Bulletin

HIGH PERFORMANCE GLASS

From Indian Green Building Council, CII-Sohrabji Godrej Green Business Centre

Glass has been used for hundreds of years in architecture. Glass forms a major part of the outer envelope of buildings. It is also used to form internal building features such as partitions, doors and enclosures.

Of late, glazing is a favoured feature in buildings. Glazing not only adds to the aesthetic element but also has a tremendous impact on energy performance of buildings besides visual and acoustic effects. **The right choice of glazing can also lead to significantly lower cost in building energy consumption.**

With an increasing need for resource efficient building solutions, selection of glazing assumes tremendous significance.

Construction industry in India is poised for a rapid growth and hence the per capita consumption of glass is expected to grow rapidly from the existing 0.54 kg per capita.

Factors to be considered in Glass Selection :

U-Value: U-value indicates the rate of heat flow due to conduction, as a result of temperature difference between inside and outside. The lower the U-factor, lower the heat transferred through the glass. U-Value is measured in $W/m^{2o}K$.

Why High Performance Glass?

High Performance Glass is one which reduces the ingress of heat and at the same time allows higher penetration of daylight.

Benefits of Using High Performance Glass:

- It can result in **energy savings to the tune of 35-40%** as compared to conventional glass
- Typical **payback period varies from 3-4 years**
- It provides access to daylighting which can **enhance occupant comfort and productivity**

Shading Coefficient of glazing (SC): Shading coefficient indicates the extent of direct solar heat gain. Lower the shading coefficient, better the glazing in preventing solar heat gain.

$$\text{Shading coefficient} = \frac{\text{Solar Heat gain coefficient (SHGC)}}{\text{Heat gain through 3mm clear glass}}$$

Relative Heat Gain (RHG) : Relative Heat Gain is the combined effect of shading coefficient and U-value. The direct heat gain component can be as high as 90% vis-à-vis 10% for conductive heat gain. Hence shading co-efficient becomes a very vital criterion in the selection of glazing particularly for tropical climates where solar intensity is high (600-900 W/m^2).

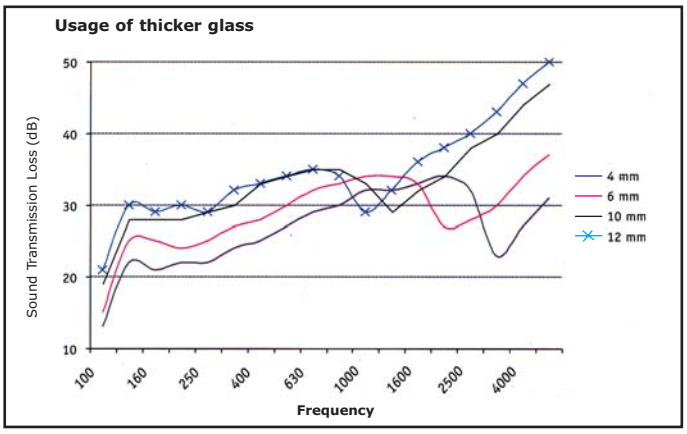
$$\text{RHG} = \text{Direct heat gain} + \text{Conductive heat gain} = \text{SC (Solar intensity)} + \text{U (Differential Temperature between inside and outside)}$$

Visible Light Transmission of glazing (VLT) : Visible Light Transmittance factor determines the visual performance of glazing. Visible Light Transmittance indicates the percentage of the visible portion of the solar spectrum that is transmitted through a given glass product. Higher the VLT, higher will be the light penetration. Visual performance is influenced by several factors like tinting (colourants added to the glass) and low - E coatings.

Acoustic performance: Understanding the type of sound coming from a source is an important step in determining what glass type to use. **Traffic sound is of most concern to people as majority of buildings are located in urban traffic areas.**

Sound Type Examples	
Low frequency (125 Hz–800 Hz)	High frequency (800-5000 Hz)
· Urban traffic(stop & go) · People talking / shouting · Appliances like TV, Radio etc · Gun shot · Disco, music	· Airplanes · Fast moving trains · Factories · Continuous traffic · Sound of truck engines accelerating · Appliances like Vacuum cleaners
Low Frequency Sounds cannot travel long distances	High Frequency Sounds can travel long distances (many Kms at times)

The simplest, cheapest and most effective way to protect against sound is to use thicker glass. For example, in the low frequency range a 6 mm glass gives about 28dB of protection, while 12mm glass provides about 34 dB of protection.



Increasing the air gap between the insulated glass units has a very significant impact on sound reduction. But, for the sound reduction to be meaningful, the air gap has to be greater than 25mm. Recent trends in glazing are moving towards double facades where the two panes are glazed upto 1-2 feet apart. This is an excellent way to reduce sound transmission.

What is High Performance Glazing?

High performance glazing is one which can contribute to optimizing energy efficiency and at the same time enhance light penetration. **High performance glazing has low U-value, low Shading Coefficient and High VLT (Visual Light Transmittance)** and is the ideal choice for today's energy stressed buildings.

Typical values of high performance glass are as shown in the table below:

Property	Range
Shading Coefficient	0.1 – 0.4 W/m^2 deg K
U-Value	1.7 – 3.0 W/m^2 deg K
Visual Light Transmittance	40-60%

Types of Glazing or Glass

There are many types of glazing available which include the following:

1. **Insulated (double-glazed, triple-glazed):** Insulated glazing refers to glazing units consisting of two or more panes of glass. Insulated glazing can be double-glazed or triple-glazed. The glass panes are spaced apart and sealed to form a single-glazed unit with an air space between each pane of glass. The glass layers and the air spaces resist heat flow. As a result, insulated glazing lowers the U-factor and solar heat gain coefficient

2. **Gas filled glazing:** To improve the thermal performance of glazing, the space between the glass panes is filled with inert gas. Because these gases have a higher resistance to heat flow than air, they are sealed between the window panes to decrease the glazing's U-factor.

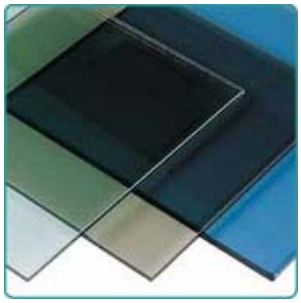
Gas filling can bring down the U-value by 0.2-0.3 W/m^2^{o}KThe most common types of gas used include argon and krypton.

3. Heat-absorbing tints:

Tinted glass absorbs a large fraction of the incoming solar radiation and glare thus reducing the solar heat gain coefficient. However they also reduce visible light transmittance.

Gray- and bronze-tinted glazings reduce the penetration of both light and heat.

Blue- and green-tinted windows offer greater penetration of visible light and slightly reduced heat transfer compared with other colors of tinted glass.



Tinted glass reflects only a small percentage of light, so it does not have the mirror-like appearance of glass reflective coating.

4. Low-emissivity (Low-E) coatings:

Low Emissivity (Low-E) coatings are microscopically thin, virtually invisible, metal or metallic oxide layers deposited on a window or skylight glazing surface primarily to reduce the U-factor by suppressing radiative heat flow.

In general, low-E coatings are designed to reduce heat transfer caused by long wave radiation.

Clear glass has an emissivity of 0.84 which means that it absorbs 84% of long wave radiation and reflects 16%.

Low-E coatings typically have emissivity ranging from 0.35 to as low as 0.04 , which means 65% - 96% of the long wave radiation is reflected back to the atmosphere.

5. Spectrally selective glass:

Spectrally selective glass also blocks long wave radiation, but they have another important function. The multiple layers of silver in the coating allow the glass to selectively transmit and reject certain wavelengths of solar radiation.

Spectrally selective glass is very similar to Low-E glass in the sense that it restricts heat ingress but the difference lies in its capacity to transmit visible light.

6. Reflective coatings:

Reflective coatings usually consist of thin, metallic layers which come in a variety of colors including silver, gold, and bronze. Reflective coatings are applied on the outer surface of glazings i.e. the surface exposed to rain.

Reflective coatings on window glazing or glass reduce the transmission of solar radiation, thereby blocking heat. However they also reduce a window's visible light transmittance (VLT).

Reflective window glazing is commonly used in hot climates where solar heat gain control is critical. Reflective glazing is used by many architects because of its glare control and uniform exterior appearance.

Integrated approach in selection of glazing:

Architecture: A good glazing with a relatively high VLT will appear fairly transparent from the outside. A desire to have a mirrored façade is often not conducive to daylighting

Interiors: Glazing colour strongly influences the colour rendering of interior finishes in daylit areas. Colour also affects the view and the occupants' sense of connection with the outdoors. Glazing with lower light transmission makes interiors gloomy when overcast but may help in glare control on a sunny day

HVAC: High Performance Glazing reduces annual energy use, peak loads, individual zone fluctuations and occupant complaints. Glazing selection could also be an opportunity for equipment downsizing.

Cost Effectiveness : High Performance Glazings cost more than their standard alternatives but may pay for themselves in four ways: reduced energy bills, reduced first costs in mechanical equipment , increased occupant productivity and avoided future retrofit costs (like addition of chillers /fans/evaporative coolers) done due to unanticipated occupant discomfort.

LEED Rating and glazing

Leadership in energy and Environmental design (LEED) rating programme of US Green Building Council awards ratings to buildings based on five environmental areas. Selection of Glazing can have an impact on 8 of the following points under the LEED Rating System:

Energy	**2 points**
Local and regional material	**2 points**
Recycled content	**2 points**
Daylight	**1 point**
Views	**1 point**

List of Buildings using High Performance Glass:

- CII-Sohrabji Godrej Green Business Centre, Hyderabad
- ITC Green Centre, Gurgaon
- Wipro Technologies – Gurgaon Development Centre, Gurgaon
- NEG Micon (India) Pvt Ltd, Chennai
- Grundfos Pumps India Pvt Ltd, Chennai
- Technopolis, Kolkata
- Olympia Technology Park, Chennai and many others

If you are constructing a building, Go Green!
CII-Godrej GBC offers Green Building Advisory Services in India to achieve the green building rating awarded by USGBC, under their LEED Rating Programme.

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