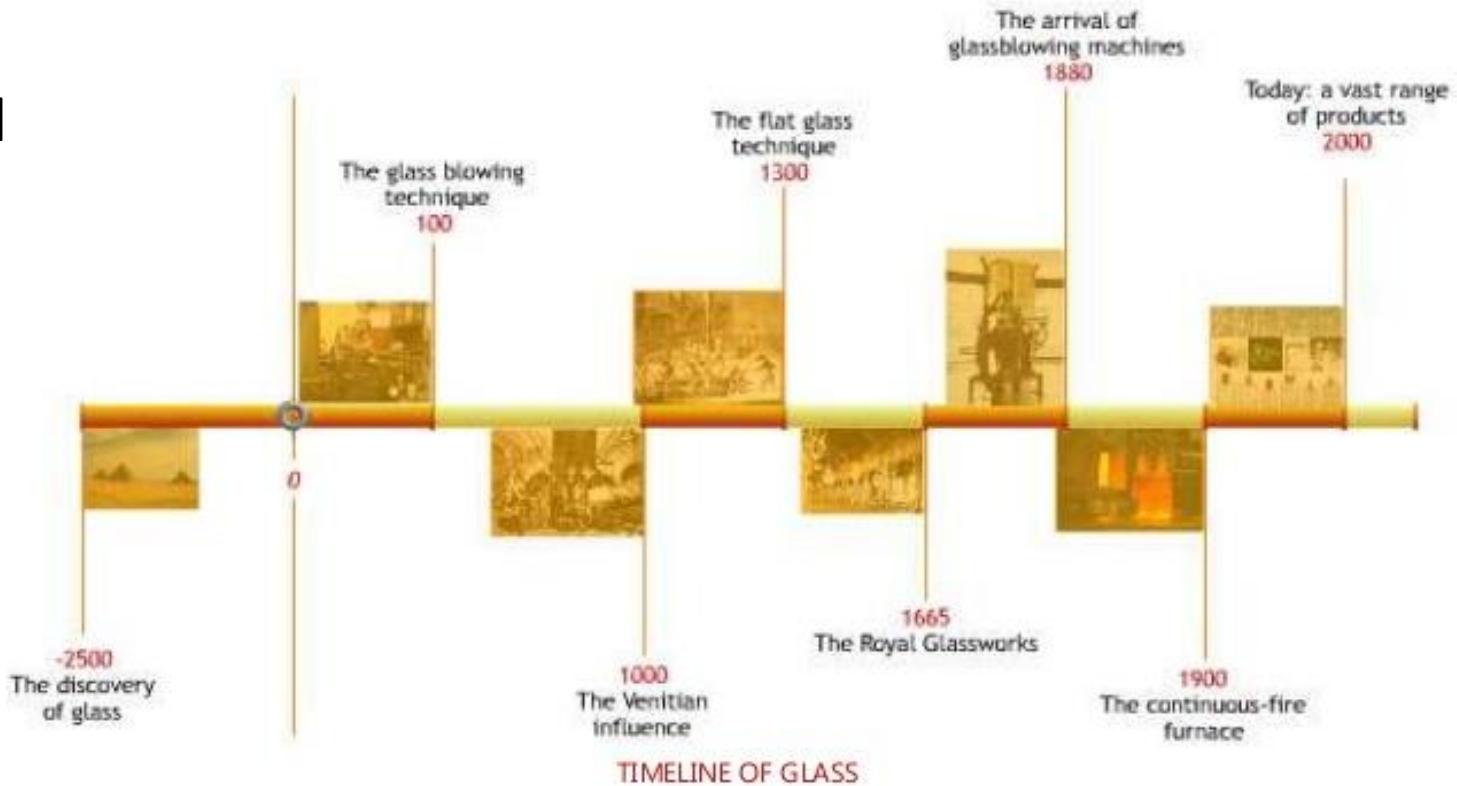
- “An inorganic product of fusion which has cooled to a rigid condition without crystallizing”
- Does not have a specific melting point
- Softens over a temperature range



Glass signifies an amorphous solid substance that has been formed by super cooling; a liquid solution containing chiefly silica and some other selected components. Generally glasses are super cooled liquid.

Timeline of Glass

- Obsidian
- 3100 BC – Earliest glass artefact found in Egypt
- 650 BC – First glass manual was written in Assyria
- 1 AD – Glass blowing technique near Babylon
- 100 AD – Prices become affordable
- 600 AD – Strong Islamic influence
- 1000 AD – Munaro Island
- 1500 AD – Clear glass
- 1800 AD – Synthetic glass
- 1843 AD – Float glass (Early forms)
- 1959 AD – Float glass



The History of Glass

In the 3,500 years since glass was first discovered it has been used to create incredibly stunning and highly practical objects and now forms an essential part of our everyday lives.

3500 BCE

The first evidence of manmade glass objects were found in Egypt and Eastern Mesopotamia, modern-day Syria.

**EACH YEAR THE UK PRODUCES AN ESTIMATED
4 MILLION TONNES OF GLASS**

650 BC



First glassmaking manual was written and found on the tablets from the library of the Assyrian King Assurbanipal.

50 BC

The Phoenicians use glass to create art.

1271

During the Middle Ages Venice became a major centre for glass production in Western Europe.

1226

Broad sheet glass was first produced in Sussex, England

1590

Glass telescope and microscope lenses are developed for the first time in the Netherlands.

1688

Polished plate glass was first produced in France. The glass was cast and then hand polished.

1678

Crown glass was first produced in London. Due to its superior quality it dominated manufacturing until the 19th century.

1800s

Synthetic chemicals become available for the first time as the Industrial revolution brings a new era in glass manufacturing.



1875

The University of Jena becomes a major glass science and engineering centre as glass chemistry begins.

1903

French artist and chemist Edouard Benedictus invented laminated glass as the result of a laboratory accident.

1847

James Hartley introduces rolled plate glass. This type of glass was commonly used in the design of extensive glass roofs such as within railway stations.

1938

Pilkington enhanced the polished plate process to incorporate a double grinding process.



PILKINGTON

90%

of glass manufactured in the UK is produced for the food and drinks industry, glazing in construction and the automotive industry.

2007

Michael J Owens is induced into the National Inventors Hall of Fame. In 1903 Owens developed an automated glass bottle making machine which is regarded as one of the most important developments in the history of glassmaking.

1959



Sir Alastair Pilkington introduces float glass to the UK, a revolutionary new process of flat glass manufacture.

1984

The first fluoride glass is discovered by Marcel and Michel Poulaen and Jacques Lucas in Rennes, France.



2012

A new type of ultra-thin glass has been developed that has the ability to warp round devices and is as thin as a sheet of paper.



1600 BC

Manmade vessels were produced in Mesopotamia for the first time during the early Bronze Age.

250 BC

Babylonian glassmakers developed new techniques and discovered that molten glass can be blown into shapes which enabled glass vessels to be produced more easily.



100 AD

There was a rapid expansion of glassmaking during the Roman Empire as glass became more commonly available and spread throughout Europe.

1330

French glassmakers first produced crown glass in Rouen, France



1608

America's first glass house was founded by settlers in Jamestown, Virginia.

1620

Blown plate glass was first manufactured in London.

1773

The English began polished plate glass production at Ravenshead. By 1800 a steam engine was used to carry out the grinding and polishing process.



1834

Improved cylinder sheet production was introduced by Robert Lucas Chance and used extensively until the early 20th century.

1773

Machine rolled glass was introduced which allowed patterns to be created.

1843

English inventor Henry Bessemer creates an early form of float glass. This proved to be an expensive method and not widely used.

1888

IN 2010, APPROXIMATELY
1.3 MILLION
TONNES OF DOMESTIC FLAT GLASS WAS PRODUCED

1913

Flat drawn sheet techniques where first developed in Belgium and introduced to the UK in 1919.

1950s

Glass science becomes a major research discipline as the Ford Motor Co established a glass research centre.



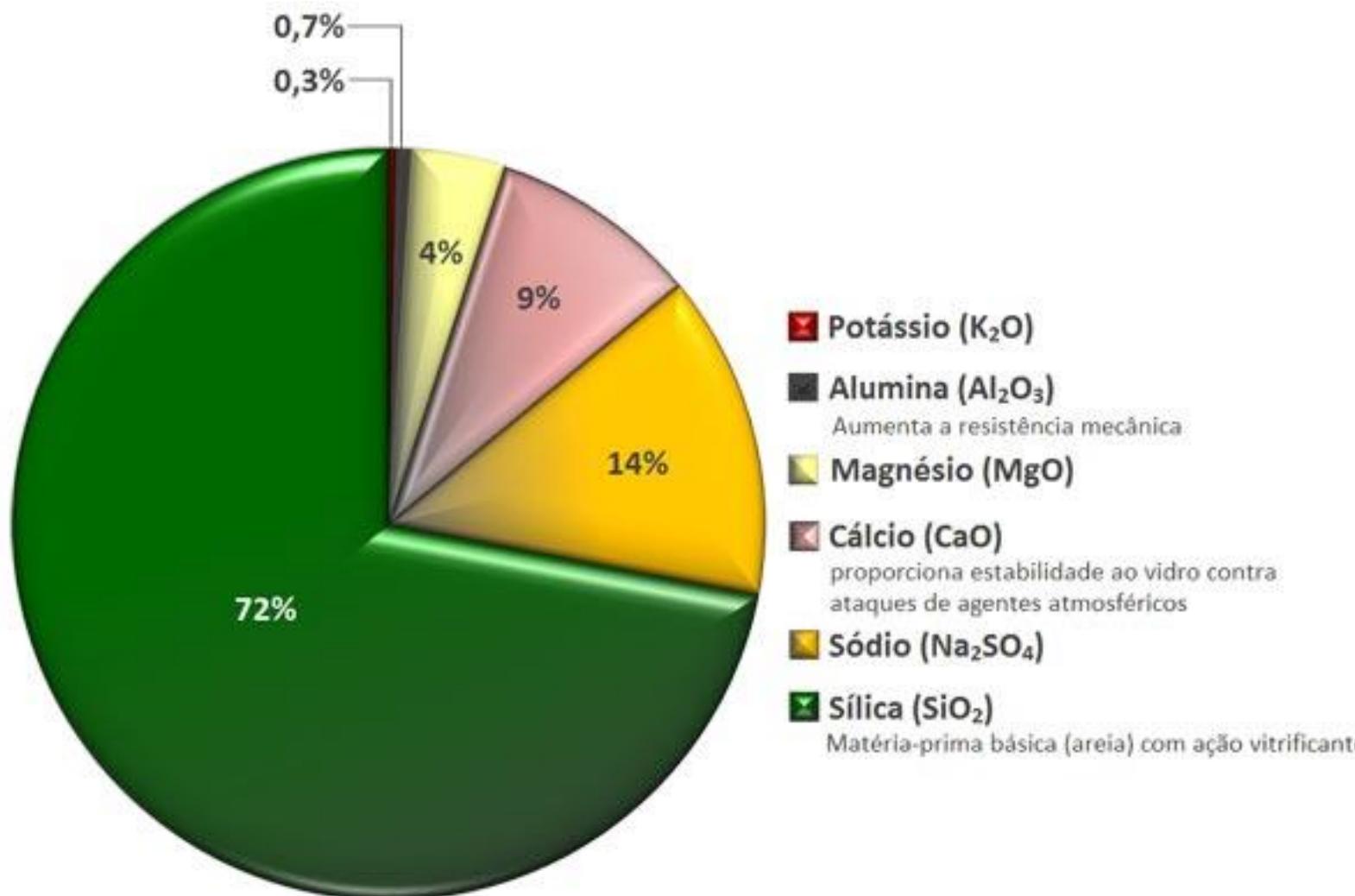
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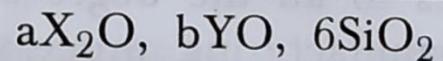
SOURCES: Brit Glass, Glass Links, London Crown Glass, Wikipedia

Composition of Glass

Glass is not a single compound. Raw materials: Sand; soda- ash; limestone; dolomite; feldspar; sodium sulphate.

Commercial glasses may be divided into soda-lime-silica glasses and special glasses, most of the tonnage produced being of the former class. Such glasses are made from three main materials—sand (silicon dioxide, or SiO_2), limestone (calcium carbonate, or CaCO_3), and sodium carbonate (Na_2CO_3).





here

a and b are numbers of molecules,

X = an atom of an alkali metal such as Na, K, etc.

Y = an atom of a bivalent metal such as Ca, Pb, etc.

With this expression, the chemical formulas for *three* groups of glass, as classified above, are as follows:

Soda-lime glass : $Na_2O, CaO, 6SiO_2$

Potash-lime glass : $K_2O, CaO, 6SiO_2$

Potash-lead glass : $K_2O, PbO, 6SiO_2$

• Formers – Network Formation

SiO_2 , B_2O_3 , P_2O_5 , GeO_2 , V_2O_5 ,
 As_2O_3 , Sb_2O_5

• Fluxes – Softeners

Na_2O , K_2O , LiO , Al_2O_3 , B_2O_3 ,
 Cs_2O

• Stabilizers – Provide Chemical Resistance

CaO , MgO , Al_2O_3 , PbO , SrO , BaO ,
 ZnO , ZrO

Raw Materials

- Sodium as Na_2CO_3 (used in soft glass).
- Potassium as K_2CO_3 (used in Hard Glass).
- Calcium as lime stone, chalk and lime.
- Lead as litharge, red lead (flint glass).
- Silica arc quartz, white sand and ignited flint.
- Zinc is zinc oxide (Heat and shock proof glass).
- Borates are borax, Boric acid (Heat and shock proof glass).
- Cullets or pieces of broken glass to increase fusibility.

Properties of Glass

- Brittle(fractures instead of deforming after a limit)
- Transparent (due to absence of free electrons) / Translucent and available in varied colours.
- Unaffected by air, water, acid or chemical reagents except HF
- It is affected by alkalies
- No definite crystal structure means glass has high Compressive strength
- No sharp melting point
- Can absorb, transmit and reflect light

Glass has quite high tensile strength. In very fine wires drawn from melts glass may show tensile strength as high as 7.0×10^5 kg/ cm².

- The ordinary glass thread possess tensile strength of 700 to 1400 kg/ cm²
- The modulus of elasticity of glass is also very high. Both these properties . However show great variation depending upon the composition of the glass and method of manufacturing.
- Glasses have low ductility, low conductivity and low coefficient of thermal expansion.
- Glasses are resistant to acids and many other chemicals hence they are ideal material for storage of chemicals.
- Glasses are very good electrical Insulators
- They have very high softening point and can be used at high temperature.

- It is possible to alter some of its properties such as fusibility, hardness, refractive power etc to suite different purposes
- Possible to obtain glasses with diversified properties.
- Possible to weld pieces of glasses by fusion
- Amorphous- permits to be blown, drawn and continuously be worked on.
Strength of glass is affected by foreign inclusions, internal defect and cords/ chemically heterogeneous areas.
- Can be cleaned by applying methylated spirit, lime wash- drying it and the washing with clean water, rubbing with damp salt and rubbing fine powdered chalk.

GLASS PRODUCTION

Glass production involves 2 main methods:

- **Float glass** process which produces sheet glass
- **Glassblowing** which produces bottles and other containers.

GLASS CONTAINER FACTORIES

Modern glass container factories are 3 part operations: the **batch house, the hot end, and the cold end**

- **Batch house** handles the raw materials
- **Hot end** handles the manufacture proper — the furnaces, annealing ovens, and forming machines.
- **Cold end** handles the product-inspection and packaging equipment.

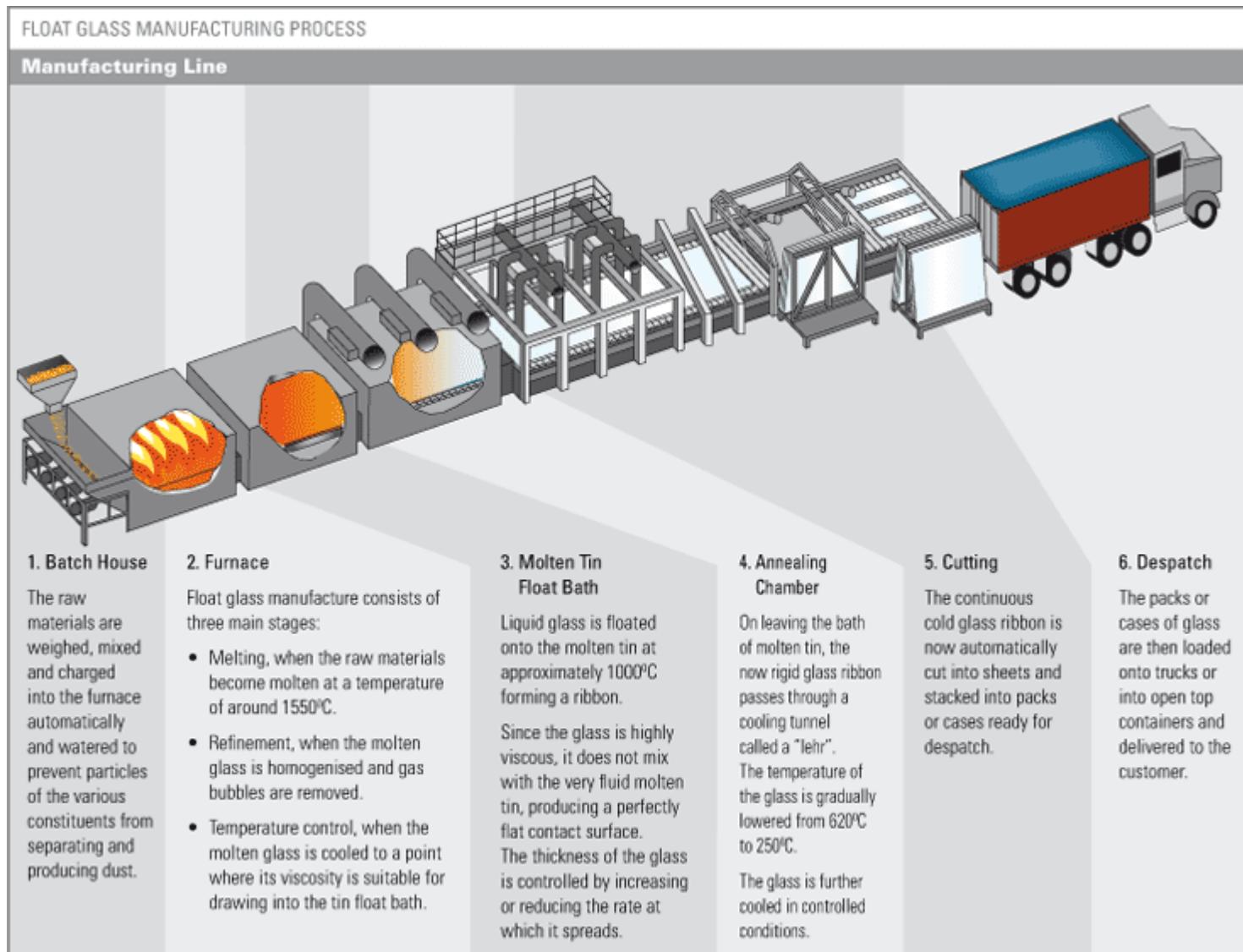
Manufacturing of Glass

Procedure in manufacturing of glass is as follows-

1. Collection of raw material
2. Preparation of batch
3. Melting in furnace
4. Fabrication
5. Annealing

1. Collection of raw material

Depending on the type of glass. Raw material feed: Silica sand, soda ash, dolomite, limestone, sodium sulphate, decolorizers and cullet (waste glass or broken glass pieces) are mixed together to form the raw material batch. Cullet increases fusibility and loss of alkali during the reaction.



No.	Type of glass	Raw materials
1.	Soda-lime glass	Chalk, soda ash and clean sand
2.	Potash-lime glass	Chalk, potassium carbonate (K_2CO_3) and clean sand
3.	Potash-lead glass	Litharge (PbO lead monoxide) or lead sesquioxide (Pb_3O_4), potassium carbonate and pure sand
4.	Common glass	Chalk, salt cake (Na_2SO_4), coke, ordinary sand, etc.

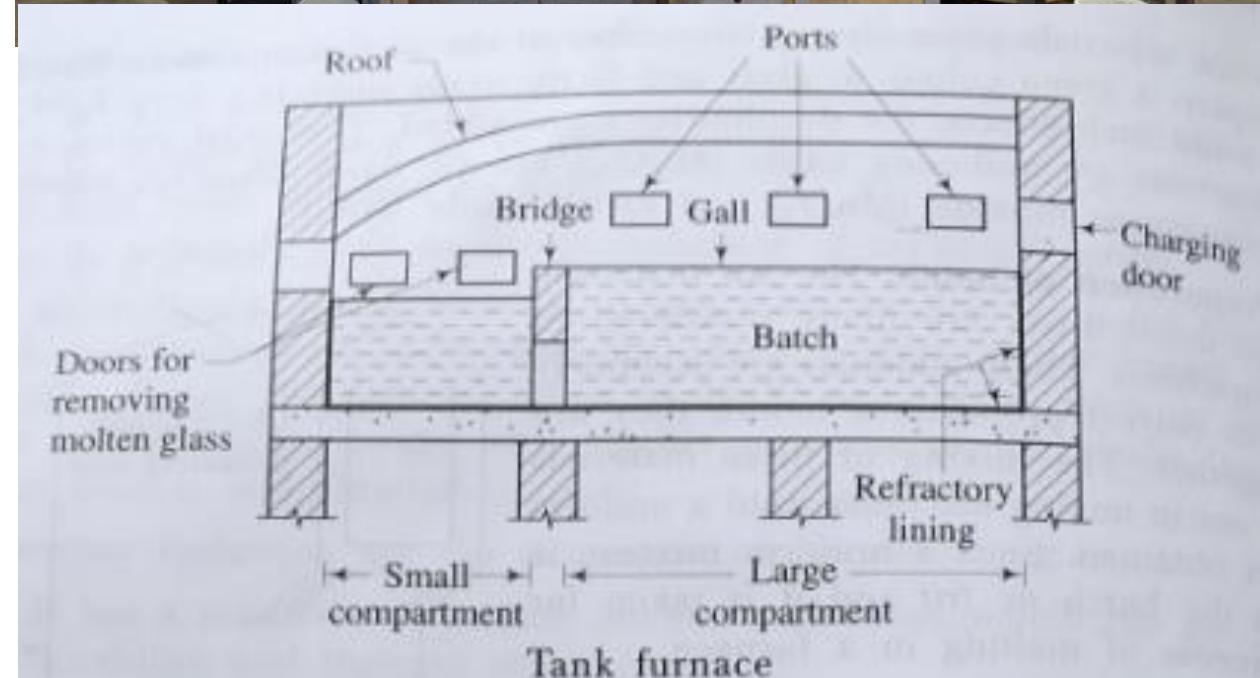
2. Preparation of batch

- The raw material, decolourizer and cullet are finely ground in a grinding machine.
- They are weighed in correct proportions before mixing.
- Mixing of material is done in a mixing machine until uniform batch or frit.
- It is then taken to the furnace for melting.



3. Melting in furnace

- The batch is melted in a pot furnace or tank furnace until the evolution of carbon dioxide, oxygen, Sulphur dioxide, and other gases.
- Pot is a vessel made of fire clay having charging and collecting doors projected for feeding of raw material and removing of molten glass. It is heated by means of produced gas.
- Tank furnace is made of reinforced masonry. Roof id having pecal shape to deflect the gases and heat. doors provided for feeding of raw material and removing of molten glass. A bridge separates the tank into two unequal components.



4. Fabrication

The viscous mass obtained from melting is poured into molds to get different types of articles of desired shape. It is done by hand or machine. Hand fabrication- small scale and machine- large scale production. Different types are blowing, rolling, drawing, casting, pressing and spinning.



5. Annealing

The glass after being manufactured is to be cooled down slowly and gradually. The superficial layer cools down first as it's a bad conductor of heat and the inner portion will be hot and is in a state of strain.



Two types –
• fuel treatment and
• oven treatment

Classification of Glass

Grouped into 4 main categories

- Soda lime glass / Commercial glass
- Potash-lime glass
- Potash-lead glass
- Common glass
- Borosilicate glass.

Soda lime glass / Commercial glass

Known as soda glass or soft glass. It is composed of SiO₂, Na₂O, CaO- sodium silicate and calcium silicate.

Uses- This is the most common type of glass used extensively for domestic purpose; window panes, plate Glass, Light Bulb, and Containers.

Properties-

- Available in clean and clear state
- It is cheap
- Easily fusible at low temperatures
- Possible to blow or weld easily with simple source of heat



- **Potash-lime glass**

Known as Bohemian glass or hard glass. It is composed of potassium silicate and calcium silicate.

Uses- This is used to make glass products to withstand high temperature- combustion tubes etc.

Properties-

- Fuses at high temperature
- Not easily affected by water and other solvents
- Does not melt easily.



- **Potash-lead glass**

Also termed as flint glass. A mixture of lead silicate and potassium silicate.

Uses- in the manufacture of lenses , prisms, electric bulbs, artificial gems etc

Properties

- Fuses easily and turns black and opaque.
- Attacked by aqueous solution and has specific gravity of 3-3.3



- **Common glass**

Known as bottle glass. A mixture of sodium silicate, iron silicate and calcium silicate.

Uses - in the manufacture of medicine bottles.

Properties-

- Does not fuse easily but attacked by acids easily
- A colored glass that may be yellow, green or brown.
- **Borosilicate glass.**

Pyrex is the trade name for Borosilicate.

It is special type of glass made by adding Boron Oxide as the chief additive with Silica at the time of Manufacturing. This property of boron oxide gives the special property of increasing its melting point and resistance against thermal shock. This Glass can be heated or cooled again & again without any risk of damage.

Uses- extensively in high temperature conditions such as Making of Laboratory wares for experiments; Cooking Utensils, telescope and Glass piping.



SPECIAL VARIETIES OF GLASS

Possible to alter chemical, electrical, mechanical and optical properties of glass by changing the basic composition to meet the suitable needs in an effective and economical way.

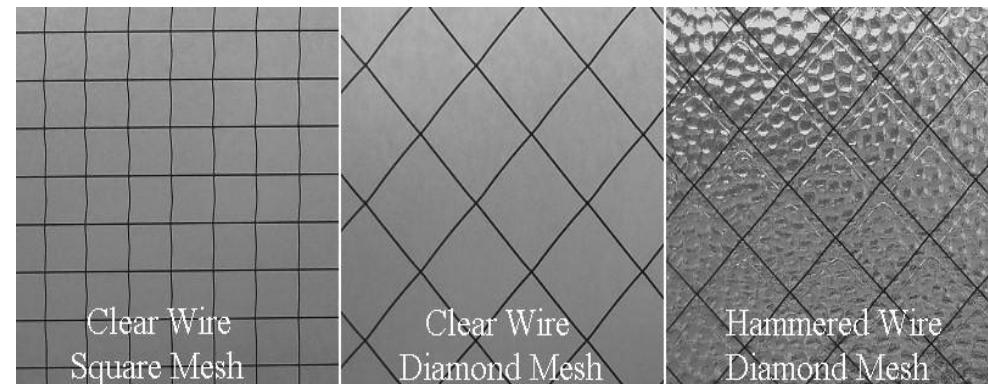
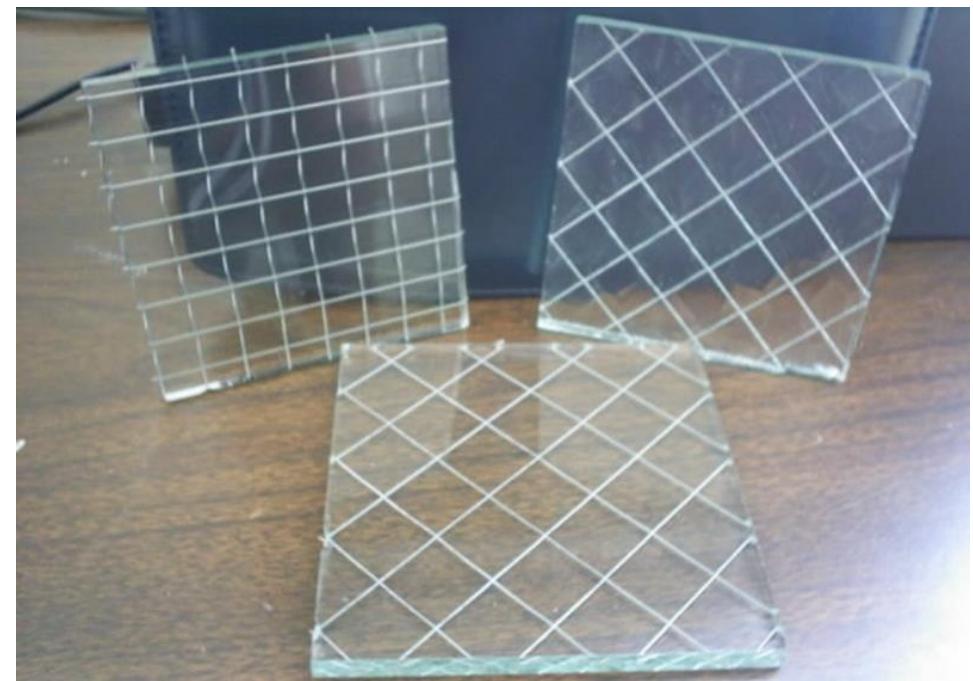
The different types are:---

- Wired glass
- Fiber glass
- Laminated glass
- Bullet proof glass
- Glass block
- Float glass
- Foam glass
- Heat excluding glass
- Patterned glass
- Optical glass
- Perforated glass
- Photo chromic glass
- Pyrax glass
- Saftey glass
- Sealing glass
- Shielding glass
- Silica glass
- Soluble glass
- Structural glass
- Ultra violet ray glass
- Technical glass
- Lead crystal glass
- Amino silicate glass
- Alkali barium silicate glass

WIRED GLASS

Wired glass is a fire-resistant material commonly used in schools and hospitals. The grid of wires that is built into the glass will hold the glass in the frame if it's shattered because of high temperatures, like in the case of a fire.

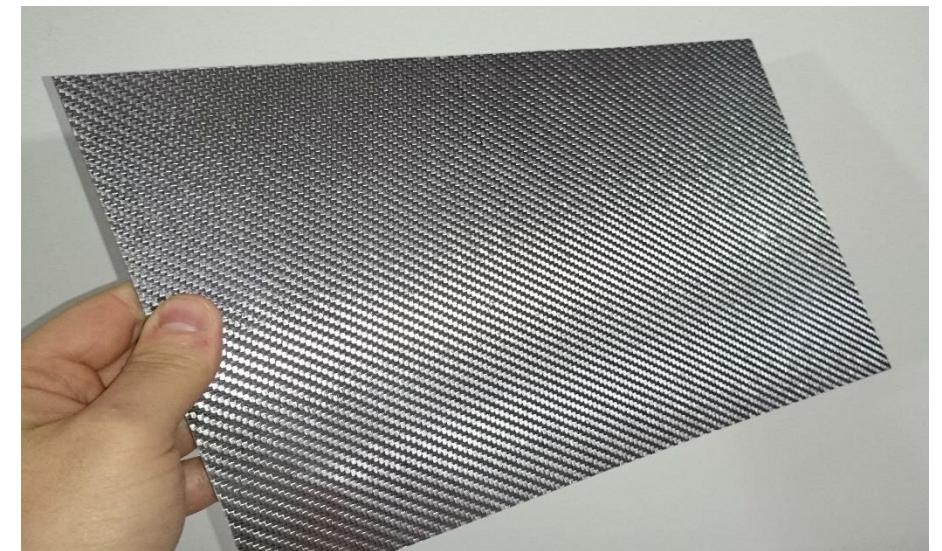
- Fine twisted hexagonal or square wire netting or mesh inserted during the process of rolling.
- May be patterned, smooth rolled or ground and polished.
- When broken, loose pieces of glass are held by the wire netting/ mesh.
- Georgian wire mesh, 13mm provided.
- Thickness: 5 to 7 mm.
- Size: 3300 x 1830 mm.
- **Used** primarily in fire rated windows, doors, skylights and applications requiring a safety glazing material.



FIBER GLASS

Fiber glass is composed of minute glass rods. It is made from glass, the molten glass is spun at a very high speed to produce continuous fine glass fibers.

- Fiberglass consists of fine but solid rods of glass, each of which may be less than one-twentieth the width of a human hair. It is soft to touch and is flexible in nature.
- Does not absorb water and is proof against fire, vermis, water and acids.
- It is found as strands of silk or in a staple form just like wool mass that can serve as heat insulation
- **Used-** wool or cotton fibers to make glass yarn, tape, cloth, and mats. It is used for electrical insulation, chemical filtration, and firefighters' suits. Combined with plastics, fiberglass can be used for airplane wings and bodies, automobile bodies, and boat hulls. Fiberglass is a popular curtain material because it is fire-resistant and washable.



PROPERTIES

1.CHEMICAL RESISTANCE- Fiberglass textile fabrics will not rot, mildew or deteriorate. They resist most acids with the exceptions of hydrofluoric acid and phosphoric acid.

2.DIMENSIONAL STABILITY- Fiberglass fabrics will not stretch or shrink. Nominal elongation break is 3-4 percent. The average linear thermal expansion coefficient of "E" glass is 5.4 by 10.6 cm/cm/°C.

3.GOOD THERMAL PROPERTIES- Fiberglass fabrics have a low coefficient of thermal expansion and relatively high thermal conductivity. Glass fabrics will dissipate heat more rapidly than asbestos or organic fibers.

4.HIGH TENSILE STRENGTH- Fiberglass yarn has a high strength-to- weight ratio. Fiberglass yarn is twice as strong as steel wire.

5.LOW MOISTURE ABSORPTION

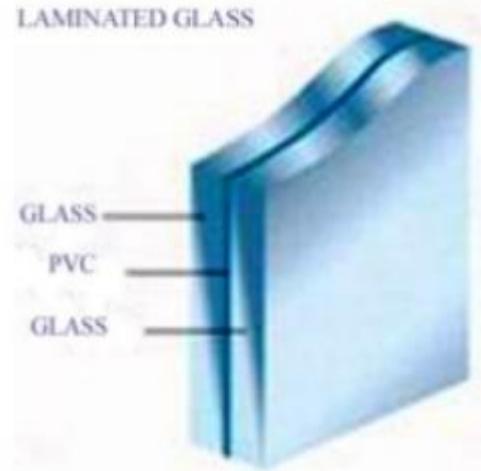
6.ELECTRICAL INSULATION

7.OTHER • resistance to corrosive attacks; • tight structure; • superior shock and wear resistance; • lightweight; • simple assembling; • damage and breakage resistance; • aesthetical and attractive look; • at temperatures below zero it doesn't become slippery or covered with ice • hardly bendable material • superior durability

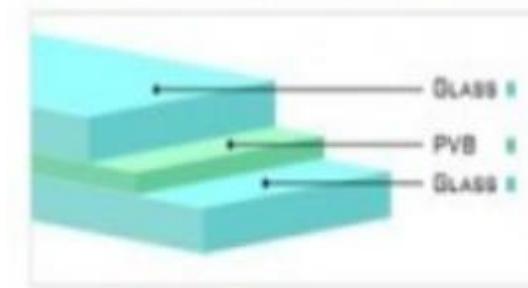
LAMINATED GLASS

It is a type of safety glass / shatter proof glass. Laminated safety glass is a “sandwich” made by combining alternate layers of flat glass and plastics.

- The outside layer of glass may break when struck by an object, but the plastic layer is elastic and so it stretches.
- The plastic holds the broken pieces of glass together like a web and keeps them from flying in all directions.
- The laminated glass has other benefits, as the reduction of external noise entrance and the protection against UV rays.
- Used- where broken glass might cause serious injuries, as in automobile windshields. As cover, facades, balconies, guard rail, doors, windows, partitions, showcase, floorings and others.



Laminated vs. Tempered Glass



Laminated
Glass



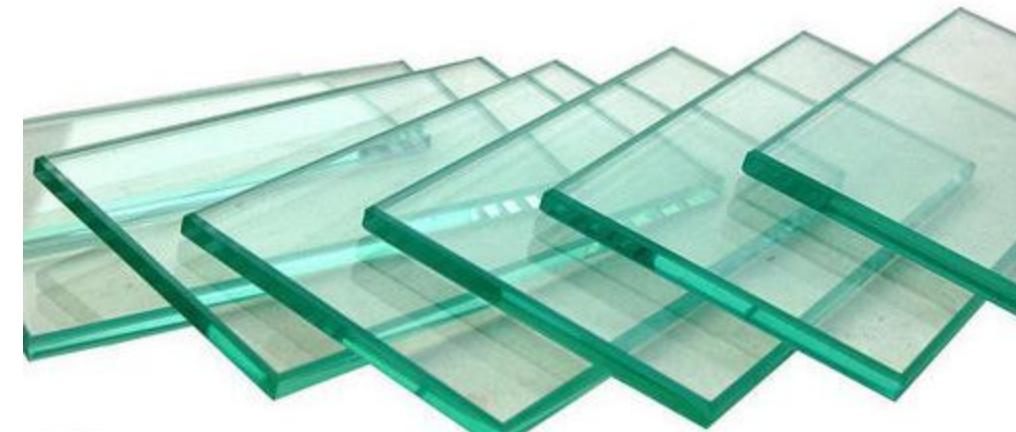
Tempered
Glass

TOUGHENED GLASS / TEMPERED GLASS

Toughened glass is another type of safety glass.

- Pieces of sheet or plate glass suspended in electric furnace 620 degrees C until soft and suddenly cooled by blowing air on both sides.
- It is important to note that the treatment must be applied only after all cutting and processing has been completed, as once 'toughened', any attempt to cut the glass will cause it to shatter.
- Toughened glass withstands 500% more resistant to heat and shock than the regular glass.
- Additional compressive stresses in the surfaces makes the glass stronger, also offers thermal resistance and it's also waterproof.
- Can safely accommodate high tensile forces due to the pre-stress.
- Fracture can occur once the pre-stress has been exceeded.
- Tempered safety glass, is a single piece that has been given a special heat treatment. But it can be several times stronger.
- It is hard to break even when hit with a hammer. When it does break, the whole piece of glass collapses into small, dull-edged fragments.

Uses- for all-glass doors in stores, side and rear windows of automobiles, and basketball backboards, and for other special purposes.

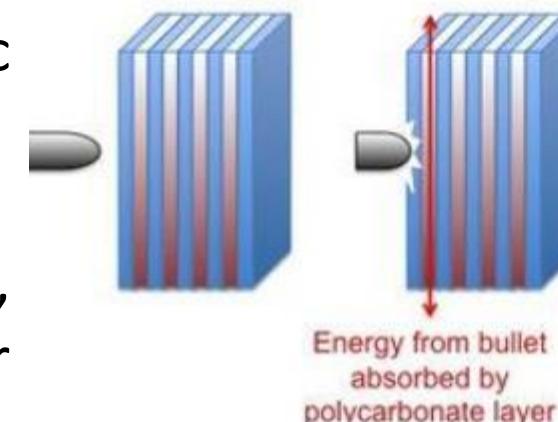


BULLET PROOF GLASS

- Bullet-resisting glass is thick, multilayer laminated glass. Made by sandwiching alternate layers of vinyl-resin plastic between several layers of plate glass.
- Outer layers are made thinner than the inner layers. Special care is taken while heating and cooling of the different layers.
- This glass can stop even heavy-caliber bullets at close range. Do not allow bullet to pierce through it.
- Bullet-resisting glass is heavy enough to absorb the energy of the bullet, and the several plastic layers hold the shattered fragments together.
- Thickness of glass vary from 15mm to 75mm
- **Uses-** in bank teller windows and cash booths, jewelry stores, display cases, in windshields for military tanks, aircraft, and special automobiles.



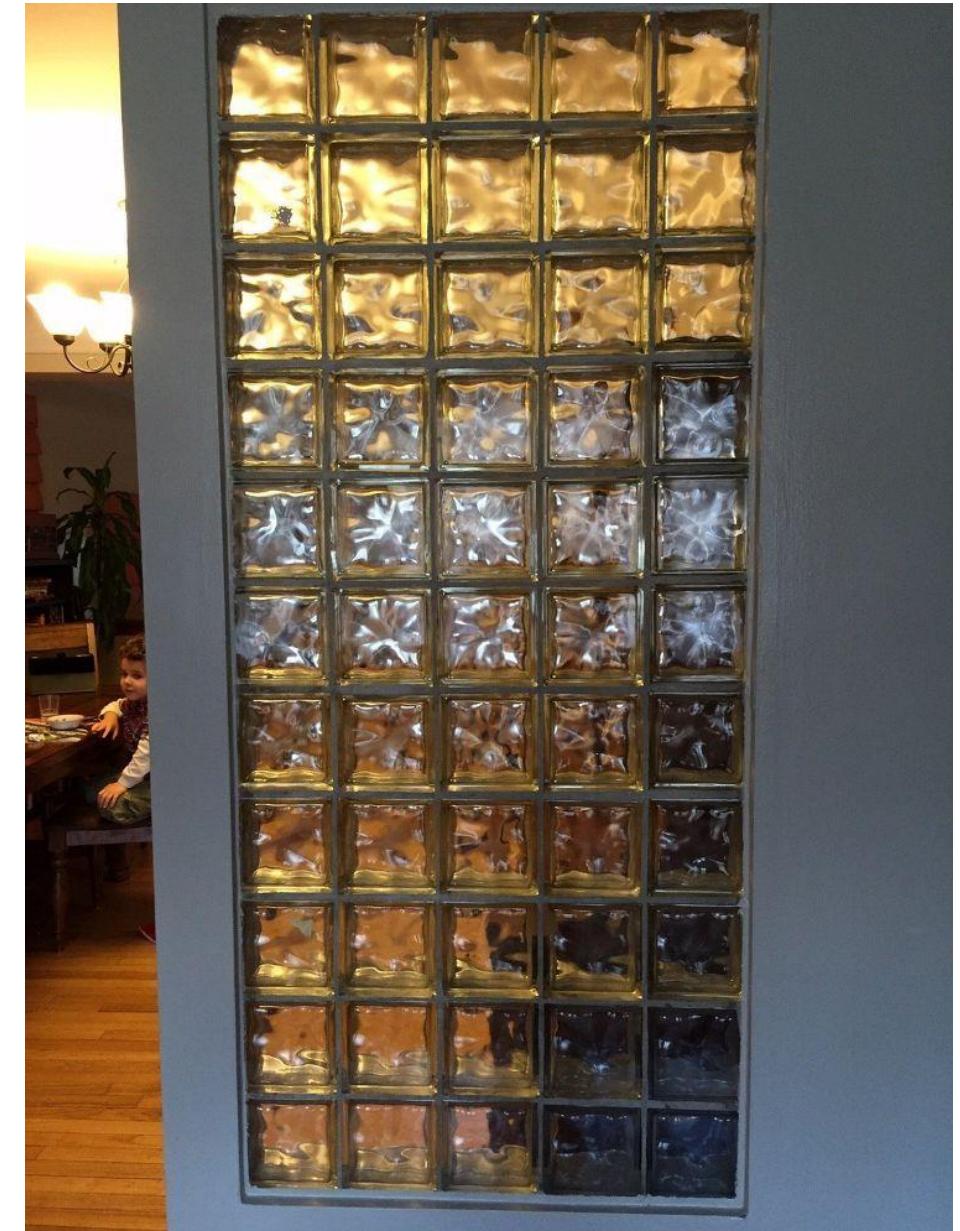
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Glass.com.cn



The first layer of glass may shatter when the bullet hits it, however the next layer of polycarbonate is more elastic so it moves when the bullet hits it which dissipates the energy of the bullet horizontally. This takes the energy away from the bullet slowing it down. If enough energy is taken from the bullet it will eventually stop it from passing through.

GLASS BUILDING BLOCKS

- Glass building blocks are made from two hollow half-sections of pressed glass sealed together at a high temperature.
- The blocks are laid like bricks to make walls and other structures.
- The edges are coated with a girt bearing plastic material or silicon sealants so that permeant and effective bond with mortar is ensured.
- The two outer, exposed surfaces may be smooth or textured, coloured and have decorated surfaces.
- Glass building blocks are good insulators against heat or cold because of the dead-air space inside.
- Easy to clean and can be well maintained.
- Excellent in light transmission. Walls of glass blocks meeting fire resistance.
- They are not intended to carry superimposed loads.
But can carry own weight up to a height of 6 m.



- Can resist lateral wind loads for individual panels not exceeding 11m.sq in area.
- Sizes – 10cm thick and 15cm, 20cm, 30cm square dimensions.
- Srilankan and Indonesian varieties: Rs 80/piece European clear: Rs 350/pc European coloured: Rs 450/pc Chinese clear: Rs 52/pc Chinese coloured: Rs 152/pc
- **Used** in the construction of non- load bearing external panel walls and partition walls, skylights, insulation.



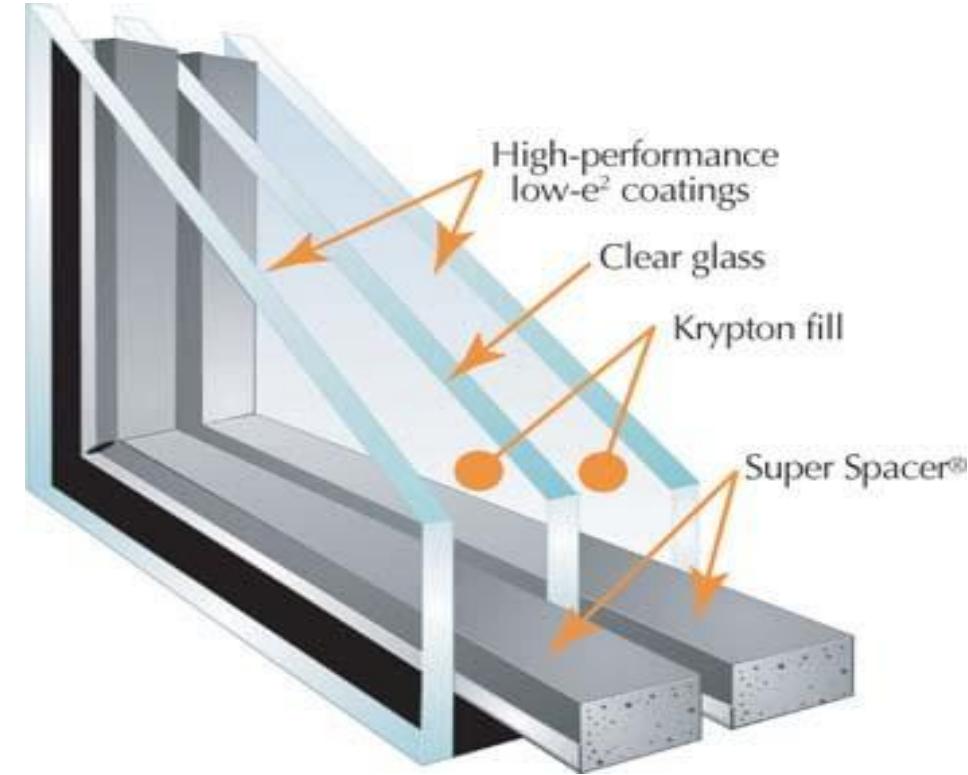
FLOAT GLASS

- Float glass gets its name from the method of production used to manufacture it.
- The molten glass is 'floated' onto a bed of molten tin - this produces a glass which is flat and distortion free. It is further annealed to remove all stresses.
- Float glass can be cut using a glass cutter and no special equipment is necessary.
- Float glass is suitable for fixed and opening windows above waist
- It produces very smooth, thin, large glass panels and highly transparent.
- Consumes 30-40% less energy and is environment friendly.
- Cost effective compared to brick wall, finishing material, painting etc.
- It is ideal for solar applications due to high light transmission leading to higher efficiency.
- It is tougher and more scratch resistant, having high optical clarity.
- Available in thicknesses 2-19 mm
- **Used** in residential and commercial complexes, furniture articles, mirrors, windows, curtain walls and doors.



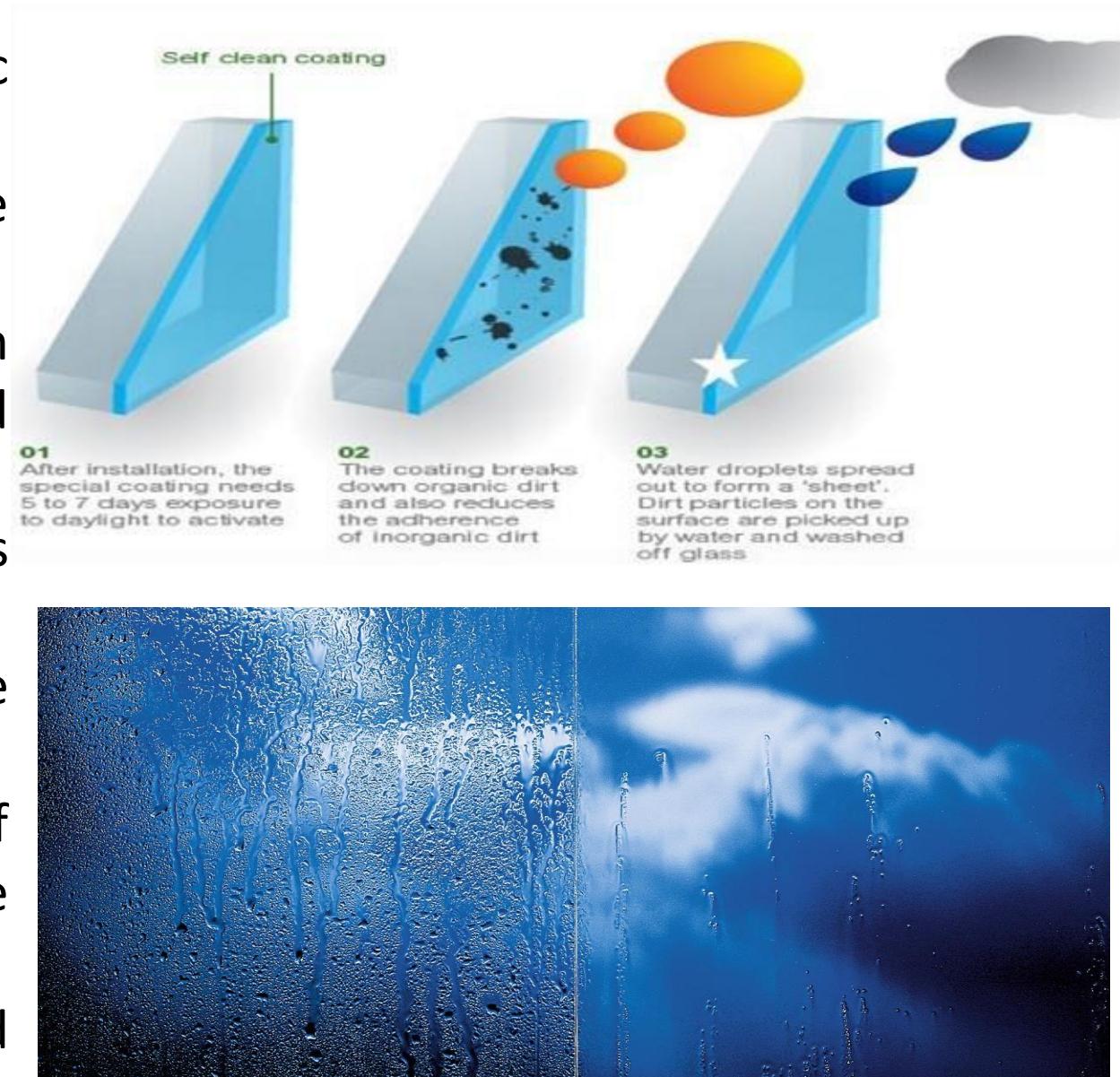
ENERGY EFFICIENT GLASS

- Some manufacturers produce float glass with a special thin coating on one side which, allows the sun's energy to pass through in one direction while reducing the thermal transfer the other way.
- The principle behind this is the difference in thermal wavelength of energy transmitted from the sun and that transmitted from the heat within a room.
- The special coating often gives a very slight brown or grey tint to the glass. The coating is not very robust and would not last very long if subjected to normal cleaning or external weather conditions
- **Used** only in sealed double (or triple) glazed units with the special coating on the inside



SELF CLEANING GLASS

- Float glass with a special thin photo catalytic coating on one side
- Uses the ultraviolet rays to breakdown the dirt on the surface using photo voltaic effect.
- It also has hydrophilic properties which when rains helps to clean out the loosened dirt from its surface.
- Both these properties help to let the glass stay cleaned for long periods.
- Bird droppings and similar dirt will take longer to clean off.
- Abrasive cleaning is not permitted and if cleaned externally it will take time for the self cleaning process to be active again.
- **Used** only in sealed double (or triple) glazed units with the special coating on the inside



FOAM GLASS

- It is prepared in the form of rectangular blocks.
- Glass and carbon are finely ground and mixture of both melted in a furnace then takes the form of a block foam.
- At the time of melting, the mixture expands and gets a form of black foam.
- Foam glass, when it is cut, looks like a black honeycomb.
- It is filled with many tiny cells of gas.
- Can be cut like wood and be cut into various shapes with a saw.
- Floats in water. Fire proof, ,rigid and excellent heat insulator.
- **Used** as a heat insulator in buildings, on steam pipes, and on chemical equipment. Substitute for cork , in refiditating and air conditioning industry.

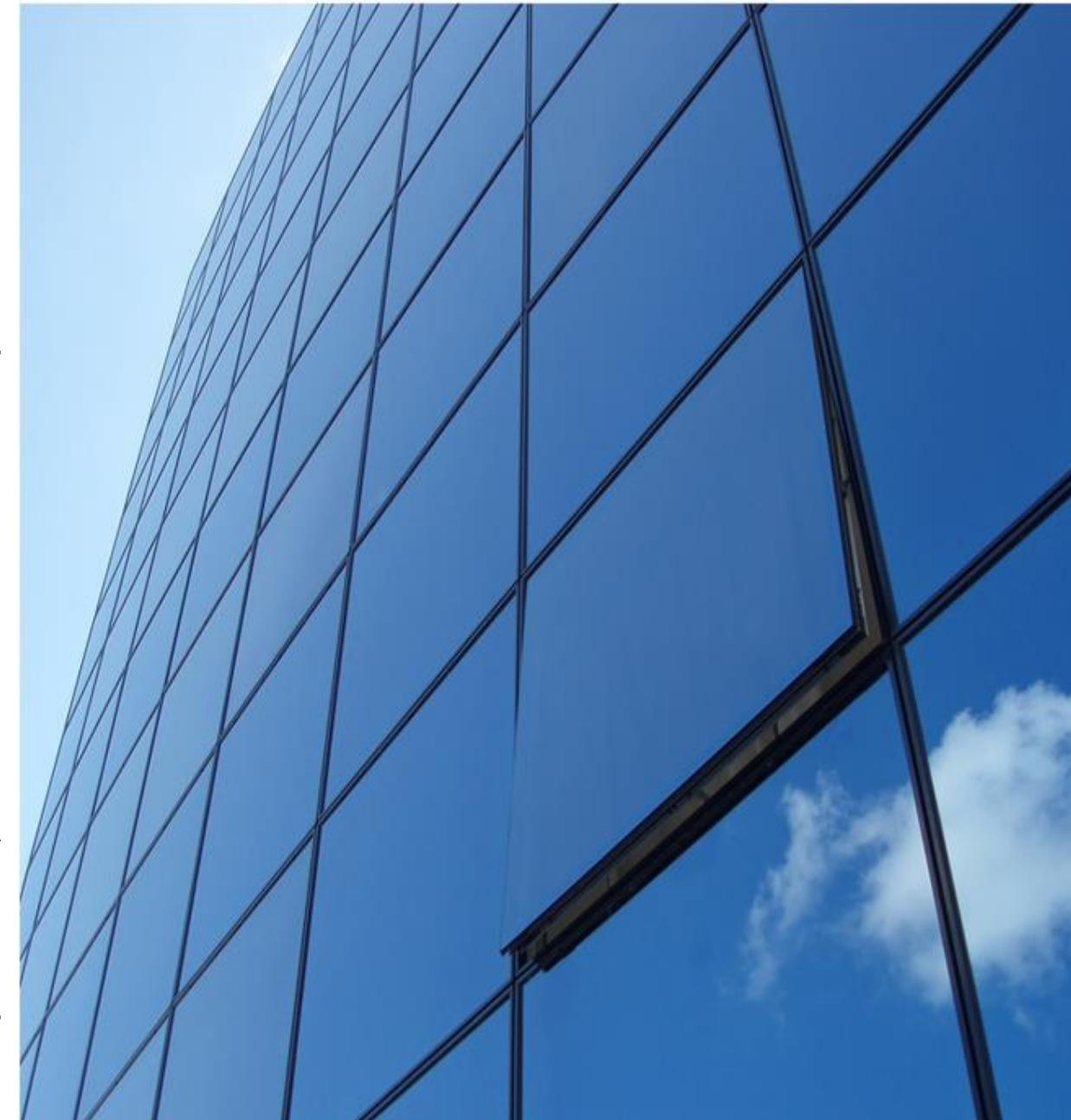


HEAT EXCLUDING GLASS

- Heat-resistant glass is high in silica and usually contains boric oxide.
- It allows light to pass through it and eliminates heat.
- Provide insulating effect. It is made of two or more plates of glass separated by 6mm to 13mm of dehydrated captive air. Edges are sealed of the glass.
- Used in windows of high class coaches, window panels of important buildings. Etc.

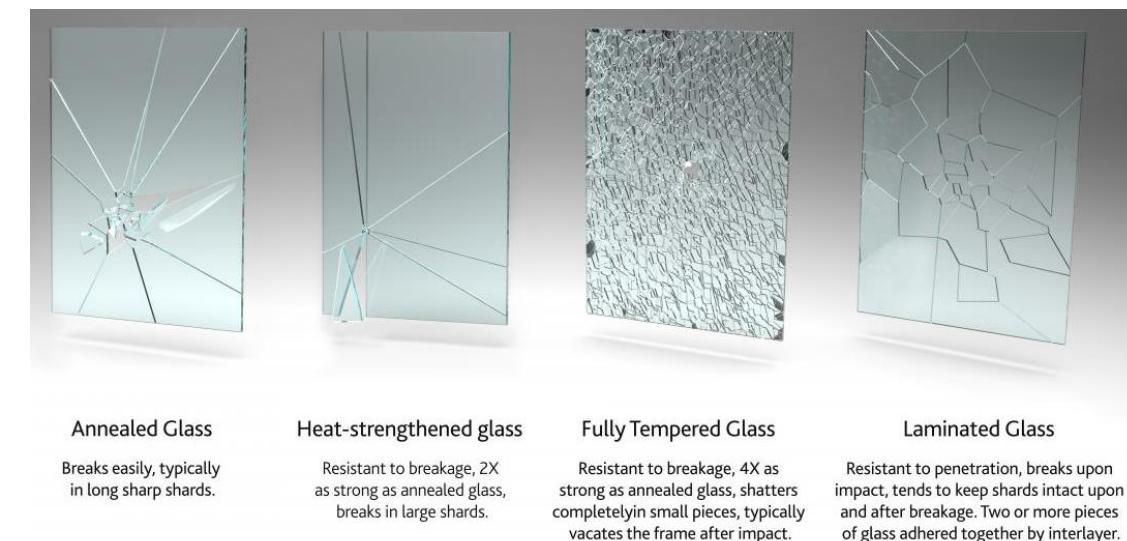
Properties

- Shading co-efficient : 0.52 for 6 mm thick gray to 0.95 for 6 mm thick clear monolithic.
- Visible light transmittance : 37% for 6mm thick gray to 87% for 6mm thick clear monolithic.



HEAT STRENGTHENED GLASS

- Heat strengthened glass is a type of tempered glass which has been strengthened thermally by inducing a surface compression of 422 to 658 kg/cm² as compared to a range of 770 to 1462 kg/cm² in case of fully tempered glass. It is a separate process.
- It is valued for its mechanical strength, which is twice that of normal annealed glass and half of fully tempered glass.
- Density (approximate) : 2.42 – 2.52 g/cm³
- Tensile strength : 120 to 200 N/sq. mm
- Compressive strength : 1000 N / sq. mm
- Modulus of elasticity : 70
- Available thickness : 3 mm - 19 mm
- Sizes up to : 2440 mm x 3660mm
- Visible light transmittance : 20% for 6mm thick bronze to 90% for 6mm thick clear



Annealed Glass

Breaks easily, typically in long sharp shards.

Heat-strengthened glass

Resistant to breakage, 2X as strong as annealed glass, shatters in large shards.

Fully Tempered Glass

Resistant to breakage, 4X as strong as annealed glass, shatters completely in small pieces, typically vacates the frame after impact.

Laminated Glass

Resistant to penetration, breaks upon impact, tends to keep shards intact upon and after breakage. Two or more pieces of glass adhered together by interlayer.

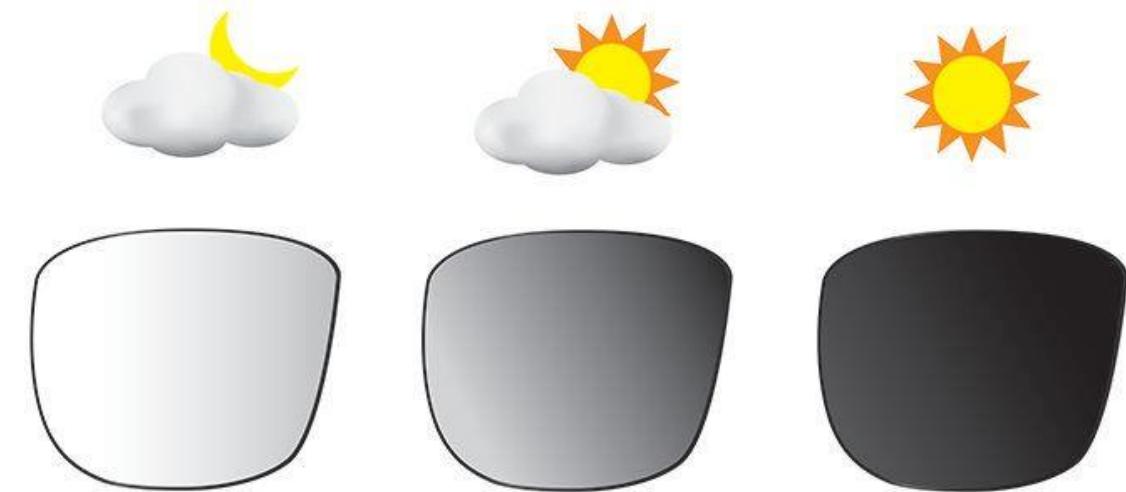
PHOTO CHROMIC GLASS

- Photochromic glass darkens when exposed to ultraviolet rays and clears up when the rays are removed.
- Useful as a sunshield.
- This automatic property of glass is due to the presence of silver bromide
- Photochromic glass is used for windows, sunglasses, and instrument controls.

PERFORATED GLASS

- This type of glass made with the help of projections attached to rollers.
- Perforations are made in the sheet glass using rollers.
- The perforations can be made during or after the manufacturing process.
- **Used** for panels in ventilators

PHOTOCHROMIC LENS



PATTERNEDE GLASS

- Sometimes referred to as “figured” or “rolled” glass.
- Has a pattern or texture impressed on one or both sides in the process of rolling during manufacture.
- This glass surface has a patterned decorative design which provide translucency and some degrees of privacy. • Patterns are classified as decorative or glazing i.e., used primarily for their functional properties. range of coloured tints as well as plain.
- the patterned side is usually on the inside so that atmospheric dirt can easily be removed from the relatively flat external face. Is difficult to clean as dust settles between the crevices
- Thickness: 4mm, 6mm,
- Sizes: 2140 x 1280 mm, 2140 x 1320 mm
- Uses: decorative glazing of windows, bathroom partitions, door.



OPTICAL GLASS

- The raw materials must be pure so that the glass can be made almost flawless.
- The care required for producing optical glass makes it expensive compared with other kinds of glass.
- The important properties are refractive index and dispersion. The index is to measure of how much the glass bends light.
- Dispersion measures of how the glass splits white light to different rainbow colours.
- **Uses-** in eyeglasses, scientific instruments, microscopes, telescopes, camera lenses, and many instruments for factories and laboratories.



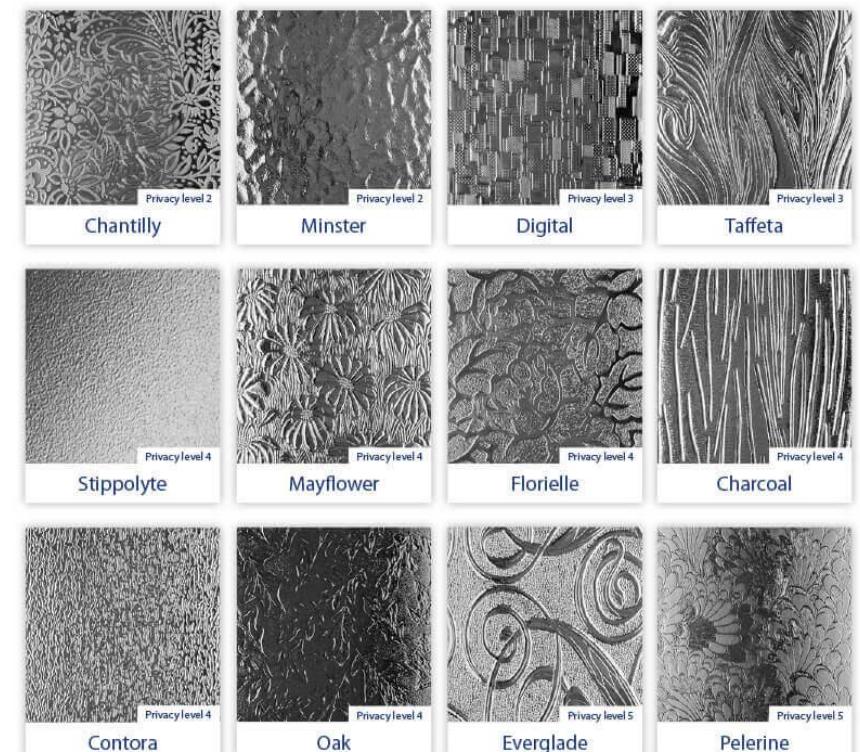
SEALING GLASS

- Glass is used to seal metals of electronic and electrical devices.
- It is matched with the thermal expansion of the metal used.
- Discharge lamps- borosilicate alkaline, aluminous silicate glasses used
- For electrical insulation- lead glasses ,30-60% lead oxide is used.



GROUND GLASS OR OBSCURED GLASS

- Made by grinding one side of the glass or melting powdered glass upon it.
- obscured glass is glass that allows light through it but not clear vision. It is a glass that is obscured by frost, etchings, coats, or other designs.
- This particular glass is very helpful for adding privacy.
- Used where light is required without transparency therefore useful for public toilet, office doors, partition.



SHIELDING GLASS

- Variety of polish lead glass.
- Contain heavy elements lead oxide as one of the elements
- **Used** for windows through which high radiations are to be observed. X- Ray, MRI window panels.
- Depending on type of radiation, the shielding is determined.



STRUCTURAL GLASS

- They are in the form of glass –crete squares which are set in cement concrete and reinforced with steel frames.
- They are popularly known as glass bricks.
- The semi prism formed on the underside collect light and project it on te other side of the dark side.
- Used- pavement lights, partitions, lantern lights, light structural members.



TINTED GLASS

- Manufactured by adding a dye at the molten glass stage
 - Used to minimize solar heat gain and glare while it also absorbs heat.
 - Available in grey, bronze, green, blue and blue/green
 - Allows for increased control of comfort and energy usage
-
- Sizes available:
 1. Grey and Bronze - 4mm, 5mm, 6mm, 8mm, and 10mm
 2. Blue - 6mm
 3. Green - 5mm, 6mm, and 10mm
 4. Blue/Green - 6mm and 10mm

THICKNESS	COST/SQ FT (RS)
3MM	22
4MM	30
5MM	35
6MM	38
8MM	70
10MM	90



SOLUBLE GLASS

- Made by melting quartz sand, grinding and mixing it with soda ash, sodium sulphate or potassium carbonate.
- The melting is carried out in glass tanks between 1300- 1400 degree celcius and takes 7 – 10 hrs.
- The resultant glass mass flows out from the furnace, cools rapidly and breaks into lumps, known as silica lumps.
- The silica lumps are transported in containers and in liquid form in glass bottles.
- This glass under normal conditions are soluble in water.
- **Used for making acid – resistant cement.**



ULTRA VIOLET RAY GLASS

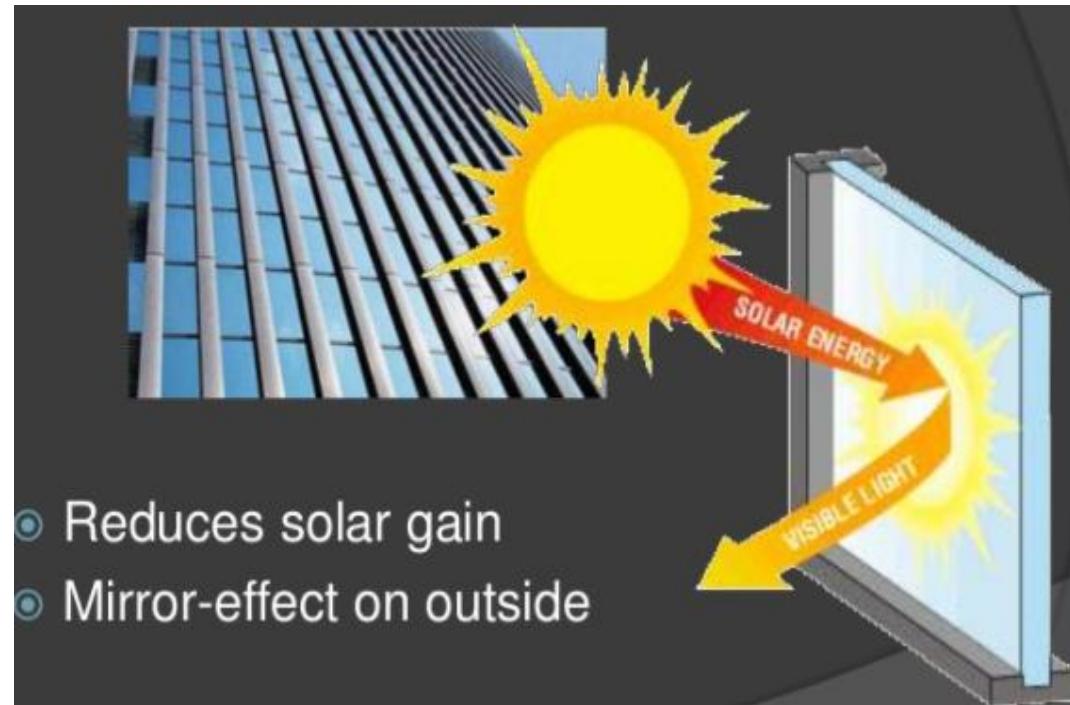
- Made of raw mixture with minimum admixture of iron, titanium and chrome.
- This glass effectively transmits ultra violet rays even if its not in the direction of rays of the sun.
- Can transmit 75% of ultra – violet radiation more than common glass. Ultraviolet glass absorbs the ultraviolet rays of the sun but transmits visible light.
- Widely used in window pane of schools and hospitals.

SOLAR CONTROL GLASSES

- Also known as reflective glass, sun protection glass or solar control
- Being indicated for places where there is great incidence of solar rays, like facade of buildings, windows, doors, balconies and cover, as it provides a better thermal comfort.

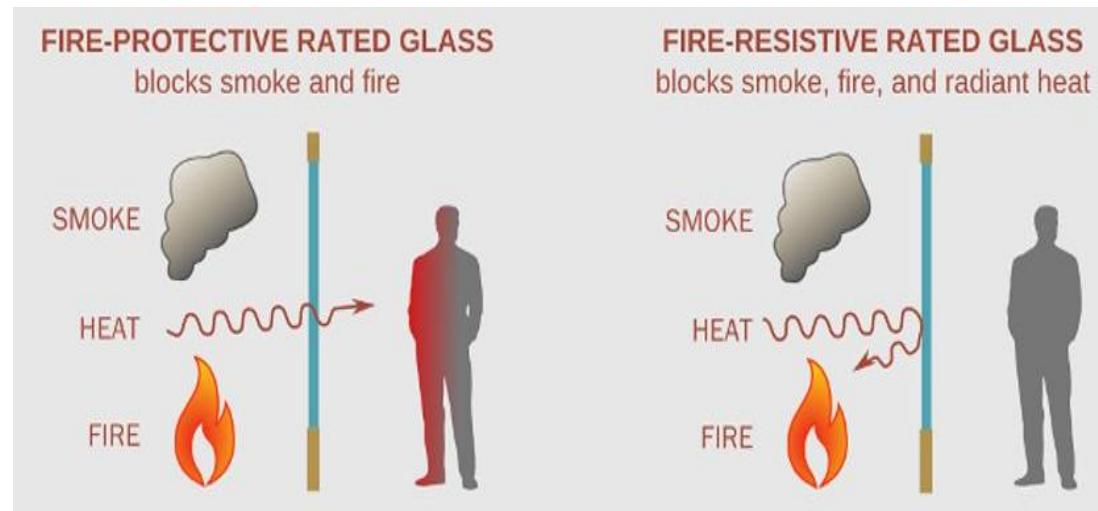


- Function to reduce the entrance of heat inside the environment, besides producing a control in the entrance of light for the interior of the buildings. Glazing without heat buildup.
- Coating of a metal compound applied on one surface by chemical deposition.
- Reflects light and 2/3 solar heat away
- May be applied on any type of glass and thickness upto half an inch
- **Uses:** principally used in curtain wall glazing and structural glazing, train windows(AC compartments), doors and windows of commercial buildings, partitions and internal wall cladding.
- Disadvantages: Causes light pollution and is hazardous to traffic.
- Thickness & Cost 4-6mm Rs 53/sqm 8-12mm Rs 63/sqm

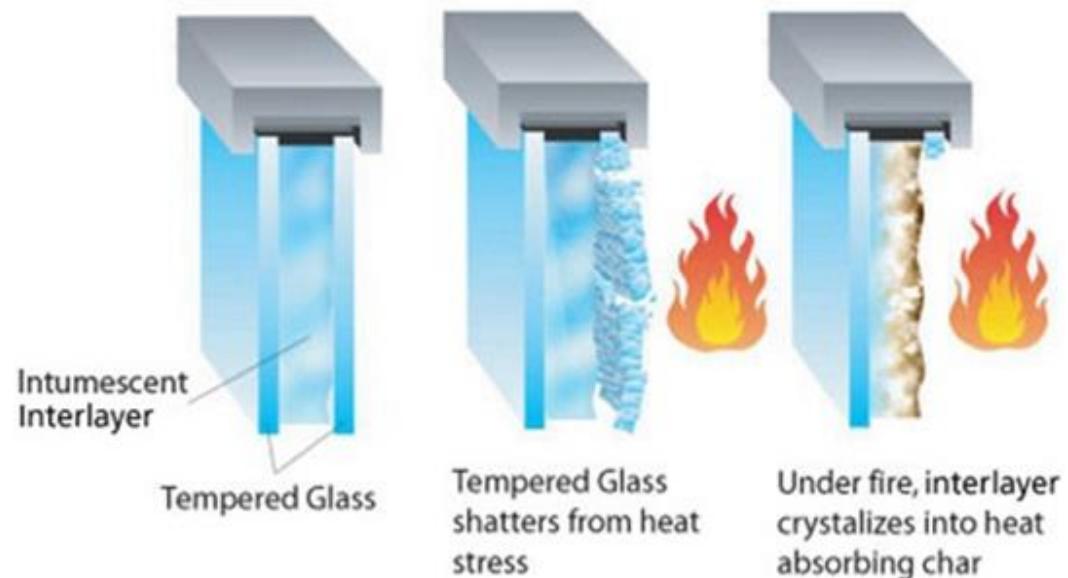


FIRE RESISTANT GLASS / FIRE PROTECTION GLASS

- Buildings that are vulnerable to fire are fundamentally unsustainable.
- Three technology types – wired glass, modified super-toughened glass and a special proprietary clear intumescent interlayer technology.
- The latter not only protects against flames and smoke, but also against the heat of a fire, and heat transfer mechanisms.
- Resist 1000 deg C for 90-120 mnts.
- All these products can be combined with other functional glasses to provide additional features, such as solar control, thermal insulation, noise control, and impact safety.
- Fire-resistant products offer passive and sustainable protection, with a long-lasting life cycle and reliability.

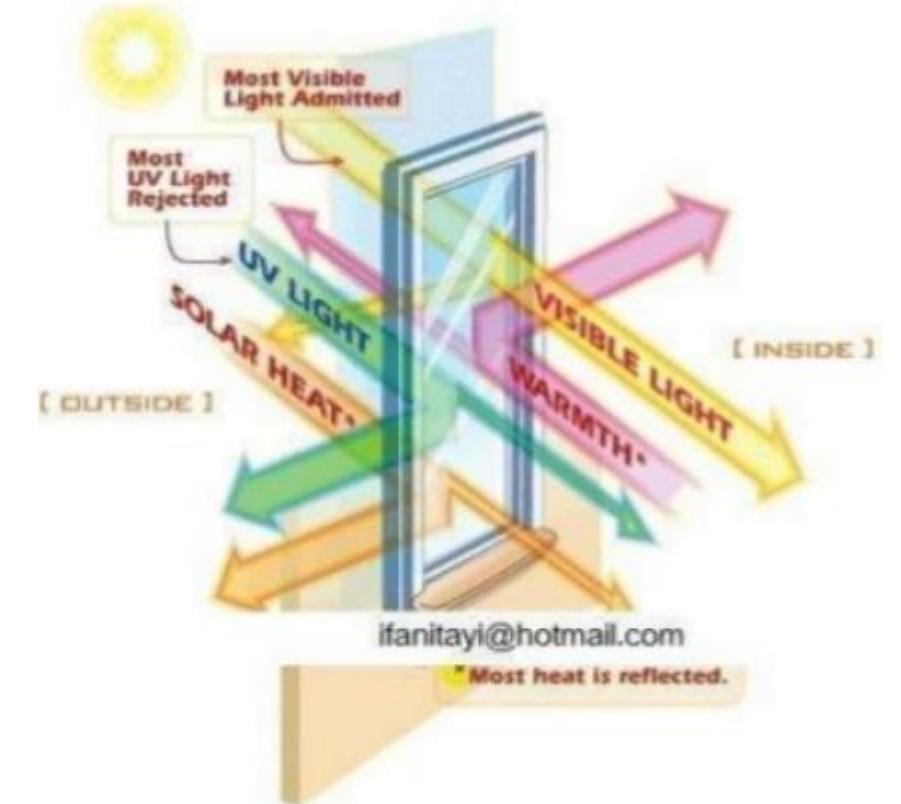


How it works:



LOW EMISSIVITY GLASS

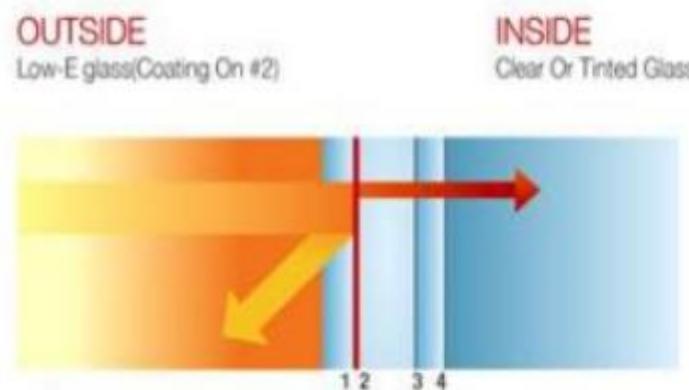
- "Low-E Glass" refers to a series of high-performance low-emissivity products.
- The vacuum sputtering process coats glass surfaces with several layers of different materials.
- Among these, a silver layer effectively reflects infrared rays while maintaining excellent thermal performance.
- Beneath the silver layer is an anti-reflective tin oxide (SnO_2) base layer that increases the transparency of the glass. The main function of the layer is to protect the other coating layers.
- Above the silver layer is an isolating nickel-chromium (NiCr) alloy coating. This product offers the high transparency, low reflectivity, good thermal insulating and energy-saving properties required of modern architectural glass.



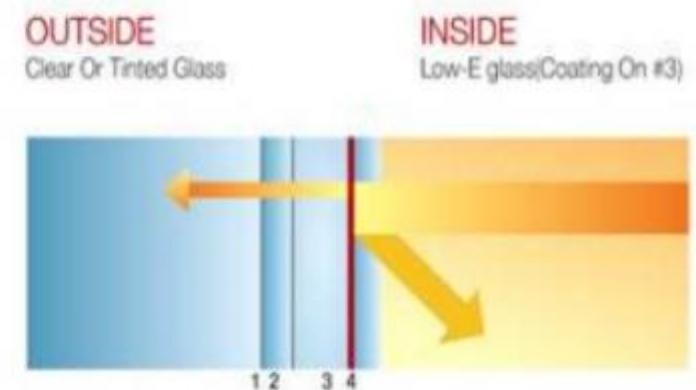
- Almost neutral in color.
- Highly transparent to visible light (wavelength 380nm ~780nm), will not cause significant glare problems due to high reflectance of visible light.
- Allows most sunlight in the visible range to enter without altering its natural color. Provides excellent natural illumination and saves energy by reducing the need for artificial lighting.

Benefits

- Relatively high reflectance of infrared radiation (wavelength 780nm~ 3,000nm). In particular, reflects nearly all long-wave infrared(wavelength over 3,000nm).
- Blocks the entrance of large amounts of heat, and leaves interior comfortably cool in the summer and warm in the winter



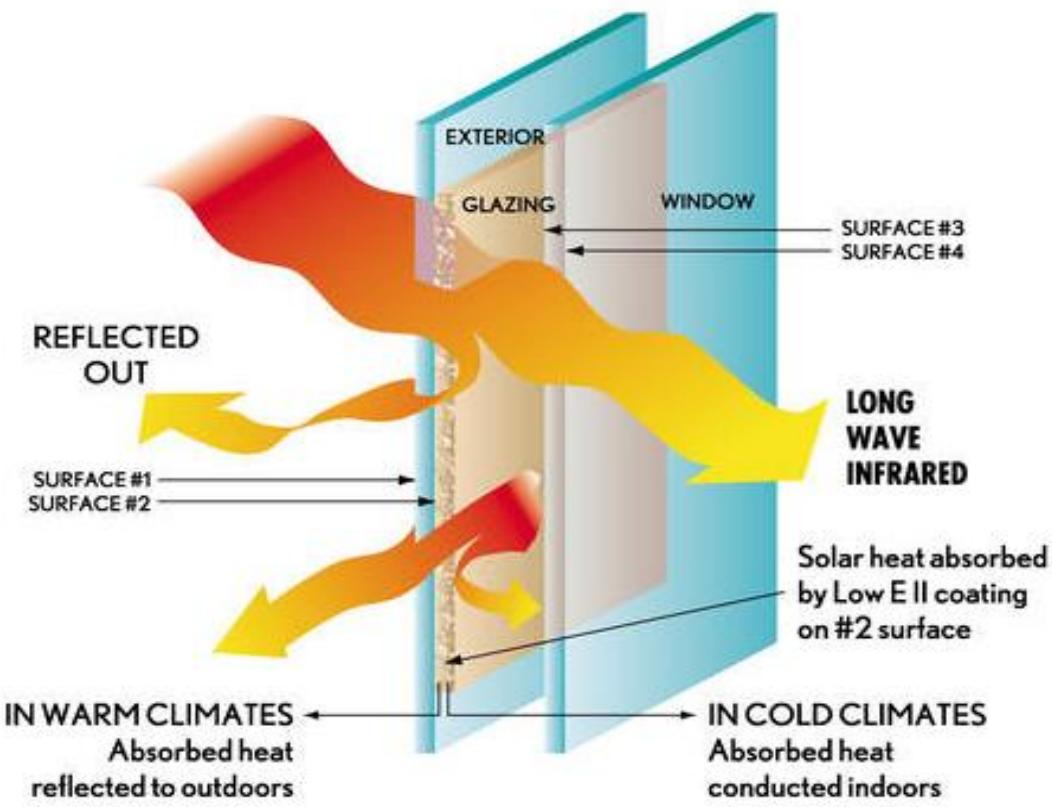
In tropical or subtropical areas, the Low-E coating should be positioned on #2 surface (facing inward from outside the building)



In cold or temperate areas, the Low-E coating should be positioned on #3 surface (facing inward from outside the building)

USE- Right assembly suitable for energy- saving glass curtain walls and skylights according to location

Low E II

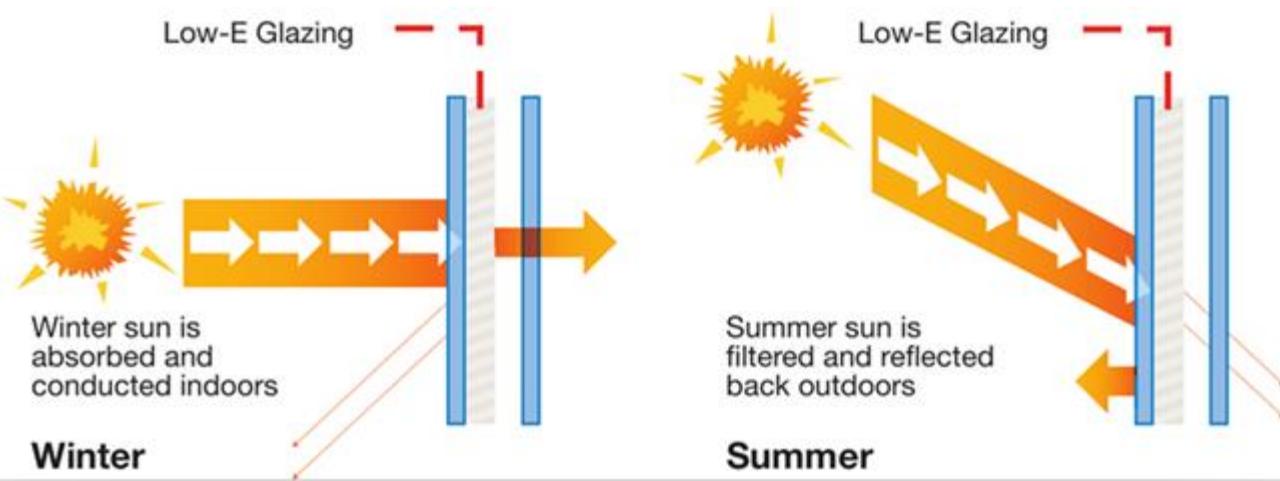


Types of Product :

- Single Low-E Glass (SLE)
- Double Low-E Glass (DLE)
- Low-E-Sun Layer Glass (LES)
- Ti-based Low-E Glass (TLE)

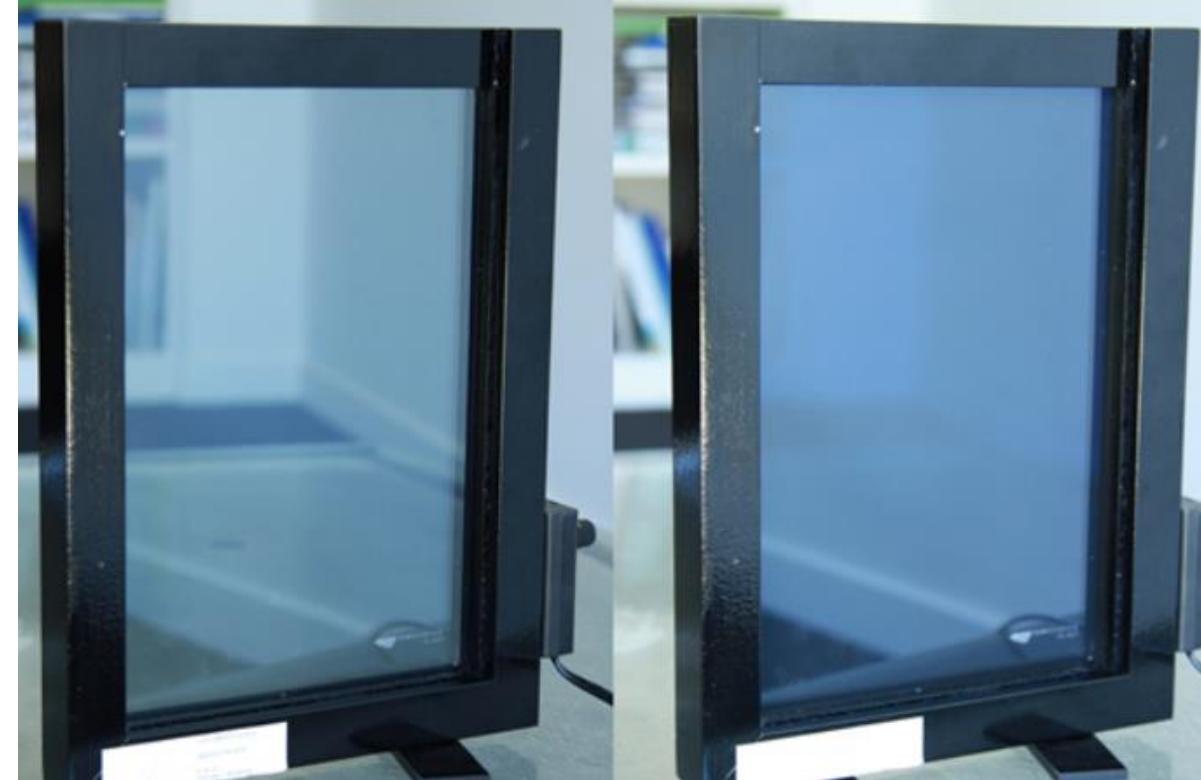
Specification :

- Thickness : 3mm ~ 19mm
- Max. size : 236" x 130" (6000mm x 3300mm)
- Min. size : 39" x 12" (991mm x 305mm)
- Low-E insulating glass max. size : 236" x 96" (6000mm x 2440mm)



VARIABLE TRANSMISSION GLASS

- Commonly called smart glass or switchable glass, variable transmittance glass can change from light to dark or from opaque to transparent and back again when exposed to voltage, light or heat.
- The catalyst triggers ions within the glass to align and reduce the amount of light the glass will transmit.
- glass that automatically tints when facing sunlight will become clear as the sun shifts in the sky and away from that part of the building.



Smart glass type-

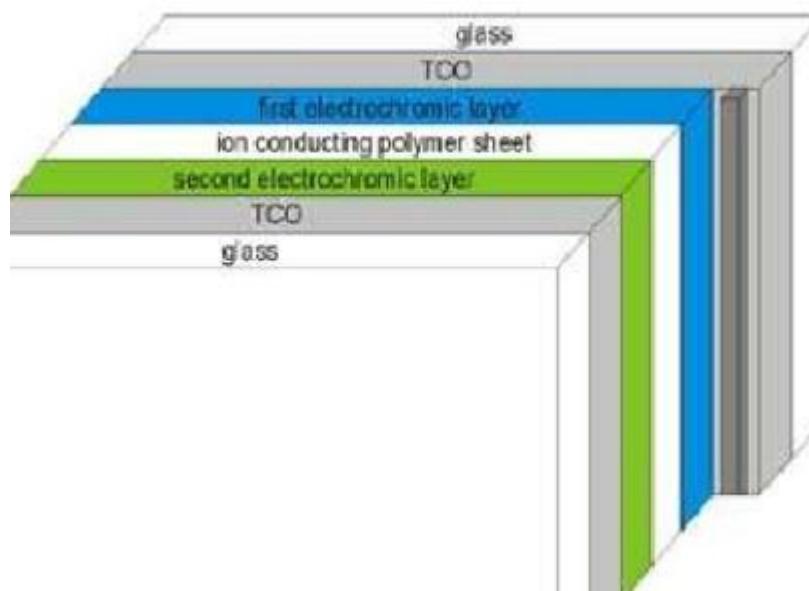
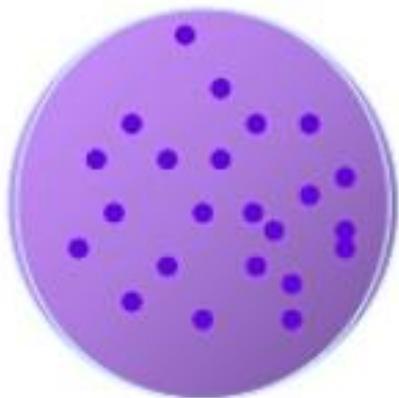
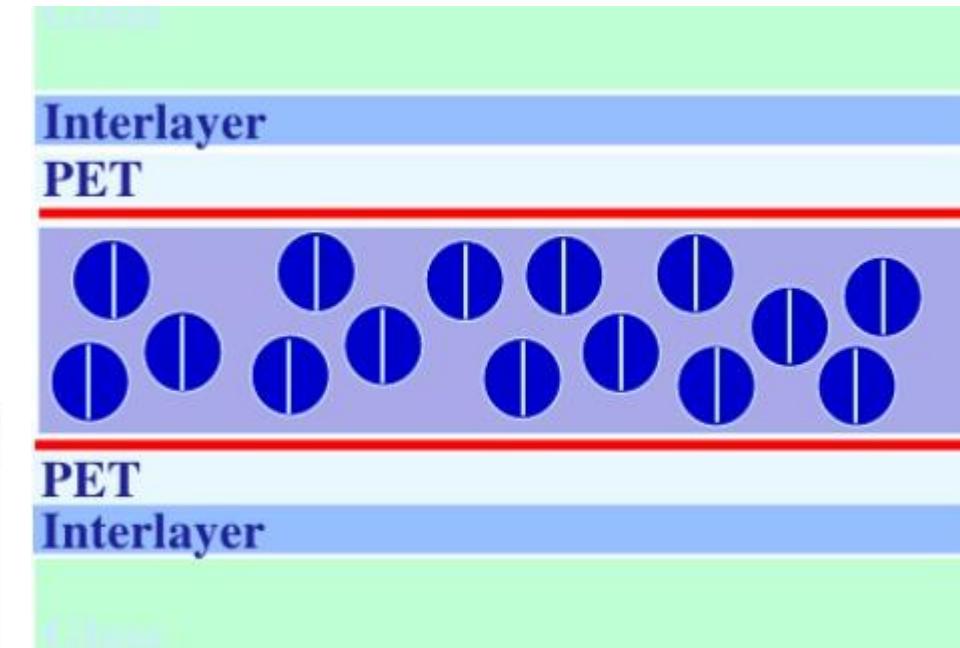
- Photochromic glass, eg: eyeglasses with coatings that automatically tint in sunlight.
- Thermochromic glass, eg: coated windows that change in response to temperature

BENIFITS

1. Ability to control transmittance, from very clear to very dark privacy glazing: 20%.
2. Elimination of mechanical shades
3. Laminated in protection: smash & grab
4. Rejects most of the sun's UV rays
5. Occupant retention potential
6. Relatively low cost to add:
7. Sound deadening interlayer
8. Increased comfort & mileage

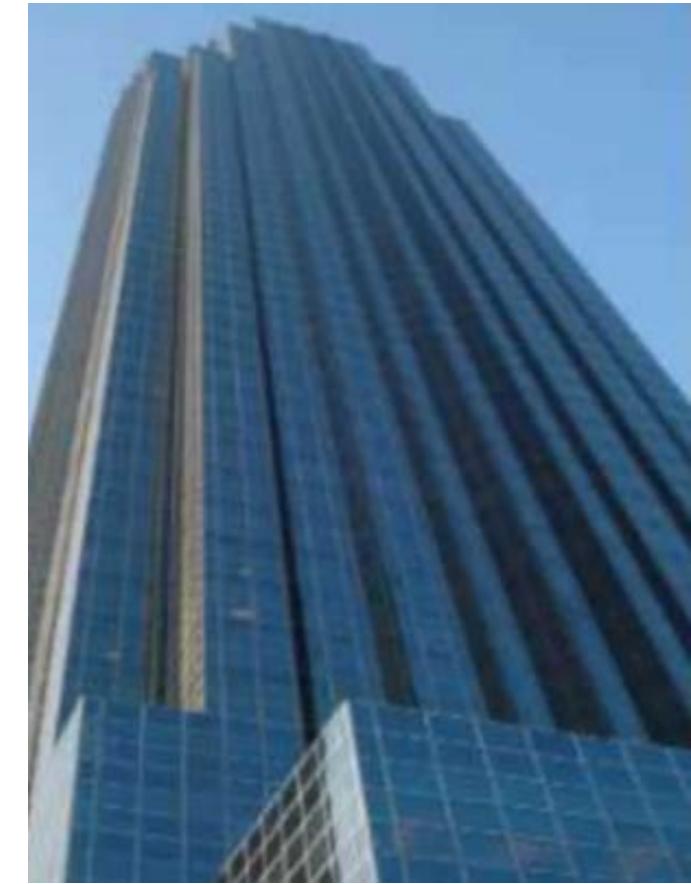
Different types:-

- Electrochromic
- Suspended Particle Devices (SPD)
- Polymer Dispersed Liquid Crystal (PDLC)



WHAT IS GLAZING

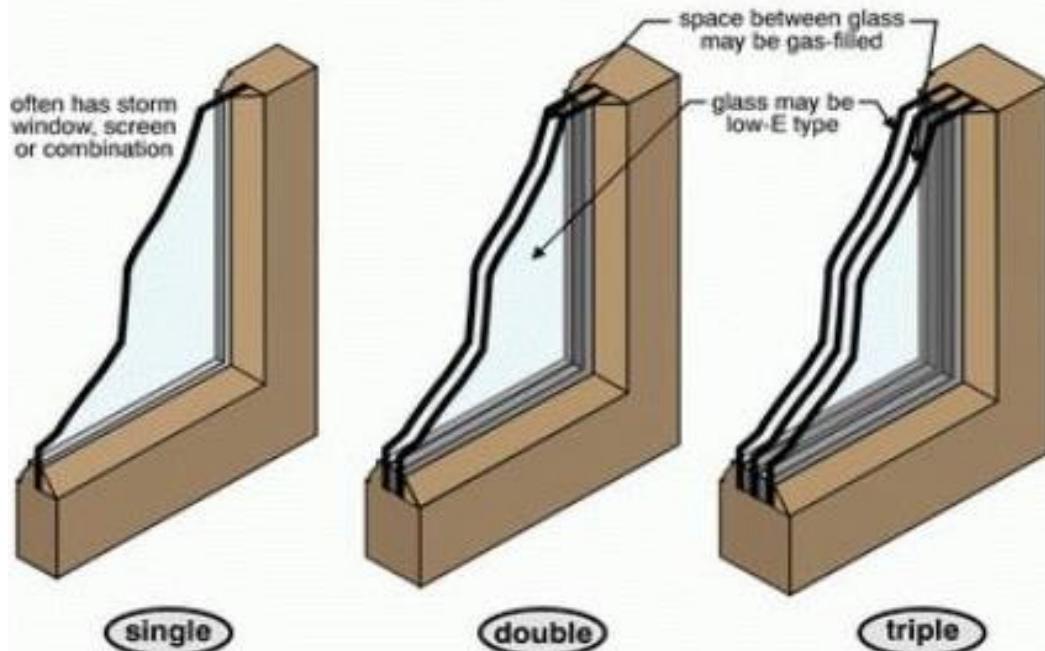
- Glazing, which derives from the middle english for 'glass', is a part of a wall or window made of glass.
- Glazing is when you paint a thin layer of minerals and glass onto a fired or unfired ceramic piece.
- The act of installing glass in windows, doors or fixed openings.
- In practically , it would be the actual installation of a piece of glass within a frame.



WHAT IS STRUCTURAL GLAZING

Structural glazing systems, in simple terms, are curtain walls of glass bonded directly to or anchored back against the structural frame of a building without the use any continuous steel or aluminium support. The glass is joined to the frame using either super strong silicone sealant to bond it directly against the steel, or by anchoring it to the structuring using stainless steel cables or rods joined to aluminium plates that hold everything in place.

Glazing types



BUILDING FENESTRATIONS

FAÇADE CLADDING

TYPES

1) STRUCTURAL GLAZING

1) BOLTED GLAZING

2) CABLE STAYED GLAZING

3) FIN SUPPORTED GLAZING

2) CURTAIN WALLS

1) STICK SYSTEM

2) UNITIZED SYSTEM

HISTORY

- Glazes have been discovered to have been used in the decoration of ceramics as far back as the early egyptian period.
- Powdered glass was originally used as the base of historic glazes.
- Minerals and water-soluble salts were added which altered the colour and texture of the final product

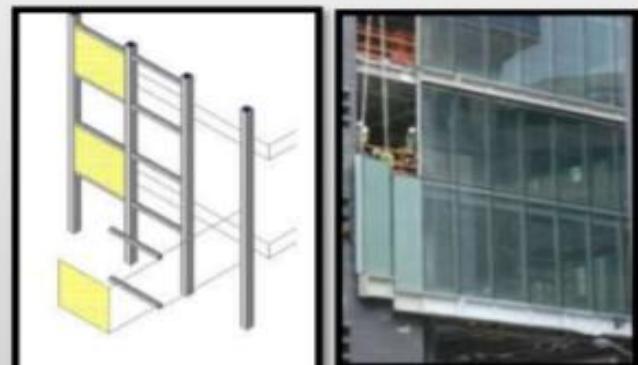
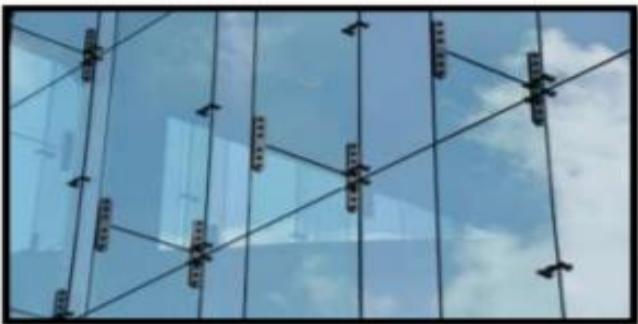
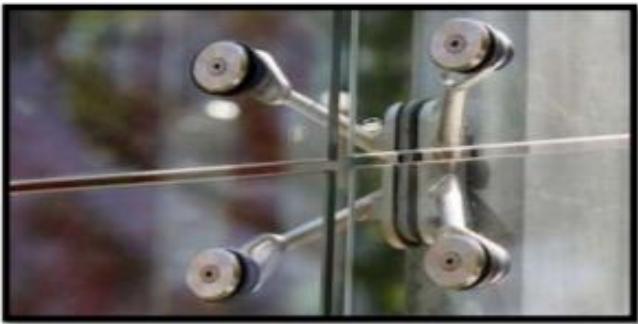


WHY GLAZING

- Structurally glazed systems create a greater transparency than traditional captured systems.
- Glazing system gives a wonderfully clean-looking, flush exterior finish that allows natural sunlight to penetrate into the building
- There are less visual interruptions due to the lack of metal on the exterior (and potentially the interior), creating a seamless, continuous glass look.

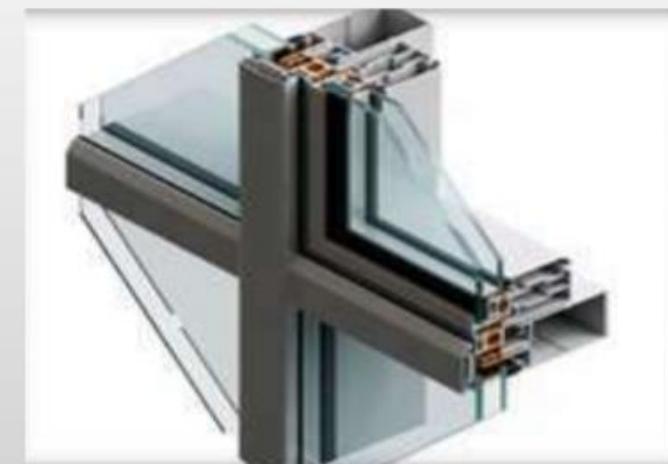


- Traditional captured curtain wall systems have pressure plates and caps that can conduct large amounts of heat in or out of the façade depending on the season.
- Since there is little to no exposed exterior metal, there is also less thermal bridging with structural glazing, saving on energy consumption costs.
- New technology and better integration with day lighting and climate control systems allow advanced glazing in building facades to
 - 1) improve the comfort and performance of building and occupants,
 - 2) assist in national and global efforts to reduce greenhouse gas emissions that contribute to global warming.



MATERIALS TO BE USED

- **GLASS**
 - 100% RECYCLABLE MATERIAL.
- **ALUMINUM**
 - LESS WEIGHT, BUT **HIGH STRENGTH**.
- **SILICONE SEALANTS**
 - SAND GEL USED FOR BONDING GLASS.
- **EPDM**
 - ETHYLENE PROPYLENE DI AMINE MONOMER.
WEATHERPROOF JOINT SEALANTS.
TO PREVENT WATER AND AIR ENTERING.
TEMPERATURE UNTO 110 DEGREE KELVIN.
- **ALUMINIUM**
- **STAINLESS STEEL**
 - Used as framing materials



STRUCTURAL FRAMING -The structural framing is normally fabricated from an aluminum alloy and may be either anodized or finished with an architectural coating.

GLASS- Glass type normally used is clear vision glass, annealed, heat strengthened, tempered, laminated, or insulating glass.

SILICONE SEALANTS - The sealant selection is made based on the type of System being used, the design parameters to be met and the requirements of the glazing contractors. Used to prevent the passage of moisture, air, dust and heat through the joints.

SETTING BLOCKS- provide support to the size of glass, glazing technique and condition of use.

LOCATION BLOCK- at edges of glass to prevent movement of glass.

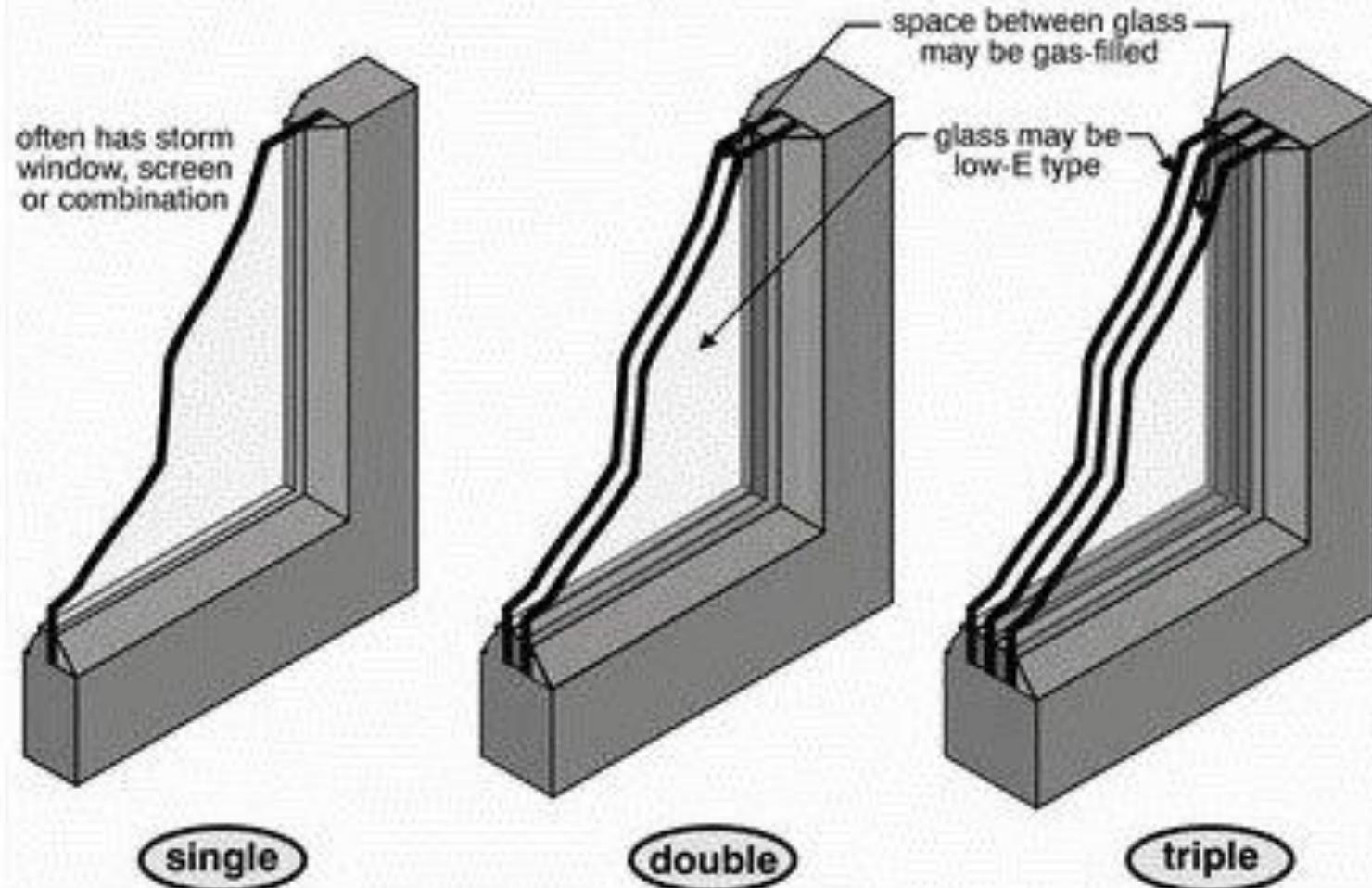
MULLION(Verticle member)- Transfers the dead load of the curtain wall.

TRANSOMS- Aluminiu sections provided horizontally between mullions.



SINGLE, DOUBLE AND TRIPLE GLAZING

Glazing types



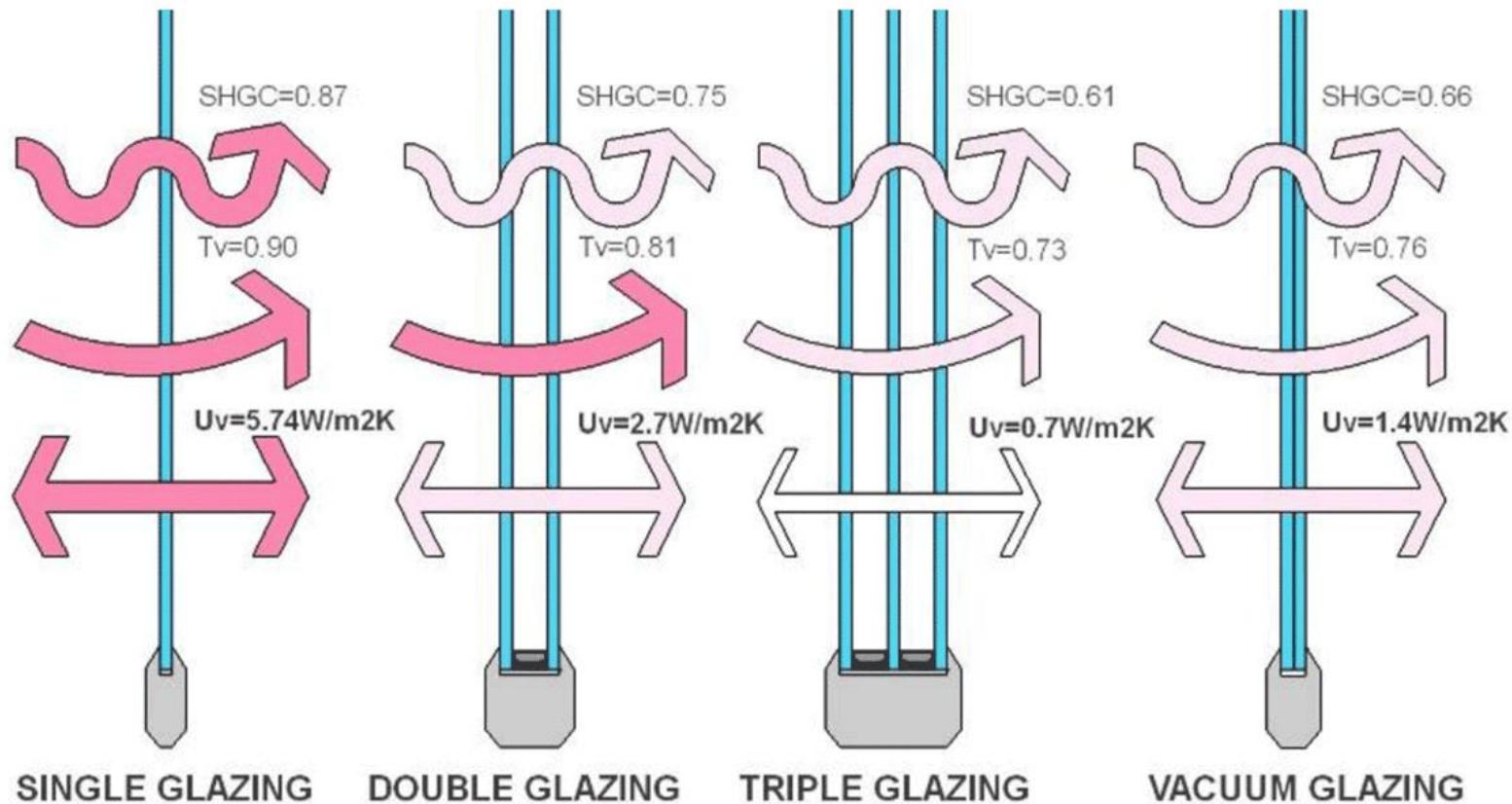
Glazing systems play a VERY important part in affecting a building's energy demand

Single glazed windows basically just keep the rain and wind out.

Double and triple glazing provides MUCH higher levels of insulation than single glazing, as heat is trapped within the panes.

The gap between panes is often filled with air, but sometimes inert gasses (e.g. nitrogen or argon) are used to boost the insulative properties.

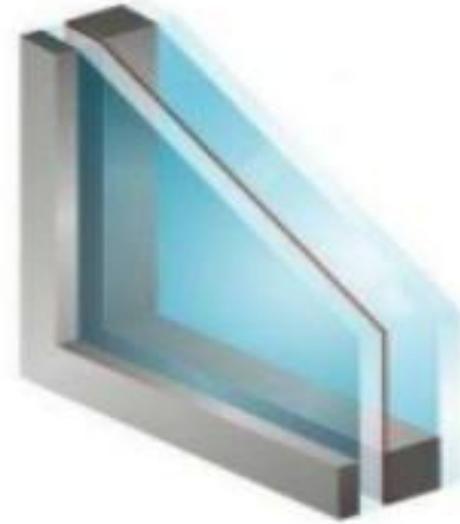
- Films and additives can also be added either inside or outside panes to give additional properties such as higher thermal insulation, heat reflection, fire resistance etc.



- Common framing materials are either uPVC (plastic), aluminum or timber.
- Timber frames have much lower embodied energy than uPVC or aluminium frames and often better insulative properties as well. They are however often more expensive.
- **Single glazing window** is the using of one glass pane to a structural frame.

Double-glazed windows have two glass panels separated by small spaces filled with air or, in some cases, with argon, a non-toxic gas.

Temperature Control Depending on the season, double-glazed windows can either keep your home cool in the summer or warm in the winter.



Warmer Winter

- The main reason most people opt for double-glazing is to stop the heat loss during winter.
- Double-glazed windows can keep up to 54% more energy inside your house.
- If you invest in more thermally efficient glass and fill the space between with argon, then you can reduce the heat loss to up to 70%!

Cooler Summer

- Insulating the windows will also have its benefits in the summer.
- Changing single-glazed windows to double-glazed will result in 13% reduction of solar heat gain.
- And like in the winter, using thermally improved glass can be even more beneficial, resulting in over 50% reduction of solar heat gain

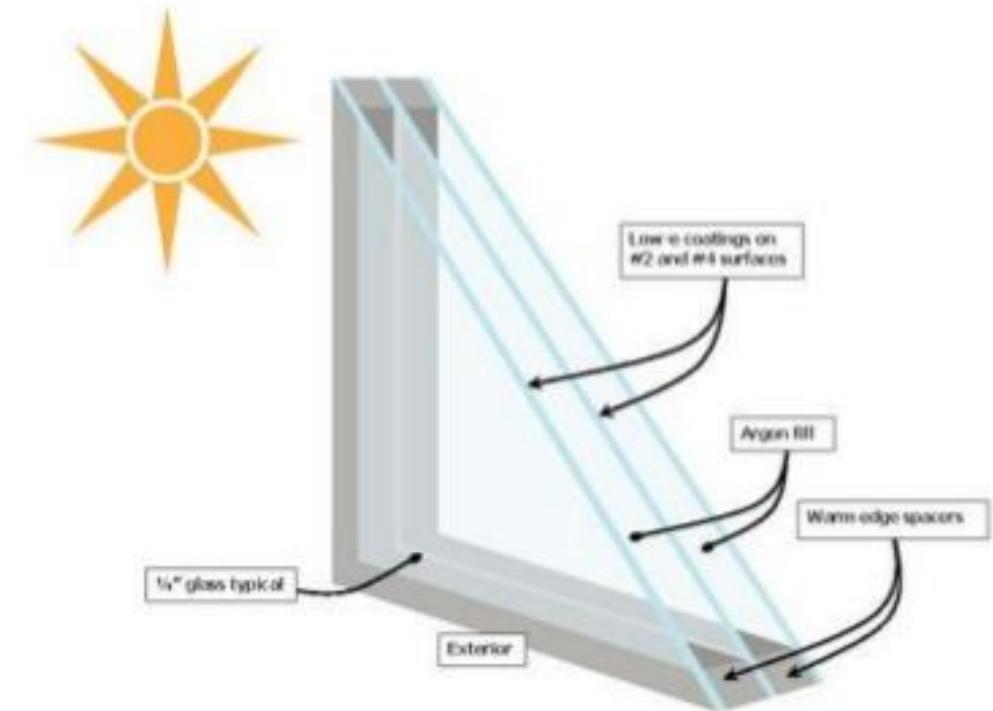
Noise Reduction Because it has to pass through two layers of glass and some air in between, the noise pollution decreases significantly. Depending on the type of double-glazing you can reduce noise between 20% to 70%.

Limiting Condensation Condensation is formed when cold air meets warm surface. Double-glazing reduces condensation and it's ideal for places with high humidity.

Triple -glazed windows have three glass panels or two with Low E film preached in between.

Energy-efficient Traditional single glazed windows come with a U-value more than 5. However, Double Glazed -more than 3. But, Triple Glazed Windows comes with lower U-value not more than 1.6.

Disadvantage- Unfortunately, double-glazed windows come with one major disadvantage – they cannot be repaired, only replaced.



The window cavities are optimized filled with Krypton or Argon gas enhance the insulation power of the windows. Along with low U-value and excellent thermal insulation properties, these windows are 40% more energy efficient than the Double Glazing Windows. It detains the heat of the daylight and keeps your home warm throughout day and night. Installing Triple Glazed Windows is equivalent to enhancement of the walls and ceilings to R-40.

Utmost Comfortable Elimination of cold spots and internal condensation maximizes the thermal efficiency of the windows, which keep the inside 2 degrees more warm than any Double Glazed window

Improved Security With a third glass pane, the sealed glass unit of the window becomes harder to breach. They are beaded within and the glass can be removed from inside only.

Acoustic Reducer Triple Glazed Windows are optimized to transmit excellent noise dropping performance. It is getting admired among those who live in areas near the highways, airports, railway stations, and busy street intersections find the high-pitched noise extremely frustrating.

Advantage of double or triple glazing over single glazing systems:

- MUCH better insulation.
- MUCH better acoustic absorption.
- Added security through multiple panes which are also more difficult to break through.

Drawbacks of multiple glazing

- Higher cost. More expensive to replace if broken.
- Interstitial condensation can occur if window seals fail, giving rise to the window fogging up and sometimes becoming dirty from the inside.

STRUCTURAL GLAZING

Structural glazing is a system of bonding glass to a building's structural framing members utilizing a high strength, high performance silicone sealant specifically designed and tested for structural glazing.

In structural glazing applications, dynamic wind loads are transferred from the glass, by the structural silicone sealant, to the perimeter structural support.



WHY STRUCTURAL GLAZING ?

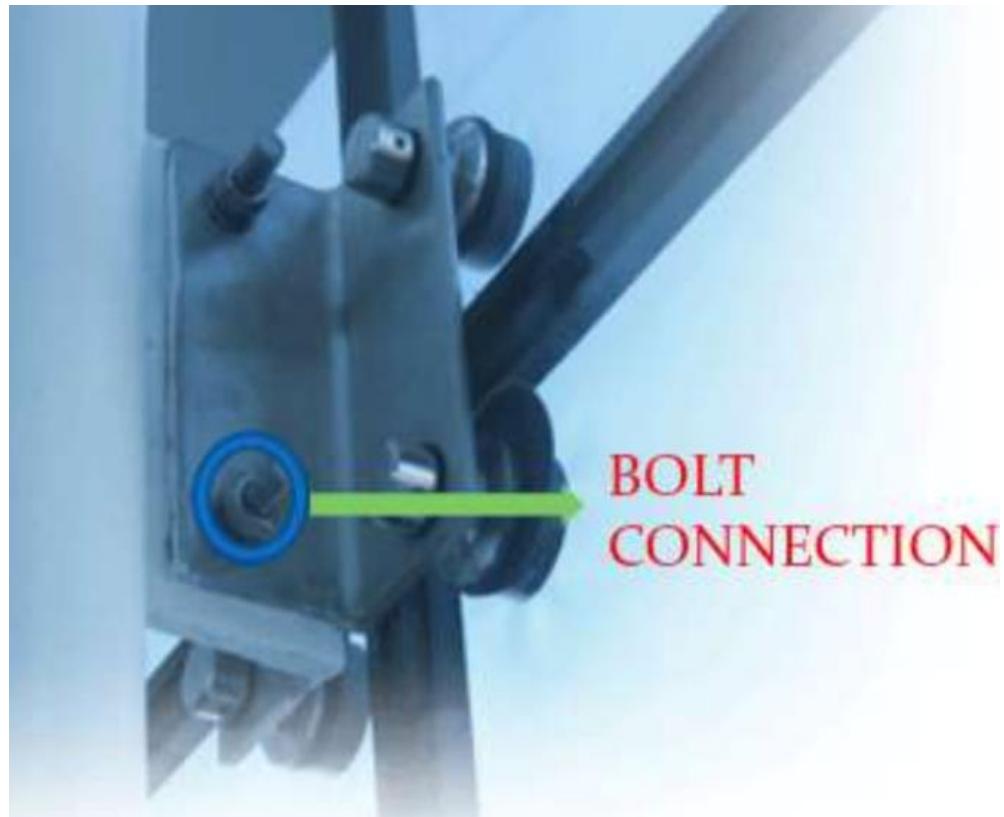
- Create a greater transparency .
- Less visual interruptions. Seamless, continuous glass look.
- Less thermal bridging with structural glazing, saving on energy consumption costs.
- Only aluminum and glass, there's no long-term risk of corrosion
- Reducing the building's carbon footprint.
- The lightweight nature of aluminium reduces the overall weight of the structure.
- Unaffected by noise, air, water and most of the acids hence discolouration, alteration in the degree of shine, softening, swelling, the detachment of coatings and blistering will not occur



STRUCTURAL GLAZING TYPES

BOLTED GLAZING

- Consist of attaching glass panel and the structure with rigid bolts and steel plates.
- Modern bolted system uses knuckled bolts for fixing glass instead of common fixed bolts.

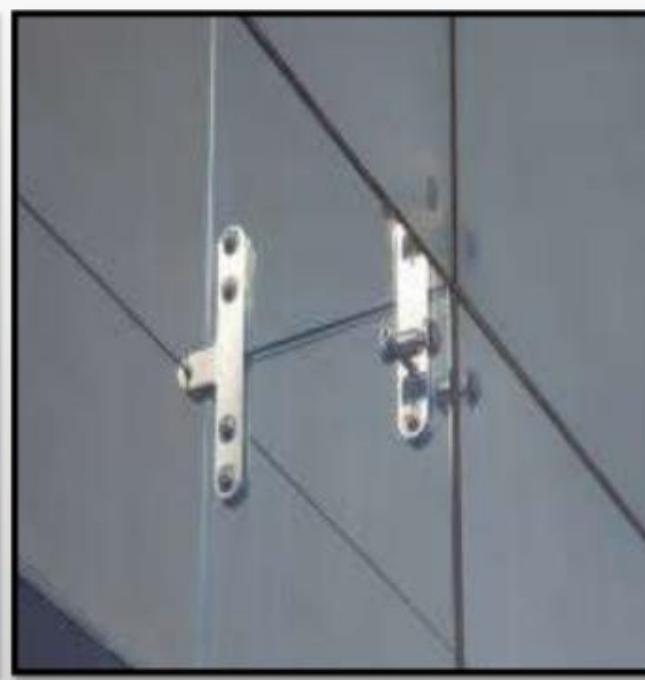
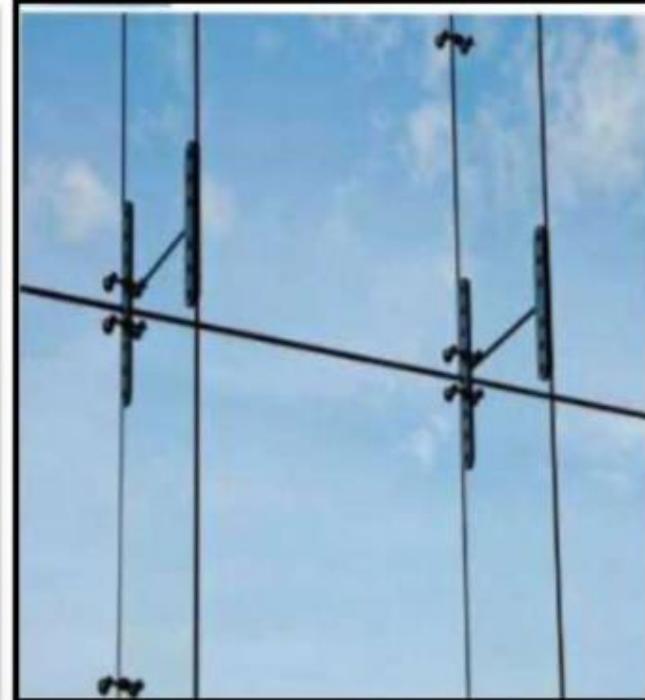
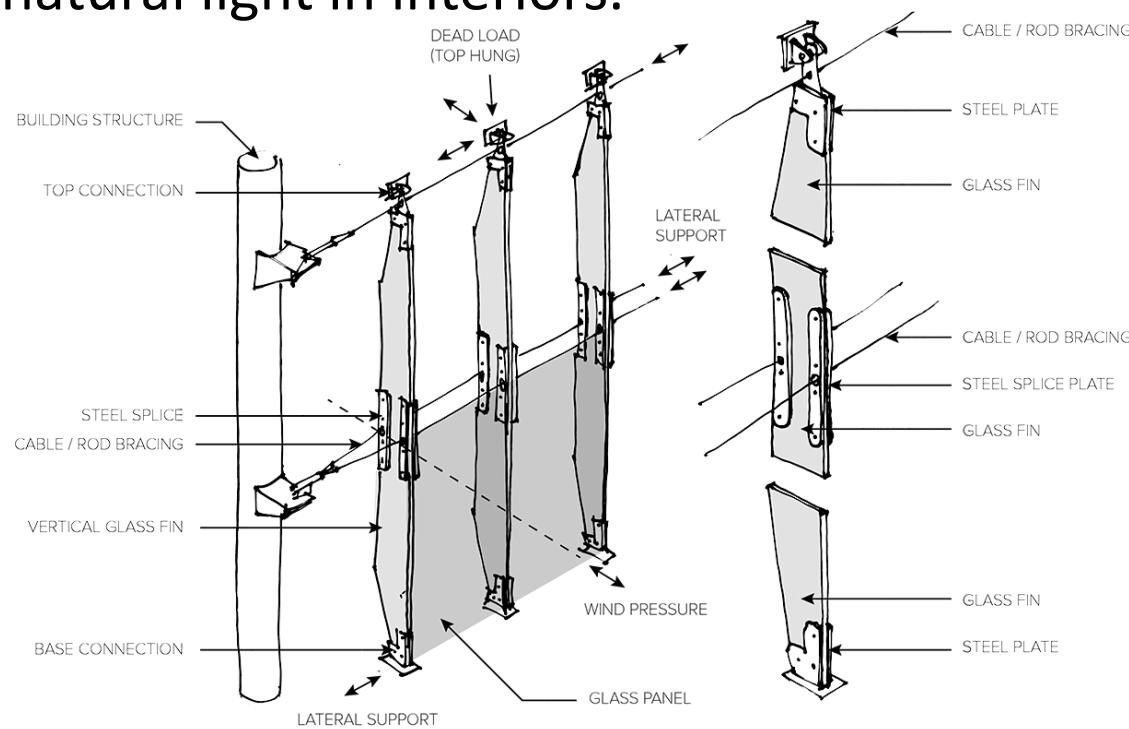


- Spider system is point supported glazing where maximum viability needed according to height of opening available.
- Spider glazing act as structural support for any high-end exterior designs.
- Toughened glass like 12mm ,15mm toughened glass and 19mm and various other components involved in spider glazing
- Spider glazing concepts provides safety and security for the end users.
- Structural support for the spider glazing can be taken from structure of the building and for the larger elevations structural support should be created with mild steel or stainless steel.
- Fin glass of 15mm is used as dead weight and pressure with standing force.
- Spider glazing fittings available like 4 way spiders, 2 way spiders and single way spider fittings to facilitate various spider glazing design options



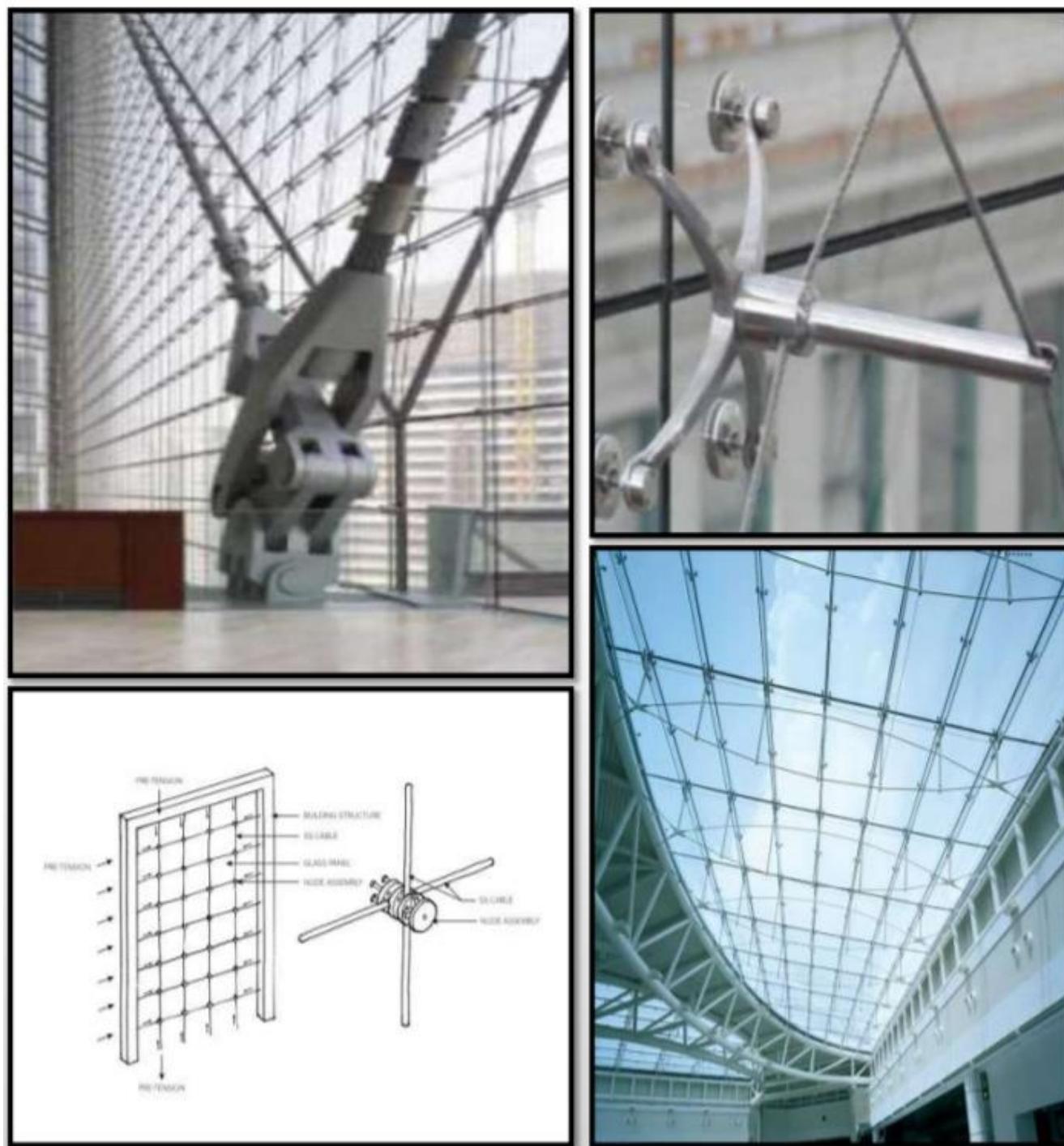
FIN SUPPORTED GLAZING

- Glass fins represent the earliest form of structural glass facade
- Glass fin is replaces a frame or mullion.
- The reaction load transferred to the top & bottom of the fin shoe.
- Fin systems are also designed with bolted joints. it create greater visibility & increase the natural light in interiors.



CABLE SUPPORTED GLAZING

- Tension facades use high tensile cables or stainless steel rods to impose the loads of the facade on the main structure.
- The two main types - are tension rod facades and cable net walls.
- This structural system supports glass by a net geometry of pre-tensioned cables.
- Cable nets are remarkably minimal structures when the boundary steel required to accommodate typically high pre stress loads is ignored.
- Cable prestress must be applied in the field via complex hydraulic jacking processes. installation means and methods are a primary consideration for all cable structures.

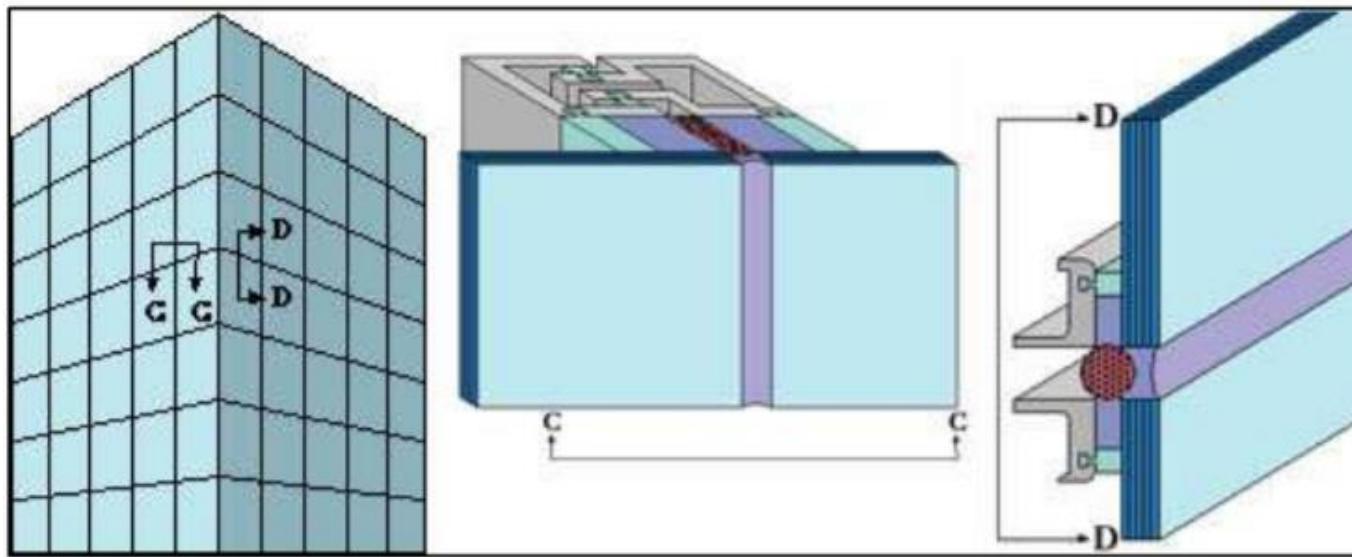


STRUCTURAL GLAZING BY JOINERY

These systems are characterized with the use of structural silicone joint sealant for structural fixing of glass or other materials to structural units of the building.

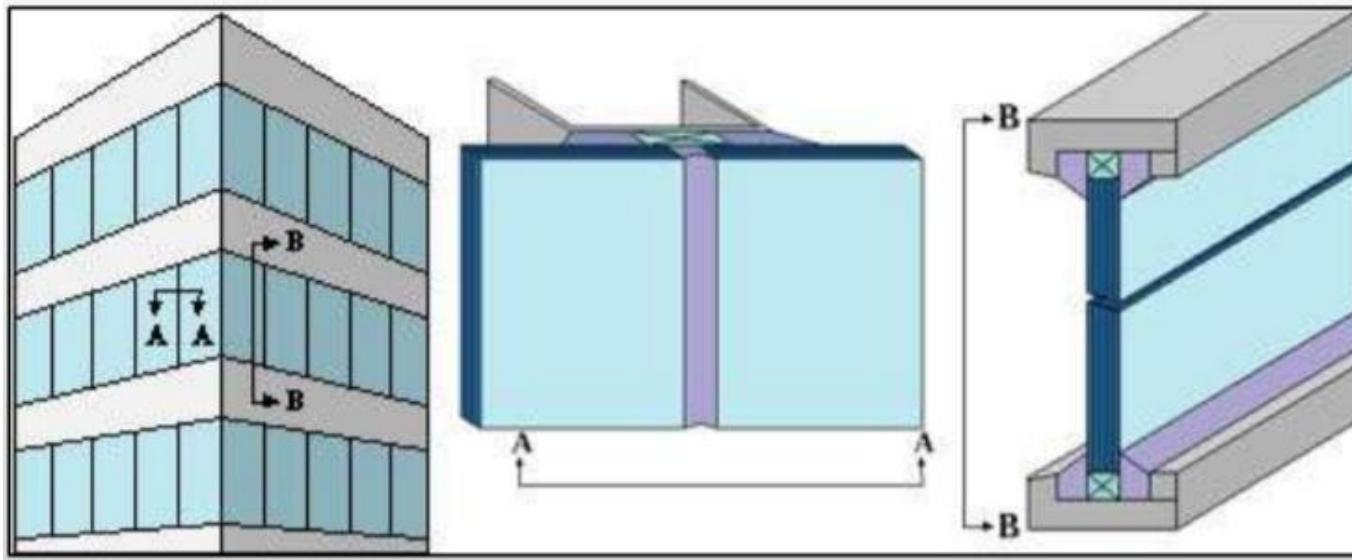
4 SIDED STRUCTURAL GLAZING

- The most widespread and economic system of structural glazing. glass is supported from 4 sides by structural silicone
- These systems are usually prefabricated and then installed at the construction



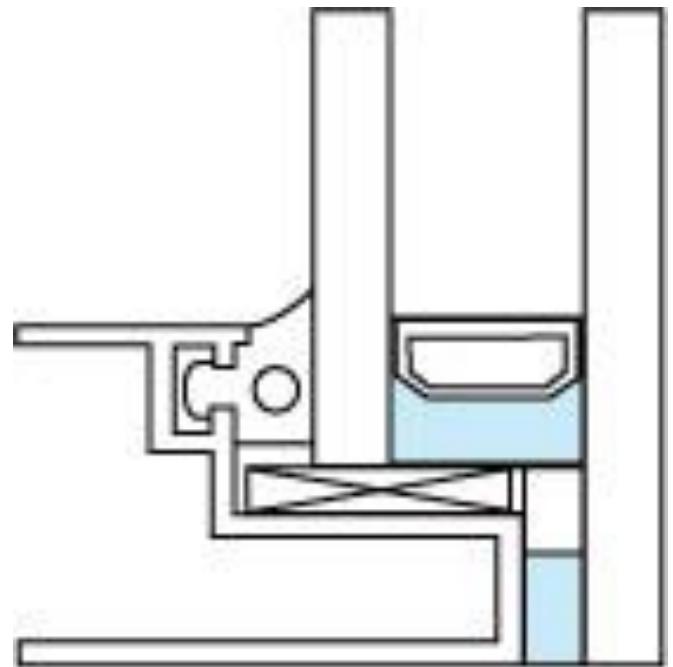
2 SIDED STRUCTURAL GLAZING

- In these systems silicone is used only on 2 sides of the glass panel. Two other sides of the glass are supported by a mechanical frame or another nonstructural method. these systems are prefabricated or assembled at construction site.
- Used for better aesthetic purpose of the building



Tooth-shape glazing

In these systems glass units are produced stage by stage: first the exterior panel, then internal panel. Structural joint is mounted on the inside surface of the interior panel of the glass unit.



Systems with U-shaped profile

In standard systems glass units are fastened to the building by a U-shaped profile. Depending on system design, silicone joint sealant can serve as gasket or structural joint sealant.



Systems with panoramic review

These systems are usually mounted on the facade in order to expand the view panorama. Glass ridges are used for structural support of the viewing glass. Silicone is used in the jointing area between glass panel and ridges.

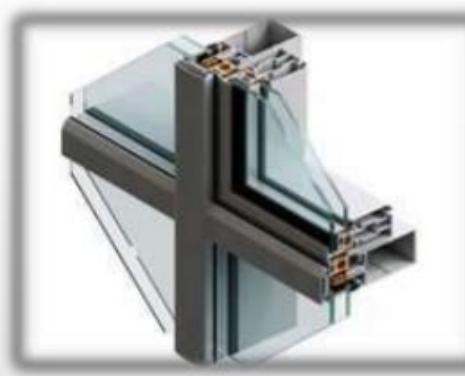
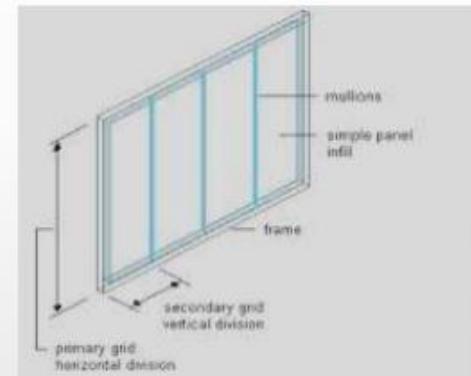
CURTAIN WALL

A curtain wall system is an outer covering of a building in which the outer walls are nonstructural, but merely keep the weather out and the occupants in. Curtain walls are non structural members and are made of a lightweight material reducing construction costs. When glass is used as the curtain wall, a great advantage is that natural light can penetrate deeper within the building. The curtain wall façade does not carry any dead load weight from the building other than its own dead load weight. Curtain wall systems must be designed to handle all loads imposed on it as well as keep air and water from penetrating the building envelope.



When a curtain wall is designed the following are taken into consideration,

- Loads
- Air Infiltration
- Water Penetration
- Deflection
- Strength
- Thermal criteria



Common types of curtain wall systems for high-rise buildings

1. Stick system
2. Unit system
3. Unit and mullion system
4. Column-cover and spandrel system
5. Various types of glass wall system

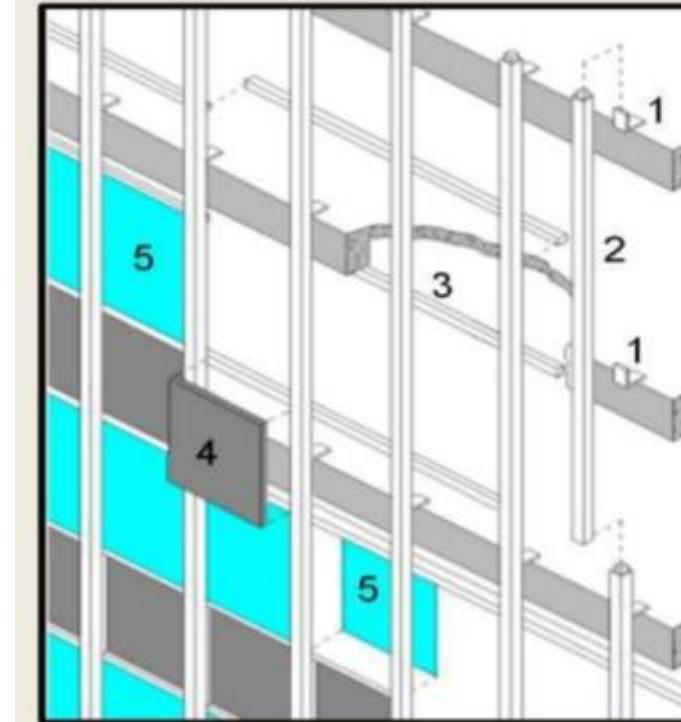
The glass and aluminum curtain wall system is a marvel of engineering and architecture. A totally non combustible system of glass and aluminum requiring minimal maintenance and providing years of aesthetic quality and building envelope performance. It is the most advanced exterior window wall system available for buildings.

ADVANTAGES:

- Great flexibility
- Site modification is possible.

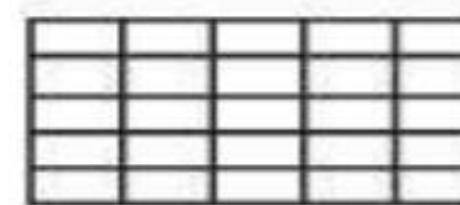
DISADVANTAGES:

- Difficulties in quality control.
- Relies heavily on site workmanship.
- Requires different trade men.
- Difficult to accommodate building movement.
- Difficult to control water drainage to individual floors.
- Too many loss parts and components on site.
- Poor acoustic and thermal insulation

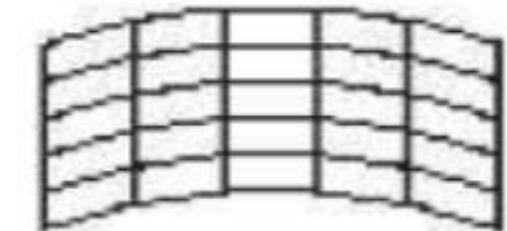


1. Anchors
2. Mullion
3. Horizontal Rail
4. Spandrel Panel
5. Vision Glass

Application of curtain wall



Vertical curtain wall



Convex contoured Curtain wall

UNITIZED SYSTEMS

Unitized curtain walls entail factory fabrication and assembly of panels and may include factory glazing. These completed units are hung on the building structure to form the building enclosure. Unitized curtain wall has the advantages of: speed; lower field installation costs; and quality control within an interior climate controlled environment. The economic benefits are typically realized on large projects or in areas of high field labor rates.

ADVANTAGES-

- Waterproofing
- Ensuring aesthetic features thanks to its synchronous surface
- Easy for installation and time saving
- Accommodates building movements.
- Shorter construction duration.
- Enables other trades to commence work much earlier.

DISADVANTAGES

- The installation work need to be done by high-skilled workers
- The price of unitized curtain wall is higher than sticks.
- The transportation of panels is more complicated.
- Units are assembled and glazed under controlled shop conditions.
- Full pressure equalization drainage system at each floor.



STICK SYSTEMS

The vast majority of curtain walls are installed long pieces (referred to as sticks) between floors vertically and between vertical members horizontally. Framing members may be fabricated in a shop, but all installation and glazing is typically performed at the jobsite. Stick curtain walls are processed, manufactured at factory and assembled, installed and completed at site. This kind of curtain wall can be used for all outside surface types of buildings and especially suitable for sophisticated and multiple joint structure architecture.

ADVANTAGES

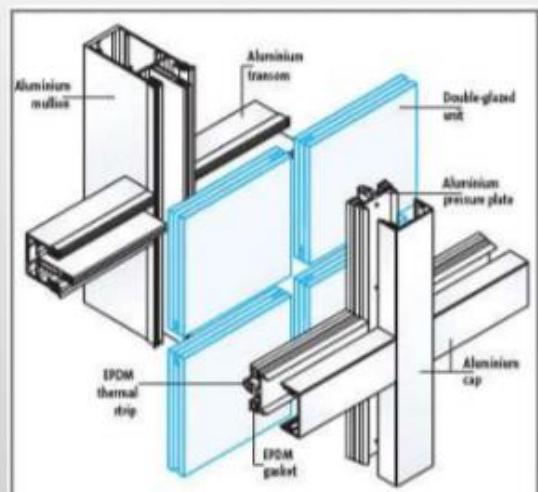
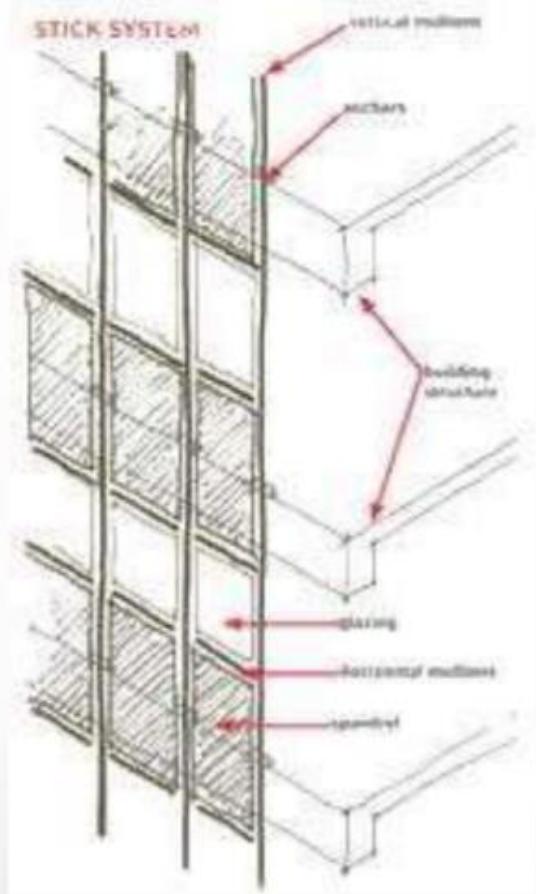
- Waterproofing
- Easy for transportation

DISADVANTAGES

- Difficulties in quality control.
- Relies heavily on site workmanship.
- Requires different trade men.
- Difficult to accommodate building movement.
- Difficult to control water drainage to individual floors.
- Too many loss parts and components on site.
- Poor acoustic and thermal insulation.
- Deterioration of expansion and sealant joints.



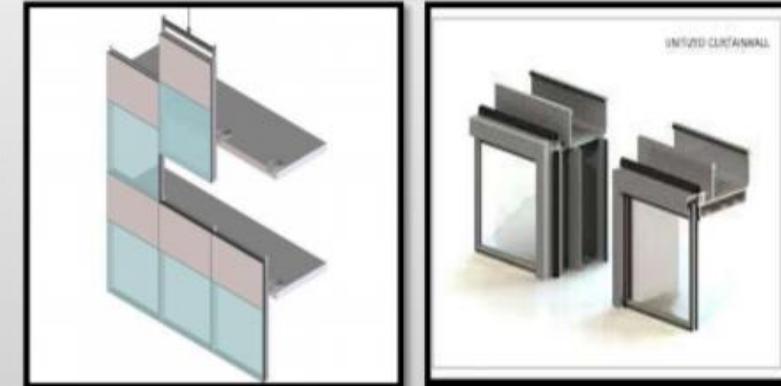
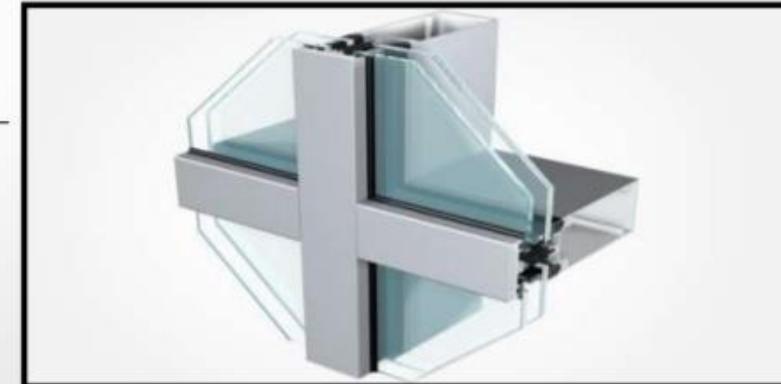
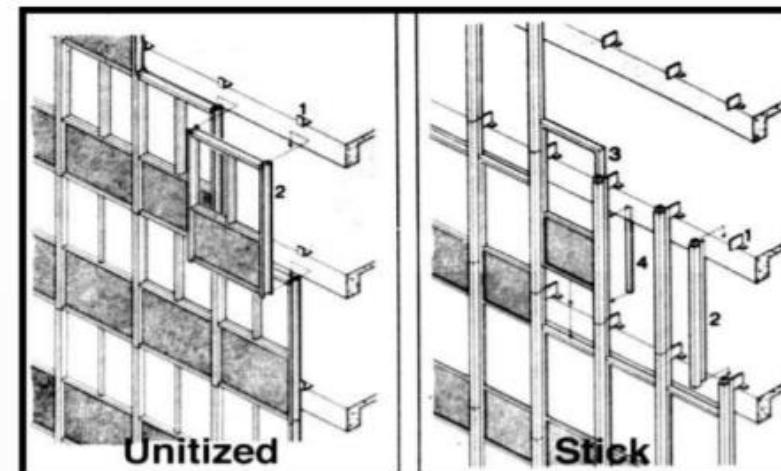
Structure of Stick systems without deck



DIFFERENCE BETWEEN UNITIZED CURTAIN WALLS AND STICK CURTAIN WALLS

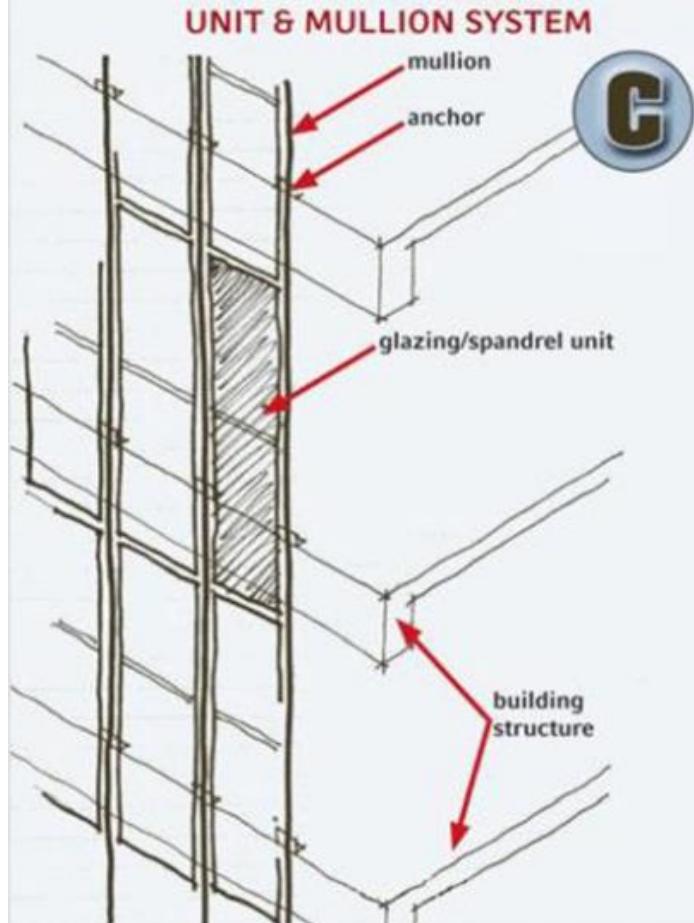
- **UNITIZED CURTAIN SYSTEMS** ARE COMPOSED OF LARGE GLASS UNITS THAT ARE CREATED AND GLAZED WITHIN A FACTORY AND THEN SENT TO THE CONSTRUCTION SITE.
- ONCE ON SITE, THE UNITS CAN THEN BE HOISTED ONTO ANCHORS CONNECTED TO THE BUILDING.
- SINCE THERE IS NO ON-SITE GLAZING, ANOTHER MAJOR BENEFIT OF USING A UNITIZED SYSTEM IS THE SPEED OF INSTALLATION.
- THE SYSTEM CAN BE INSTALLED IN A THIRD OF THE TIME OF A STICK-BUILT SYSTEM.
- THIS SYSTEM IS WELL SUITED FOR CASES WHERE THERE ARE HIGHER FIELD LABOR COSTS (THEREBY SHIFTING THE LABOR TO A MORE COST-EFFECTIVE FACTORY WORK FORCE), WHERE HIGHER PERFORMANCE IS NEEDED (FOR WIND LOADS, AIR/MOISTURE PROTECTION, SEISMIC/BLAST PERFORMANCE), FOR TALLER STRUCTURES, AND MORE REGULAR CONDITIONS FOR PANEL OPTIMIZATION

-
- **STICK CURTAINS WALLS** THE VAST MAJORITY OF LOW TO MID-RISE CURTAIN WALLS ARE INSTALLED IN THIS WAY.
 - LONG PIECES OF ALUMINUM ARE INSERTED BETWEEN FLOORS VERTICALLY AND HORIZONTALLY BETWEEN VERTICAL MEMBERS TO SUPPORT AND TRANSFER THE LOAD OF THE GLASS BACK TO STRUCTURE.
 - MOST OF THE ERECTION AND GLAZING FOR A STICK-BUILT SYSTEM IS DONE ON SITE.
 - ONE OF THE BENEFITS OF STICK-BUILT SYSTEMS IS ITS **FRIENDLINESS FOR FACADES** THAT HAVE LOWER REQUIRED VOLUMES AND MANY COMPLICATED CONDITIONS.
 - THIS IS SHORTER IN COMPARISON TO A UNITIZED SYSTEM, WHERE SIX MONTHS TO A YEAR CAN BE REQUIRED FOR THIS PROCESS.
 - YOU ALSO NEED A SIGNIFICANT AMOUNT OF SPACE FOR INSTALLATION AND STORAGE OF MATERIAL ON THE SITE, WHICH CAN BE DIFFICULT IN MANY HIGH-TRAFFIC CITIES WITH TIGHT JOB SITES.



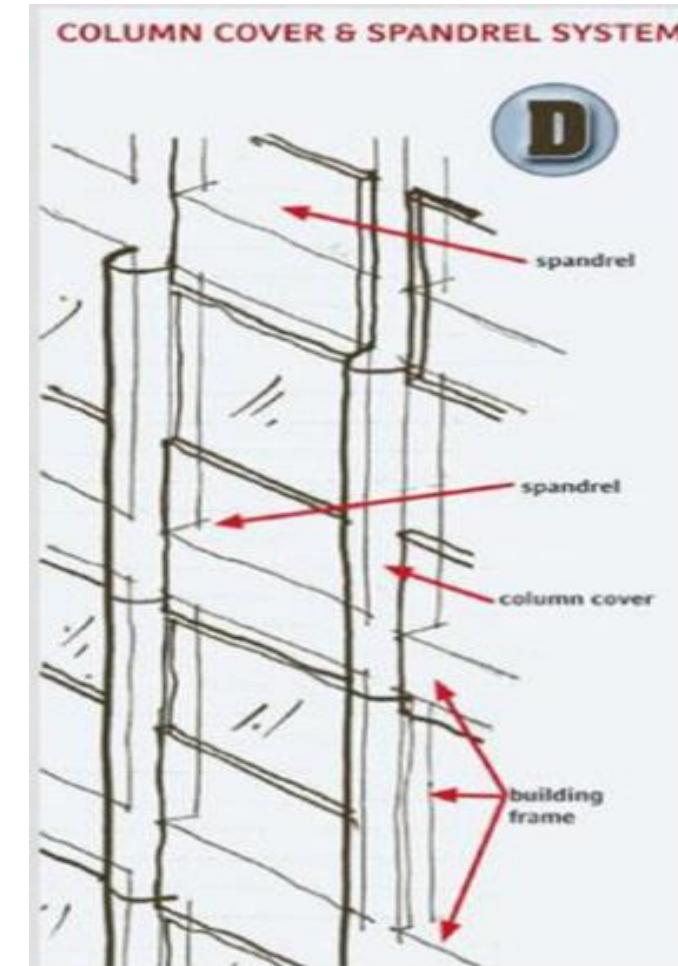
UNIT AND MULLION SYSTEMS

Similar to the stick system, mullions are the first tube to be installed in the unit and mullion system. Spandrel and glazing, however, are inserted into the stick system as a complete unit.



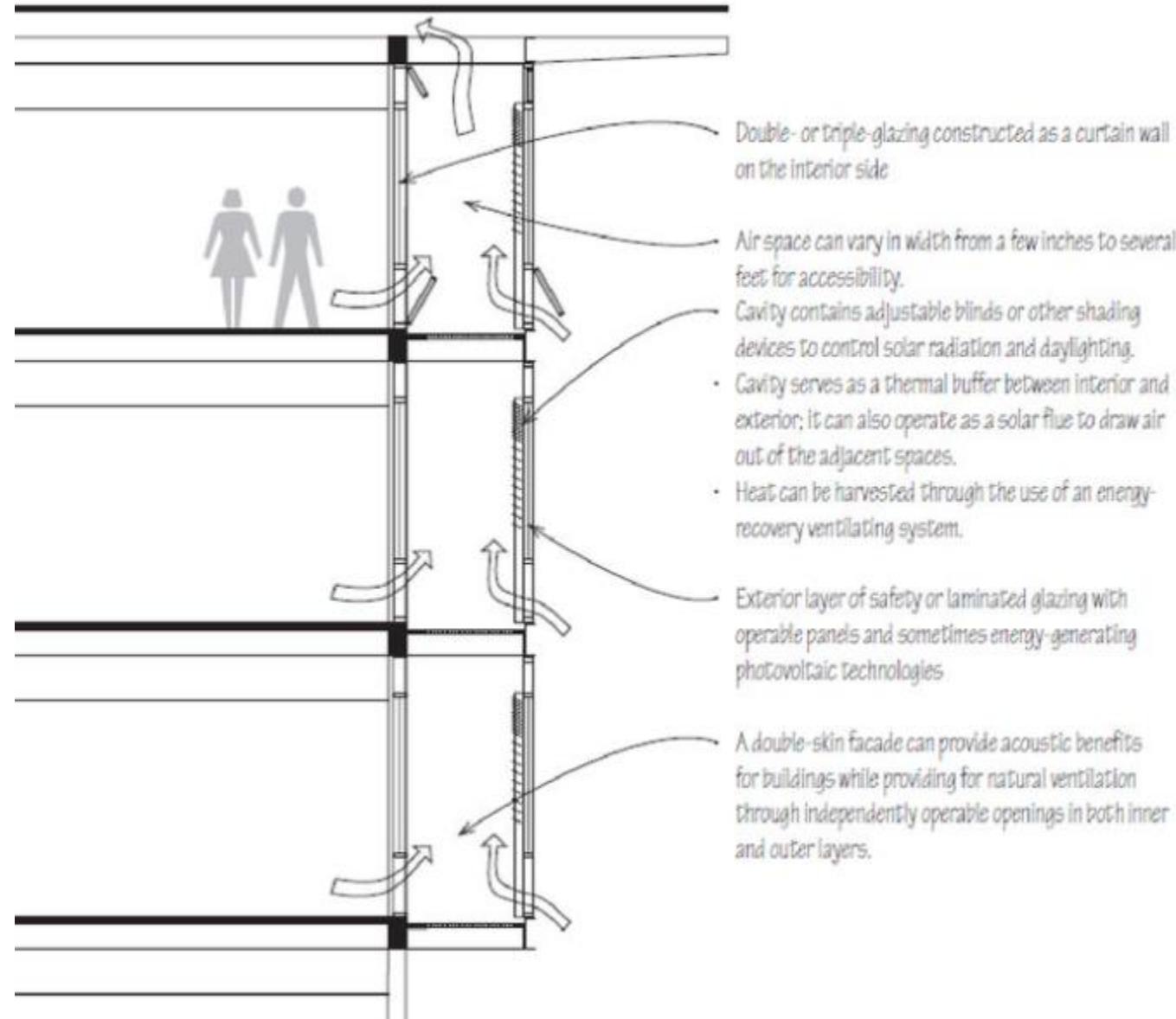
COLUMN COVER AND SPANDREL SYSTEM

While column cover and spandrel systems are similar to unit and mullion systems, they differ in that the building frame is emphasized with column covers, which act as sticks.



DOUBLE SKIN FAÇADE

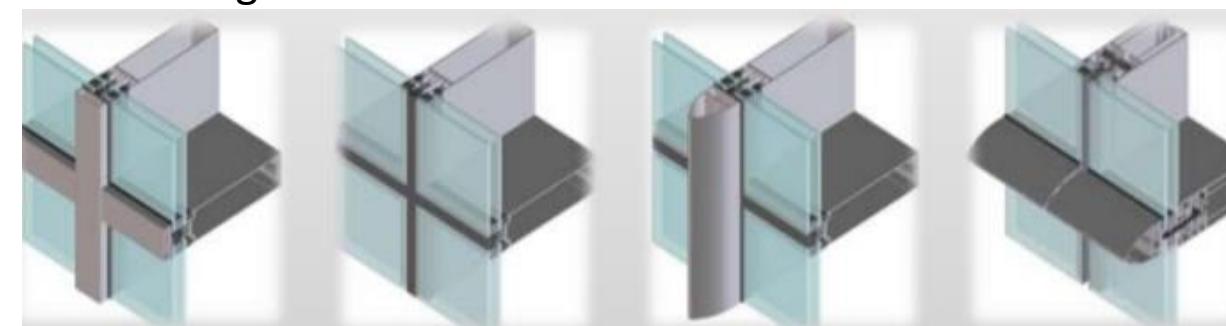
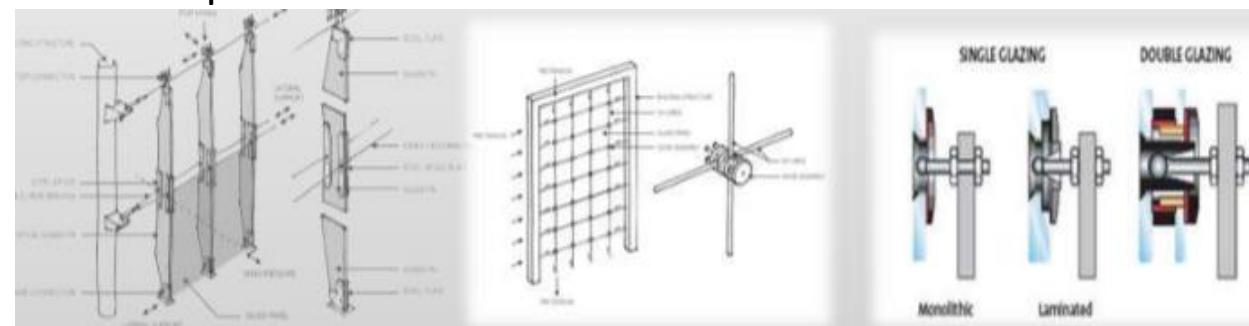
- Double-skin facades, also known as smart facades, are cladding systems designed to conserve and reduce the energy needed for heating, cooling, and lighting a building by integrating passive solar collection, solar shading, day lighting, thermal resistance, and natural ventilation into its assembly.
- The assembly usually consists of a double- or triple-glazed unit on the interior, an air space for harvesting heat and containing adjustable shading devices to control solar radiation and daylighting,
- An exterior layer of safety or laminated glazing with operable panels and sometimes energy-generating photovoltaic technologies.



DIFFERENCE BETWEEN STRUCTURAL GLAZING AND CURTAIN WALLS

While closely related, there are differences between curtain walls and structural glass facades.

- Structural glazing is a system of bonding glass to a building's structural framing members utilizing a high strength, high performance silicone sealant specifically designed and tested for structural glazing in structural glazing applications, dynamic wind loads are transferred from the glass, to the structural
- Structural glass façade technology embraces a design objective of high transparency and expressed structure, and incorporates some type of glass as the cladding material.
- The facades are used in longer spanning applications where an aluminum extrusion as the primary spanning member becomes impractical or impossible.
- A curtain wall system is an outer covering of a building in which the outer walls are non-structural, utilized to keep the weather out and the occupants in. since the curtain wall is non-structural, it can be made of lightweight materials, thereby reducing construction costs comparission structural glazing curtain walling
- Curtain walls typically span only from floor to floor, the primary spanning member being an aluminum extrusion. curtain walls are separate from the building framing system, but attached to and supported by it.
- The panel structure may be expressed, or completely covered on both the inside and outside of the building.



SKY LIGHTS

Skylight can be defined as a special type of opening provided in the roof of the building covered with translucent or transparent material so as to allow natural light to come into the house directly during daytime - Windows installed in roofs or ceilings. They deliver many benefits to the home such as high light levels, potential for energy savings, a view and connection to the outdoors and light.

SKYLIGHT SIZE:

The size of skylight is directly related to daylight levels and solar heat gain. The skylight should not be more than 5% of the floor area in rooms with many windows and not more than 15% in rooms with few windows.



ORIENTATION:

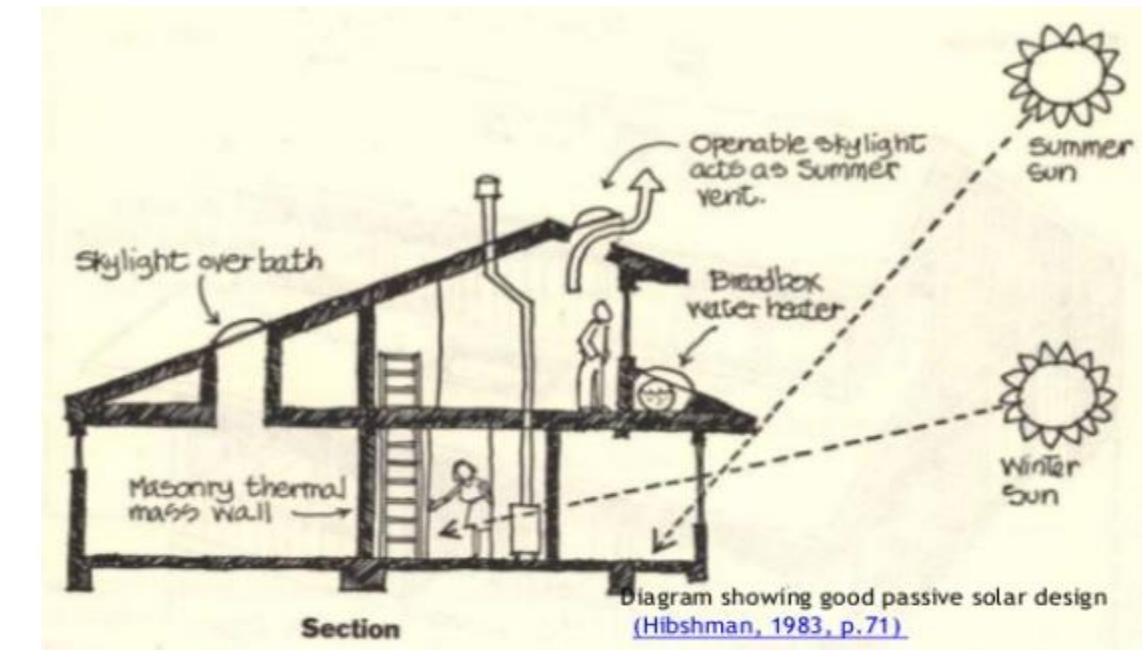
Skylights on north facing roofs provide relatively constant illumination with a cool light appearance while skylights on south facing roofs provide constant high illumination levels and the greatest potential of heat gain.

VENTILATION:

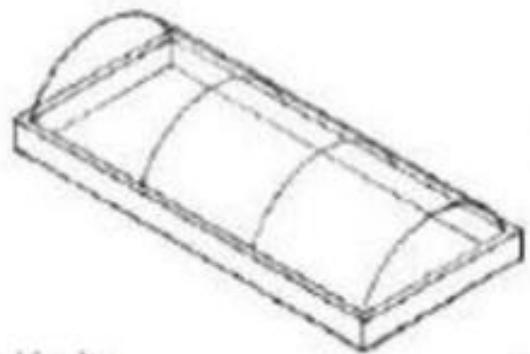
Some skylights offer the ability to ventilate hot air that gathers near the ceiling. The skylight may open manually or automatically.

MOISTURE CONTROL:

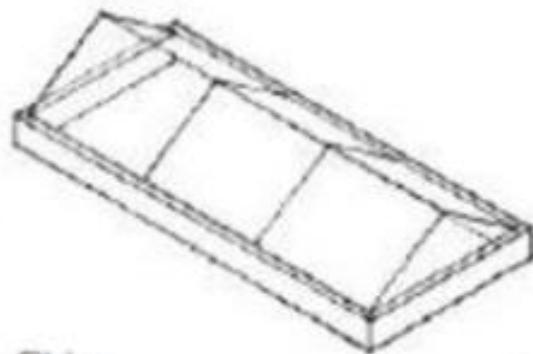
Poorly installed skylights can be prone to water leaks. Skylights are best installed by professionals in accordance with manufacturer instruction.



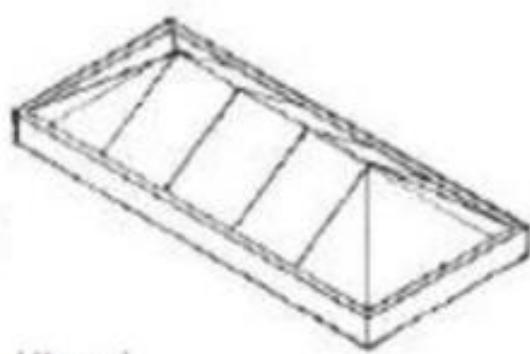
TYPES OF SKYLIGHT



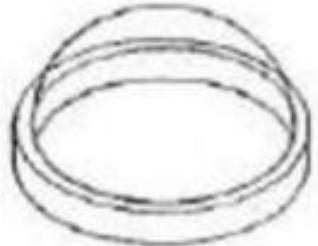
- Vault



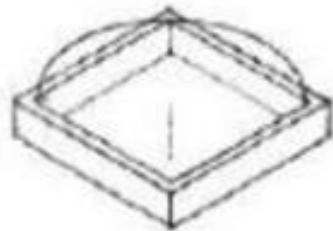
- Ridge



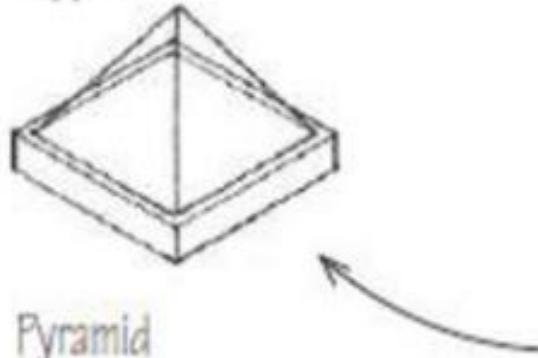
- Hipped



- Circular Dome



- Square dome



- Pyramid

Some types of skylights are discussed below.

1. Fixed skylight
2. Ventilated skylight
3. Tubular skylight
4. Custom skylight
5. Pyramid skylight

There are many types of skylights depending upon the materials, type of use, types of roof and room type.

Fixed Skylight

The most popular type of skylights are fixed skylights. These type of skylights doesn't open for air ventilation. If the ceilings in your home are quite high, then you could easily have one of these. Fixed skylights are used at low lit areas like stairwell and attics. 90% of the materials used in this is glass. The frame of the skylight is made up of aluminum or timber or steel. The joints always need to be tightly sealed to ensure that moisture doesn't get inside and cause any problems.



Ventilated Skylight

Ventilated skylight is a multi-purpose type of skylight. It does the work of ventilating of light and air. These types of skylights are well suited for kitchen and bathrooms, so that it can remove excess of moisture and keep constant flow of fresh air in the building, while illuminating the place. This skylight can be controlled manually or automatically or even remote controlled. While rain starts it closes automatically and so on. Due to constant flow of air in the building the need of electrical equipment's like AC are not required.



Tubular Skylight

The new type of skylights in the market are tubular skylight or tube skylight. When the roof space required for fixed and ventilated skylight is not available or very small roof space is available for skylight, this type of skylights is preferred. Tubular skylight consists of a small tube shaped pipe of diameter around 10-15 inches covered with a spherical dome on the top. This dome collects the light and transmits the light to tube. The tube is made up of silver finished mirror type quality, so that the light transfers completely without any loss of light. This skylight illuminates the rooms evenly. This can be used for specific lighting of objects like living walls or aquariums, pantries, closets, foyers, and even hallways. Able to angle the skylight to fit into spaces where you wouldn't be able to fit another type of skylight.

“sun tubes,” “sun tunnels,” “solar tubes,”
“light tunnels”



Custom Skylight



This types of skylights are preferred when the roof condition doesn't allow any common type of skylights. Majorly when the aesthetic appearance of the building is to be improved, this skylight adds to the beauty of the building. In particular cases where the structure of a roof is unique. They can be of any geometric shape and size as per the requirement. The only things to be ensured in this type of custom skylights are that the material used and the fillets are correctly used. The materials must be hurricane resistant glass and temperature control and rain sensors.

Pyramid Skylight

This name of this skylight is given depending on the shape of the pyramid. In this pyramid shaped skylight had on main Rafter with horizontal purlins. It can be made of any size depending upon the requirement of the use. This type if skylights are usually preferred in for lobbies, entry ways, and other larger spaces. The seal between the glass and purlins is to be properly made as the chances of leak are high. This skylight can be 20feet wide and the length may vary as per the requirement. Pyramid skylights have a system of serrated screw spline, integrated internal weep and drainage, internal purlin to rafter connection (no exposed fasteners), thus better aesthetics. These types of skylights are typically mounted on curbs on flat roofs. Takes a pyramid shape over a square opening and is identified as a Double-Hip over a rectangular opening.



Barrel Vault Skylight

This type of skylight is frequently used in non-residential buildings. This cannot be used in the residential buildings as the area of skylight is more, privacy aspects are very less. Here complete or more than 80% of the roof area is covered by skylight. This type of skylight is preferred usually in passageways, canopies, parking shelters, mall arcades, medical and educational institutions, and industrial complexes.

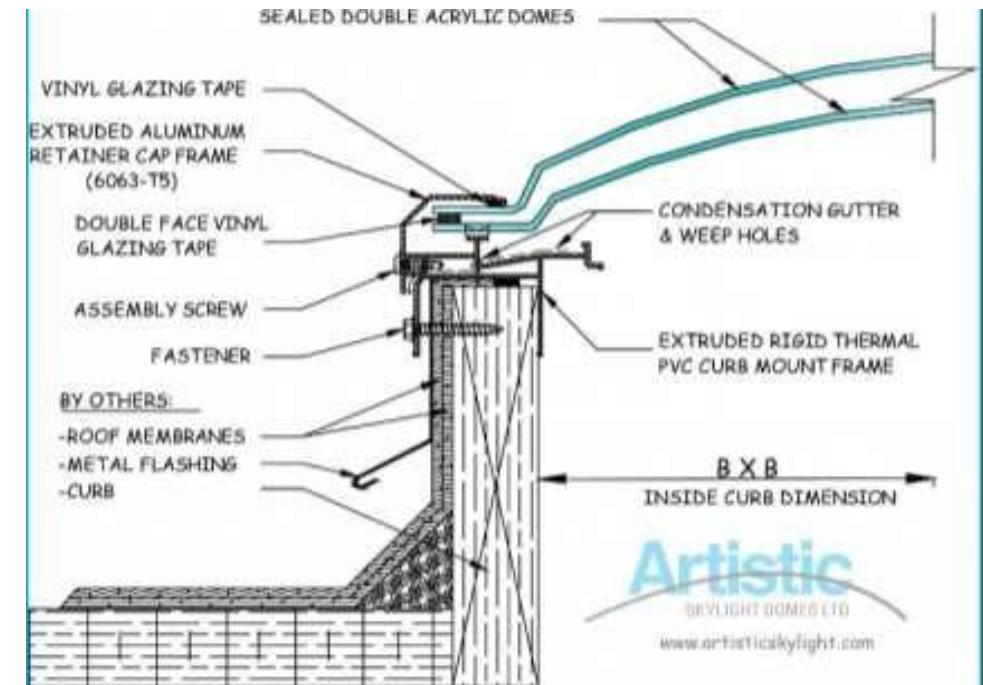


Dome Skylight

These dome shaped skylights are made up of strong and flexible plastics. The shape is in the form of dome as the sunlight is evenly spread in the room rather than direct rays penetrating in the room. If the sunlight is not directly coming in the skylight, even in small light, this skylight lights up the room.



Mostly this skylight come in two layers for protection and insulation. A thick outside layer is tainted and inside thin layer which is clear material. Dome Skylights may also be used to advantage in building entrances to enhance foyers or spotlight attractive features such as sculptures, murals, paintings, planters, reflecting pools, etc.



Dome skylights are designed to shut out severe weather, are shaped to wash themselves in rain, can be insulated (double domes), will provide ventilation, access to the roof and even help fight fires

Glass Skylights

The skylight glass roof can be used as a source of natural light in your room. By using a skylight roof, your room will be brighter and look natural. Using skylights also makes your room warmer and can improve your mood for indoor activities. As that gorgeous natural light comes streaming into your room, it first passes through the skylight. That means that whatever material your skylight is made of must be designed to handle extended UV light exposure.



Ridge Skylight

This type of skylights is applicable to conditions where the skylight continues in the same plane as the roof pitch and the ridge of the skylight follows the line of the ridge of the roof. These can also be mounted on the curbs on flat roofs with a variety of skylight pitch options and glazed vertical ends. It can also be attached to head-to-head vertical walls at either or both ends. Ridge Skylights are an outstanding way to let a significant amount of light into the structure, much more so than a comparably sized window.



Skylight Materials: Glass and Plastic

Glass tends to be more durable, although skylights must be made of safety glazed glass – either tempered or laminated, or a combination of the two. Double-glazing is more energy-efficient, solar control glass.

Plastic for skylights can be either polycarbonate or acrylic. Acrylic, while less costly, is also weaker. One disadvantage of polycarbonate is that it tends to yellow as it ages. A special UV-resistant film must be applied to both kinds of plastic to avoid fading of furniture and carpets in the room below. Plastic is preferable to glass for skylights in a flat or low-pitched roof, because water pooling will deteriorate the seal of double-glazed glass.

Advantages of Skylight

- 1) They provide more natural ventilation of both air and light.
- 2) It improves the aesthetical appearance of the building.
- 3) It minimizes the need of artificial lightning in the room.
- 4) It maintains the temperature balance in the room by constantly replacing the hot air by fresh and cool air by the ventilated skylight. Thus reducing the use of Air Coolers and reduces the emission of greenhouse gases.
- 5) The eco-friendly addition of natural lighting means that skylights can also increase the resale value of a home.
- 6) Use of tainted glasses reduces the glare effect and evenly distribute the light in the building.

Disadvantages of Skylight

1. The major disadvantage of the skylight us that the amount of light and heat cannot be controlled that comes through the skylights.
2. Accumulation of dust in the skylights, which needs to be cleaned regularly.
3. As the placement of the skylight is in the roof, cleaning of the skylight becomes a hectic job.
4. Due to the improper sealing of skylights, leakage is the major problem faced in the homes.
5. The intense sunlight coming through the skylight also can cause fading of exposed furnishings.
6. The installation cost and maintenance of the skylight is more compared to normal windows.