Vol. 3 | Issue 2 December 2016

Clariti

LET'S TALK GLASS

Dear Readers,

I am immensely pleased to bring to you a new issue of Clariti, which has been so well-received since its inception.

As always, this issue of Clariti delves into some exciting trends and developments in the world of glass. The **Cover Story** explores the science of sound and human hearing, and tells us how glass helps achieve acoustic insulation. The **Case Study** shows how 'Selectivity' is an important factor in choosing glass for the right comfort level.

The **Eye Catcher** section presents a commercial project completed by AIS Glasxperts. **Inside Info** talks about the versatility and popularity of glass flooring and staircases in homes and offices. In **AIS Fresh**, read about the latest additions to our architectural glass product range.

I hope you like reading this issue of Clariti. I look forward to hearing your thoughts and opinions.

Happy reading!

Vikram Khanna
COO – Consumer Glass
COO – Architectural Institutional Business
CMO, CIO
Asahi India Glass Ltd. (AIS)

Cover Story: The science of sound and the art of acoustics in glass

In any fast urbanising society, sound – as noise – is one of the most important causes of stress and fatigue. The irony is, many people do not know that noise is a silent killer. Many more buildings are being built with extensive use of glass, yet, not many builders are aware of how a glass façade can block noise.

Before we talk about acoustic glass and its role in eliminating noise from the human environment, let us understand a little about the science of sound and its perception by humans.

The nature of sound waves

Sound is a variation in pressure. Sound waves are longitudinal waves. That is, the particles in the medium vibrate in a direction parallel to the movement of the wave. The amount of energy that passes through a given area of air or water per unit of time is known as the **intensity** of the sound wave (measured in decibels). How often the air or water particles vibrate when a sound wave passes through them is called its **frequency** (measured in Hertz). The sensation of a frequency is known as the **pitch** of a sound; a high pitch sound corresponds to a high frequency sound wave, and vice-versa.

The medium: When talking about waves, a medium is the substance that transports a wave from one place to another. For example, when you pluck a guitar string, it begins to vibrate from side to side. When the string moves to the right, it pushes on the air particles and makes them press together. It is called a **compression**. When the string moves to the left, it creates a gap in the air particles and they get farther apart. It is called a **rarefaction**.

These areas of higher and lower air pressure travel outward, away from the string. However, the air particles themselves do not travel. They simply oscillate back and forth, in a direction parallel to the motion of the sound wave. In this example, the air surrounding the guitar is called the **medium**, because it is the material that carries the sound. The medium for sound waves is often air. But sound can also travel through liquids and solids.

Unlike our ears and hydrophones, fish ears don't detect sound pressure, which is the compression of molecules. Instead, they perceive something called particle motion, the tiny back-and-forth movements of particles in response to sound waves.

Speed of sound: The speed of sound is the distance travelled per unit time by a sound wave as it propagates through an elastic medium. In dry air at 20°C (68°F), the speed of sound is 343.2 metres per second. The speed of sound depends upon the type of medium and its state. It is generally affected by two things: elasticity and inertia.

In general, the speed of sound c is given by the Newton–Laplace equation:

$$c = \sqrt{\frac{K_s}{\rho}},$$

where

- K_s is a coefficient of stiffness, the isentropic bulk modulus (or the modulus of bulk elasticity for gases);
- þ is the density.

Human hearing and speech

Humans are capable of detecting sound waves with a wide range of frequencies, ranging between approximately 20 and 20,000 Hertz. Infrasounds are sounds with frequencies below 20 Hz, and ultrasounds are sounds with frequencies above 20,000 Hz. Typical sounds produced by human speech have frequencies of the order of 100 to 1,000 Hz.

1. The peak sensitivity of human hearing is around 4,000 Hz.
2. Locating the source of sound:
   - Interaural Time Difference (ITD): This is the difference in arrival time of a sound between two ears, it provides a cue to the direction or angle of the sound source from the head.
   - Interaural Phase Difference (IPD): Phase differences are one way we localise sounds. Only effective for wavelengths greater than 2 head diameters (ear-to-ear distances).
   - Interaural Level Difference (ILD): Sound waves diffract easily at wavelengths larger than the diameter of the human head (around 500 Hz wavelength equals 69 cm). At higher frequencies, the head casts a 'shadow'. Sounds in one ear will be louder than the other.
3. The human ear can distinguish some 1,400 different pitches and four vocal registers:
   - Whistle
   - Falsetto
   - Modal — the usual speaking register
   - Vocal fry — the lowest of the four vocal registers

The art of achieving acoustic insulation in glass

The use of glass is a wonderful way of achieving noise insulation and an acoustically balanced environment. Different thicknesses of glass will enable different levels of acoustic insulation. By combining different glasses, the acoustic properties of glass facades can be considerably improved. Here are various ways in which the acoustic insulation properties of glass can be enhanced:

- **Using thicker glass:** This is the simplest and most effective way of achieving noise insulation.

- **Asymmetrical double glazing:** Using glasses of different thicknesses will give slightly better noise protection, as they will resonate at different frequencies.

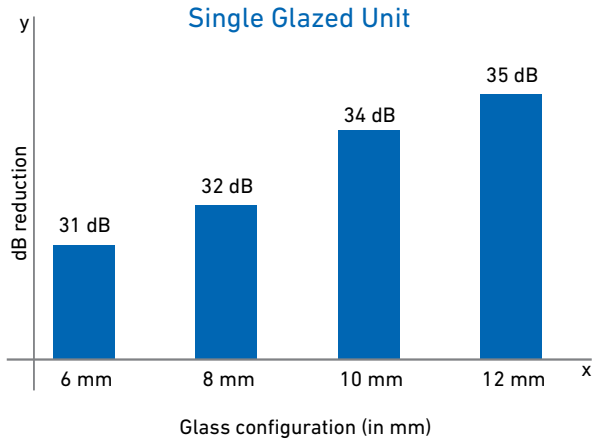
- **Increasing air gap between insulated glass units:** This has a significant impact on sound reduction, as the spring-weight-spring effect will be attenuated by the additional air.

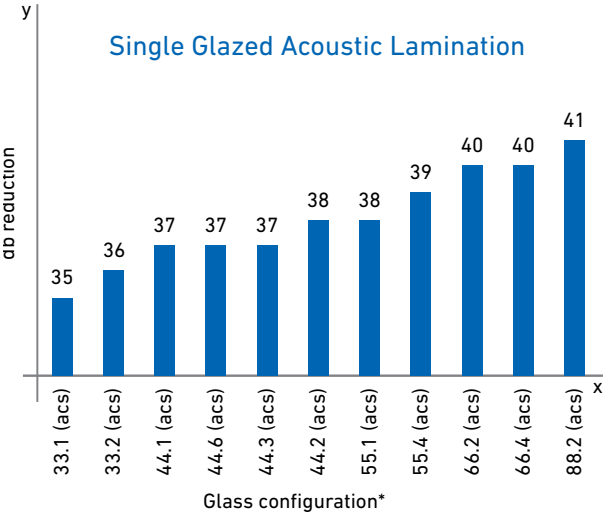
- **Using laminated glass:** The polyvinyl butyral (PVB) interlayer in laminated glass dampens sound and reduces sound transmission. Lamination also provides benefits like safety and security. Acoustic insulation can be further enhanced by the use of acoustic PVB.

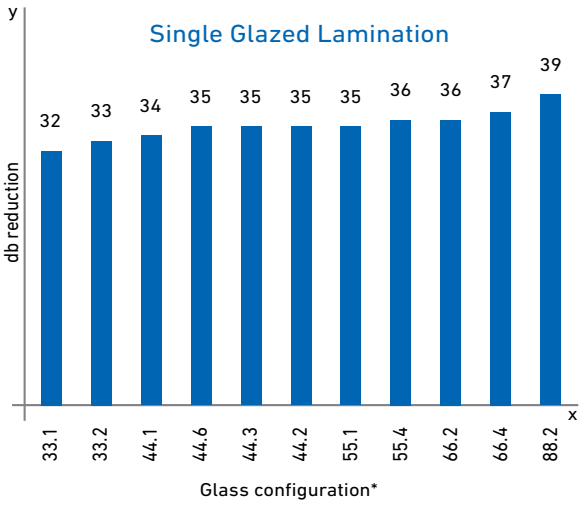
Glass configuration and noise reduction

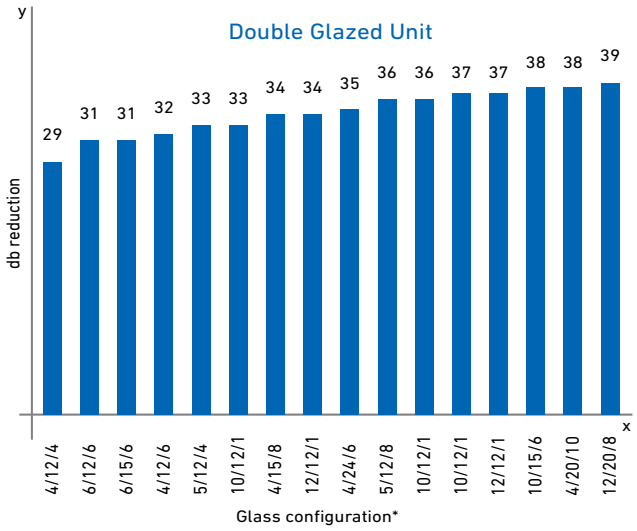
Different configurations of glass can help reduce noise by up to 55 to 60 dB.

Sound reduction (in dB) using different glass configurations









*33.1 (acs) - 3 mm glass + 0.38 mm Acoustic PVB + 3 mm glass

*33.1 - 3 mm glass + 0.38 mm PVB + 3 mm glass

*4/12/4 - 4 mm glass - 12 mm airgap - 4 mm glass

Sound insulation is not affected by: • Tint / colour of glass • Coating (Reflective or Low-E) on glass • Position of glass • Tempering

Case Study: Choosing glass on the basis of Selectivity

Buildings which provide better comfort to occupants enable better productivity. Comfort can be achieved by having a well-conditioned space. However, glass has an edge as it provides comfort in both visual as well as thermal terms. The selection of the right glass is important to achieve the right comfort level. This is where the factor of 'Selectivity' comes into play.

Selectivity (VLT/SF)

The 'Selectivity' of a glass is the ratio between its light transmission and the solar factor. The higher this ratio, the more selective is the glass – that is, it reflects invisible rays (UV and infrared) but allows a maximum amount of visible solar rays (light) to pass through. Glasses with high Selectivity combine solar control with high light transmission.

A high-performance glass can contribute to more savings by lowering air-conditioning running costs. Similarly, a glass with higher VLT can contribute to more energy savings by reducing the need for artificial lighting.

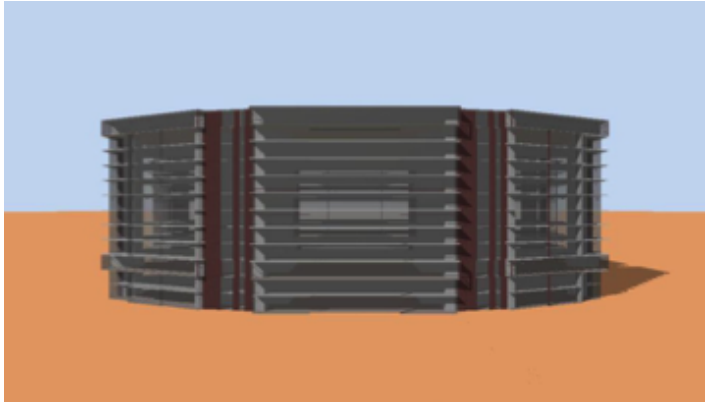


Fig. 1: An IT building in Hyderabad

How Selectivity helped a building achieve the best comfort

An IT building located in Hyderabad (Fig. 1) had floor-to-floor glazing design with enough horizontal projections in elevations to cut the direct solar radiation of peak times. AIS conducted an energy simulation of the building to provide a solution for achieving visual and thermal comfort.

Different glass options from the AIS product portfolio with different Selectivity values were considered for the simulation (Table 1).

Products	VLT	SHGC	U-Value	Selectivity
	%	%	W/m²K	VLT/SF
Clear DGU	75	69	2.8	1.09
Exceed Bluevision	24	20	1.7	1.20
Exceed Bluelite Plus	38	27	1.7	1.41
Exceed Blue Radiance Plus	34	24	1.7	1.42
Excel Blue Pearl	27	19	1.62	1.42
Excel Blue Sparkle	31	20	1.6	1.55

Table 1: Glasses from AIS considered for simulation and their values.

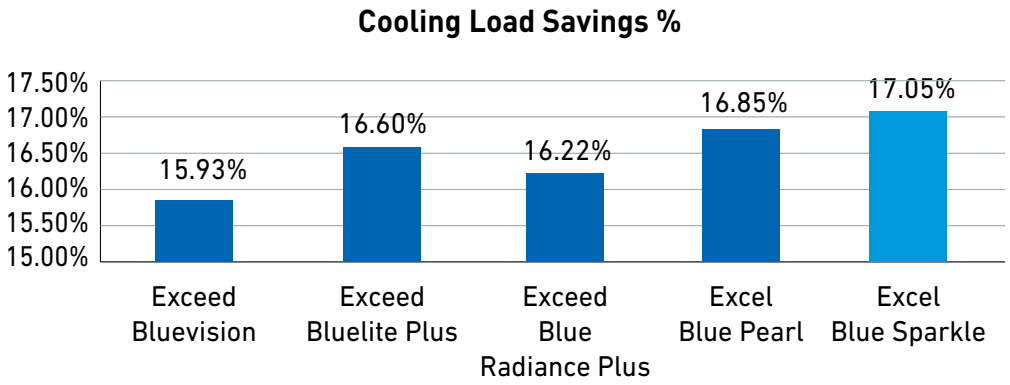


Table 2: Comparison of Cooling Load Savings of different Ecosense glasses

Results

The graph indicates that the Cooling Energy savings are higher for Excel Blue Sparkle DGU option than Excel Blue Pearl DGU option with lower SF due to the higher Selectivity of Blue Sparkle DGU. Higher Selectivity aids in reducing artificial lighting loads and its associated sensible heat, which indirectly reduces the cooling load inside the building. There is availability of nominal 400 lux levels in an entire working space and low requirement for artificial lighting at daytime. Thus higher Selectivity glass with lower SF and higher VLT option can help to downsize the HVAC & Lighting load during the design stage itself.

Eye Catcher!

A commercial-space interior project by AIS Glasxperts, which offers world-class glass products, 360° customised solutions, and design and installation services.

AIS Décor Chrome Yellow (Lacquered Glass)
AIS Stronglas (Tempered Glass)

AIS Décor Snow White (Lacquered Glass)

AIS Coloured PVB Laminated Glass (Deep Red)

Inside Info: Get floored with glass

Traditionally, the materials used for designing and decorating homes have been wood, metal, or cloth. Few people realise the elegance and aesthetic value that glass can add to their homes. Available in a wide variety of styles, colours, designs, and textures, glass has the potential to create stunning ambiences that can transform living and elevate lifestyle.

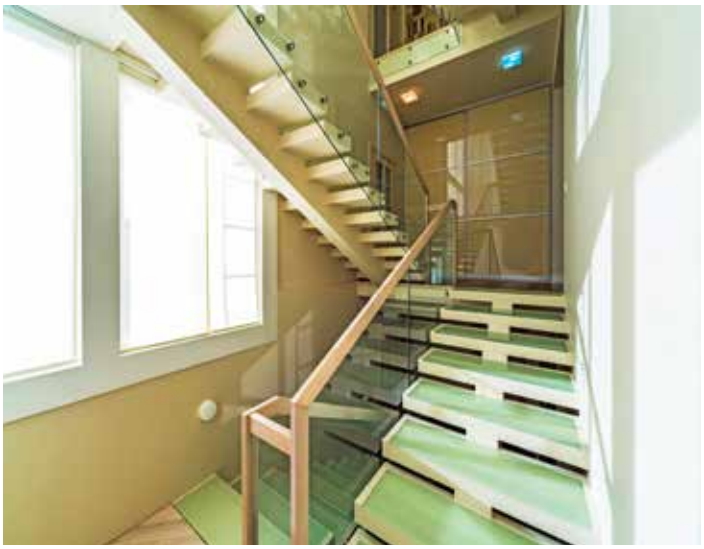
Glass is a smart, adaptable, and versatile material, offering itself to endless possibilities in terms of both design and functionality, across exterior and interior applications. All in all, glass stands in a league of its own. The inherent beauty of glass as a material, when combined with contemporary design sensibilities, makes for an irresistible combination – one that mesmerises and enthrals in equal measure.

Glass flooring and glass staircases are increasingly becoming a popular choice for homes and commercial spaces. This is because they help create the illusion of space, and with recent innovations in glass and glass fittings, any design can be executed for glass stairways and floors. They can look like artistic showpieces – as such, they can enhance the visual appeal of living spaces, and add a touch of modernity. LED lighting enhances this appeal even more, and is frequently used in clubs, discos, restaurants, and hotels. The various applications in this area include glass stair treads, ramps, and foot bridges.

As always safety is an important criterion when designing glass floorings.

A commonly perceived notion is that glass compromises safety and security. However, continuous research and advances in technology have made glass safer and more secure than ever before. The range of specialised laminated glass from Asahi India Glass Ltd. (AIS) includes:

- **Valuglas** (heat-strengthened laminated glass with 1.14 mm PVB interlayer)
- **Securityglas** (intrusion-resistant laminated glass with 1.52 mm PVB interlayer), and



- **Securityplus** (Dupont Sentry Glass interlayer makes it 5x stronger and 100x stiffer than conventional laminating materials).

The first step in designing a glass floor is calculating the glass size and thickness, depending on the estimated loading or foot traffic on it. Also, the support systems for the glass should be adequately sturdy to prevent distortion under load. Another issue is that the glass used should be skid-resistant for safety, and scratch-resistant for good maintenance. Etched or printed surfaces help to improve grip. Imbedded textures provide an anti-skid and scratch-proof surface that easily hides smudges and streaks.

Last but not the least, it is important to keep glass flooring clean. A soft, clean cloth and a mild detergent, or a mild glass-cleaning solution, is suitable. After cleaning, the water should be removed immediately. Abrasive cleaners, bleaches, powders, or pads can scratch and damage the glass. A little care will help maintain the function and beauty of glass floors for years.

AIS Fresh

AIS has expanded its portfolio, again! The new offerings are:

In the lacquered glass range -
AIS Décor Sparkling Regal Gold

In the high-performance soft-coat glass range -
Ecosense Excel series (Double Low-E)