

# GLASS goes green



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*The transparent and ethereal nature of glass allows for extraordinary creations; its versatility means that it can be used in many ways and forms, and in buildings of all types. Once vilified in the context of Indian architecture and climate, the material is now designed taking into account safety, security, insulation and maintenance.*

*The best innovation seems to be that glass has now acquired a green touch, and is now available in a variety of colours and with high-performance characteristics that conform to green building standards.*

TEXT: Teja Lele Desai

Long ago, glass was only used in window applications. The purpose? To allow light in, keep heat or cold out, and to provide a view. These days, with innovation at the forefront of glass technology, the material is used in a variety of ways – to control the elements, provide thermal comfort, control heat gain/ loss, allow natural daylighting, for safety, and to create a chic aesthetic.

Glass has always been a popular building material in India – the numerous glass-fronts that have sprung up over the years across the country, be it in Gurgaon or Mumbai, stand testimony to that. The versatility it offers – aesthetically, environmentally and construction-wise – help it score over traditional building materials. But the great glass wave led to a flood of criticism initially. The high levels of solar radiation, the greenhouse effect produced by glass, and the rising costs of electricity were major concerns.

It may have been vilified for long in the context of Indian architecture, owing to the climate, but glass has taken on a green hue these days. It offers the chance to make design statements, creates a sense of transparency, and lends a feeling of lightness to a building. What's more is that innovations and techniques have led to the creation of an extremely sustainable, cost-effective and long-lasting construction material.



Lalita Tharani, co-founder and principal at Collaborative Architecture, feels “most of the innovation in glass technology has been to decrease the U value and the emissivity of glass to control the passage of heat and cold through the building envelope”.

### Why Glass?

Gone are the days when glass only offered ornamental value; the new types of glass on the market allow architects and designers to give wings to their imagination. Most companies, be it Saint Gobain Glass, HNG Glass or Asahi, offer products in a variety of colours and with high-performance characteristics that conform to green building standards. When designed for maximum performance, glass allows massive savings in energy costs. These include up-front HVAC system cost reductions and annual energy cost savings.

K.C. Jain, President, HNG Float Glass, states that glass is extremely suitable for the Indian climate. “Materials like brick, mortar, cements and steel fade away over a period of time and need heavy maintenance. Glass just needs to be installed, requires no maintenance. It is easy to install and fabricate. It is also economical when compared to other building materials. Modern technology has enabled glass to evolve as a user-friendly and easy-to-use material,” he says. On glass’ green characteristics, he

**1.** The numerous glassfronts that have sprung up over the years across India stand testimony to the material’s popularity

**2.** The use of glass offers the chance to make design statements and lends a sense of transparency

*“Modern technology has enabled glass to evolve as a user-friendly and easy-to-use material. [It] is the most environment-friendly material”*



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adds: “Unlike cement and steel, glass is 100 per cent recyclable. Modern glass is the most environment-friendly material.”

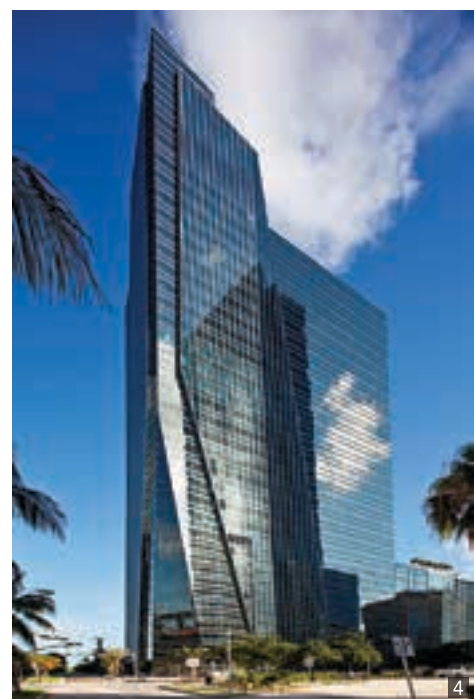
Tharani agrees. “The climate of India is so varied and so distinct in many places. Technology allows glass to be retrofitted in any climatic conditions. We need to use low U-value/low e-glass or double-glazed units,” she says.

Clearly, using glass in a green building is a win-win situation. After all, which other material is flexible enough to help redefine architectural design and space management? Is extremely green, owing to its transparency, recyclability, day-lighting, lightness and energy efficiency. Can help reduce the lifecycle costs and maintenance costs of a building? Can help achieve a high degree of acoustic comfort?

Korah John, principal at Coimbatore-based JK Arkitekts, says: “Glass is the best building material known to mankind since its birth – right from its application in stained-glass design in medieval Gothic architecture to present-day glass skyscrapers. It not only allows transparency but also controls heat and energy level within buildings.”

### Energy Efficiency

A Saint Gobain newsletter states that there are three parameters for measuring the energy efficiency of glass – light transmission (the measure of what percentage of light enters an interior through a glass pane), solar radiation transmission (measure of direct solar radiation entering the building; needs to be as low as possible in tropical countries



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like India), and UV light transmission (measure of the amount of heat transferred through the glass pane due to the temperature difference between the two environments).

A wide variety of glass is available these days, offering a range of energy-efficiency possibilities that optimise light transmission, the solar factor and U-value. This ensures that the air-conditioning load is reduced, the heat entering the buildings is controlled and interiors are insulated efficiently. According to Saint Gobain, glass can help reduce as much as 35 to 40 per cent energy usage.

Clearly, energy efficiency is what matters when measuring a building material's environmental sustainability. Depending on type, the energy efficiency of building materials can be calculated using factors such as R-value, shading coefficient, luminous efficiency, or fuel efficiency. A green material should ideally slow the transfer of heat through a building's skin and reduce the need for heating or cooling.

When it comes to glass, what counts is the shading coefficient – the ratio of the solar heat gain of a building's particular fenestration to that of a standard sheet



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of double-strength glass of the same area. The lower the number, the better the performance at reducing solar heat gain. This ratio also allows a comparison of the sun-blocking efficiency of various kinds of glass, shading devices, and glazing patterns. Other properties studied include solar transmittance (percentage of ultraviolet, visible and near infrared energy within the solar spectrum that is transmitted through the glass), solar reflectance (percentage of solar energy reflected from the glass surface), solar absorptance (percentage of solar energy absorbed by the glass) and solar heat gain coefficient (ratio of solar heat gain entering the space through the fenestration to the incident solar radiation).

For a glass to be considered sustainable, LEED ratings need to be considered. The



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- 3.** Continued innovations have helped glass evolve into a sustainable, cost-effective and long-lasting construction material
- 4.** When designed for maximum performance, glass allows massive savings in energy costs
- 5.** The glass available these days offers a range of energy-efficiency possibilities that optimise light transmission, solar factor and U-value
- 6.** Green glass ensures that the airconditioning load is reduced, the heat entering a building is controlled and the interior is insulated efficiently

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Leadership in Energy and Environmental Design (LEED) green building rating system is a nationally and internationally accepted benchmark for the design, construction and operation of high-performance green buildings. LEED-INDIA provides building owners, architects, consultants, developers, facility managers and project managers the tools they need to design, construct and operate green buildings.

Among the various kinds of glass that can be used are tempered glass, which has four times the strength of annealed glass; laminated glass, which has two or more lites of glass stuck together with a plastic interlayer that provides protection from ultraviolet rays and attenuates vibration; coated glass, which has a low-emissivity (low-E) coating that improves the thermal performance; insulated glass units (double-glazed, triple-glazed) that comprise two or more lites of glass with a continuous spacer that encloses a sealed air space (helping reduce heat gain and loss, and sound transmission); and gas-filled glazing (spaces between panes are filled with inert gases, enhancing the glass U-value or resistance to heat trapping).

### On the Market

Saint Gobain Glass India (SGGI) invests largely in research and development to bring out products that are eco-friendly and contribute to energy conservation. Its range of products in the solar control glass category fall under the SGG PARSOL range. These include SSG Parsol (for external facades, sky lights, building envelopes, windows and doors), SSG Reflectasol (sun control glass for residential and commercial applications), SSG Antelio Plus (Solar control glass with high light transmission and low reflection), SSG Cool Lite (solar control glass with optimum light transmission and excellent solar control properties), SSG Planitherm (low-emissive, thermal insulation glass with high light transmission), SSG Envision (advanced solar control and thermal insulation glass with higher transparency, lighter

shades, high energy saving and low reflection properties), and SSG Evo (dual advantage solar control and thermal insulation glass with high energy saving and low reflection).

Asahi India has three strategic business units – AIS Auto Glass, AIS Float Glass and AIS Glass Solutions. Apart from many other products, it offers Ecosense, which the company claims sets the “green standard in glass”. Ecosense offers ideal solar and thermal heat insulation parameters, is eco-friendly and conforms to all international and national green standards. This new product offers to fulfil five senses – architectural, aesthetic (is available in wide range of shades), energy efficiency, environmental and economic.

HNG Float offers varieties such as clear float glass, tinted float glass, reflective glass, mirrors, low-e glass, low iron solar glass and automotive glass. The clear float glass has a lustrous finish and functional properties like clarity, uniform thickness, scratch-resistance, bubble free and devoid of distortion. The company's Cool Insulating Glass is designed especially for green buildings. Also known as double-glazed or triple-glazed units, it has units that are separated by a spacer filled with desiccant, and sealed

### Through the Looking Glass

Created almost 4,000 years ago, glass has played a role in the construction industry since the Syrians spun molten glass into a flat shape in the seventh century. Much later, in the 20<sup>th</sup> century, molten glass was shaped into sheets, creating sheet glass. Technology brought about a sea change in 1959, when Sir Alistair Pilkington, of England, invented the float glass process, in use till today. Under this, molten glass flows onto a bath of molten tin, forming a continuous ribbon of glass.

hermetically with dry air or inert gas (such as argon).

“Glass can be fabricated into double-glazed, triple-glazed, tempered, laminated and insulated safety glass units, leading to substantial energy savings,” Jain says.

The future is green as far as glass is concerned. Keeping this in mind, SGGI has launched the Saint-Gobain Glass Academy, which offers a variety of courses that offer training in solar control, thermal insulation and ways in which glass can be used in creation of sustainable buildings. Course material includes the various factors involved in sustainable design, selecting the right glass for buildings (considering climatic conditions, direct solar radiation and other vital aspects), heat transfer, factors affecting the performance of glass, and types of glass coatings.

Today's glass scores over other building materials, Tharani feels, on account of “reduced dependence on craftsmanship, quality can be controlled in the factory and onsite, speedy erection, reasonably low maintenance, versatility, and fast-upgrading technology”.

### Glass in Modern Architecture

We round up a few examples of buildings where glass has been used effectively to reduce the carbon footprint:

→ **Pearl River Tower, Guangzhou, China:** Designed by Skidmore, Owings & Merrill's (SOM), this building uses natural resources such as wind and sun power. The tower structure is designed as a high-performance building shaped by the sun and wind. The design for the tower incorporates a series of other integrated sustainable and engineering elements, including solar panels, wind turbines, double skin curtain wall, chilled ceiling system, under floor ventilation air, and daylight harvesting, all of which contribute to the building's energy efficiency.

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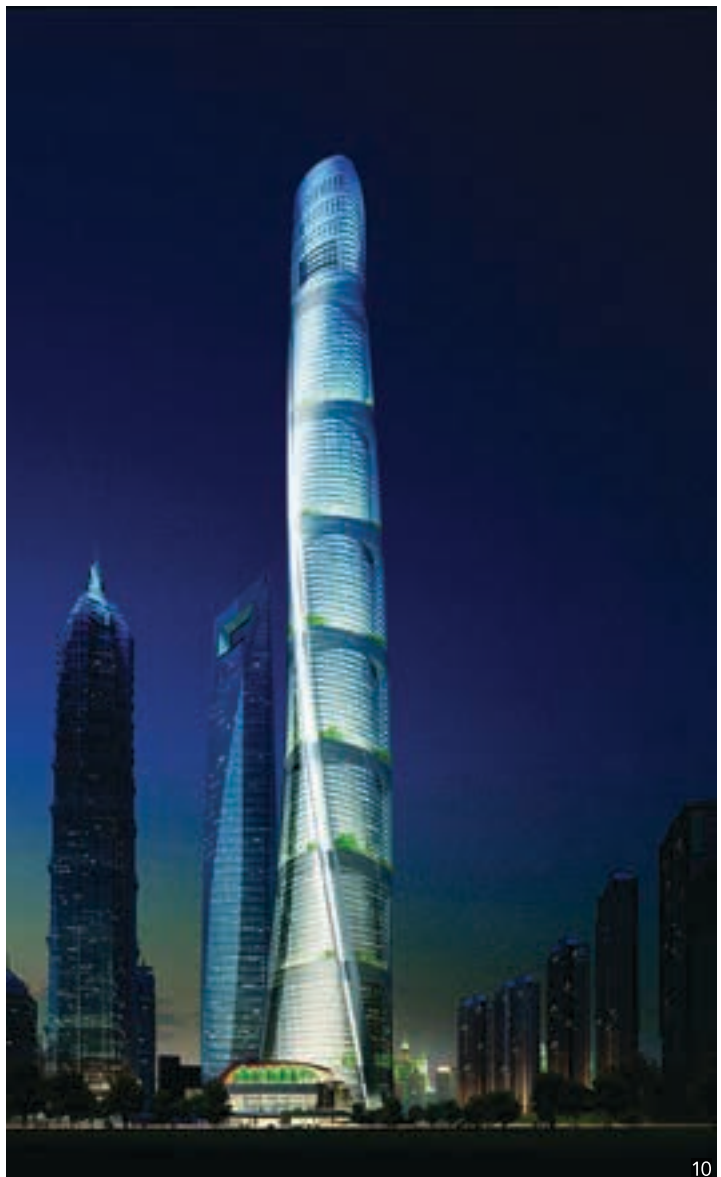
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→ **European Investment Bank, Luxembourg:** Designed by Ingenhoven Architects, this tubular glass building won first place in the Emilio Ambasz Prize for Green Architecture for International Buildings. The energy-efficient design and layout that promotes interaction have come in for rave reviews. The building, which has winter and summer gardens, received a rating of “very good” under the UK’s Building Research Establishment Environmental Assessment Method (BREEAM).

→ **GreenPix Zero Energy Media Wall, Beijing, China:** Designed by Simone Giostra & Partners, this building has the largest colour LED display – spread over 20,000 sq. ft., the display (used to showcase events, weather forecasts, video-art

installations etc.) can be seen from a kilometer away. The building has a photovoltaic system integrated into the glass curtain wall, allowing solar energy to be harvested. The energy is stored during the day and is used to illuminate the screen at night.

→ **Shanghai Tower, Shanghai, China:** A beacon for a sustainable future, this twisting skyscraper is scheduled to be opened in 2014. Designed by Gensler, the structure’s high-performance façade has nine sky gardens, a rainwater recycling system, and a series of wind turbines beneath its parapet. The use of rainwater recovery and gray water recycling cuts down water use by at least 40 per cent. The 632m skyscraper also allows for black water treatment and wind energy harvesting. ●

**8.** The European Investment Bank in Luxembourg is a tubular glass building with an energy-efficient layout that promotes interaction

**9.** The GreenPix Zero Energy Media Wall in Beijing, China, has a photovoltaic system integrated into the glass curtain wall

**10.** At Shanghai Tower in Shanghai, China, rainwater recovery and the use of gray water recycling cuts down water use by at least 40 per cent

### Design Considerations

The principal design considerations to be taken into account by a designer, or specifier, when selecting glass:

- The properties of materials, in particular their breakage characteristics
- Structural integrity of glazing systems supporting the glass
- The type of the building and its use, in particular the number and likely behaviour of the people expected to be in close proximity to the glass in critical locations

- Requirements for fire, security and wind loading
- Thermal breakage, energy efficiency and deflection, vision, acoustics and other consideration
- Impact of trolleys, carts, luggage etc. used
- The design of the glazing system should be such that it has the ability to hold glass in place and prevent it from falling out as a whole.

(Source: *Guidelines on Use of Glass in Buildings - Human Safety, Confederation of Construction Products and Services, November 2007*)



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