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Glass & translucent materials Supplement

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Annual subscription costs just £48 for 12 issues, including post and packing. Phone 01435 863500 for details. Individual copies of the publication are available at £5 each inc p & p.

FROM THE EDITOR

Welcome to this special supplement to *ADF*, focusing on what remains one of the most popular facade materials for the majority of architects, particularly in the commercial sector – glass.

We bring you a mix of news, comment, and product innovation features, as well as an outstanding case study from Canada. The Sustainable Energy Engineering Building at Simon Fraser University in British Columbia not only has the laudable positioning of developing clean power innovation to tackle climate change, it also employs some interesting design strategies in order to support students and staff in doing that.

Glass is the means by which the building's attractively formed facade (which is echoed in its interior) is constructed, bringing light into the atrium and other areas in the traditional way for such relatively deep planned schemes. However it also helps visual connection in further ways, such as via the many glass balustraded walkways, giving a sense of unity to the internal areas.

Elsewhere, we have thought leadership from Pilkington UK, on how solar control glass is broadening its application by being able to provide a wider range of functions such as self-cleaning or enhanced acoustic performance. In this way, according to our contributor Leo Pyrah, it will prove to be a major weapon in the battle to achieve the UK's net zero carbon target in 2050, and as Building Regulations progressively tighten, well before then.

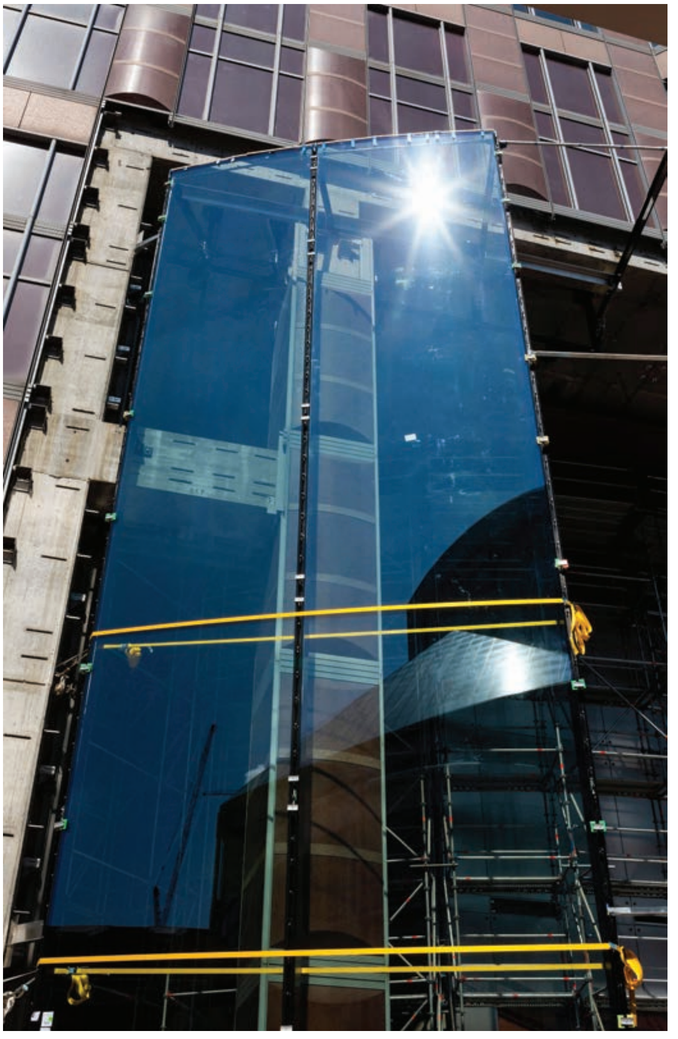
While this article looks at a broad requirement, our other comment piece usefully tackles a niche technical issue, that of glazing performance in smoke vents. Understandably a tightly regulated, somewhat complex area, given its critical importance for fire safety for commercial projects for example. Darren Wainwright of SE Controls gives the lowdown on what specifiers need to know to begin an informed decision that ensures compliance.

Wainwright however refers to harmonised European standards in his piece, and while things may not change in the short term following our departure from the EU, I can't help wondering where we will be in a few years when it comes to regulatory rigour in the construction industry. One of the benefits of EU membership has surely been that we have had a level playing field for product suppliers and specifiers to aim for (ie CE Marks). Now there must be a degree of uncertainty, not to say that we cannot, and should not, achieve regulatory best practice as the UK goes it alone.

James Parker
Editor

ON THE COVER...
The design of the facade at Simon Fraser University features white precast concrete sandwich panels that alternate with reflective glazing, inspired by the patterns of elecrical circuit boards

Cover Image © Ema Peter
For the full report on this project, go to page 17



REFURBISHMENT

World's biggest curved insulating glass units installed on Frankfurt tower

Facade and building envelope construction company seele has installed what are thought to be the world's largest curved insulating glass units, for the revamp of the lobby facades at Frankfurt's Messeturm. The office building, which was completed in 1991, is the second-tallest building in Germany.

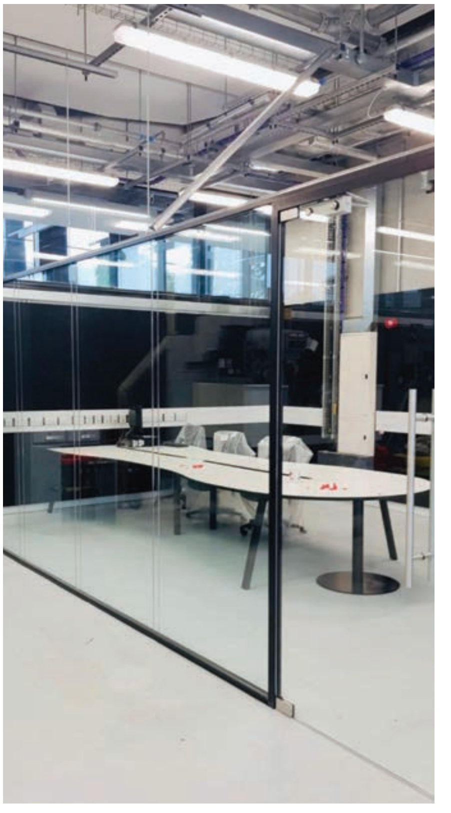
The lobby at ground floor level has been revamped to a design by architect Helmut Jahn, working with Matteo Thun & Partners. Engineers from Werner Sobek co-operated in the design of the facade, including developing the 17 metre high insulating glass units. The panes were bent to a radius of 24 metres. Flat panes arranged in polygonal form were "ruled out," said seele, which meant that every pane had to be bent with a particular amount of curvature.

Another feature of this design is that the facade essentially consists of only a few parts – nine panes and 10 posts on either side of the tower. There are no horizontal members interrupting the glass, which helps to "create a sense of lightness and transparency despite the dimensions," said the firm.

Owing to the large size, each pane requires special bearings and must be held in place with glazing bars. The cold-bent insulating glass units measure approximately 17 m x 2.8 m and are supported by stainless steel posts weighing approximately 3.5 tonnes each. With solar-control coating on level 4 to reduce solar heat gains, the insulating glass "combines aesthetic and functional criteria," commented seele.

REFURBISHMENT

Partition project completes at Lancashire campus



Architectural glass firm Altitude Glass have completed the final element of a £35m scheme at the University of Central Lancashire to create an Engineering Innovation Centre.

The scheme was developed by the client to "drive engineering innovation in the north west," said Altitude Glass.

Altitude Glass fitted glass partition walls in the building, designed to create a "clear separation" between some of the centre's facilities, said the firm. This work involved a major installation of an 11 m long x 3 m tall glass wall, with two pivoting doors in the centre, which divides the technician's office – located on the ground floor of the centre – from the workshops.

The work has involved installing glass partitions that create a lot of light, as well as separating spaces, but also creating a link between them.

Sharon Snape, managing director at Altitude Glass said: "We've consulted with contractor R Walker and Sons during several stages of the build, in relation to specifying architectural glass within the building.

"The installation of the 11 metre long wall on the ground floor was technically challenging, as we had a complicated ceiling to work with and were unable to attach glass directly to it. Cabling, lighting and air-conditioning pipework had all been left exposed due to the nature of the industrial design."

COMMERCIAL & WORKPLACE

Wimshurst Pelleriti 'breathes life and character' into historic Richmond office building with glass extension

Wimshurst Pelleriti have completed the renovation and extension of a historic office building in Richmond for client CBRE Global Investors. Planning was approved within five months and the building completed earlier in 2019, 15 months after permission was granted.

Occupying a small site in central Richmond, Indigo House is in the centre of a conservation area surrounded by historic properties, many of which are listed, which demanded "a very sensitive approach to the design and planning process," said the architects. In response, Wimshurst Pelleriti submitted a glass extension on the ground floor where there was no impact on the conservation area, and a "careful approach" to the roof extension that overlooked, and could be seen from, surrounding properties.

The design features a frameless glass extension with a green roof at ground floor level that brings more natural light into an already unobstructed ground floor plan, while the new second floor, built in place of an existing plant area, features zinc cladding and dormer windows that "blend with the character of surrounding properties." The refurbished interior has a "light-industrial feel," featuring a minimalist palette, with an exposed structure, exposed brickwork and exposed services, and timber flooring throughout.

COMMERCIAL & WORKPLACE

Council office facelift's bespoke facade

The £42m refurbishment of the 1970s Merrion House, Leeds City Council's offices, which is located in the city centre, was part of the council's workplace strategy designed to unite staff from multiple buildings under one roof to create a better working environment, while also reducing rental costs.

The refurbishment also included the creation of an additional 15,500 m² of office space in an annex building, which is linked to a new community hub – including several retail spaces on the ground floor – via an atrium.

The building was designed by architectural practice BDP and delivered by main contractor BAM Construction, while the curtain walling system for the bespoke facade was supplied and installed by specialist contractor FGS.

Developed to achieve a BREEAM Excellent rating for sustainability, BDP designed the remodelled building with a material palette that reflected the conservation area and landmark buildings that are within close proximity of the project. The design of the project has been shortlisted for the 2019 RIBA Yorkshire awards.

The curtain walling, which was fabricated by Facade & Glazing Solutions (FGS), is Wictec by Wicona, which was specified for its slim face width and strength, enabling it to carry brick slip feature beams with steel frame reinforcements.

COMMENT

The need to embrace solar control glass for net zero

Leo Pyrah of Pilkington UK outlines the role of solar control glass in the battle to get to net zero carbon by 2050, and explains what could be holding the solution back from being specified more widely by architects

The race to hit net zero carbon by 2050 has renewed discussion in Government and across the building design industry about how we make our new and existing buildings more energy efficient.

When glazing's role is considered here, the industry has historically focused on trapping heat in with low-emissivity glass, led by Building Regulations, resulting in reduced demand for heating spaces in colder months. Indeed, improving the thermal efficiency of the glazing used in our built environment will be important to meeting the net-zero target.

But preventing solar energy from being transmitted into buildings through windows and facades will be equally pertinent for lowering emissions. Solutions like solar control glass will help alleviate this issue, resulting in less energy used by mechanical cooling systems.

The issue of overheating, and its impact on energy efficiency, is forming part of Government consultations surrounding Building Regulations. This could introduce great change in the way we design buildings in as little as 12 months' time.

With regulations driving change, it could lead to greater proliferation of solar control glass – catalysed by manufacturer innovation in the category. This is coupled with an increasing ability to combine glass coatings, so not only can one glazing solution deliver solar control performance, but it can be toughened, self-cleaning and thermally efficient too – delivering on multiple objectives for technical architects.

New specifications for solar control glass

Solar control glass is currently being specified in all manners of climates, and for all sorts of projects.

For example, Pilkington recently installed 50,000 square metres of solar control glass at the Palm Tower, a new landmark building in Dubai's iconic Palm Jumeirah district. The advancement of solar control coatings has allowed the tower to be clad entirely in glass while resisting the desert heat, keeping a naturally cool temperature inside for occupants.

Looking ahead, advanced technologies like dynamic and switchable glazing – glazing which can react to daylight exposure and limit heat transmittance – may also provide a solution for homes and commercial buildings

It's solar control glass' increasing ability to be combined with other solutions, such as self-clean or acoustic glazing, that is opening new opportunities for its specification.

Solar control glass in the home

While the commercial sector strides ahead in using solar control glass to curb energy use and maintain comfortable temperatures indoors, the UK residential market lags behind.

In the forthcoming Building Regulations Part L (Conservation of Fuel and Power) consultation in England, overheating is expected to be a focus area, not only for commercial buildings but also for residential properties.

This is unsurprising given that last year's hot summer drew a lot attention to just how serious the overheating issue in homes currently is. Research by Loughborough University published in the *Building Research and Information Journal (2017)* outlined how deaths related to overheating could triple by 2040.

Given solar control glass' ability to reduce the amount of heat transmitted into buildings via windows, and subsequently reduce the risk of overheating without the need for mechanical cooling, the Part L consultation could lead to regulations that place more importance on its specification in the home. Currently, Part L only recognises the problem of solar heat gain in non-residential properties, where solar control glass or shading devices are required for large glazed projects to meet the solar gain benchmark.

Currently, we're waiting to learn how the Government proposes to address these growing concerns. For new, non-residential properties, the current 'notional building' used in the Regulations is based on a maximum g-value of 0.4, where 40 per cent of the total sun's energy is transmitted. A lowering of this value could drive the market for more highly performing solar control glass. As an alternative to counterproductive designs such as reducing glazed areas, we could also see more importance placed on architects specifying glass with better solar control properties in the home.

Zero energy buildings

Undoubtedly, over the next two decades we'll see a step change in the way buildings are designed, driven in part by increasingly stringent Building Regulations, with each project striving to be a zero-energy building.

Looking ahead, advanced technologies like dynamic and switchable glazing – glazing which can react to daylight exposure and limit heat transmittance – may also provide a solution for homes and commercial buildings.

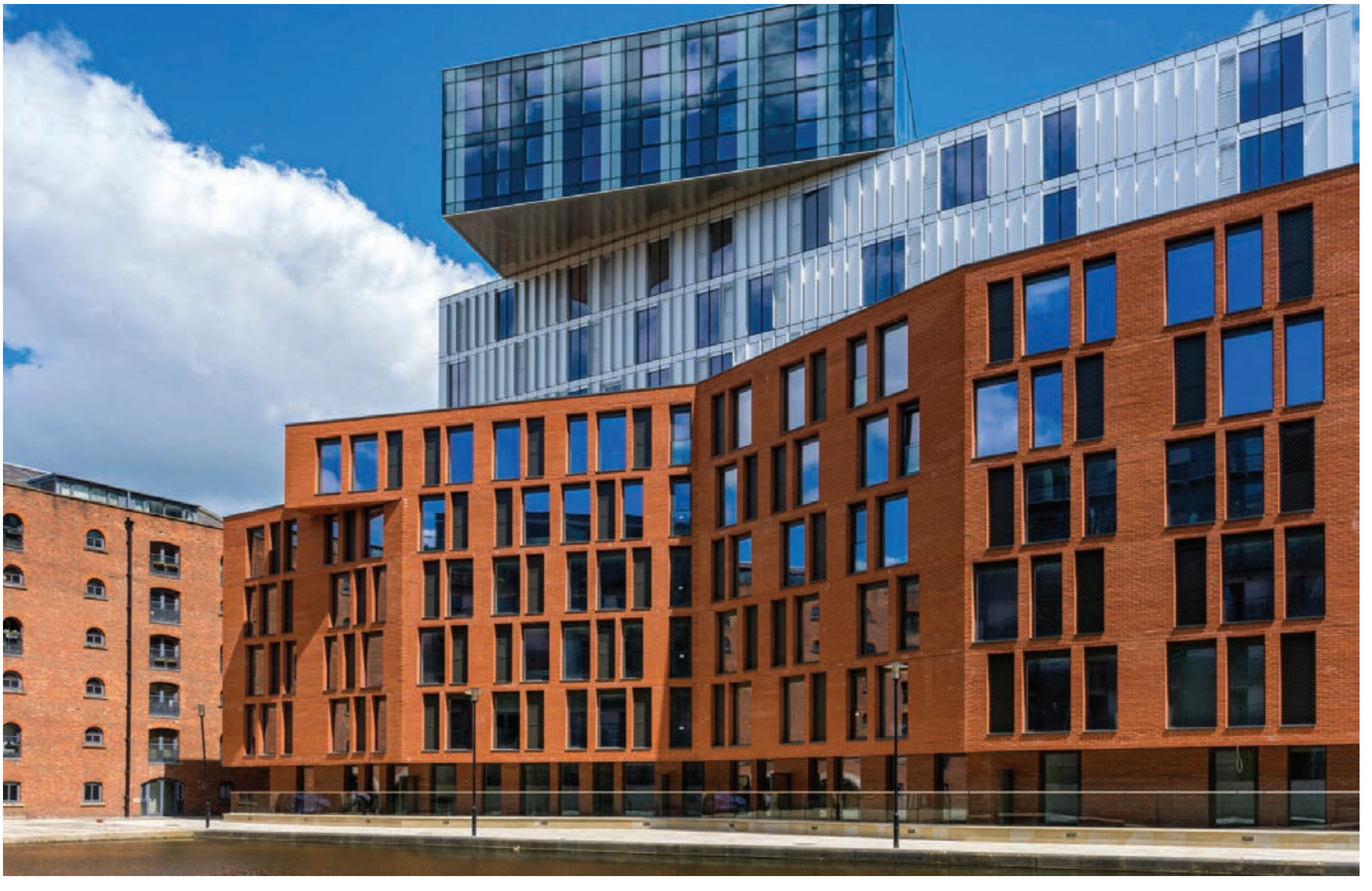
For now, it will be important for architects to watch the Government's consultations surrounding energy efficiency and overheating closely. By the end of next year, the specification of solar control glass is likely to extend beyond the large commercial projects we see frequently now and to be seen in far smaller commercial and residential projects.

Leo Pyrah is product manager at Pilkington UK

COMMENT

A clearer view of safety

Among the functions performed by glass and glazing systems as part of the building envelope, fire safety and protecting lives are critical. Darren Wainwright of SE Controls explains systems' roles in smoke control and compliance issues



Within residential buildings over three storeys high, smoke control systems need to be incorporated as a compulsory part of the building's design, to ensure that in the event of a fire, escape routes can be kept free of smoke.

For other building types, such as hospitals, office buildings, transport terminals and airports, smoke control solutions perform the same function. Even though each design may be unique, the buildings' glazing systems are usually an integral and vital part of the smoke ventilation strategy, by opening automatically and allowing smoke to be vented.

This critical life safety role means that smoke control is one of the most highly regulated aspects of a building's design and construction, which, by necessity, also includes the glazing systems that are used as automatic opening vents (AOVs) within the solution. As a result, compliance is an absolute requirement, especially when designing, testing, fabricating and installing

systems that are used for smoke control.

While Approved Document B is widely acknowledged as the default reference document for building design and compliance for smoke control systems, a number of British and European standards, as well as the 2013 Construction Products Regulation (CPR), also form an essential part of the regulatory framework.

The EN12101 family of European standards has two parts that predominantly affect the facade and glazing industry. EN12101-10: 2005 covers smoke ventilation power supplies and EN12101-2: 2003 applies to smoke vents or smoke and heat exhaust ventilation (SHEVs).

Compliance to EN12101-10 can be readily policed, as the entire control panel, containing the power supply, is tested at an accredited test facility to the defined criteria within the standard.

The CE Mark label can then be applied to the product and a Declaration of Performance (DoP) certificate issued as proof of compliance to the CPR. It's important to note that just using 'CE marked power supplies' within the panel is insufficient for compliance, as the entire panel must be tested as a whole.

However, compliance and testing for EN12101-2 is more complex, as there are two core components for the AOV – the actuator and the window/ventilator. While the actuator and window vent might already be compliant as individual items, to be fully compliant, both products must be tested together as a single unit by an independent accredited test facility.

In addition, the glazed vent must be manufactured under a third party audited Factory Production Control (FPC) scheme with the actuator either installed as part of this process, or with it on site. If it is the latter, an audited process is also required to ensure the detail is identical to how it was tested. Once again, the only proof of compliance is the CE labelling on the product and the issuing of a DoP certification.

Failure to adhere to this process is already resulting in non-compliant windows that are being used as SHEVs being removed following the stringent compliance policing by approved inspectors, such as LABC and NHBC. In short, if the window/vent and actuator assembly doesn't have a DoP, then it's not compliant.

The importance of this requirement has already been embraced by the glazing and facades industry with system manufacturers having their products tested with actuators to ensure they are compliant and can be specified with confidence. SE Controls' actuators have been compliance tested and approved for use with 27 facade system companies.

Until recently, the glazing and facade systems that have been used as part of smoke control and SHEV solutions have been predominantly manufactured from aluminium for a range of reasons, including its fire performance, heat resistance and inherent strength and light weight.

Although the widespread use of PVCu (un-plasticised polyvinyl chloride) in domestic window installations, primarily in low-rise buildings, provides several advantages, such as cost, aesthetics and insulation, the big disadvantage is its low melting point of around 300°C – less than half that of aluminium.

While in normal use a PVCu window needs to comply with EN14351-1:2006, as soon as it is fitted with an actuator, its performance is governed by EN12101-2:2003. To comply with this standard, smoke vents must withstand test temperatures in excess of 300°C, while maintaining their structural integrity and being able to function as an AOV as part of the building's fire safety system.

As PVCu systems tend to use welded corner joints, this immediately made them unsuitable for SHEV applications. However, a number of PVCu window system companies have taken a fresh look at the problem and developed products that can now pass the industry standard EN12101-2 tests and achieve the required DoP certification.

By extending the use of metal reinforcement, which is already a feature of PVCu systems, to increase the windows' rigidity and reinforce the corner joints, the latest systems can maintain their integrity even at the 300°C test temperature.

Four system companies have already introduced compliant products that have been tested with SE Controls actuators, with further product ranges in development and other manufacturers following suit.

This inevitably provides a new specification opportunity for architects and public sector specifiers dealing with residential buildings, as well as the potential to reduce costs on suitable projects.

The requests for testing we're currently receiving for PVCu window products, in relation to SHEV applications, is growing rapidly, which indicates that this sector is likely to grow considerably in the near future. This innovation is yet another indication of how the glass, glazing and facade industry continually adapts to new challenges and market requirements.

Darren Wainwright is technical manager at SE Controls

Images © Ema Peter

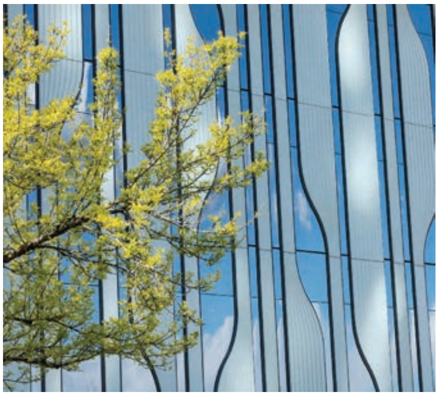
BUILDING
PROJECTS

**SIMON FRASER UNIVERSITY SUSTAINABLE ENERGY ENGINEERING BUILDING
BRITISH COLUMBIA**

Climate control

A new Canadian engineering faculty building will research and develop solutions for clean power innovation, as part of the Government's response to climate change. *ADF*'s Sébastien Reed speaks to its architect Venelin Kokalov about a project that uses glazing to engage with its surroundings

INNOVATION IN SUSTAINABILITY
The new Sustainability Energy Engineering school housed within the building will develop solutions for harvesting, storage, transmission and use of energy, carefully considering socio-economic impacts



Revery Architecture was first approached by Simon Fraser University (SFU), which has three campuses in British Columbia, Canada, to design its new Sustainable Energy Engineering Building in 2015. The architects were initially requested to work on the functional programme and indicative design for the new centre, whose eventual construction was contingent on grants from the Canadian Government under the Federal Department of Innovation, Science and Economic Development Canada's Post-Secondary Institutions Strategic Investment Fund (SIF).

After receiving confirmation of funding in 2016, the client pressed on with interviews to find a suitable architectural lead to take the project from design through to construction. They did not have to look too far, as they selected Revery to continue the work they had already begun.

According to the project's original brief, the client envisioned "a five-storey, world-class, state-of-the-art, LEED Gold building designed to reduce emissions and energy consumption, situated on lands contiguous to the university's Surrey campus. The gross floor area of the proposed building is 14,445 m^2, plus one level of underground parking." The building was to represent the university's first expansion beyond the original campus, as well as being a vital new addition to downtown.

Beyond having completed initial feasibility work for the new building, the architects list some other core reasons why they were awarded the project; the first being their significant design experience in the city of Surrey. This includes planning work for the city centre, a library and an aquatic centre, all of which make Revery particularly attuned to Surrey's unique dynamic, and planning landscape. "We've developed a strong understanding of and relationship with the approving authorities," says Kokalov.

Another reason; the practice's alignment with the ethos of the project. Seeing eye-to-eye with the client in the "quest for innovation," they wanted to create a "community building" which would "engage the world" in addressing the most timely issues.

Responding to the brief, Revery's aim was to create a building that integrates with its urban context, engages SFU and the local Surrey community, and becomes a place that elevates user experience.

Flexible in function

The programme is organised around a central atrium space, oriented east-to-west on axis with the adjacent Surrey Central SkyTrain line – providing light, rapid transit, and opening onto University Drive. Wider in the east than towards the west, the full height 'flatiron'-style tapered atrium divides the building in two; to one side an L-shaped block and to the other a more regular rectangle-shaped block.

The atrium facilitates circulation between the ground and third floor, while the integrated spectator seating and a large, open, ground floor base provide functional space for both formal and informal gathering and activities. "It's become the living room of the building," says Kokalov, "it's where the cross-fertilisation of ideas can take place; it welcomes the public."

Because the building is in the heart of Surrey's downtown, the architects deemed it vital to somehow continue the public realm into the building, both to "activate" it and to illustrate the partnership between SFU and the city itself. In this vein, the most socially active parts of the programme are all found on the ground floor; the cafe, a pre-function area and a 400-capacity lecture hall – available to both SFU and the local community, student central services, common and recreational rooms, and the atrium base.

The upper floors are devoted to teaching functions with another 120-seat lecture hall and 'innovation space' housed on the first floor; library, lounges and process laboratories on the second floor; research, prep and classrooms on the third floor; further educational spaces on the fourth; and staff offices on the fifth.

"It's become the living room of the building; it's where the cross-fertilisation of ideas can take place – it welcomes the public"

Venelin Kokalov, Revery Architecture

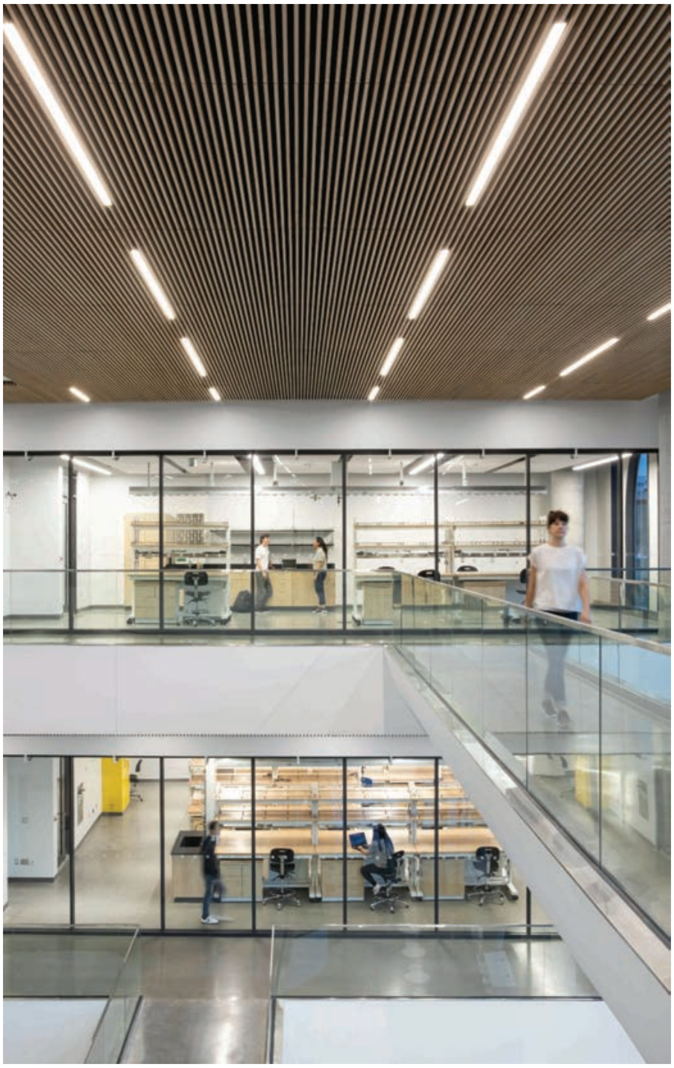
When quizzed on changes to the design that might have interrupted the architectural process, Kokalov answers: "The schedule wouldn't allow it. SFU was clear from the outset." With the client stressing the "importance of flexible spaces," research labs had to accommodate a spread of topics and classrooms needed to support diverse teaching styles. This is perhaps best illustrated by the rooftop, which was designed to accommodate a research lab, should it be needed.

Inside, the building has a mix of exposed concrete and white painted drywall. Timber is also used liberally throughout. This includes wooden slat ceilings, maple accents to the atrium balconies, timber floors to the tree pods, and timber for the spectator benches in the atrium. Maple plywood and dark-stained plywood furnish the lecture hall there, along with dark fabric-wrapped panels. Additionally, perforated dark-stained plywood and paper-faced insulation are used to provide acoustic treatment.

SE3P's location directly across the street from existing SFU buildings enabled the architects to establish dialogue between the two. For example, the main entrance was placed towards the south-east to clearly bridge old and new.

Circuit board

Inspired by the geometric pattern of electrical circuit boards, the facade's design is clearly and symbolically linked to the technological themes that make up the pedagogical content taught within the building. White precast concrete sandwich panels alternate with reflective glazing which is framed by white precast fins outlining the entire facade.



WORK SPACES
The upper floors are devoted to teaching functions, including laboratories, research areas and classrooms

This precast box is elevated several metres from the ground, and appears to float thanks to a band of transparent glazing at its base. Together, the different areas of glazing increase visibility and connection, providing a sense of public realm to both the interior and the exterior of the building.

Kokalov continues: "The juxtaposition of the heavier precast elements versus the reflective glazing helps to animate the facade while symbolising the opposing forces commonly encountered in engineering; tension and compression, positive and negative." Throughout the scheme, glass was used as a means of making the building seem more porous. Clear glass at ground level "allows for the interior public space to extend from the street and engage the neighbouring community," says the architect.

The same materials were used on each of the elevations except for the cut-out on the south west corner. Here, insitu concrete was used as a cost-saving tactic. The architects expected the cut-out to eventually be filled in as the facility and university continue to expand and develop, so material specification wasn't seen as pivotal.

Less is more

"Through careful sculpting of space, selection of muted and natural materials, and the introduction of natural light and views to the outside," says Kokalov, "we tried to create spaces within the building that elevate and enhance the user experience."

Kokalov remarks that the ratio of opaque solid wall to glazed wall is approximately 70 per cent to 30 per cent

OPEN UNIVERSITY
The 400-capacity lecture hall is available for use by the local community as well as the university

PROJECT FACTFILE

Architect: Revery Architecture
Client: Simon Fraser University
No. of students: 515 (approx)
No. of staff: 60
Gross floor area: 14,445 m^2
Sustainability: LEED Gold

respectively, making it a relatively lightly glazed building. "Having said that," Kokalov qualifies, the visual dominance of translucent material "is due to the strategic placement of the glass that it gives that perception." He continues: "It is very successful in this regard – it gives an open feeling to people which meets SFU's philosophy of a 'community engaging a school'."

The architects faced some difficulties in achieving their desired exterior aesthetic, most notably in the construction phase. The precast panels and curtain wall infill panels were made independently, rather than being prefabricated together, and all of the mounting brackets were located on the slab edge. The main challenges, according to Kokalov, came from the installation sequence, the achievable tolerances, and the glass fabrication lead time.

The orientation of the precast and glazing systems is not entirely vertical. Instead, they weave left and right as they climb the building. This required the gap between the two systems to be increased in order to accommodate both horizontal and vertical movement due to expansion and contraction originating from temperature fluctuations. "Simply caulking the joint was not an option because of the load transfer between the system," insists Kokalov.

As a consequence, meticulous on-site quality control of precast concrete panels was critical to the curtain wall installation; for example the 2 cm gap established between the precast panels and glazing panels. The glazing contractor had to meet and install the panel accordingly otherwise the panel had to be rejected.

Two main types of glazing were specified by the architects. Highly reflective glazing was used functionally; to reduce heat transmission, and also aesthetically; to reflect the sky and create visual interest for passers-by. Secondly, to draw as much natural light as possible into the building, high VLT (Visual Light Transmittance) glass was used for the storefronts at street level, for the atrium glass wall, and at the south east corner on level five where the staff lunchroom and open office are located.

LEED-ing in sustainability

In addition to specifying durable materials and designing long-lasting and flexible places into the scheme, the building had to embody the sustainable ethos underlying the facility's function. To do so, the architects sought to achieve LEED Gold certification – awarded by the Canada Green Building Council (CaGBC).

Reductions in car parking spaces needed by the local municipality, the provision of extensive vegetation – including native and local species – throughout the site, the implementation of a stormwater catchment system, and a passive ventilation approach taking advantage of the atrium's natural draughts and minimising the need for mechanical ventilation. These were just some of the measures taken to sensitively meet the certification requirements.

The approach produced significant praise from the client, as Ian Abercrombie, architect and director of campus planning and development for the university, who admits: "SFU was a demanding client. We required an architect that understood the complexities of an academic and research facility, yet also understood its need to provide a high standard of urban design in the emerging Surrey City Centre." He concludes: "Revery Architecture responded to these challenges and took direction from SFU facilities staff, academics, and researchers, in shaping a functional, yet inspiring building." ■

Sound advice on architectural glazing

Enhanced acoustic requirements are becoming a commonplace consideration in contract documents, says Mark Hargreaves of Technal, who discusses glazing strategies to mitigate noise and the correct approach to acoustic design

As a main element to most buildings, the glazed openings have long played a key role; contributing natural daylight and ventilation, as well as being integral to overall energy performance, both in terms of thermal insulation and solar gain. Arguably, however, it is in terms of their acoustic performance that the bar is continuing to be raised most dramatically, in response to the growing impact of noise pollution on our everyday lives.

This worsening situation stems from a variety of sources – including higher traffic volumes, expansion of rail and air travel, and a growing tendency towards a 24/7 society where the population lives, commutes, works, shops and seeks entertainment in ever closer proximity.

It is in fact recognised that UK housing developments have among the highest densities in the world. It is not just the noise of neighbours and passers-by, which pose a problem: being beside a trunk road or beneath a flight path can also have a serious impact on places such as schools and hospitals.

Acoustic designs

The different elevations and roof areas that often occur on commercial or large residential projects have to provide protection against the weather, while complying with most parts of the Building

The choice of glass type and dimensions, including that of the cavity, impacts dramatically on the level of acoustic performance that is achieved

Regulations: among which Approved Document E – covering resistance to sound – is becoming increasingly important.

The official guidance regarding acoustics for the design process is provided by BS 8233: 2014, taken in tandem with other authoritative documents such as LEED or BREEAM, which is widely regarded as the most holistic measure of a property's environmental credentials.

It is important to recognise the very complex nature of sound, with different components and frequencies, which lie within the pressure spectrum to the decibel scale. All such sounds can be attenuated and reflected through careful detailing of glass, air gaps, interlayers and frame components.

In compiling their acoustic report, the acoustician conducts a detailed survey, measuring the noise levels expected on the projected footprint, at multiple points and at different times. Each level of the building is assessed to determine the degree to which the facade system and its glazing elements must be specified: taking account of the minimum attenuation required to deal with the noisiest periods.

Avoiding acoustic bridges

The next stage in achieving good acoustic conditions within a building is to understand how the control offered by different materials or elements to the envelope can be compromised by their interconnections, or the surrounding structure.

The phenomenon known as 'flanking sound' or 'flanking noise' refers to the energy waves, which pass over or around, rather than directly penetrating a barrier. So, although an insulating glass unit or architectural glazing system may offer good acoustic insulation, noise can still penetrate to the building interior, or pass between spaces.

The system provider and facade consultant must therefore seek to address rigid connections, especially metal-to-metal interfaces, in order to prevent sound waves being transmitted through pressure plates frame profiles, joints, brackets and anchor points. Flanking noise can therefore be reduced greatly by careful detailing, such as acoustic infills to mullion and transom profiles, and creating additional acoustic barriers between the frame and floor slabs.

It is therefore essential to ensure the window; door or curtain walling system chosen features an effective acoustic seal, together in tandem with effective sealing for guaranteed air tightness.

The selection of glass type and double or triple glazing

The choice of glass type and dimensions, including that of the cavity, impacts dramatically on the level of acoustic performance that is achieved. Industry standard double-glazing will deliver in the region of a 30 dB to 35 dB reduction in sound against normal passage through air.

This can be improved upon significantly through specifying thicker panes and special acoustic grade glass, and widening the cavity or by introducing secondary glazing: which can generate a 40 dB or greater reduction. Rather than this being a linear improvement, every 3 dB achieved represents a doubling in performance. And just as combining varying densities of material is effective at combating sound transmission, the best results for glazing units are obtained when the inner and outer panes are of different thicknesses.

It should also be assessed whether to include a laminate interlayer for enhanced acoustic performance – potentially also improving thermal efficiency and safety – or perhaps to go from double to triple glazing. In addition to increasing overall unit thickness, the latter raises the cost of glass by some 50 per cent, and the additional weight may move beyond the capacity of the framing system originally considered.

Mark Hargreaves is national specification manager at Technal

Getting to grips with daylighting

Gary Dean of OnLevel UK explores the importance of daylighting in building design and the benefits of specifying glass clamps to help facilitate it

Ensuring your home, workplace or recreational space maximises the use of natural light is fast becoming an integral part of building design. The wellbeing benefits of natural light are compelling, from boosting your vitamin D, helping to ward off seasonal depression, and improving sleep, while natural sunlight boosts energy and strengthens organs. Natural sunlight is also economical and sustainable. By increasing a building's exposure to the sun with effective design and space planning, it can create a cost-effective, light filled sustainable building.

At the end of 2018 the British Standard EN 17037:2018 was released. Relating to daylight in buildings, the standard encourages designers to assess daylit spaces in buildings and ensure they're successful. It allows building designers and developers to focus on a building's daylighting objectives, as well as tackle other issues related to daylight design, such as views out, protection against glare, and exposure to sunlight. The document gives information on how to use daylighting to provide lighting within interiors, and how to limit glare. It defines metrics to be used for the evaluation of daylighting conditions and gives principles of calculation and verification.

Fundamentally daylighting is the practice of efficient design; the positioning of windows, skylights, and reflective surfaces to allow the flow and capture of sunlight within a building, so that sunlight can

By increasing a building's exposure to the sun with effective design and space planning, it can create a cost-effective, light-filled sustainable building

A glass clamp balustrade can make any interior or exterior space look bright and airy

provide effective internal lighting, reduce the use of artificial light and harness thermal capability to ensure energy savings.

As well as being perfect for creating daylit spaces, glass maximises efficiency due to its capacity to 'trap' sunlight for thermal gain. Furthermore, the structural benefits of glass provide building designers with the opportunity to create large expanses of sunlight-filled interiors and greater ability to capture and flow natural light in and around building spaces.

In addition to natural light in building design improving occupant wellbeing, it reduces artificial light and electricity use – which benefits both the building owner financially, and the wider environment.

Glass fixtures and fittings play a big part in ensuring effective daylighting in buildings, specifically glass balustrades and Juliet balconies. Frameless glass balustrades are particularly well suited due to the 'all glass' look and the minimal 'frame' (fixing channel). Likewise, more traditional glass clamp balustrading, commonly used upon staircases in atriums and hallways to maximise the flow of natural light to create light filled spaces.

The popularity of glass clamps in a changing marketplace

The growth in popularity of glass clamps has flourished in recent times due to the aesthetic benefits of glass and minimal hardware. Specifically, the sense of space, light and air that glass provides mean glass railings and balustrades are a common site in towns and cities across the UK.

There are many benefits to using a glass balustrade with glass clamps, including the visual benefits gained through the use of large panels of glass with clamps to create the 'all glass' look. A glass clamp balustrade can make any interior or exterior space look bright and airy.

Toughened glass and metal glass clamps are tremendously tough and durable. When used in combination to create balustrading, the end result is a safe and secure barrier or screening. British Standards 6180:2011 gives guidance and recommendations for the construction of railings and balustrades.

Important criteria include the material selection for the balustrades; the specified height that balustrades are to be constructed to, the various loadings that balustrades are meant to withstand, and the application or use of the balustrades and how this affects the design.

Additionally, glass clamp balustrades are very easy to clean and maintain. A simple lint-free cloth and a good glass cleaner is all you'll need to keep your glass balustrade looking new.

Alternative designs

The majority of the glass clamps on the market are similar in design, both mechanically and aesthetically. An L-shaped bracket that can be screwed into the post and base rail, and a double-sided rubber insert that holds the glass panel in place, with a plate to complete the clamp. The clamps are typically square, rectangular or rounded 'D' shape in style, with a flat or radius back depending on the profile of the surface the clamp is being fixed to.

OnLevel recently launched 'Kronos', which was developed to be the world's first adjustable clamp. To complement a broad range of interior spaces and applications, the clamp is available in a range of finishes. Due to its 'one piece' design, the product provides a cost-effective alternative to traditional glass clamp design.

Gary Dean is managing director at OnLevel

Glass built to last

Susan Sinden of ESG Group explains why glass advances make the material one of the most versatile for creating modern, attractive and secure environments

Toughened glass was an important development early in the 20th Century – because it shattered into small granular fragments rather than potentially dangerous large shards. However, in the last few decades, glass processors have far exceeded this with huge advances in laminated toughened glass, made by sandwiching sheets of toughened glass together with a PVB (polyvinyl butyrall) interlayer. If a sheet of toughened laminated glass becomes damaged, the interlayer holds nearly all the glass fragments in place, reducing the risk of falling glass fragments. This lamination process has opened up a whole range of possibilities for the use of glass, in partitions, balustrades and facades.

Toughened laminated glass now allows us to vary the degree of strength and provide additional properties, by using different thicknesses of glass and types of interlayer, according to the intended purpose of the glass panel. With toughened laminated glass having greater tolerance to stress, we can increase the size of each panel, so that lighter, taller and wider expanses of glass can be used to create the modern uninterrupted vistas which are a feature of so many iconic modern buildings.

By selecting different technical interlayers, we can also introduce a range of added benefits such as fire resistance, sound reduction, ballistic protection, and even opacity, to each glass panel.

Using a fire-resistant interlayer provides a fire-resistant safety glass that is certified to the Certifire E30 and E60 tests, which assess glass for 30 minutes and 60 minutes of fire resistance respectively, for panels used in timber and steel doors and screens. This helps to ensure greater visibility and safety – the fire door delaying the spread of smoke and flames, while the glazed door panel allows a fire fighter to make a critical check for occupants, or a vital assessment of a situation, before tackling a blaze.

We can also utilise interlayers to provide sound attenuation. This can be an

The characteristics of toughened laminated glass are such that even when the panel is damaged and its clarity compromised by fractures, it will normally stay in place

A further type of interlayer can be used with thicker sheets of toughened glass to manufacture high security, ballistic, and even blast-proof glass, helping to design into the built environment a degree of deterrent against criminals and terrorists

invaluable benefit in offices and boardrooms, where openness and clear sight lines are valued by a client, but confidentiality for sensitive discussions is essential. In domestic settings this is also a huge benefit in urban locations where street noise can be a problem.

Another option that is growing in popularity in both commercial and domestic settings is LCD privacy glass. This is created using a specialised technical interlayer, through which a small electric current is run, allowing the user to choose between transparency and opacity at the push of a button. When the current is passed through the interlayer, light is allowed through and the glass is made optically clear. Once the current is switched off, the panel instantly becomes opaque. In open plan domestic settings this is proving very versatile for screening and zoning living areas such as the bedroom or bathroom, and also in place of curtains or blinds, giving a minimalist approach to alternating between privacy or enjoying the view.

This switchable glass can also be useful for security. If potential thieves cannot see their target, they are often deterred from making an attempt to steal it. This type of glass is therefore increasingly being used by high-end retail outlets from car showrooms to jewellers, and even in banks, to protect tellers from armed robbers.

A further type of interlayer can be used with thicker sheets of toughened glass to manufacture high security, ballistic, and even blast-proof glass, helping to design into the built environment a degree of deterrent against criminals and terrorists. The characteristics of toughened laminated glass are such that even when the panel is damaged and its clarity compromised by fractures, it will normally stay in place. The glass panel may be dented or pushed out of shape, but it takes a long time and a high level of tooling to make an actual breach in high security glass, especially that designed to withstand ballistics. Law enforcement support will usually arrive well before the perpetrator would manage to achieve a hole large enough to enter the premises.

Glass has been a highly desirable element in construction since Roman times, simply because it lets in natural light. Thanks to developments in toughened laminated glass processing, despite the passage of many centuries, modern processed glass can now do so much more, keeping it firmly at the forefront of building materials development.

Susan Sinden is commercial director at ESG Group

Lighting the way to sustainability

William McDowell of Hambleside Danelaw explains how recent innovations in GRP rooflights can help specifiers contribute towards BREEAM and sustainability

It is impossible to be unaware of the drive to increase our sustainability in building design. However, many architects are unaware that by looking upwards they can shed light on a simple way to help increase a building's sustainability.

A solution is rooflights manufactured from glass-reinforced plastic (GRP), whether designing a sustainable new build, fit-out or refurbishment project. GRP rooflights can make a positive contribution towards a building's construction and operating energy efficiency, and its lifetime carbon footprint.

It is accepted that rooflights contribute towards BREEAM. They provide natural daylight, reducing the need for artificial light, and enhance occupant health and wellbeing. The contribution is seen as difficult to quantify – but is it? Rooflights that carry an Environmental Product Declaration (EPD) can make a tangible, proven contribution of 1.5 points towards BREEAM in the Materials (Mat 02) category. Now, for the first time, there are GRP rooflights that have attained an EPD (Environmental Product Declaration), from the Building Research Establishment.

The concept of rooflights being able to quantifiably contribute towards a BREEAM rated project in this way is a major innovation for the market. It provides massive potential for a change in the way we conceive, plan and construct the roofs of commercial and industrial buildings in the private and public sector. It builds on the historic platforms for rooflights within BREEAM. Now, GRP rooflights can 'tick the boxes' in all of the three most heavily weighted BREEAM categories – Materials, Energy, and Health & Wellbeing.

To address energy, both as part of BREEAM and beyond, the natural daylight transmitted through rooflights reduces the amount of supplementary, artificial lighting. A rooflight allows up to three times more daylight into a building than an equivalent-sized wall light or glazed penetration.

Historically, it has been accepted that a 10 per cent rooflight to roof area was the optimal ratio. The National Association of Rooflight Manufacturers (NARM) has commissioned independent research on the subject. The conclusion was that a 12 per

Now, GRP rooflights can 'tick the boxes' in all of the three most heavily weighted BREEAM categories – Materials, Energy and Health & Wellbeing

cent rooflight area achieved Building Regulations Approved Document L requirements, and a rooflight area of 15-20 per cent is optimum. The cost of energy in financial and CO_2 terms required to light a building using artificial light is accepted to be far greater than any potential heat loss through rooflights.

However, it costs four times more to heat a building than to light it. Modern rooflights increasingly tend to be composite, with an insulating core. Thus they actually enhance the building's thermal performance. Indeed, depending on the specification, rooflights can achieve a U value as low as 0.9 W/m^{2}K.

Increasing the thermal performance can adversely impact on the light transmission values, depending on the structure of the insulating core. Standard rooflights use structured multiwall polycarbonate for their insulating core, the internal horizontal layers of which reduce light transmission through reflectance. New, greener technologies are seeing the use of honeycomb cellulose acetate to form the insulating core. The honeycomb structure eliminates the multiple layers of multiwall polycarbonate, which delivers more light for the same insulation performance.

As an added weapon in the battle to reduce carbon emissions, cellulose acetate is a low embodied energy material, and is compostable at end of life. Technologies are being developed to reduce the carbon footprint of GRP too. Options now exist which use a mesh of continuous glass filaments to achieve greater strength than conventional GRP with 40 per cent lower embodied carbon.

Beyond Energy, the Health & Wellbeing category for BREEAM aims to "encourage best practice in visual performance and comfort by ensuring daylighting, artificial lighting and occupant controls are considered."

Even without the need to address climate change, there is growing awareness of the need to take into account the health and wellbeing of a building's occupants. Scientific studies have shown that the cost of not having a workplace wellness programme is greater than the cost of implementing one: a healthy workforce is a happier workforce, and a happier workforce is more productive. Similar studies have also shown people learn and heal more quickly in naturally-lit buildings.

Consideration needs to be given to the type of light. Being translucent, GRP provides a diffused, uniform light into the building, avoiding solar glare and shadowing. It minimises sudden transition between lit and unlit spaces, and actually disperses the light to a wider area. The improved uniformity of light increases the range of tasks that can be safely undertaken in the building, which potentially adds to the building's value. Glass and polycarbonate, by contrast, give a direct light, often more appealing in locations such as enclosed shopping malls, but increasing solar glare and shadowing.

So sustainable design can be achieved using tools already known about. All that is needed is for them to be looked at in a different light.

William McDowell is national business development manager at Hambleside Danelaw

Kalwall rockets away

Aerospace company Blue Origin's vast new 70,000 square metre factory in Kennedy Space Centre's Exploration Park in Florida is now manufacturing 'Glenn' rockets for launches at Cape Canaveral 10 miles away. In addition, it is expected that the factory's upper-level spaces will be used as launch control for the space vehicles including those recently announced for the new manned missions to the moon.

Owned by Amazon founder Jeff Bezos, the Blue Origin building features specially-designed Kalwall® translucent cladding which has been used across the top of the building in a clerestory design. Manufactured with a bespoke face sheet to match the corporate colour scheme, 100's square metres of Kalwall transmits high quality diffused daylight into the structure whilst also solving the twin requirements of privacy and security. Interestingly, the use of a bespoke coloured face sheet does not affect the quality of light internally.

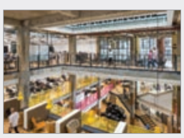
Kalwall offers complete line-of-sight protection, maintaining privacy for building occupants and operations while throwing diffused daylighting deep into the interior space. It also eliminates shadows and glare and the stark contrasts of light and shade making it safer for within. The system also enhances simplicity in external design by negating the need for blinds, curtains or solar control.

In the United States, Kalwall is accepted as one of the core materials for the construction of secure locations. It can be configured to exceed Large Missile D hurricane compliance for wind-borne debris protection making it suitable for facilities needing enhanced protection or serving critical national defence functions. It can also be manufactured for blast resistance and is compliant with ASIAD, DoD, GSA anti-terrorism, ATFP and UFC.

The exterior face is colour stable and includes a UV resistant, self-cleaning surface. This means that normal rainfall helps to keep the surface free of dust and dirt while at the same time retaining its original colour during the weathering process.

01233 501 504
www.structura-uk.com/kalwall

Added protection where needed from Crittall



Crittall's Corporate MW40 steel windows can be specified where superior air, wind or water resistance and greater sound attenuation are required. Offering the same high-quality appearance as the company's successful Corporate W20 range the MW40 variant can accept glass up to twice the thickness as its stable mate. Either double, or triple glazing up to 32mm thick can be installed with a consequent higher level of thermal or sound insulation. This is achieved while retaining the same slender steel profile for which Crittall products are renowned thereby ensuring maximum light ingress.

01376 530800 www.crittall-windows.co.uk

Squid self-adhesive window fabric

Already causing a stir with interior designers and architects, the innovative Squid window fabric retains privacy and lets in natural light. The moisture resistant woven fabric is available in six colours, providing endless glass design possibilities. The breathable fabric can even deflect between 25 to 36 per cent of the sun's energy, reducing the solar heat gain during summer months. Marketing Manager of **Architextural**, Lindsay Appleton, said: "Squid represents a unique textile window solution as an alternative to traditional PVC or polyester window films."

www.architextural.co.uk

Clear cut facades

As glass is increasingly being used to breathe new life into old architectural buildings Simon Boocock, MD of CRL Europe, looks at the benefits of the material and some of the systems available to aid installation and maintenance

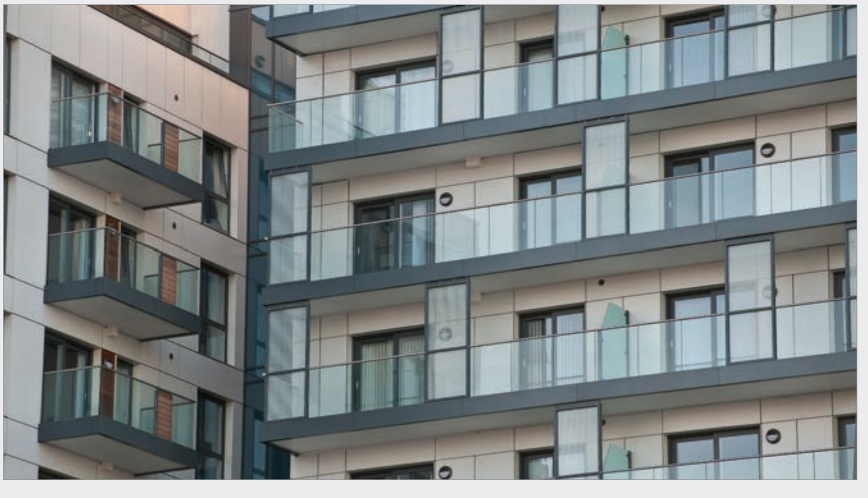
What do the Shard, the Gherkin and the skyscrapers of Canary Wharf have in common? Aside from being some of London's most iconic buildings, they are also all clad in glass. The reasons for using glass as part of the external structure of such architecture are numerous. From an aesthetic viewpoint, few materials can compete with glass in creating a high-end, minimal look. From a practical stance too, glass offers many advantages. It is a versatile solution that provides all-weather protection which is all-important with the UK's notoriously inclement climate.

All of these benefits make glass not only suitable for cladding new buildings, but for protecting old architecture too and, thanks to new installation methods, glass is increasingly being used to regenerate buildings, preserving the original materials while allowing the beauty of the building to shine through.

The CRL Langle Al-Wall® system is ideal to regenerate an existing building, creating a modern impression with a highly durable and long-lasting finish

In modern architecture, the glass curtain wall is typically thin and framed with aluminium or steel, which is mounted on the external structure of a building, providing protection against air, water and wind. Providing a safe installation method, a clip system, such as that seen on the CRL Langle Al-Wall® joins individual glass panels and securely fixes them in place, completely eradicating the need for glass cut-outs which can often require a lengthy, costly and detailed installation process. Importantly, good ventilation of the building is also achieved, ensuring that it is safe for occupants.

For much the same reasons, glass is also increasingly being chosen for exterior balconies and balustrades to improve the aesthetics of the building itself and increase the occupant's outdoor view.



TAPER-LOC® frameless glass balustrade system from CRL can be installed from the 'safe-side' of the balustrade, avoiding the need for time-consuming and expensive scaffolding

Systems that need to be fitted from the outside typically require scaffolding, which can add to the time and expense of a project, and are overall much trickier to install than systems that can be fitted from an internal position. Posing similar issues, traditional wet fit balcony systems need to be held securely in place, usually with cement, to ensure a tight fit, which can be messy too, particularly when fitting the balcony retrospectively on to a building or when changing a broken glass panel. A dry-glazed railing system, such as that from CRL, is a hassle-free alternative to working with cement and scaffolding as it can be installed from the safe side of the balcony or balustrade, cuts installation times and provides safety and security for all. For more details email crl@crlaurence.co.uk

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