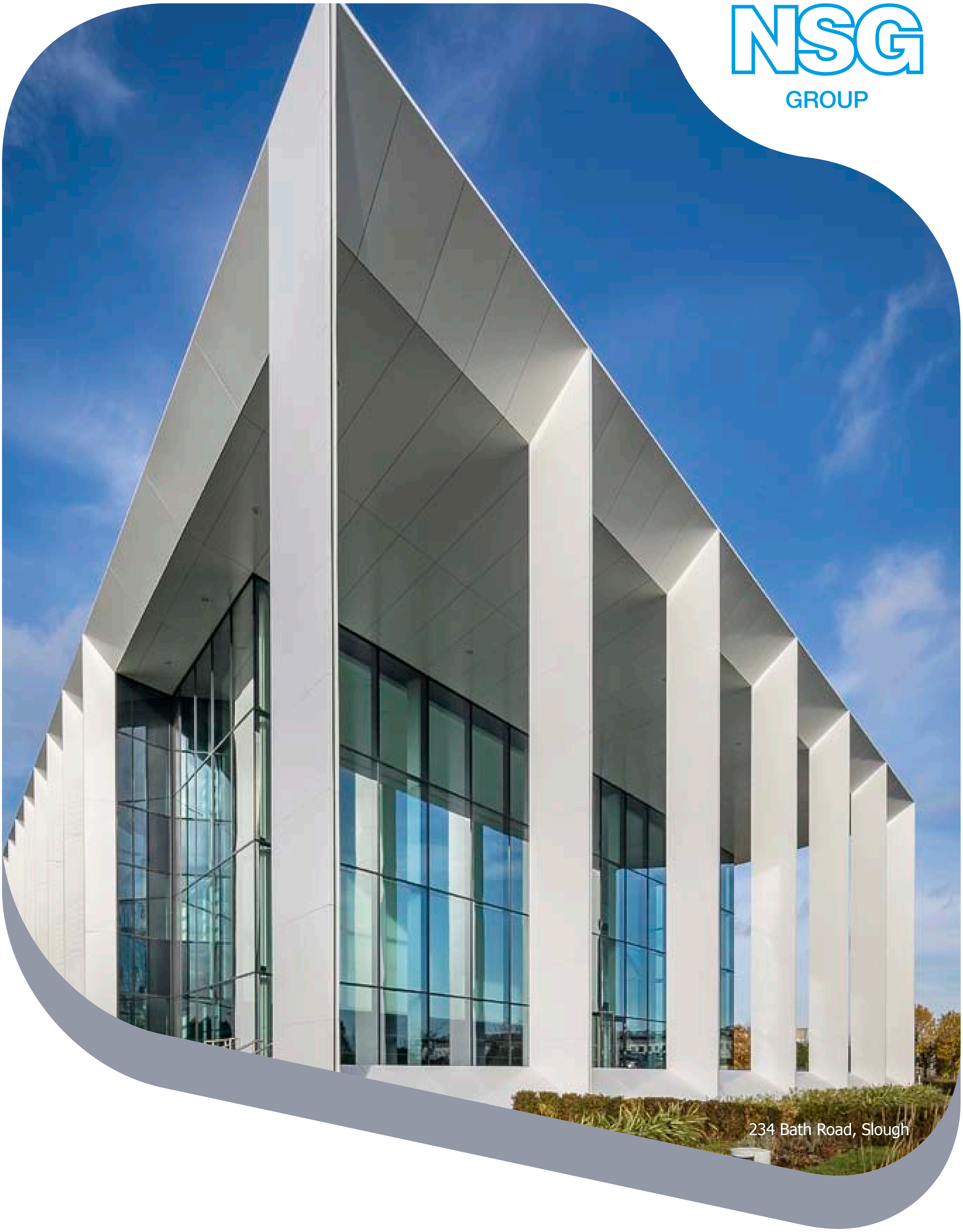

Future glazing

What next for glass
in commercial buildings?

One Central Square, Cardiff

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Maxwell Centre, University of Cambridge
Photo: Gareth Gardner

Foreword

Phil Savage

Commercial contracts sales manager, Pilkington United Kingdom Limited

Glass is one of the materials that best defines the modern built environment.

It is one of the most used components in the façades of commercial buildings as architects strive for greater transparency and light transmittance to create contemporary designs that are defined by light-filled spaces, clean lines and uninterrupted views.

However, it's not just aesthetically that glass has a leading role to play – it's also vital to buildings' energy performance and the comfort of occupants. Glass-coating technology has advanced rapidly in recent years and architects are now able to specify a range of high-performance products that enhance the building envelope, from insulating glass units (IGUs) that improve energy-efficiency to IGUs that offer enhanced noise control or security properties.

The ability to create larger and more impressive glass structures has also developed in line with technological and engineering improvements.

Arguably, one of the most significant architectural innovations of modern times has been the development of structural glazing systems as designers and engineers have pushed to create spaces with a minimal visual barrier between the interior and exterior, while maintaining structural strength.

What began as a niche technology used only in a select few high-end buildings has become a widespread feature of everyday commercial architecture. I believe this has ushered in an exciting new chapter in commercial building design.

In this report, two leading figures in the commercial building sector give their views on the evolving role of glass in the sector, as well as what the future holds in technological terms.

I'd like to take this opportunity to thank our contributors and I hope you find this report a useful read.

Structural glazing – an overview

The use of glass in buildings dates back to ancient Rome. Ever since, its fundamental purpose has remained the same – to allow light to enter a space and occupants to see out while providing a barrier against the elements.

As the processes for manufacturing glass and installing it in structures have advanced, the proportion of a building envelope that can consist of glass has increased. Today, commercial buildings with almost entirely glazed exteriors are commonplace.

One of the advances that made this possible was the advent of structurally glazed curtain walls, in which individual panes of glass are held by a self-supporting arrangement that stands apart from the structure of the building itself. It meant designers were no longer restricted by placing windows in the load-bearing outer walls but could instead surround central structural elements with a wall of almost uninterrupted glass.

In the 1960s, Pilkington developed the very first point-fixed structural glass system, the Pilkington Suspended Assembly System, which transformed the way glass could be integrated into the envelope of a building by removing the need for any framing.

The compressive strength of the glass is extremely high, allowing frameless, fixed-point systems based on tensile steel structures that hold the panes in place. They tend to feature minimal component profiles that enhance the overall transparency of the façade.

Using this approach, the systems can form otherwise unsupported walls of glass of great height.

The Pilkington **Planar**™ system – the successor to the Suspended Assembly System – has been used to create glazed surfaces taller than 70 metres.

Toughened glass is used to increase the strength of the system. The addition of vertical glass mullions – glazed elements that sit perpendicular to the main glass surface – or laminated glass can add further resistance against mechanical forces such as wind loads and blasts.

As it has advanced in design and engineering terms, structural glazing has also moved from being seen as an experimental approach used only in cutting-edge projects like The Shard or the Gherkin, to a more accessible technology that can add aesthetic appeal to a wide range of commercial buildings.

Today structural glazing is widely specified for use in retail, hospitality and public sector developments large and small. It is also becoming increasingly popular in heritage building refurbishments, where its low-profile fittings mean it is able to serve a practical function without obstructing historic architectural features.

Stonehenge Visitor Centre

The benefits of advanced glazing systems

Paul Williams
Managing director, Vitrine Systems

Vitrine Systems is a specialist contractor that delivers structural and architectural glazing systems for new-build and refurbishment projects.

Glass is arguably the most popular building material across today's architect-designed building projects. From large city-centre commercial office builds to heritage building renovations, glazing almost always has a role to play.

The rapid development in glazing technology we have seen in recent years, and low-profile structural glazing systems in particular, has resulted in big steps forward in terms of what can be achieved.

The fundamental reason designers like to use glass in buildings is that it forms a barrier to the elements – whether wind and rain or other factors like noise and air pollution – while letting in light and maintaining a visual connection between inside and out.

The ideal aesthetic for many architects is a free-standing wall of glass that provides physical separation while leaving the view completely unimpeded.

By increasing the clarity and physical strength of glass, and by evolving the design of the fittings that hold it in place, the past 10 years have seen us get much closer to this ideal. The technology continues to develop, offering intriguing possibilities of what we'll be able to achieve 10 years down the line.

It's interesting that the more advanced structural glazing systems become, the less visually imposing they are in design, allowing other architectural features to be showcased.

In the most contemporary projects, this means designers can create striking, light-flooded spaces with an almost outdoor aesthetic but which also benefit from excellent insulation and, if necessary, shielding from excessive heating from the sun.

Another area where the minimal profile of cutting-edge glazing systems is particularly relevant is in refurbishment of heritage buildings, where minimal intervention is a requirement of the project. Because we can now use glass of almost complete transparency and with very low levels of reflection, along with well-engineered bolting systems, we can modernise historic buildings with very little change to their appearance.

We've already arrived at a situation where the glazing systems available today, despite being minimal in size, are actually more robust in terms of structural strength and quality of weather sealing than ever before. We can expect installations being made today to last decades with little maintenance and, as materials and design develop further, this performance will only improve.

Structural glazing systems have become widespread in many different kinds of projects and settings in recent years, where once they were only available to the most high-end projects. The result is more visually pleasing, brighter interiors for the benefit of millions of end users.

Products in practice

Kaisa-Talo, Helsinki
Pilkington **Suncool**™, Pilkington **Optitherm**™,
Pilkington **Optiwhite**™

Pineapple Contracts Office Building, Kent
Pilkington **Eclipse Advantage**™, Pilkington **Optitherm**™

The Rose Centre, New York
Pilkington **Planar**™, Pilkington **Optiwhite**™

The British Museum, London / Pilkington **Optilam**™

In conversation with…

Ian Ritchie

Founder, Ian Ritchie Architects

Currently, glass in architecture is used primarily for its aesthetic properties – its unique ability to transmit, refract and reflect light. However, as new manufacturing and coating technologies emerge, glass will begin to play a more active role in regulating the environment inside buildings.

Environmentally-responsive coatings would allow g-values to change throughout the day, and the seasons, in response to weather conditions. This would also bring aesthetic benefits, especially for windows that are only exposed to sunlight for a short period of time.

For example, currently when specifying glass for the north side of a building, if the orientation of the building is true north, the window will see only a very brief daily period of high solar-gain. Nevertheless, a lower g-value glass is often used.

If the glass could respond to the brief period of exposure by darkening, this would allow windows to deliver higher levels of transparency for the majority of the day.

This technology has in fact already existed for more than 50 years and is commonly used in the lenses of glasses. Microcrystalline molecules of silver chloride or another silver halide are embedded in the glass. They are transparent to visible light without a significant ultraviolet component – artificial lighting, for example. However, when exposed to ultraviolet (UV) rays, as in direct sunlight, the silver halide molecules undergo a chemical process that causes them to change shape and absorb a significant percentage of the visible light – so they darken.

Once the lens is removed from strong sources of UV rays, the silver compounds return to their transparent state.

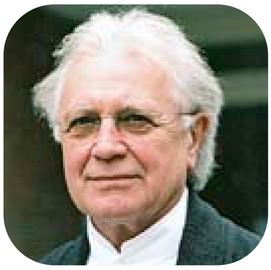
This process has not yet become commercially viable at the scales needed for architectural glazing, but could we see this emerge in years to come?

There is even the potential for glass to adjust its light transmission properties in response to air temperature, made possible by thermally responsive coatings – vanadium dioxide, for example.

Electrochromic tints based on metal oxides such as tungsten trioxide, molybdenum trioxide, nickel oxide and iridium oxide is another example of technology that shows promise in terms of enabling glass to be environmentally responsive. We've already seen many examples of 'smart' glass based on these materials used for visual screening, but there is considerable potential for these to be used in the future for environmental control.

We have also seen early development of angular selectivity coatings which can block summer light from higher angles while transmitting winter sunlight from lower angles. This could allow problematic solar gain to be reduced without any change in the appearance of the glass from street level.

It's an interesting time in the evolution and development of glass technology. I'm confident that the important scientific and technological breakthroughs we've seen will scale rapidly for architectural use, and this will be greeted with enthusiasm by the profession.



Ian Ritchie established the award-winning practice Ian Ritchie Architects in 1981. In the same year, he also co-founded Rice Francis Ritchie (RFR), a design engineering office in Paris. These practices have realised and contributed to major new works throughout Europe, including the Reina Sofia Museum of Modern Art in Madrid, the Leipzig Glass Hall, the Louvre Sculpture Courts and Pyramids, and La Villette Cité des Sciences in Paris.

Lepzig Glass Hall, Germany

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