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
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.

1. **Glass for Windows**

![Building Image]
2. Glass doesn’t bend

3. Glass is Fragile
A single element added to glass can significantly change its properties.

4. All Glasses are Same

- Clear
- Tinted
- Reflective
- Hard Coat
- Soft Coat
- 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.

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
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).

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Usually 80% is contributed by Solar gain and 20% through temperature differential
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U-value = \[ \frac{\text{Heat loss or gain}}{(W/m^2.K)} \]

Temperature difference

-Outdoor temperature : \( T_{\text{out}} \)

-Indoor temperature : \( T_{\text{in}} \)
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.

<table>
<thead>
<tr>
<th>Window Glass</th>
<th>Normal STC Range</th>
<th>Typical Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single pane glass</td>
<td>26-28</td>
<td>27</td>
</tr>
<tr>
<td>Dual pane glass</td>
<td>26-33</td>
<td>28</td>
</tr>
<tr>
<td><strong>Soundproof Window</strong> over a single pane window</td>
<td>43-49</td>
<td>48</td>
</tr>
<tr>
<td><strong>Soundproof Window</strong> over a dual pane window</td>
<td>45-54</td>
<td>48</td>
</tr>
</tbody>
</table>
Energy Efficient Glazing
## Glazing selection Parameters

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aesthetic</td>
<td>Enhances look of the building</td>
</tr>
<tr>
<td>Energy Efficiency</td>
<td>It is a combination of lighting &amp; cooling energy saving</td>
</tr>
<tr>
<td>Improved Day-lighting</td>
<td>Reduces artificial lighting requirement by using glazing</td>
</tr>
<tr>
<td>Glare Reduction</td>
<td>It can defeat the purpose of using glass</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Glass</th>
<th>Colour</th>
<th>Visual light transmission</th>
<th>Internal Reflection</th>
<th>External Reflection</th>
<th>Solar Factor</th>
<th>Shading coefficient</th>
<th>U value</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Shade</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>W/m²</td>
</tr>
</tbody>
</table>
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
# Right Selection of Glass

<table>
<thead>
<tr>
<th>DGU Glass (DGU 6-12air-6 Clear)</th>
<th>Solar Factor (%)</th>
<th>U-Value (W/M².K)</th>
<th>RHG (W/M²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear</td>
<td>71%</td>
<td>2.8</td>
<td>535</td>
</tr>
<tr>
<td>Tinted</td>
<td>45%</td>
<td>2.8</td>
<td>347</td>
</tr>
<tr>
<td>Solar Control Glass</td>
<td>35%</td>
<td>2.8</td>
<td>275</td>
</tr>
<tr>
<td>Solar Control Low E Glass</td>
<td>20%</td>
<td>1.7</td>
<td>158</td>
</tr>
</tbody>
</table>
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
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.
Glazing Selection process - Orientation

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.
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.
Glazing Selection process – Passive Design

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.

- 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.

<table>
<thead>
<tr>
<th>Glazing combination options</th>
<th>VLT</th>
<th>SHGC</th>
<th>U - Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear (SGU)</td>
<td>87</td>
<td>0.81</td>
<td>5.7</td>
</tr>
<tr>
<td>Tinted (SGU)</td>
<td>72</td>
<td>0.59</td>
<td>5.7</td>
</tr>
<tr>
<td>AIS Opal (SGU)</td>
<td>34</td>
<td>0.22</td>
<td>5.7</td>
</tr>
<tr>
<td>Ecosense Enhance</td>
<td>31</td>
<td>0.24</td>
<td>5.4</td>
</tr>
<tr>
<td>Ecosnese Exceed (DGU)</td>
<td>47</td>
<td>0.28</td>
<td>1.7</td>
</tr>
<tr>
<td>Ecosense Excel (DGU)</td>
<td>41</td>
<td>0.23</td>
<td>1.6</td>
</tr>
</tbody>
</table>
Glazing Selection process

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.

<table>
<thead>
<tr>
<th>Type</th>
<th>Total Electricity consumption (KWH)</th>
<th>Electricity cost Annual (Rs)</th>
<th>Savings Annual (Rs)</th>
<th>Glazing Cost (Rs)</th>
<th>Extra payment for HP glass (Rs)</th>
<th>Payback years</th>
<th>Payback Months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base case Clear DGU</td>
<td>2403120</td>
<td>14418720</td>
<td>660000</td>
<td>660000</td>
<td>660000</td>
<td>0.73</td>
<td>8.80</td>
</tr>
<tr>
<td>Grey Radiance</td>
<td>1027763</td>
<td>6106578</td>
<td>8252142</td>
<td>12650000</td>
<td>6050000</td>
<td>0.69</td>
<td>8.29</td>
</tr>
<tr>
<td>Grey Vision</td>
<td>944143</td>
<td>5664855.6</td>
<td>8753864.4</td>
<td>12650000</td>
<td>6050000</td>
<td>0.76</td>
<td>9.15</td>
</tr>
<tr>
<td>Grey Lite</td>
<td>1080116</td>
<td>6480696</td>
<td>7938024</td>
<td>12650000</td>
<td>6050000</td>
<td>0.68</td>
<td>8.16</td>
</tr>
<tr>
<td>Grey Brook</td>
<td>919781</td>
<td>5518686</td>
<td>8900034</td>
<td>12650000</td>
<td>6050000</td>
<td>0.68</td>
<td>8.16</td>
</tr>
</tbody>
</table>

Assumptions:
- Cost of electricity assumed to be Rs. 6/- per 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.m: 3290000
  - Rs. 1600 x 300 sq.m: 460000
  - Additional cost: 3770000
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)
Don’t in Indian context

- 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

![Graph showing U value comparison between different materials (glass, Al, awb, wood, ins, sin).](image-url)
Learning

• 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

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

![App icons](image-url)
New technology in Glass
Façade Retrofitting for better energy performance:

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

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

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.
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

Application
• Windows
• Doors
• Sunroofs
• Partitions

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

AIS Swytchglas
Smart Glass
## Fire Safety

<table>
<thead>
<tr>
<th>Performance criteria</th>
<th>Integrity</th>
<th>Radiation</th>
<th>Insulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prevention of passage of flames</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Prevention of passage of smoke</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Restricted heat transfer of max. 15 kW/m²</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Prevention the increasing of temperature ≤ 140 K average, max. 180 K</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Prevention of self-ignition (cotton pad test)</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>
Thank you for your time

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