

Optimizing Building Design With Glass

Asahi India Glass Ltd

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Glass – A quick background

Glass is an amorphous (non-crystalline) solid material

The word 'Glass' is derived from the Latin term 'Glesum' which means transparent substance

Glass is typically brittle and optically transparent

The commonly used glass types are Flat glass and Container glass

Flat glass is a type of glass, initially produced in plane form, commonly used for windows, glass doors, transparent walls and windshields and of two types:

- Sheet Glass
- Float Glass

Container glass is a type of glass used for the production of glass containers.

Glass – A paradigm shift



Concrete Building



Clear or Tinted Glass



High Performance Glass



Smart Buildings with
High Performance
Glasses

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Shattering Myths



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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.



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2. Glass doesn't bend

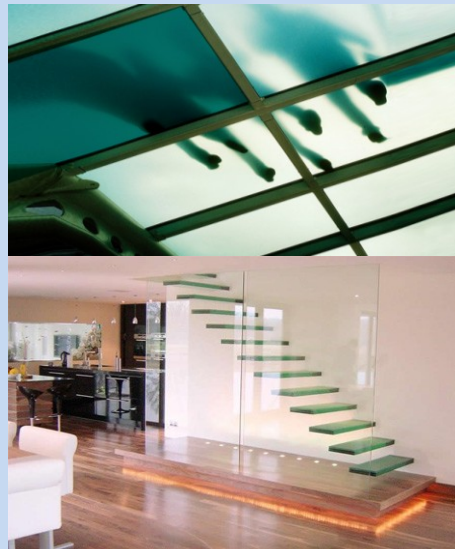


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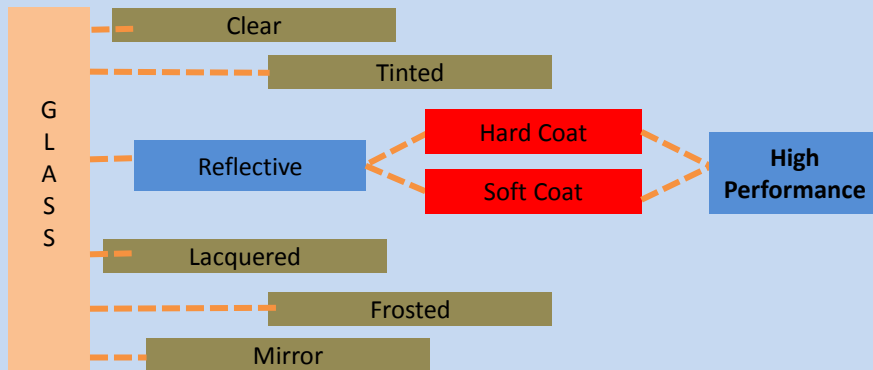
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3. Glass is Fragile



4. All Glasses are Same

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



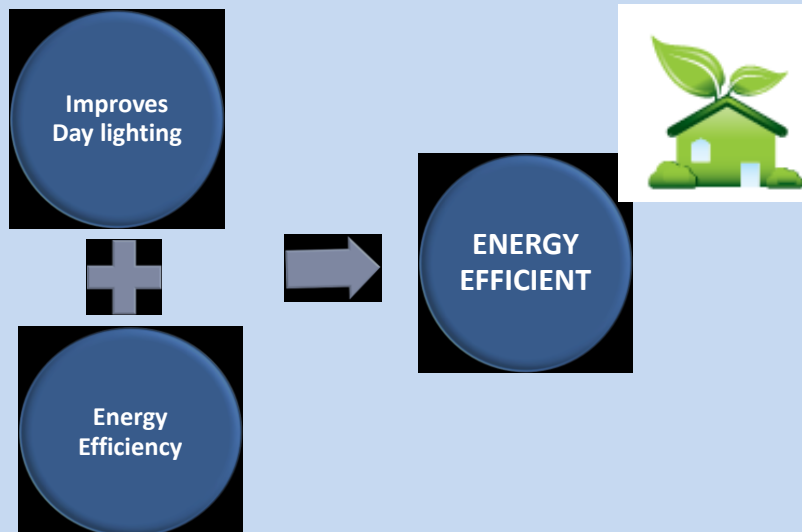
USE GLASS, DON'T ABUSE IT

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5. Glass – (Not) A Green Building Material

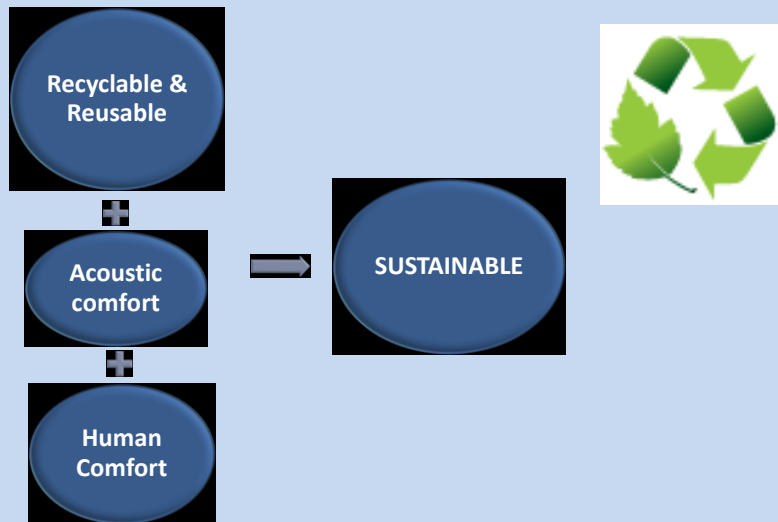


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5. Glass – (Not) A Green Building Material



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Opportunities with Glass

- Gives shape to your imagination by giving enormous application possibilities
- Can be bent to shapes and is strong enough to suffice strength requirement.
- Different types of glasses gives freedom for different application
- Fulfills requirement prescribed for materials to be a Green Building material.
- Helps in energy Efficiency.

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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
Acoustic	It can reduce sound transmission significantly
Strength	Gives strength that even can be used as flooring



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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

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Right Selection of Glass

DGU Glass (DGU 6-12air-6 Clear)	Solar Factor (%age)	U-Value (W/M ² .K)	RHG (W/M ²)
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

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

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Design factors impacting Glass Selection

Climate Analysis :-

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

Optimum Orientation of Building: -

Before selecting any glazing material, study of building orientation is must, if rightly oriented, we may get energy efficiency without using high performance glass. (according to Indian context, South West orientation is responsible for maximum heat gain)

Shadow Analysis: -

Shadow of the building as well as surrounding also impacts heat ingress (direct & defused), hence changes the glazing requirement.

Daylight Analysis :-

Study of available lux level, window size and other passive design should be consider before defining the required VLT of a glass.

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Energy Savings with Glass- Real Life Case Studies

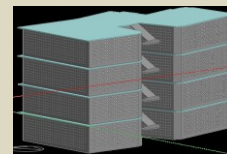


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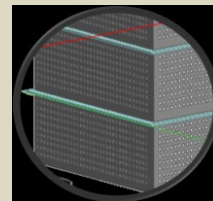
How glass is integrated - Double skin facade

A school in Mumbai

Type	Total Electricity Consumption	Electricity Cost	Savings
	(Mwh)	Annual (in lakhs)	Annual (in thousands)
Non - ventilated cavity			
Base case - 12mm AIS Clear	871	52	
12mm Ref	884	53	-78.88
12 mm Low SF Ref	876	52	-27.80
Low SF Ref	876	52	-27.80
SC + LE	876	52	-27.80
Ventilated cavity			
12mm Low SF Ref	718	43	921.07
Low SF Ref DGU	718	43	921.07
SC + LE DGU	718	43	921.07



Double skin facade – Combination of perforated aluminum sheet & glazing



The non-solar heat gets trapped between the perforated aluminium façade and inside skin when using a low-E glass.

Non-solar heat gain is the reason for increase in heat gains.

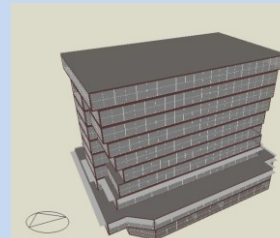


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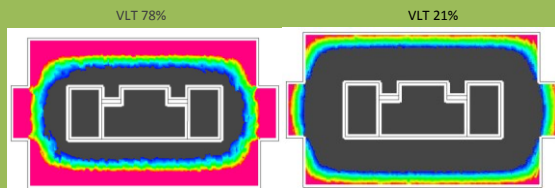
Inclined Facade

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 identically in terms of achieving the optimal lux levels. Clear Glass, in fact, caused glare in certain portions of the building.



Pink 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.



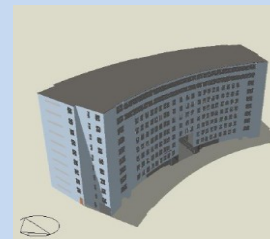
- Daylight analysis is important as it prevents overdesigning of the building and at the same time optimizes VLT requirement.
- In the case mentioned, we can use high performance glass which will reduce cooling load without compromising on lighting load.

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Climate Analysis

Office Building in Bangalore

Climatic condition of the location is important to select type of glazing as different weather conditions have different impact on glass.



Calculations	Total (KWh)	Cost of Electricity	Savings (Kwh)/Yr	Savings (Rs.) / Yr	Cost of Glass	Cooling design (Kwh)	Cooling Load In TR	Units	Cost	Saving	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	0.00	2750000
Enhance Reef SGU	7034942	42209653	-2082	-12491	5500000	2905	820	300tr*3	21375000	0.00	2750000
Proposed Glass	7099559	40597354	-66699	-400191	5750000	2800	790	300tr*2 + 200tr*1	19000000	2375000	3000000
Proposed Glass with lighting controls	7320208	43921247	-287347	-1724085	5750000	2876	812	300tr*2 + 200tr*1	20187500	1187500	3000000
Proposed Glass without lighting controls	7640898	45845389	-608038	-3648227	4250000	2885	814	300tr*2 + 200tr*1	20187500	1187500	1500000

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 and still be energy efficient.

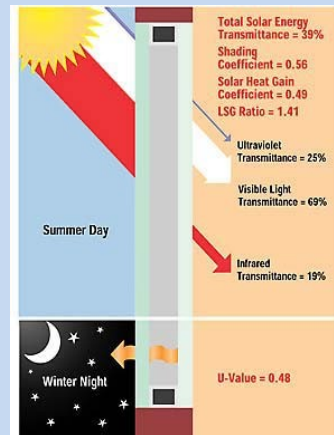


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Glazing Selection process

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



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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)



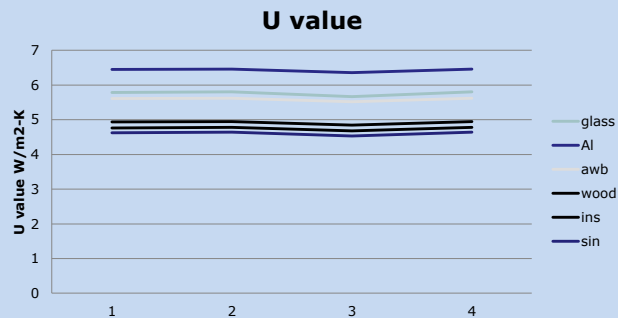
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Don't in Indian context

- 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



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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 thorough considering the design.



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Beyond just glass products – AIS 4G Solutions

Glass Selection – AIS helps in the selection of the right product depending on your requirements

Glass Products – AIS, with its wide range of products, offers solutions to fulfil all requirements, exteriors as well as interiors, performing well on parameters

Glass Processing – AIS provides all kind of processing of glass as per your requirements

Glass Integration – AIS fulfils all your needs related to glass as it is present in every part of the value chain, be it glass manufacturing, processing, consultation, interior installation, window solutions and much more



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AIS – An overview



Asahi India Glass Limited (AIS) is the largest integrated glass company in India offering end-to-end solutions across the entire glass value chain

AIS offers the ideal combination of customised glass solutions, expertise and knowledge of design, installation and retail

AIS has grown from being a 'single product, single customer' company to a world-class integrated company with 13 plants/sub assembly units and global customers

Today, AIS is broadly structured into four verticals:

- Auto
- Architectural
- Consumer Glass
- Solar Glass



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About AIS – the journey so far

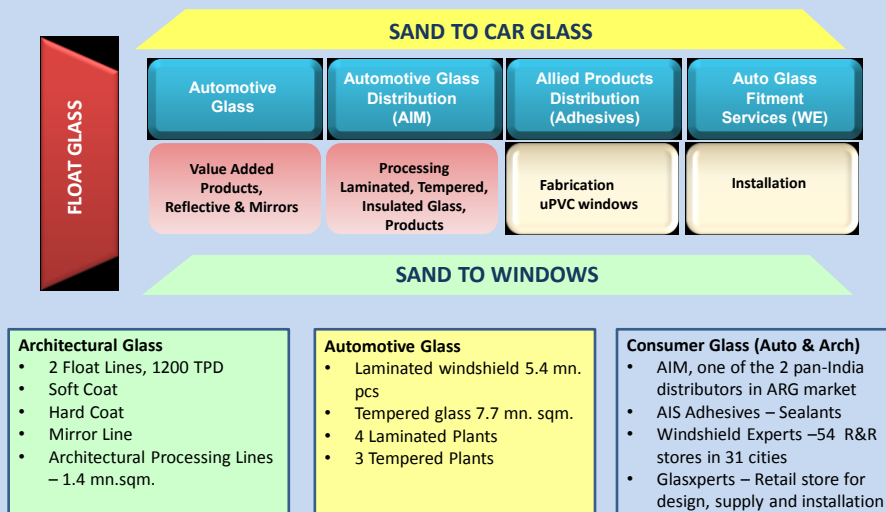
AIS in 1987	AIS today
Automotive glass manufacturing	Largest integrated glass company in India, and probably among the very few glass players in the world, with significant presence in the complete glass value chain
Single Product – Tempered Safety Glass	Offering end-to-end glass solutions, with complete range of automotive and architectural glass products and services
Single Customer – Maruti Suzuki	Wide spread customer-base across all business verticals. Market leader in automotive glass with ~ 69 % share, and a significant market share in architectural and consumers glass business
Single Plant – Bawal (Haryana)	13 manufacturing units at 4 locations , supported by a network of warehouses, zonal and local offices and facilities with pan-India spread out
Local operations – National Capital Region	Pan-India presence with strategically located manufacturing units, warehouses, sales and marketing offices

From being a manufacturer of automotive tempered glass supplying to one customer, AIS has grown and transformed to be a complete solutions provider in the glass value chain



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Value Proposition - Integrated Glass Operations



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