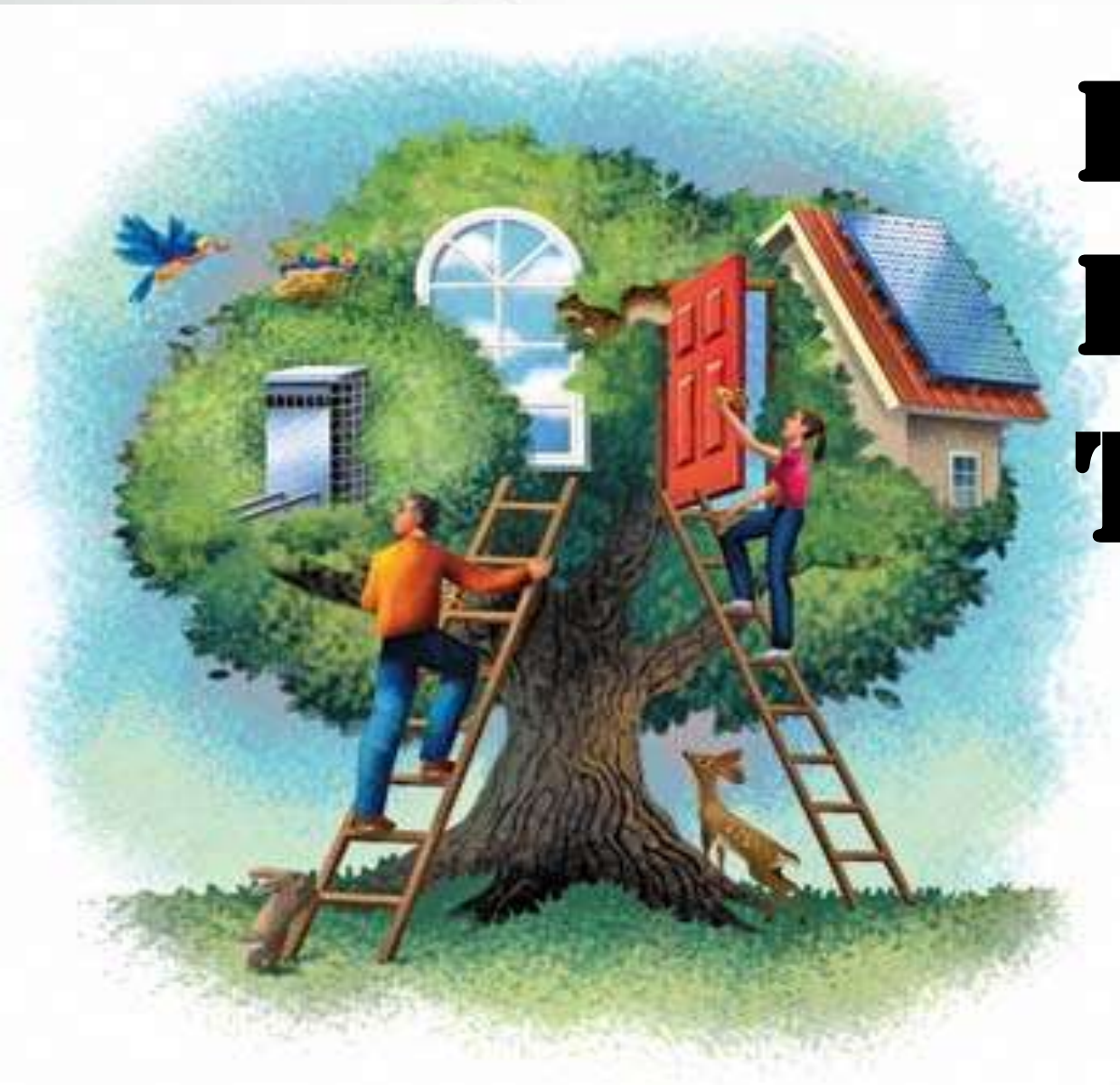**Asahi India Glass Limited**

Glass
Where technology meets design

Building
Dwelling
Thinking ???

Glass – A paradigm shift

Concrete Building
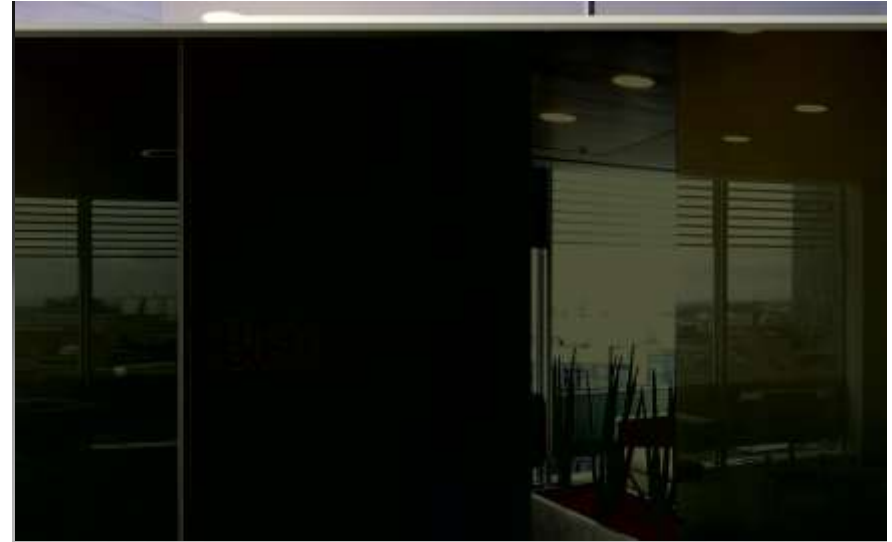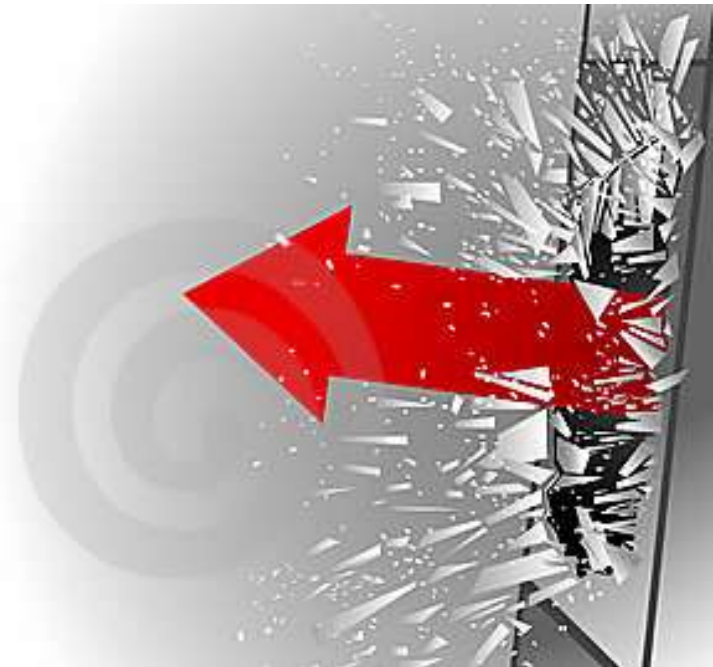
Clear or Tinted Glass

High Performance Glass

Smart Buildings with High Performance Glasses

Used in

- Glass touches various components of a building like :-

    - ➤ External Façade

    - ➤ Internal partition

    - ➤ Shop fronts

    - ➤ Furniture

    - ➤ Glass floors

    - ➤ Staircase

    - ➤ Decorative application in interiors

    - ➤ Fire resistance

    - ➤ And many more…

Shattering Myths

1. Glass for **Windows**

When people think of glass, they tend to think of simple applications, like windows and cookware; but scientists have manipulated glass at the molecular level to take on countless capabilities.
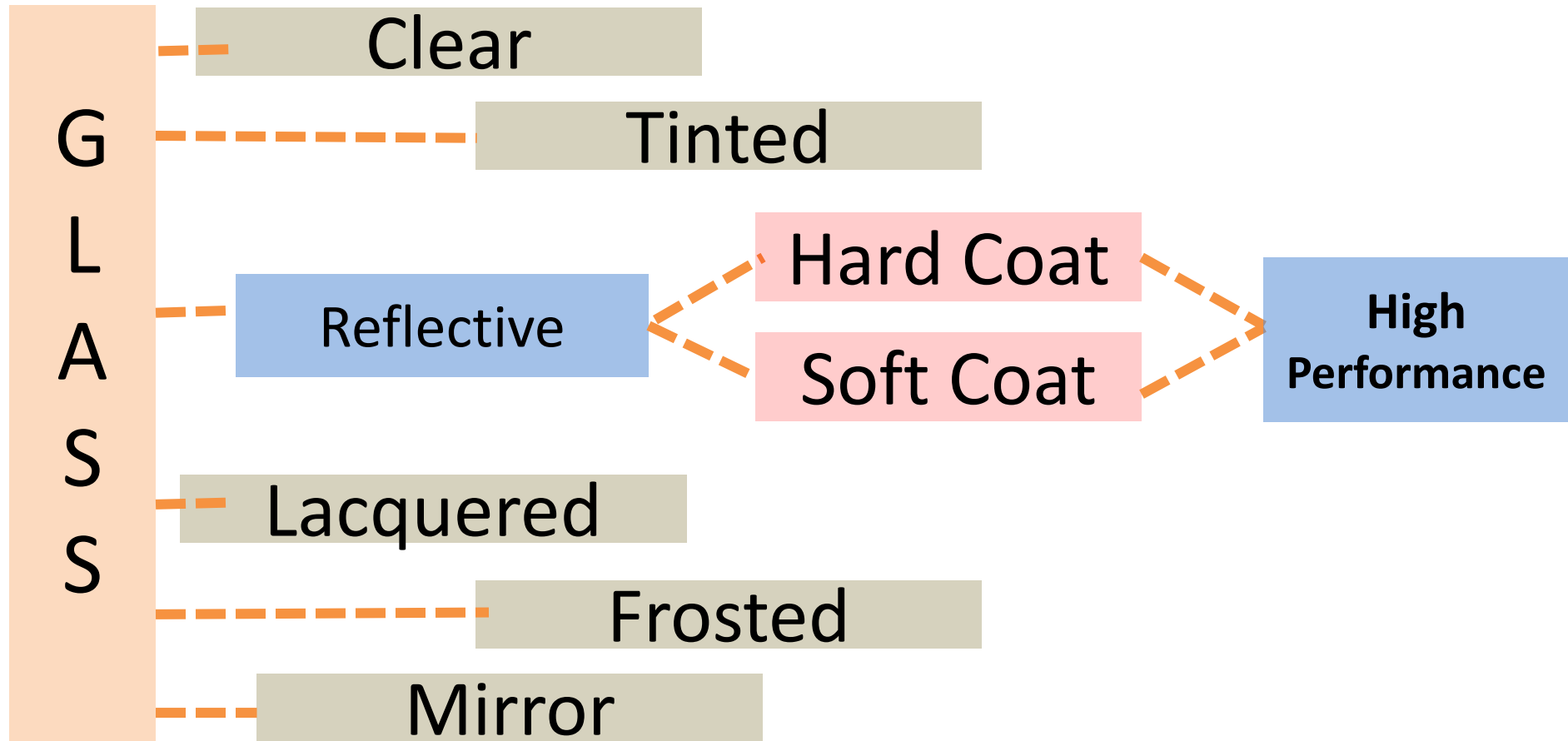
2.Glass **doesn't bend**

3. Glass **is Fragile**

4. All Glasses are Same

A single element added to glass can significantly change its properties.

GLASS
- Clear
- Tinted
- Reflective
  - Hard Coat → **High Performance**
  - Soft Coat → **High Performance**
- Lacquered
- Frosted
- Mirror

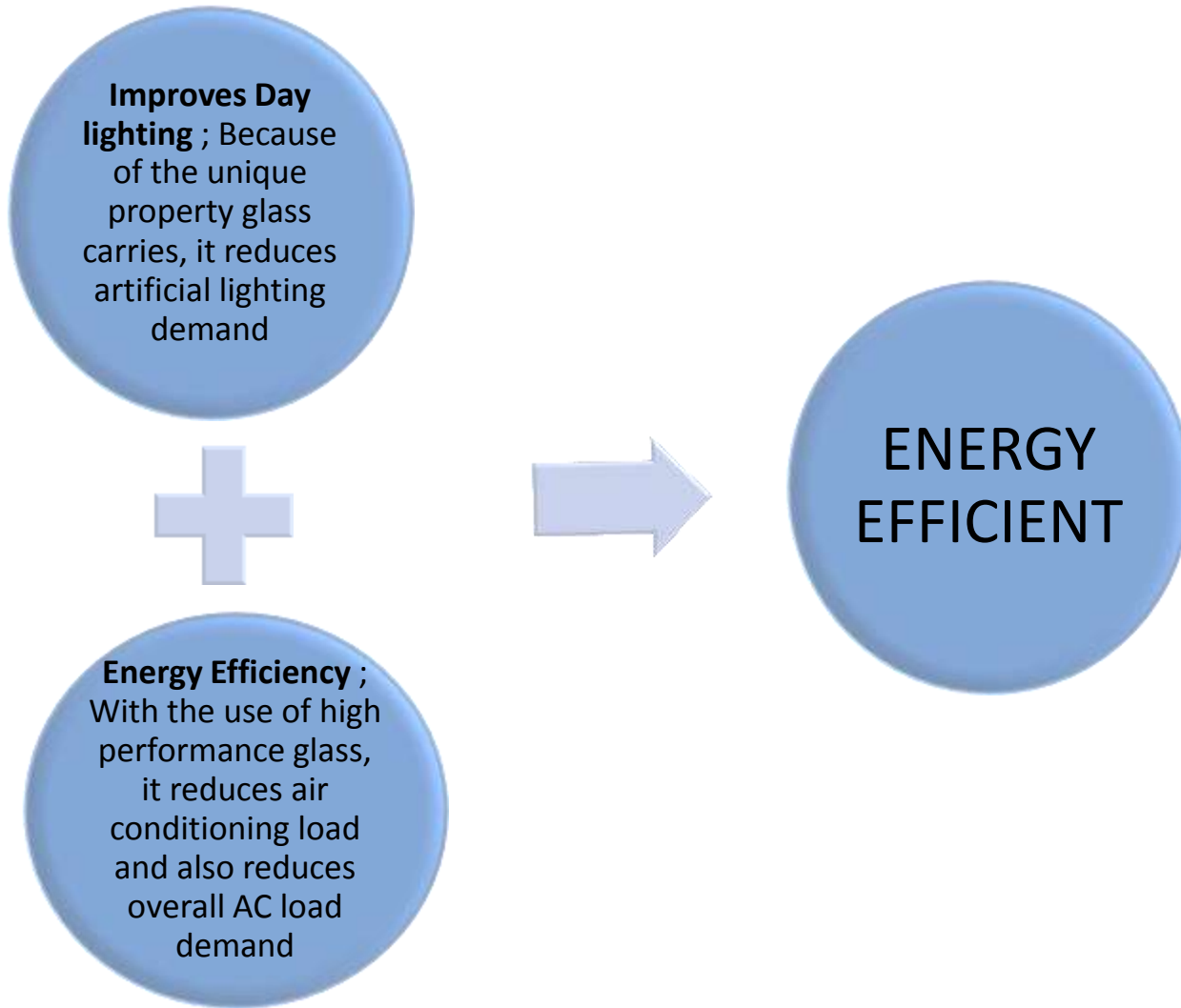## USE GLASS, DON'T ABUSE IT

Glass & Energy (in)efficiency

Why Glass is important in energy conservation

➢ For a standard building, Windows contribute approx. 41% of the total heat transfer.

➢ This is for a WWR of 15% and naturally more the WWR, more will be the heat gain

➢ Right selection of glazing will positively impact the energy requirement of the building.

Roof 24 %

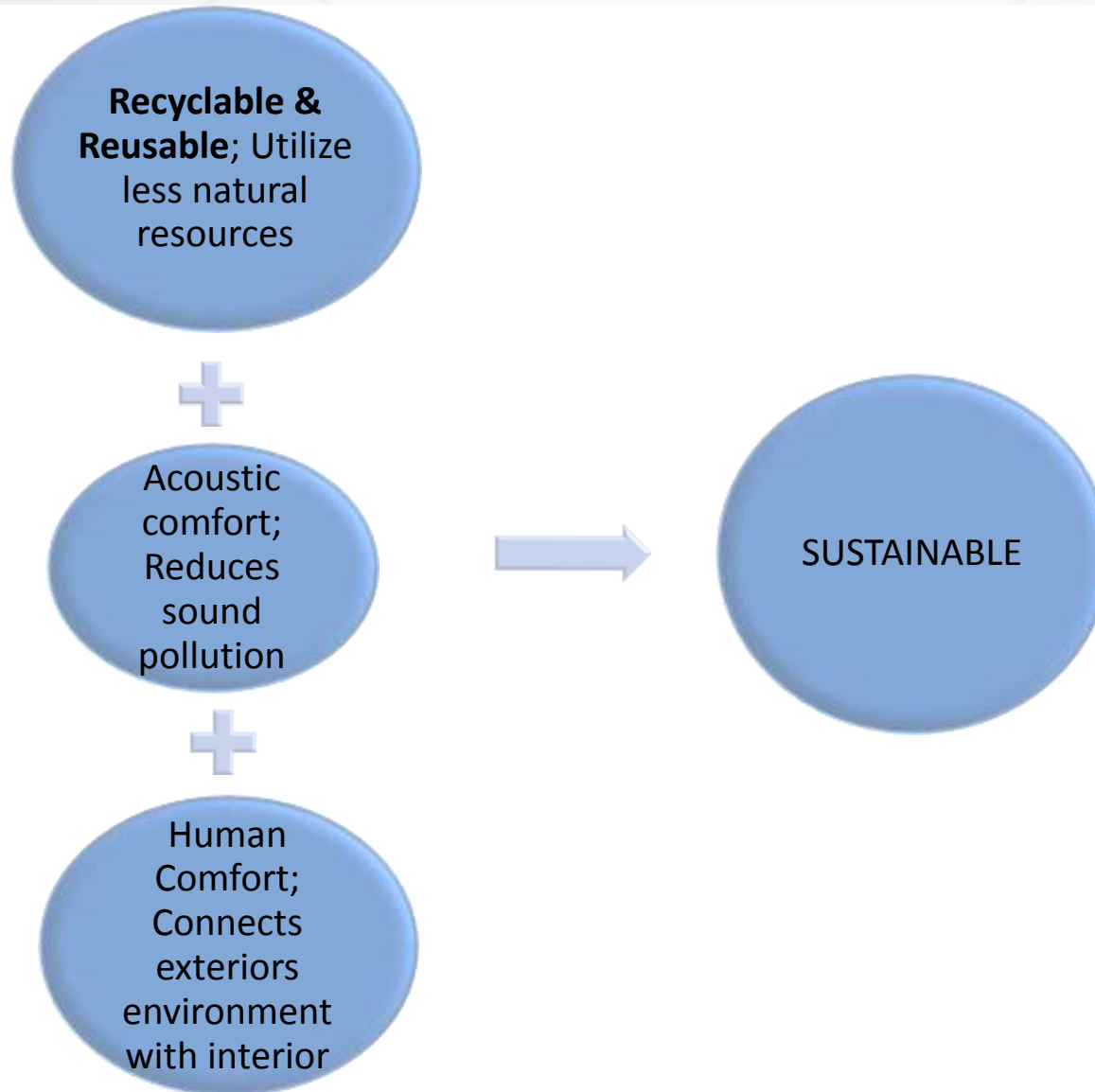Walls 26 %

Windows 41 %

Floor 9 %
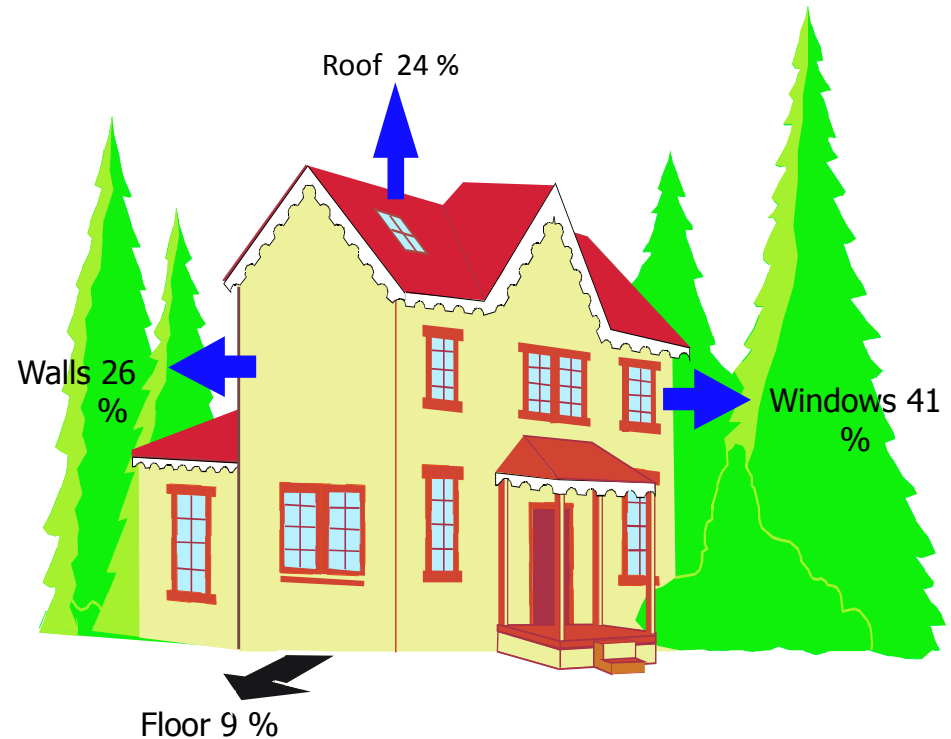
As windows contribute to a significant portion of the heat transfer in a building, choice of glazing plays a vital in the total heat gain to the building.

Glass – A Green Building Material

Improves Day lighting ; Because of the unique property glass carries, it reduces artificial lighting demand

+

Energy Efficiency ; With the use of high performance glass, it reduces air conditioning load and also reduces overall AC load demand

→

ENERGY EFFICIENT

Glass – A Green Building Material

Recyclable & Reusable; Utilize less natural resources

+

Acoustic comfort; Reduces sound pollution

+

Human Comfort; Connects exteriors environment with interior

→ SUSTAINABLE

Using Glass – Indian Context

Evolution in Glass for facade

AIS

Clear → Tinted → Hard Coat Reflective Glass → Soft Coat Reflective Glass

Soft Coat Glasses

AIS

Ecosense

- **Solar Control**
  - Solar Control (Non Silver)
    Enhance

- **Single Silver (Low E)**
  - Low E only
    Essence
  - Solar Control & Thermal Insulation
    Edge
  - Solar Control Low E
    Exceed

- **Double silver**
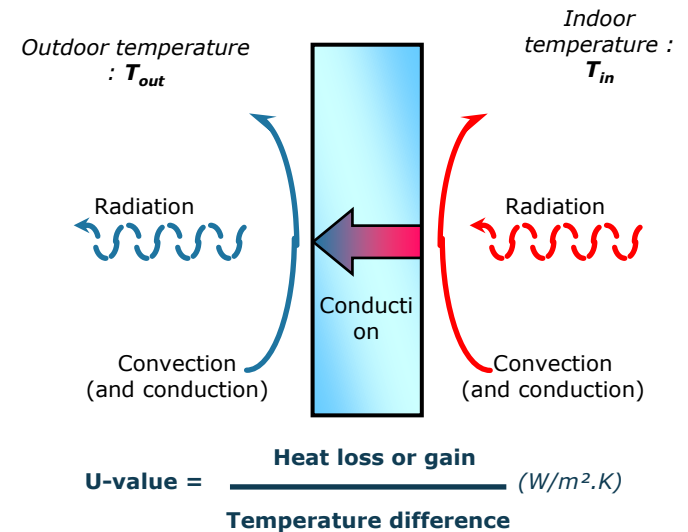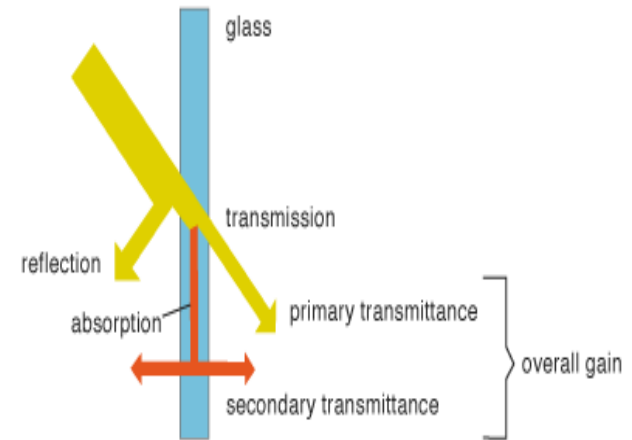 - Double silver
    Excel
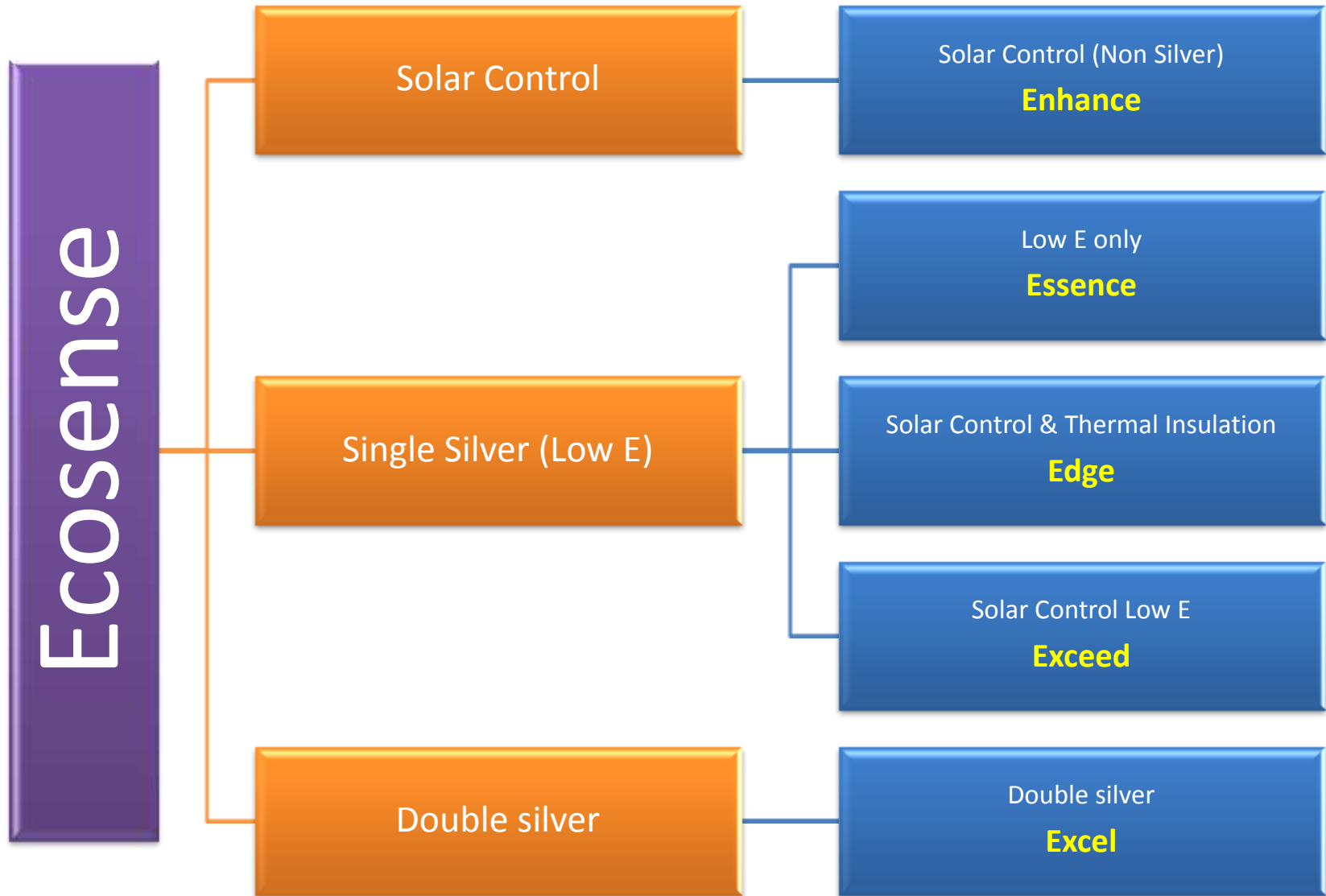
Glance At Terminology

SHGC (Solar Heat Gain Coefficient)/SF (Solar Factor) :-The fraction of external solar radiation that is admitted through a window or skylight, both directly transmitted, and absorbed and subsequently released inward.

U Value (W/m²-K) :- A value that describes the ability of a material to transmit heat. The lower the number, the lower is the heat transferred through the material.

RHG (Relative Heat Gain) :- An attribute which describes the total performance of the glazing with regard to heat transfer due to temperature differential (U-Value), as well as solar gain (shading coefficient).

Usually 80% is contributed by Solar gain and 20% through temperature differential

Outdoor temperature : T_{out}

Indoor temperature : T_{in}

Radiation

Conduction

Radiation

Convection (and conduction)

Convection (and conduction)

$$\text{U-value} = \frac{\text{Heat loss or gain}}{\text{Temperature difference}} \quad (W/m^2.K)$$

Glance At Terminology

Visible transmittance (VLT) – It is the percentage of visible light, incident on the glazing, that will pass through.
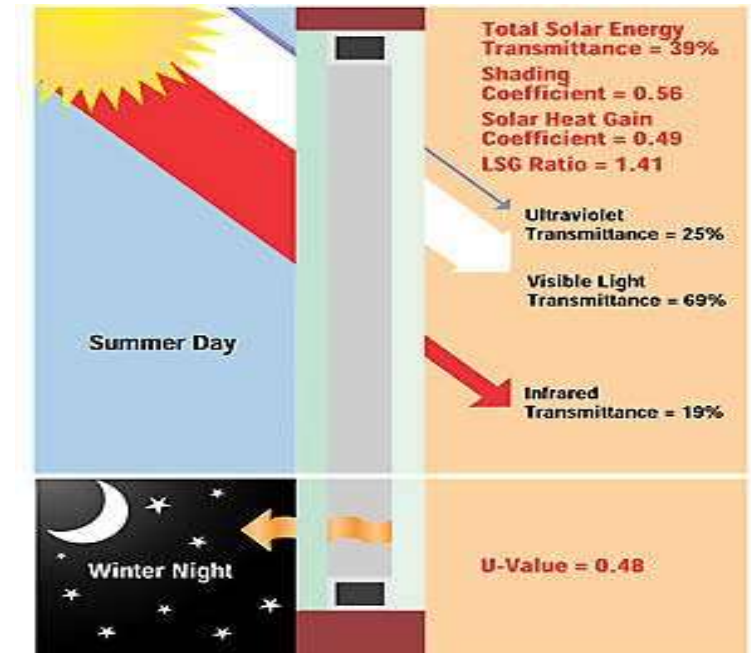
Ultraviolet transmittance – It indicates the percentage of ultraviolet radiation, striking the glazing, that will pass through.

WWR- Window to wall ratio

Effective Aperture (EA) = WWR X VLT

M factor = multiplication factor

Sound transmission- It is represented by Outdoor to Indoor Transmission Class (OITC). Higher is this rating, better will be the glazing unit at sound insulation.

Total Solar Energy Transmittance = 39%
Shading Coefficient = 0.56
Solar Heat Gain Coefficient = 0.49
LSG Ratio = 1.41

Ultraviolet Transmittance = 25%

Visible Light Transmittance = 69%

Summer Day

Infrared Transmittance = 19%

Winter Night

U-Value = 0.48

Window Glass	Normal STC Range	Typical Value
Single pane glass	26-28	27
Dual pane glass	26-33	28
Soundproof Window over a single pane window	43-49	48
Soundproof Window over a dual pane window	45-54	48

Energy Efficient Glazing

Glazing selection Parameters

Parameters	Importance
Aesthetic	Enhances look of the building
Energy Efficiency	It is a combination of lighting & cooling energy saving
Improved Day-lighting	Reduces artificial lighting requirement by using glazing
Glare Reduction	It can defeat the purpose of using glass

Glass	Colour	Visual light transmission	Internal Reflection	External Reflection	Solar Factor	Shading co-efficient	U value
		VLT	IR	ER	SF	SC	
A	Shade	%	%	%	%		W/m2

Energy Efficiency

➢ Use high performance glass

➢ Use glass in appropriate orientation

➢ Smartly design building with shades, inclination etc. to reduce direct heat ingress

➢ Use IGU, if building design requires

➢ Use rated frames

Climate Response   ➕   Orientation & Design   ➕   Façade Design   ➕   Material used
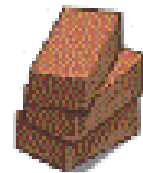
Right Selection of Glass

DGU Glass (DGU 6-12air-6 Clear)	Solar Factor (%age)	U-Value (W/M².K)	RHG (W/M²)
Clear	71%	2.8	535
Tinted	45%	2.8	347
Solar Control Glass	35%	2.8	275
Solar Control Low E Glass	20%	1.7	158

Strength, Safety & Sound Insulation

Strength

➢ Use tempered, heat strengthened or laminated glass

Safety

➢ Use Laminated Glass

➢ Select the types of lamination according to safety requirement & safety norms

Sound Insulation

➢ Use laminated glass with special acoustic interlayer

Pa	dB
20	120
2	100
0,2	80
0,02	60
0,002	40
0,0002	20
0,00002	0
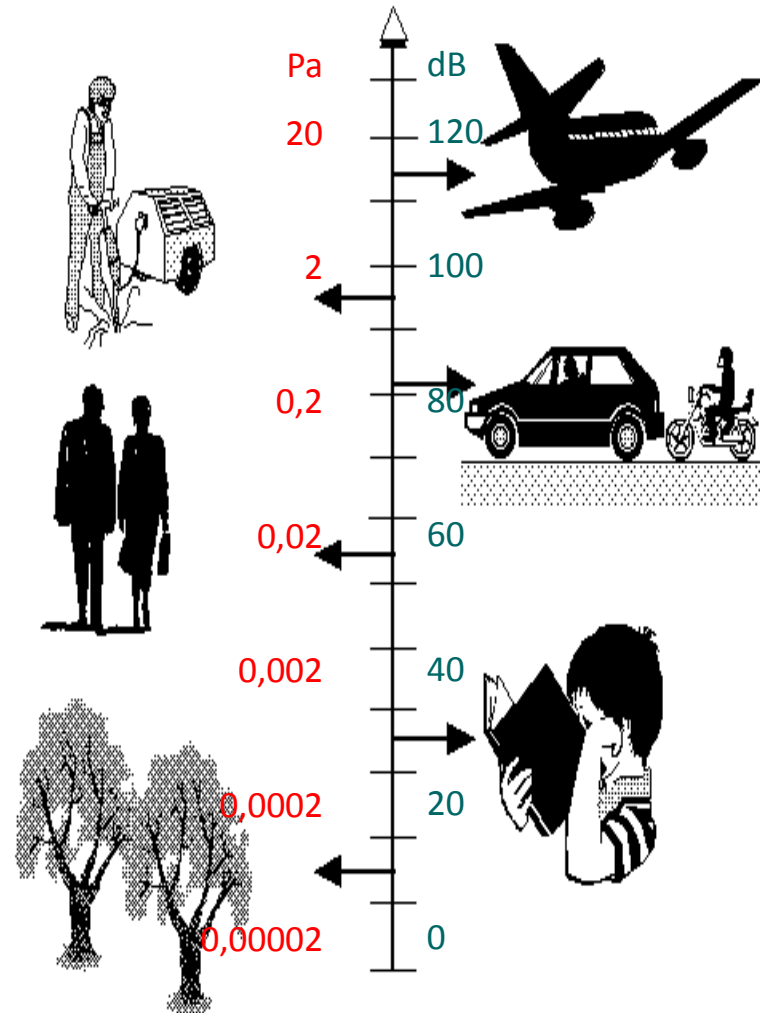
Design Factors affecting Glazing Selection

Climate Analysis : -

Climatic condition of the location is important to select type of glazing as different weather impacts differently.

An Office building in Bangalore, where glass with SF of 37 & U-Val – 5.7 was as efficient as a glass with SF of 25 & U-Val – 3.7. The building design & the local weather conditions meant that you can relax the glass values & still be energy efficient.

| Calculations	Total (KWh)	Cost of Electricity	Savings (KWh)/Yr	Savings (Rs.)/Yr.	Cost of Glass	Cooling design (KWH)	Coolin Load in TR	Units	Cost	Savings	Extra Paid for Glass
base case Clear Glass SGU	7032860	42197163			2750000	3052	862	300tr*3	21375000		
Enhance Pine SGU	7244067	43464400	-211206	1267237	5500000	2960	836	300tr*3	21375000	0	2750000
Enhance Reef SGU	7034942	42209653	-2082	-12491	5500000	2905	820	300tr*3	21375000	0	2750000
Proposed Glass	7099559	42597354	-66699	-400191	5750000	2800	790	300tr*2 +200*1	19000000	2375000	3000000
Proposed Glass as per Green Consultant with Lighting controls	7320208	43921247	-287347	-1724085	5750000	2876	812	300tr*2 +250*1	20187500	1187500	3000000
Proposed Glass as per Green Consultant without Lighting controls	7640898	45845389	-608038	-3648227	4250000	2885	814	300tr*2 +250*1	20187500	1187500	1500000

Optimum Orientation of Building: -

A commercial complex at Navi Mumbai with glazing on East & South Façade showed that Clear Glass performed as good as the so called "high – performance glasses" and the choice came down to aesthetics

Shadow Analysis :-

January
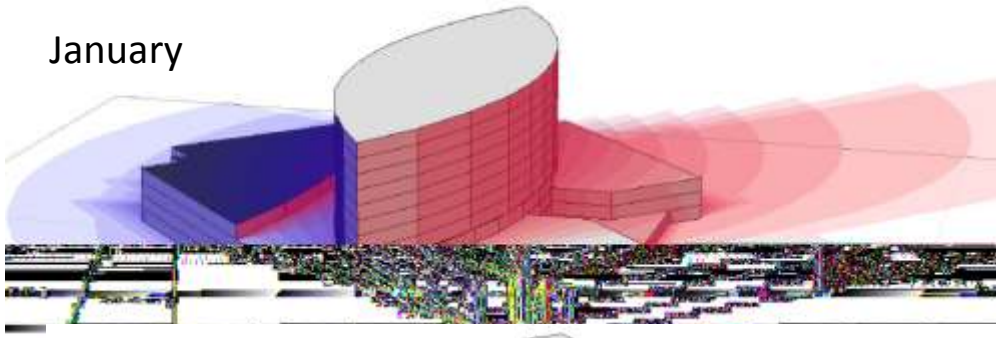
May
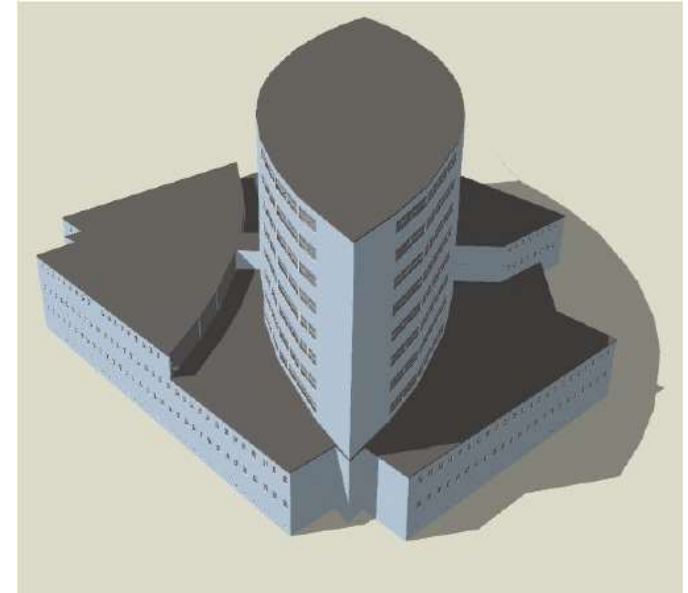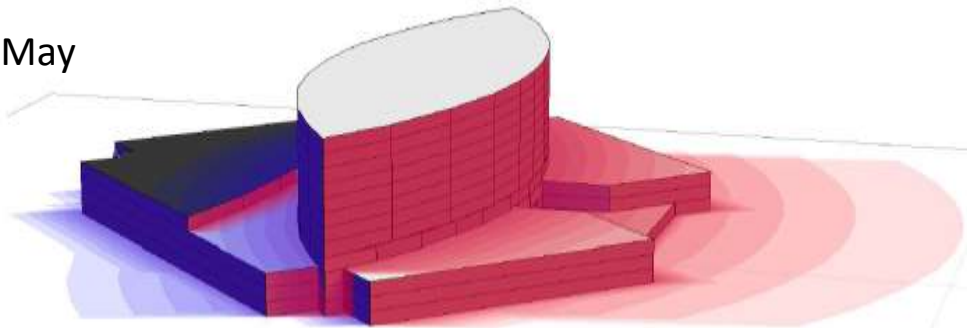
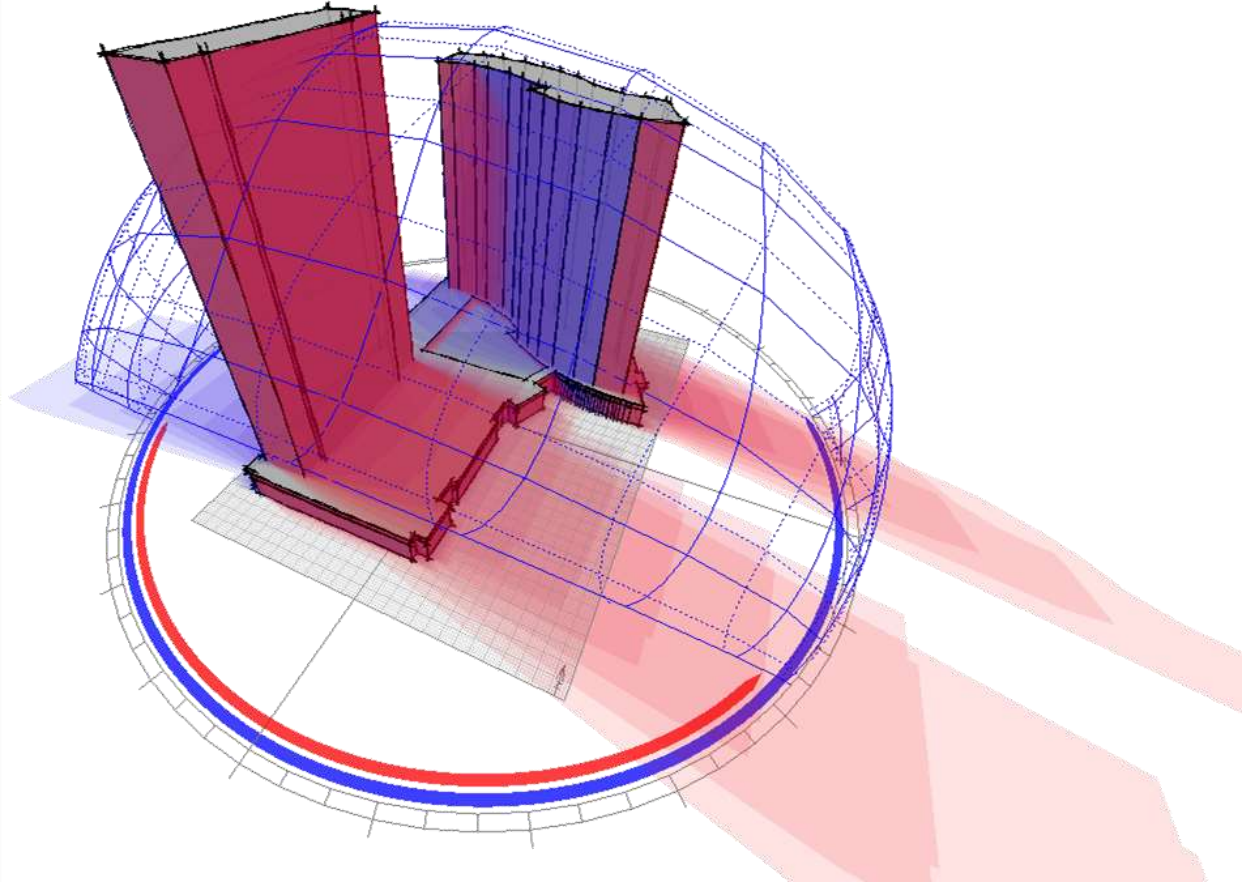**Right orientation reduces the demand for high performance parameters.**

Glazing Selection process – Sun Path

## Shadow Analysis: -

Blue indicates Summer sun path and Red indicates Winter sun path.

Shadow Analysis suggests the optimum requirement of Glazing performance parameter to be used.

Passive Design: -

➤ A hotel building in Gurgaon had avoided their demand of high performance glasses just by adding shading devices.

➤ Correct shading reduces overall solar radiation intake in the building and also optimizes Light inside the building.
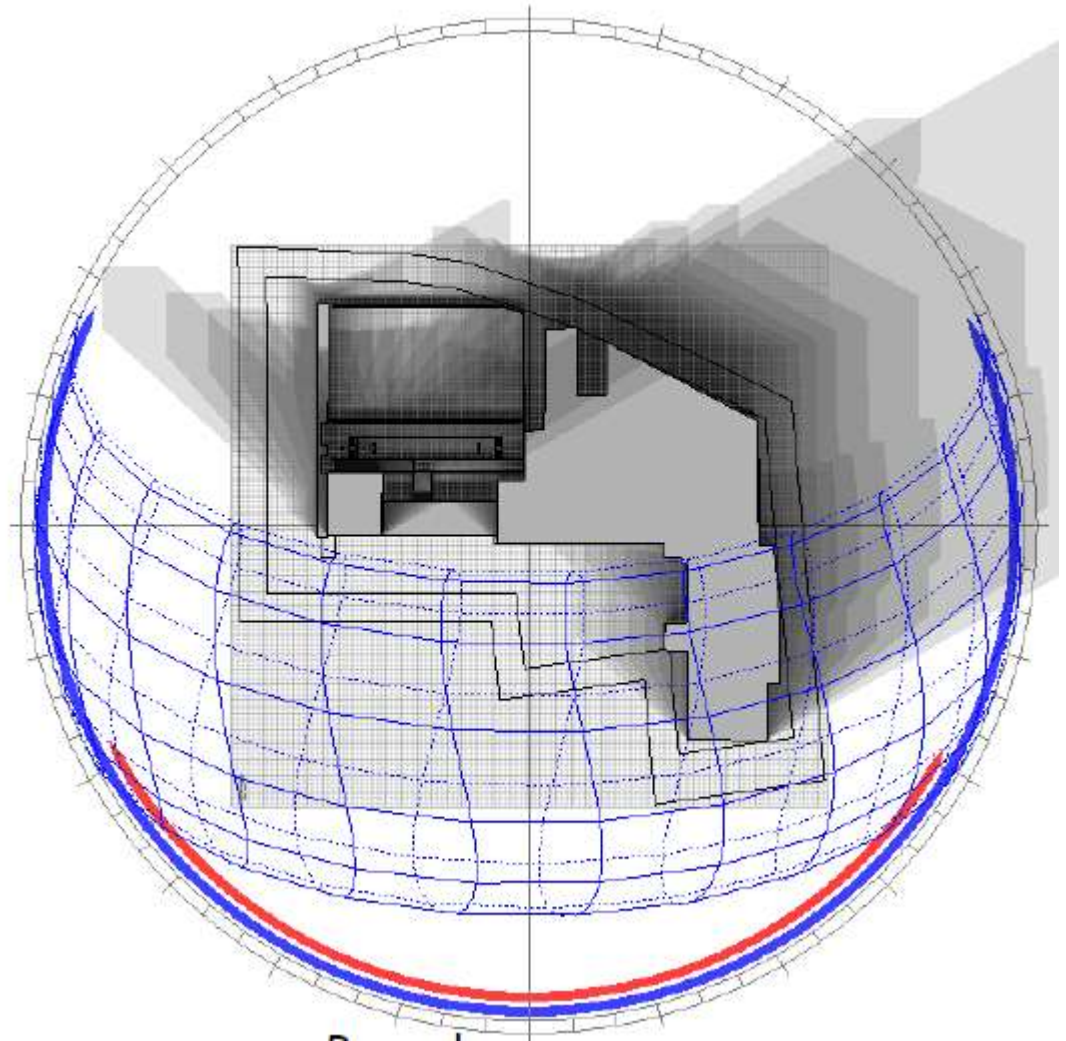
Glazing Selection process - Daylighting

Daylight Analysis : -

For a corporate building in Mumbai daylight analysis was done for Clear Glass (VLT = 78%) and the high performance glass (VLT = 21%). Both the Glasses performed identical in terms of achieving the optimal lux levels. Clear Glass, in fact, caused glare is certain portions of the building.
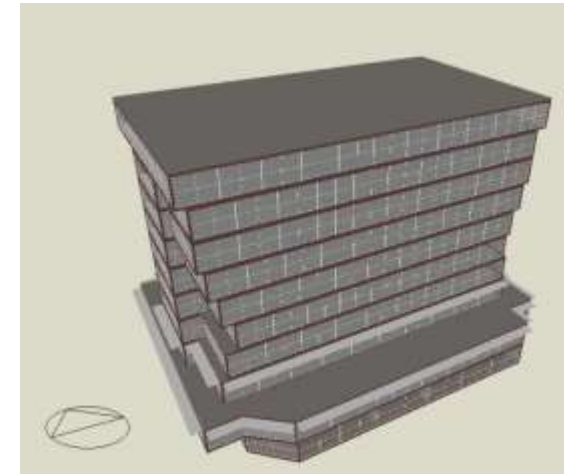
Red Colour region shows area which will have Glare and grey indicates sub-optimal lighting In 2nd case, we can see reduction in Glare area without reducing optimum lux level.

VLT 78%

VLT 21%
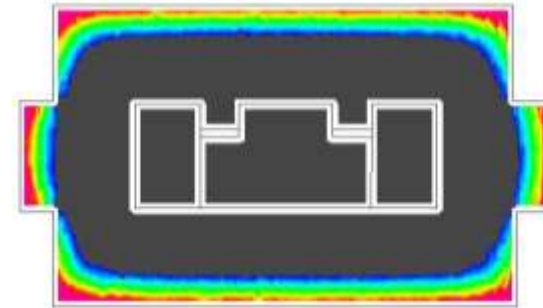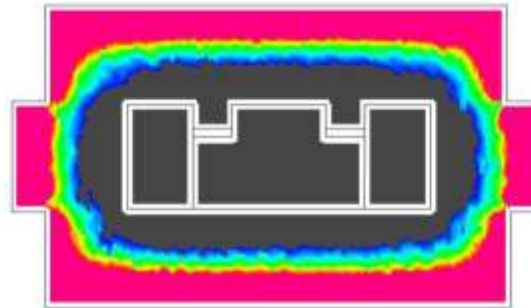
> **Daylight analysis is important as it prevents overdesigning of the building and at the same time optimizes VLT requirement.**
> **In the case mentioned, we can use high performance glass which will reduce cooling load without compromising on Lighting load.**

Glazing Selection process (Active Design)

Glazing Products: -

Before selecting the glass, we need to look at the key performance parameters and select the best suited one depending on the building property

Glazing combination options	VLT	SHGC	U - Value
Clear (SGU)	87	0.81	5.7
Tinted (SGU)	72	0.59	5.7
AIS Opal (SGU)	34	0.22	5.7
Ecosense Enhance	31	0.24	5.4
Ecosnese Exceed (DGU)	47	0.28	1.7
Ecosense Excel (DGU)	41	0.23	1.6

Overall Energy consumption & Payback period: -

Once the aesthetic of the glazing is chosen, a comprehensive analysis of the products available, when integrated with the building systems, should be done to arrive at the optimal glazing parameters without overdesigning or under-designing the glazing systems

This will justify the glazing selection both by performance & cost

Type	Total Electricity consumption (KWH)	Electricity cost Annual (Rs)	Savings Annual (Rs)	Glazing Cost (Rs)	Extra payment for HP glass (Rs)	Payback years	Payback Months
Base case Clear DGU	2403120	14418720		6600000			
Grey Radiance	1027763	6166578	8252142	12650000	6050000	0.73	8.80
Grey Vision	944143	5664855.6	8753864.4	12650000	6050000	0.69	8.29
Grey Lite	1080116	6480696	7938024	12650000	6050000	0.76	9.15
Grey Brook	919781	5518686	8900034	12650000	6050000	0.68	8.16

Assumptions	
Cost of electricity assumed to be Rs. 6/ unit	
Required quantity = 5500 sqm	
Cost of following glass:	Rs./-
DGU	1200
Grey Radiance	2300
Grey Vision	2300
Grey Lite	2300
Grey Brook	2300
Enhance Mist (Spandrel Area) N/S	2000
Reflective Low e glass (Spandrel Area) E/W	1600
Additional spandrel area glass cost	Rs./-
Rs. 2000 x 1645 sq.mt	3290000
Rs. 1600 x 300 sq.mt	480000
	3770000

Payback (yrs)
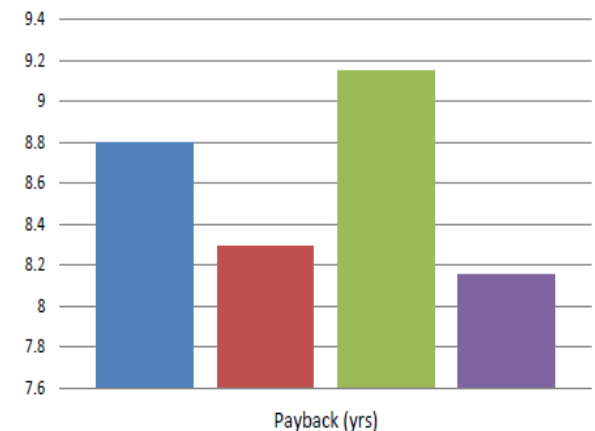
Grey Radiance ■ Grey Vision ■ Grey Lite ■ Grey Brook

Glazing Selection process

To summarize: -

- Effective Aperture Approach-Keep EA between 0.2 and 0.3. Larger windows will permit more light hence low-VLT glazing will do.

- Bigger windows require better glazing.

- Choose products with least SHGC and U value and optimum VLT.

- Vary glazing selection by façade

- Determine an optimum set of values for U-value, solar heat gain coefficient, and visible transmittance through more rigorous computer modeling with whole building simulation programs
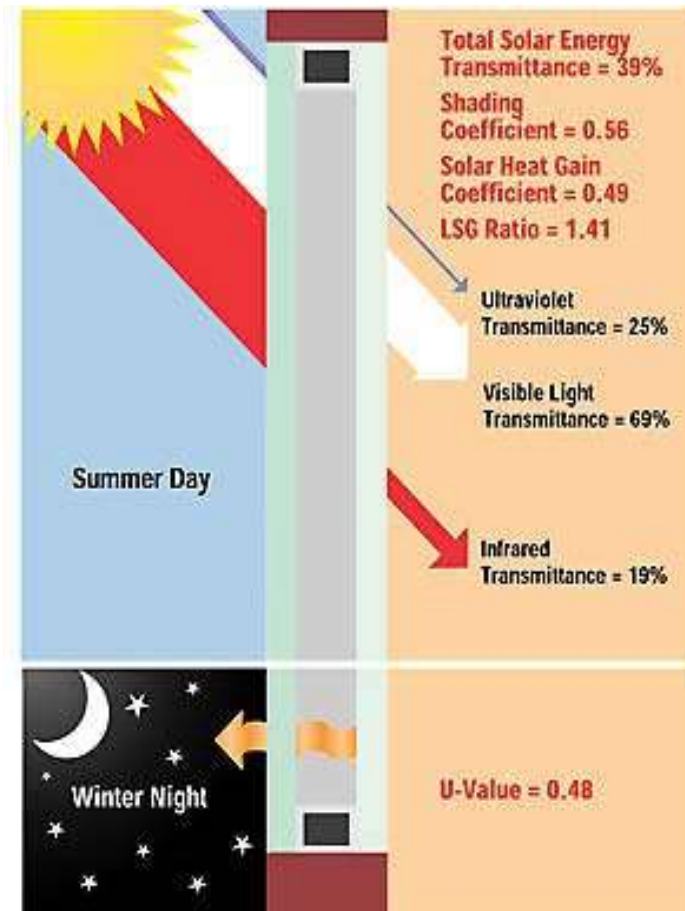
Do's in Indian context

- Add overhead shading

- Add internal shading

- Have more windows on North and South facades

- Use glazing with Optimum VLT ; low SHGC and U value

- Use dark tinted glass at visible height and clear at higher levels

- Use EA between 0.2 to 0.3

- Add light shelves to interiors

- Use high windows (ventilators in naturally ventilated buildings)

- Do not use glass with very low U value and moderate SHGC.

- Do not assume dark tinted glass brings solar control

- Do not use un-insulated frames

- Do not use Tempered glass as safety glass

- Do not use IGU as sound insulation glass
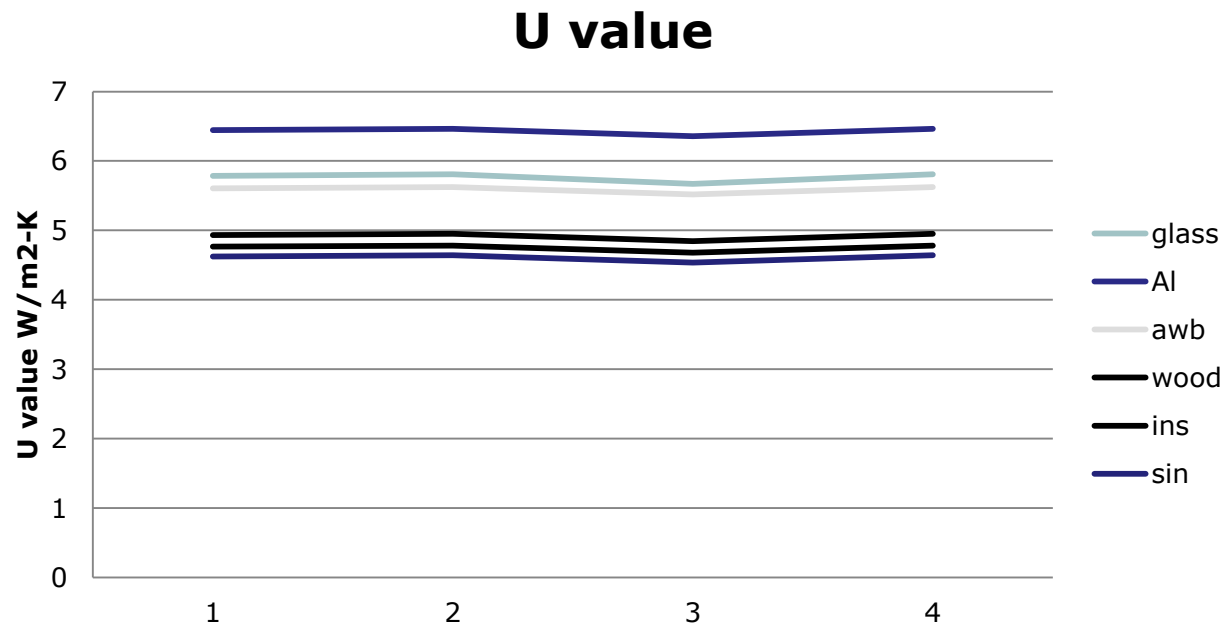
U value

- Remember that same fenestration product behaves differently w.r.t. the specific design.

- It should not be assumed that products with Low U-value and SHGC are best and universal solution.

- Direct radiation falling on the windows should be minimized.

- For shaded windows, products with lower U values perform better.

- For un-shaded windows receiving high amount of solar radiation, products with low SHGC would perform better.

- Hence glazing should be selected after thoroughly considering the design.

Technological support

Mobile app and VR apps – Unique interactive experience of AIS solutions

Mobile Apps	Description	Benefits
AIS Glass Simulator	Energy Simulation App - Based on inputs like Building size, Orientation of building, WWR – get the 'Right' AIS solution offering optimum energy savings	It helps in the decision making process
AIS World Of Shades	Virtual reality App which lets one visualize the different shades of AIS products on exterior facades and interiors	Enable one to choose the right shade for their designs and architectural creations
AIS World of Glass	Mobile app showcasing various AIS products and Experience zone for Privacy & Security solutions demo	One can have details of all AIS products and solutions with technical parameters, color swatches at their fingertips
AIS Virtual World	Virtual Reality app – An immersive tour of a Virtual villa showcasing AIS innovative glass solutions	A unique Immersive experience to experience AIS glass solutions in actual applications
AIS Glass Visualizer - Launching Soon	Visualize Building aesthetics with different AIS High performance glasses for your upcoming projects.	Unique visualizer for your projects to make the right selection of glass

New technology in Glass

Façade Retrofitting for better energy performance:

"ATTOCH" an Ecoglass product that is ideal for energy-saving window renovations

Existing sash
Existing glass
ATTOCH™

Facts and Figures :

- Installation takes only 30 to 60 minutes per window.
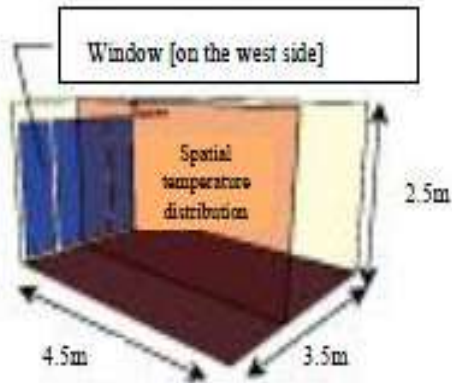- The existing glass continues to be used, and so does not require disposal.
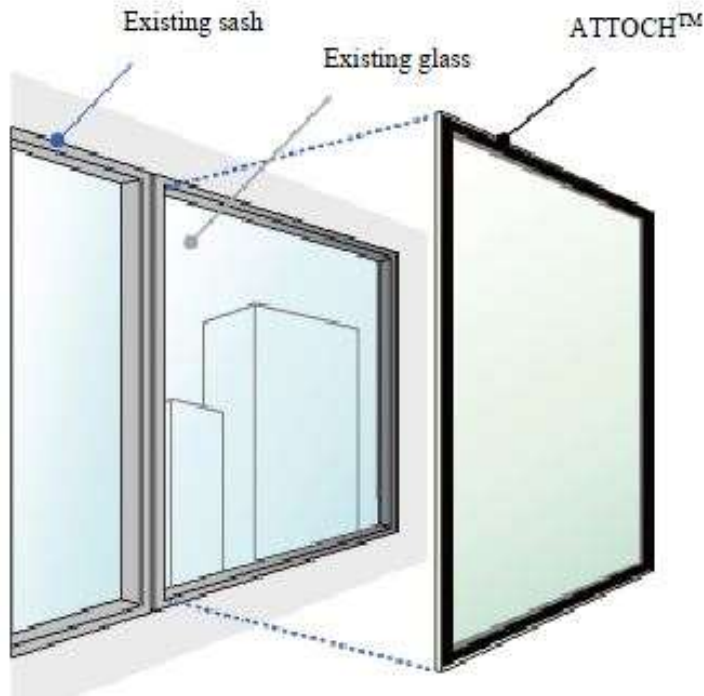
How is it installed?

This product converts an existing windowpane into Ecoglass simply by applying Low-E glass to the inside of the window.

Before installation

After installation

Energy Savings :
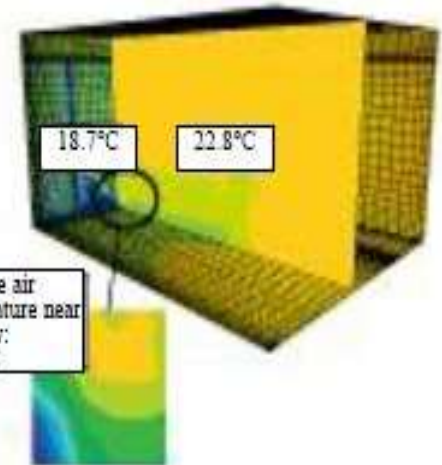
This Innovative technique of Retrofitting helps to reduce air-conditioning energy use by about 30% a year

Smart Glass

Smart glazing refers to electrically switchable glass or glazing which changes light and heat transmission properties when voltage is applied.
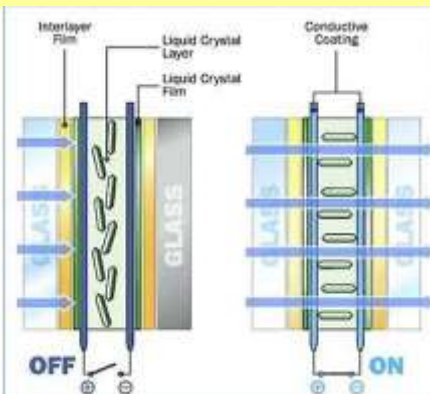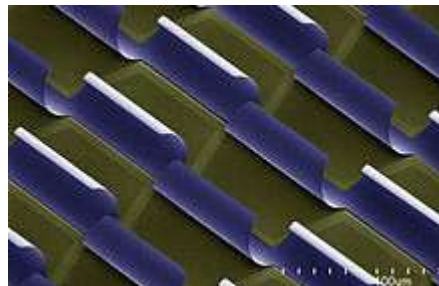
1) Electro-chromic glass
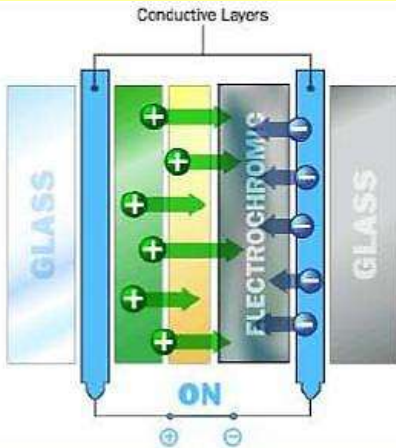
2) Suspended particle device
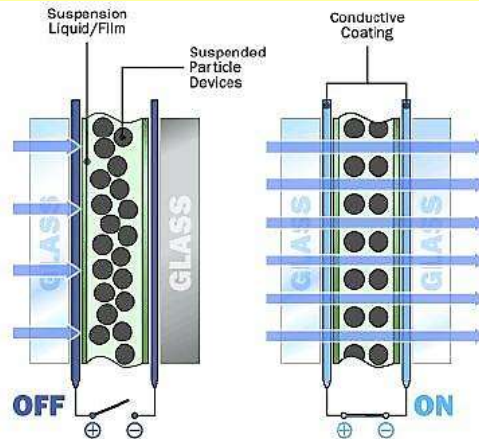
3) Liquid crystal device

4) Micro Blinds

AIS Swytchglas

Application
- Windows
- Doors
- Sunroofs
- Partitions

Benefits
- Energy Efficiency
- Health & Beauty salons
- Conference rooms
- Personal cabins
- Projection screens

Fire Safety

Performance criteria	Integrity	Radiation	Insulation
	E	EW*	EI
Prevention of passage of flames	✓	✓	✓
Prevention of passage of smoke	✓	✓	✓
Restricted heat transfer of max. 15 kW/m²		✓	
Prevention the increasing of temperature $\leq$ 140 K average, max. 180 K			✓
Prevention of self-ignition (cotton pad test)			✓

Thank you

for your time

Shailesh Ranjan
98332 98984
shailesh.ranjan@aisglass.com