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The Minimal Wall: Full-Scale Testing and Structural Evaluation of Enhanced Glass-Aluminium Composite Façade

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Abstract

Innovation in façade design and material efficiency is essential to meeting stringent sustainability targets and reducing the embodied carbon of building envelopes. This study presents full-scale structural testing of unitised façade panels incorporating advanced glass–aluminium bonding technology, in which adhesive connections are utilised to enhance flexural stiffness. Tests conducted under controlled laboratory conditions demonstrate that the system enables structural optimisation while satisfying serviceability and strength criteria, allowing up to a 15% reduction in aluminium framing without compromising performance or service life. In addition, the technology enhances transparency by reducing frame depth, thereby improving daylighting and increasing usable floor area. When combined with appropriate design detailing, it also accommodates glass replacement and allows recycling, minimising non-reusable waste.

Keywords

Facades, Structural Sealant Glazing, Composite Structural Behaviour, Material Optimisation, Sustainability

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1. Introduction

Structural silicone glazing (SSG) is a well-established bonding technology that has been implemented in the building façade industry for nearly six decades. Since its introduction in 1965, SSG has gained significant popularity due to its clean and seamless aesthetic appearance (Alcaine, 2024), particularly among architects, contributing to a transformation of the contemporary architectural design and the visual character of modern cities (Ma, 2010).

Supported by the development and adoption of numerous regional and country-specific regulations and codes of practice, such as (EOTA, 2018) in Europe and (ASTM, 2022) in the United States, SSG has proven to be a durable and structurally reliable bonding technology (Vandereecken, 2014). As a result, it has increasingly been used as an alternative to traditional glass retention systems, such as captured glazing.

However, in a world where achieving carbon reduction targets and conserving resources are becoming increasingly critical, greater innovation in the building sector is essential to meet these goals (Blandini, 2022). In this context, challenging conventional practices, using powerful computational tools and exploring new materials, including those adopted from other industries, have become necessary to improve existing products and technologies.

In this framework, the "Minimal Wall" concept firstly presented in (Chen, 2026) aims to overcome the traditional structural hierarchy of SSG unitised curtain wall modules and improve material efficiency. The approach considers the partial composite behaviour enabled by adhesive connections and further enhances shear transfer between glass and metal through the local application of a secondary polyurethane adhesive at the unit corners.

Previous studies have already demonstrated that glass panels linearly bonded to profiles using high-strength adhesives can achieve composite action under flexural loads resulting in reductions in terms of deflection and exhibit significant post-fracture strength. (Nhamoinesu, 2014) and (Pascual C. N., 2019), for example, investigated steel-glass composite assembly subjected to out-of-plane loads. These units consisted of two glass panes with rectangular steel profiles positioned either along their longitudinal edges or along both their longitudinal and transverse edges. Similarly, (Pascual C. M., 2016) (Gargallo, 2021) tested composite sandwich panels composed of glass face sheets adhesively bonded to a centred core profile made of glass fibre-reinforced polymer (GFRP).

The present study builds on the work initiated in (Trifonov, 2024) and on the findings of previous extensive experimental campaigns (Galvez, 2025), by carrying out large-scale mock-up testing to validate the concept on full-scale unitised modules, thereby paving the way for the future implementation of this technology in real projects.

As illustrated in Figure 1, the proposed "Minimal Wall" concept introduces a secondary adhesive applied locally at the corners of the units. The location of this second, more rigid adhesive is selected based on the expected peak shear stresses in a conventionally supported unit subjected to out-of-plane loading. Therefore, the SSG unit remains predominantly bonded using conventional structural silicone. The polyurethane adhesive is intended solely for structural optimisation at the serviceability limit state (SLS), which is typically the governing condition for the sizing of framing members. On the other side, the safety concept of the façade system at the ultimate limit state (ULS) can be maintained in line with current systems and their traditional level of conservatism.

Fig. 1: Typical unit configuration with the Minimal Wall concept.

2. Experimental test

To complete the validation of the concept, experimental testing and complementary finite element method (FEM) studies were conducted on a full-scale mock-up. The present paper focuses exclusively on the experimental campaign, while the results of the FEM modelling performed on the same units will be presented in future publications.

The objective of the testing programme was to validate the proposed concept by evaluating its performance and reliability, and by identifying any unacceptable behaviour during full-scale testing of unitised façade modules. The experimental data will also be used to compare with numerically derived results and to support the validation of the finite element models.

The overall test configuration consisted of six structurally glazed units. The unit dimensions were selected to represent typical sizes and typologies commonly implemented in contemporary façade projects. Units 1, 2, 3 and 4 were manufactured according to the Minimal Wall concept, which adopts a dual-sealant strategy incorporating a stiffer sealant at the corners of the insulated glass units. In contrast, Units 5 and 6 were manufactured using a conventional configuration in which the glass was bonded to the aluminium frame with standard structural silicone.

The four units incorporating the new concept also represented different sizes and configurations. The upper units consisted of full-height glazed panels, while the lower units incorporated, respectively, a spandrel panel and an openable element. In addition, different glass build-ups were implemented to assess their influence on the overall rigidity of the assembly.

2.1. Description of the mock-up

A detailed drawing of the tested mock-up is provided in Figure 2. The overall dimensions of the mock-up are 4.2 m × 7.5 m, corresponding to a total area of 31.5 m².

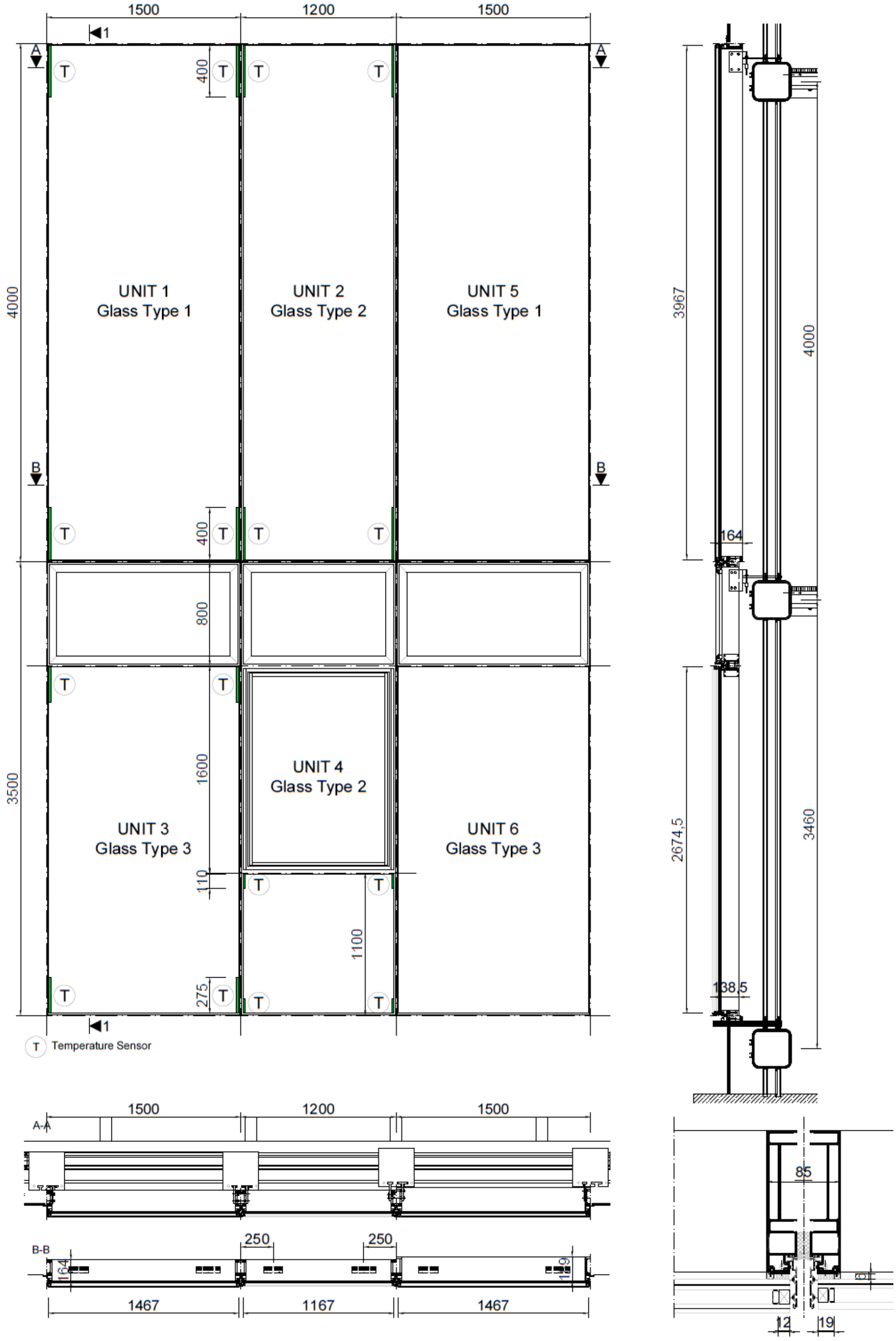


Fig. 2: Representation of the test mock-up.

All the units were top-hung using a standard Schüco aluminium bracket system, previously tested and certified (Schüco). At the horizontal stack joint, two interlocking EN AW 6005–T6 aluminium coupling pieces per unit, each positioned 250 mm from the mullion centres, were fixed to the transoms to provide out-of-plane restraint of the upper unit. The units were installed to allow in-plane movement on one side, while being restrained on the opposite side.

All units were assembled using the Schüco unitised AF UDC 80 SG framing system (Schüco). An anodised E6/C0 aluminium adapter profile was mechanically fixed to the main framing with countersunk screws at a maximum spacing of 200 mm. All aluminium profiles were manufactured from EN AW 6060-T66 alloy. The anodised adapter profile provides the bonding surface for the structural sealant. The perimeter structural sealant joint has dimensions of 19 mm in width and 6 mm in thickness.

The structural sealant used for all units was the silicone Sikasil® SG-500. However, in Units 1, 2, 3 and 4, at the edges of the vision glass, the structural silicone was replaced with the polyurethane adhesive SikaForce®-930 L15. The compatibility between the two sealants has previously been demonstrated (Galvez, 2025). Units 1 and 2 have a total length of polyurethane adhesive of 400mm at each end of the mullions, while unit 3 and unit 4 have a length of polyurethane adhesive equal to 275mm and 110mm, respectively, at each corner of the vision glass panel.

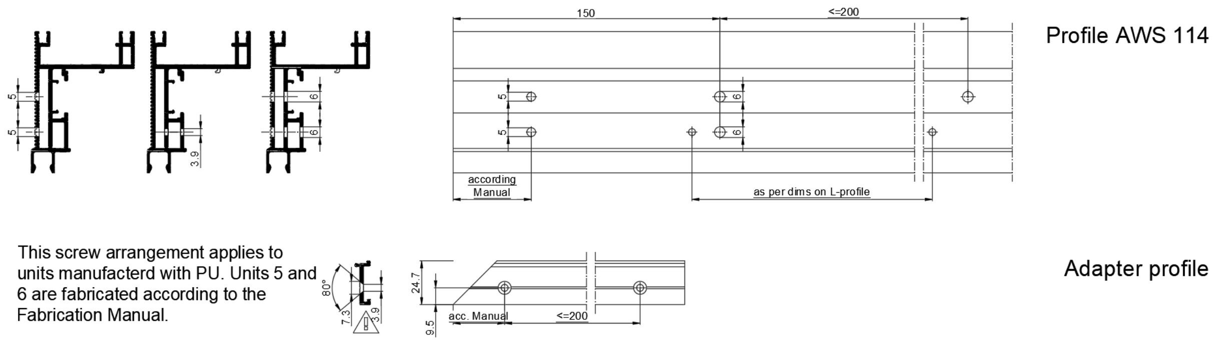
During the fabrication of the units, temperature sensors were installed on the lateral surface of the polyurethane sealant, within the cavity between the sealant and the perimetral plastic profile. These sensors were used to record the surface temperature of the polyurethane bite during the controlled heating process with halogen lamps.

As the objective of the testing was to independently measure the out-of-plane deflection of the mullions for each individual unit, no coupling pieces or coupling gaskets were installed vertically at the junctions between adjacent units. Instead, a single taped foam strip and a weather silicone seal were applied to achieve the required internal chamber pressure during the wind resistance testing. Furthermore, the mullion depth was optimised for each unit. A summary of the framing profiles used for each unit is provided in Table 1.

Table 1: List of selected framing elements.

Unit nr.	Art. Number	Profile depth [mm]	Profile inertia I_X [cm^4]
1	524010	164	335.88
2	524010	164	335.88
3	524000	139	213.53
4	524000	139	213.53
5	524020	189	502.79
6	524010	164	335.88

In Unit 4, as previously discussed, a window was incorporated. In this case, the additional stiffness typically provided by the bonded glass was instead provided by the outer frame of the window system, which was mechanically fixed to the main framing with screws at a maximum spacing of 200 mm. For the test, an outer frame of the Schüco AWS 114 system was used. To ensure a realistic distribution of the wind load, an 18 mm plywood board was mechanically fixed and sealed around the outer frame. In this test, a complete window assembly was not installed, only the outer frame was used.



This screw arrangement applies to units manufacterd with PU. Units 5 and 6 are fabricated according to the Fabrication Manual.

Fig. 3: Spacing of the mechanical fasteners in window outer AWS 114 profile and unitised adapter profile.

The glass specifications used for the different units are presented in Table 2. All insulated glass units were manufactured with a 12 mm bite of Dow Corning® 3363 secondary sealant. All glass plies were supplied with seamed edges.

Table 2: List of glass specification for unit

Unit nr.	Insulated glass type	Glass size [mm]	Outer ply	Intermediate ply	Inner ply
1	DGU[1]	1467 x 3967	6mm HS[3] glass 0.76mm Trosifol® Extra Stiff B230 6mm HS[3] glass	-	5mm HS[3] glass 0.76mm Trosifol® Extra Stiff B230 5mm HS[3] glass
2	DGU[1]	1167 x 3967	8mm FT HST[4] glass	-	5mm HS[3] glass 0.76mm Eastman Saflex® RB41 PVB 5mm HS[3] glass
3	TGU[2]	1467 x 2675	8mm FT HST[4] glass	6mm HS[3] glass	5mm HS[3] glass 0.76mm Eastman Saflex® RB41 PVB 5mm HS[3] glass
4	DGU[1]	1167 x 1075	8mm FT HST[4] glass	-	5mm HS[3] glass 0.76mm Eastman Saflex® RB41 PVB 5mm HS[3] glass
5	DGU[1]	1467 x 3967	6mm HS[3] glass 0.76mm Trosifol® Extra Stiff B230 6mm HS[3] glass	-	5mm HS[3] glass 0.76mm Trosifol® Extra Stiff B230 5mm HS[3] glass
6	TGU[2]	1467 x 2675	8mm FT HST[4] glass	6mm HS[3] glass	5mm HS[3] glass 0.76mm Eastman Saflex® RB41 PVB 5mm HS[3] glass

[1] Double Glazing Units; [2] Triple Glazing Units; [3] Heat-strengthened; [4] Fully toughened – Heat soaked tested

The mock-up was sealed around its perimeter with an EPDM membrane, loosely fixed on one side to the adjacent unit profile and on the other side to the perimetral plywood. This allows the unit to move independently from the perimeter while still ensuring tightness of the mock-up.

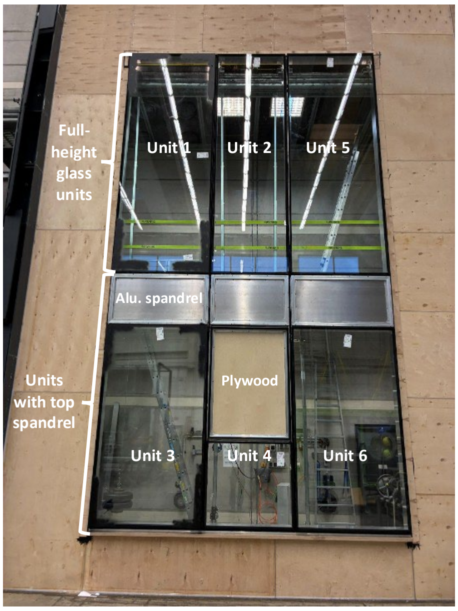


Fig. 4: Test mock-up after installation.

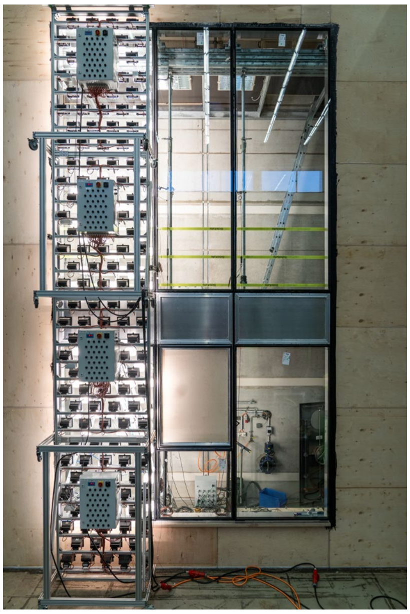


Fig. 5: Test mock-up with heating panels.

2.2. Description of testing method

Since the objective of the testing programme was to validate the proposed concept and the units were manufactured using a façade system that has already been extensively tested and certified for full façade performance, the experimental campaign focused primarily on structural performance. Consequently, watertightness and air permeability tests, which are typically included in façade performance assessments, were not conducted.

The testing programme, therefore, concentrated on wind resistance and impact testing, following the regime described in Table 3.

Table 3: Testing sequence.

Item nr.	Test	Standard
1	Resistance to wind load – positive design pressure +2.5kPa at room temperature	DIN EN 12179:2000-09
2	Resistance to wind load – negative design pressure -2.5kPa at room temperature	DIN EN 12179:2000-09
3	Resistance to wind load – positive design pressure +2.5kPa at 37°C avg. sealant temperature	DIN EN 12179:2000-09
4	Resistance to wind load – negative design pressure -2.5kPa at 37°C avg. sealant temperature	DIN EN 12179:2000-09
5	Resistance to wind load – positive increased safety pressure +3.75kPa at room temperature	DIN EN 12179:2000-09
6	Resistance to wind load – negative increased safety pressure -3.75kPa at room temperature	DIN EN 12179:2000-09
7	Internal impact test – Pendulum	DIN EN 14019:2016-11

All tests were carried out at the OneLab Technology Center in Bielefeld using the Profi 5000-800/3000-2W measurement and supply unit technology from ift MessTec GmbH, together with sixteen

DK100PR5 Magnescale displacement sensors with a measuring range of 100mm. Temperature sensors RS PRO RS181/0816 Series Type T Thermocouple were also installed on the surface of the sealant to monitor the variation of surface temperature during the heated test conditions.

The wind resistance test was first carried out in accordance with the procedure described in DIN EN 12179. A design wind load of ±2.5 kPa was applied, with the chamber maintained at 20°C and 30% relative humidity. The test sequence began with the application of a positive pressure to the mock-up. Frontal displacement measurements were first recorded at 900Pa, after which the pressure was increased incrementally in 200Pa steps up to the maximum pressure of 2500Pa. In accordance with the standard requirements, each pressure stage was maintained for a minimum duration of 15s ± 5s. After unloading, the permanent deformation of the system was assessed. The same procedure was subsequently repeated under negative pressure.

The displacement of each mullion was monitored using three displacement sensors equally spaced along the mullion and positioned at the relatively same locations for both the upper and lower units. For the units incorporating polyurethane sealant, the out-of-plane displacement of both mullions was measured. Due to the limited space between the two mullions of adjacent units, the tests were repeated twice in order to properly measure the displacement on both sides of the unit. For the units with structural silicone applied along the entire perimeter, only the mullion on one side of the unit was instrumented to measure the out-of-plane displacement.

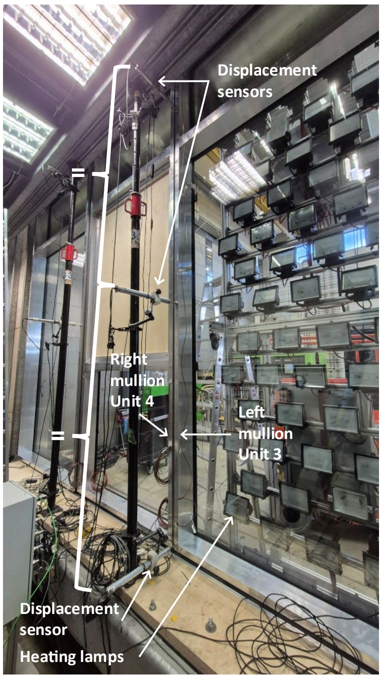


Fig. 6: Internal view of the test mock-up.

The wind resistance test was subsequently repeated to evaluate the variation in displacement measurements at an elevated sealant surface temperature of approximately 37°C. This condition was considered relevant to the study based on the findings of the material characterisation presented in (Galvez, 2025) showing a variable elastic modulus. The target temperature was identified as the expected temperature of the sealant, derived from thermal calculations performed using Flixo Pro 8.2.1178.1. The calculations was carried-out for a worst-case summer scenario for a typical European location, with a maximum external air temperature of 40°C and a solar irradiation of 1200 W/m².

To increase the temperature of the façade elements, four heating panels, each consisting of 36 halogen lamps stacked vertically, were installed in front of the mock-up (Figure 5). Once the installed temperature sensors indicated an average sealant surface temperature of 37°C, the wind resistance test was performed while maintaining the heating lamps in operation for the entire duration of the test. As the four heating panels were sufficient to cover only two units at a time, the heating and testing procedure had to be repeated twice in order to investigate the temperature effect on all four units assembled using the polyurethane adhesive.

In addition to the design load test, an increased load test was carried out. In line with DIN EN 12179, the mock-up was subjected to a positive pressure followed by a negative pressure of 3750Pa, corresponding to 150% of the design wind load, which was maintained for 15s ± 5s in each case.

Finally, a pendulum impact test was performed in accordance with DIN EN 14019:2016. The impact was applied from the interior side with a drop height of 950mm, and several impact locations were tested as specified in Figure 7.

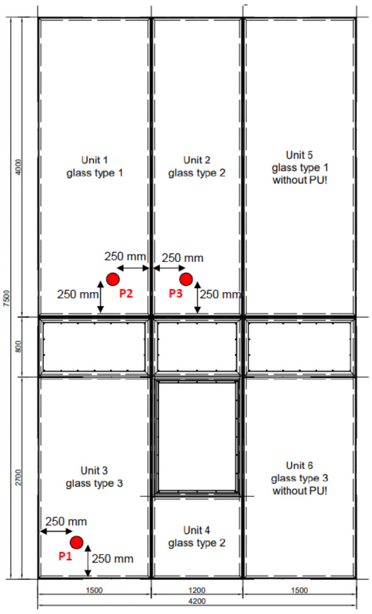


Fig. 7: Location of the impact test.

2.3. Summary of test results

The following graphs present the progressive mid-span out-of-plane deflection of the analysed unit as the applied pressure increased up to the design pressure of 2.5 kPa recorded during the resistance to wind load testing. The graphs refer to negative pressure. However, similar results were obtained under positive pressure. For Units 1 to 4 (Figure 8, Figure 9, Figure 10 and Figure 11), fabricated with polyurethane sealant at the corners, the reported deflection values represent the average of the left and right mullions of the respective unit. For Units 5 and 6 (Figure 12 and Figure 13), the deflection results refer only to the rigth mullion (from inside).

In accordance with (CEN, 2024), the mid-span out-of-plane deflection of each mullion was determined by post-processing the displacement sensor measurements. The deflection was calculated as the maximum frontal displacement measured along the member minus half of the sum of the frontal displacements measured at each end of the member.

In each graph, the grey line represents, for comparison, the expected deflection obtained by designing the same unit with the same mullion size while neglecting any partial composite action between the glass and the aluminium. In this case, it is assumed that the design load is applied directly to the framing only. This represents the standard and still widely used design approach for structurally glazed (SG) unitised façades.

The results clearly show that units built according to the Minimal Wall concept can reduce mullion deflection by more than 50% under the same applied pressure when tested at room temperature. When the tests were performed with an average sealant surface temperature of approximately 37 °C, the reduction ranged between 46% and 51%. This behaviour can be attributed to the combined effects of temperature on the stiffness of both the SikaForce®-930 L15 adhesive (Galvez, 2025) and the glass interlayer, whose elastic modulus properties are known to decrease with increasing temperature.

Moreover, it can be observed that as the height of the units decreases, the difference between the results obtained at room temperature and those obtained at elevated temperature also decreases. An opposite behaviour, however, was observed for Unit 4. Although the influence of temperature on the sealant is expected to be negligible in this case due to the very limited quantity of sealant present, the reason for the lower out-of-plane deflection measured at the higher temperature remains unclear.

The results for the units with only structural silicone Sikasil® SG-500 are shown only for room temperature since in this case no increased temperature test was carried-out.

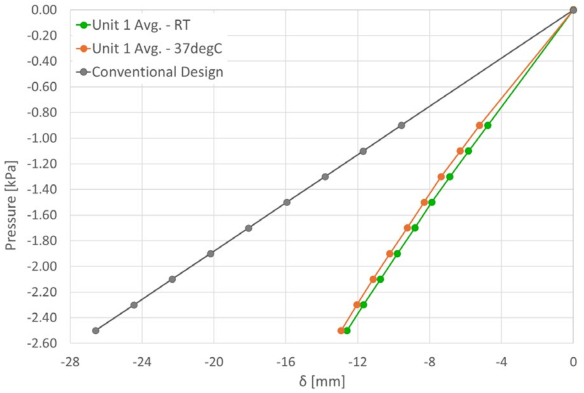


Fig. 8: Comparison of pressure (negative) - deflection behaviour of Unit 1 against conventional design.

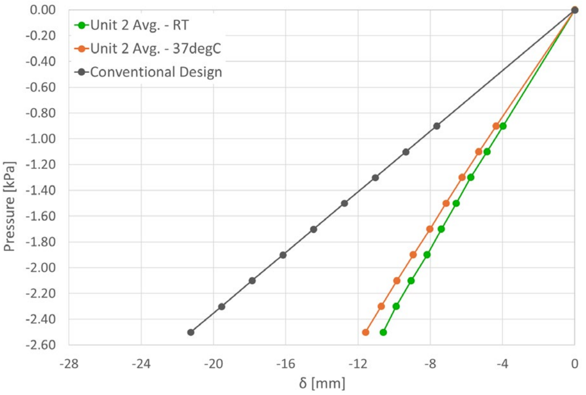


Fig. 9: Comparison of pressure (negative) - deflection behaviour of Unit 2 against conventional design.

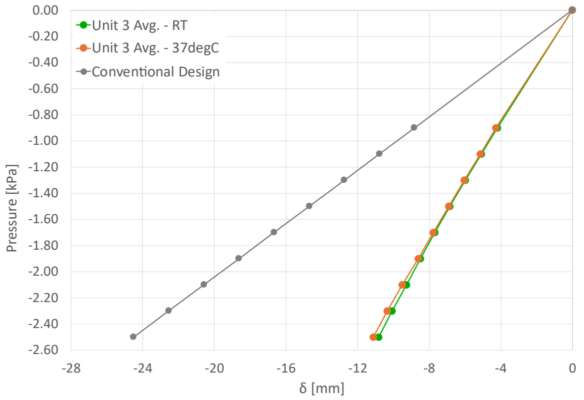


Fig. 10: Comparison of pressure (negative) - deflection behaviour of Unit 3 against conventional design.

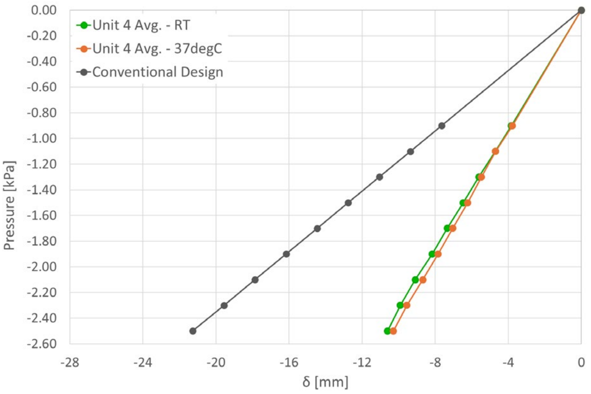


Fig. 11: Comparison of pressure (negative) - deflection behaviour of Unit 4 against conventional design

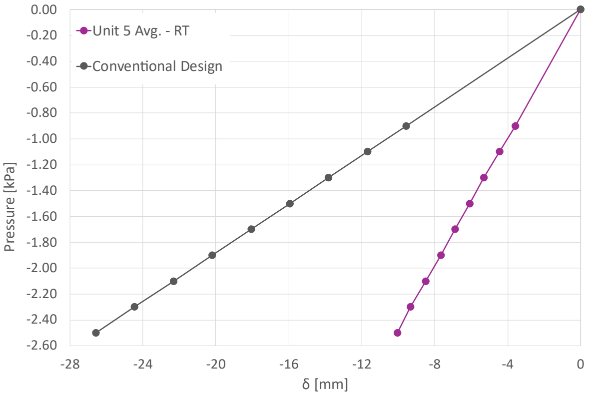


Fig. 12: Comparison of pressure (negative) - deflection behaviour of Unit 5 against conventional design.

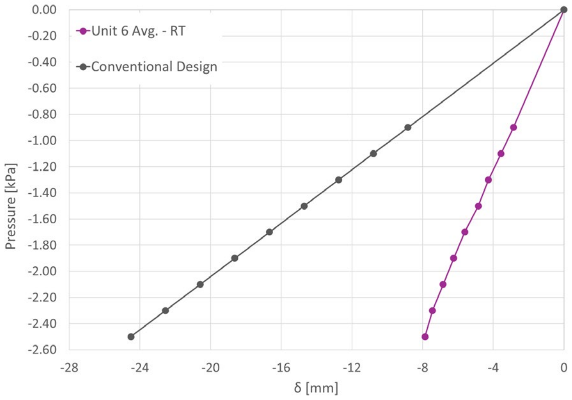


Fig. 13: Comparison of pressure (negative) - deflection behaviour of Unit 6 against conventional design.

In addition to the results presented above, a comparison between the deflection of units constructed with SikaForce®-930 L15 adhesive and equivalent units with Sikasil® SG-500 applied along the entire perimeter is shown in Figure 14 and Figure 15. Units 1 and 5, and Units 3 and 6, were manufactured with the same layout, dimensions, and glass build-up. However, different mullion depths were adopted to ensure the successful completion of the wind resistance tests.

In the following graphs, the results are presented as the variation of the product of deflection and mullion inertia (deflection × inertia) with applied pressure. This parameter provides a clearer indication of the relative rigidity of the assemblies.

When comparing the equivalent units at room temperature, it is evident that the Minimal Wall concept provides an increase in assembly rigidity of up to 20% for Unit 1 at the design wind load of 2.5 kPa. Unit 3 shows a maximum increase in stiffness of 16% compared to Unit 6.

Moreover, during the wind resistance tests at the design wind load, no damage or functional defects were observed.

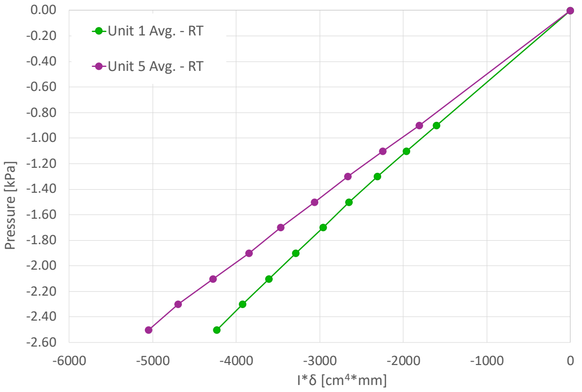


Fig. 14: Comparison of pressure (negative) - deflection × inertia trend of Unit 1 against Unit 5.

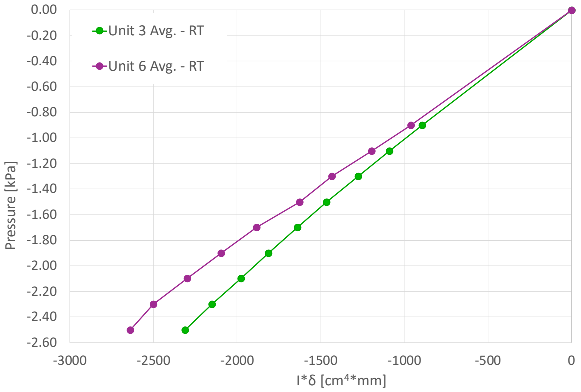


Fig. 15: Comparison of pressure (negative) - deflection × inertia trend of Unit 3 against Unit 6.

The complete testing mock-up successfully met the standard requirements for wind load resistance at the increased safety pressure of +3.75 kPa. No permanent damage was observed in the framing, glazing, or brackets; all glass panels remained securely attached and the sealants showed no visible cracks or signs of deformation. However, furthermore detailed inspection of the polyurethane sealant was carried-out after dismantling.

Also impact test was successfully passed by the test mock-up with no visible damages on glass, framing or sealant for all the three locations tested.

3. Deglazing and inspection

After completion of the experimental campaign, three units were dismantled and deglazed. A comprehensive inspection was performed on all components of the system, including the glass pane, the aluminium frame, and the adhesive materials used in the assembly: the structural silicone Sikasil® SG-500 and the polyurethane adhesive SikaForce®-930 L15.

The objective of this inspection was to evaluate the condition of the system components after testing and to assess the interaction between materials following exposure to conditions representative of real-life service.

Procedure:

a. Visual inspection of the external parts of the units

A visual examination of the external parts of each unit was conducted after the completion of the tests. No failure or damage to the adhesive materials was observed. All units successfully withstood both the testing procedures and the installation and dismantling processes, without exhibiting any visible signs of wear, degradation, or structural failure.

No cracks or other visible damage were detected in the glass panes following the completion of the tests (Figure 16). The combined use of the structural silicone Sikasil® SG-500 and the polyurethane adhesive SikaForce®-930 L15 effectively accommodated the differential shear displacements between the glass and the aluminium frame. This behaviour prevented the development of additional stress concentrations in the glass, indicating that the adhesive system provided adequate deformation capacity and stress redistribution under the tested conditions.

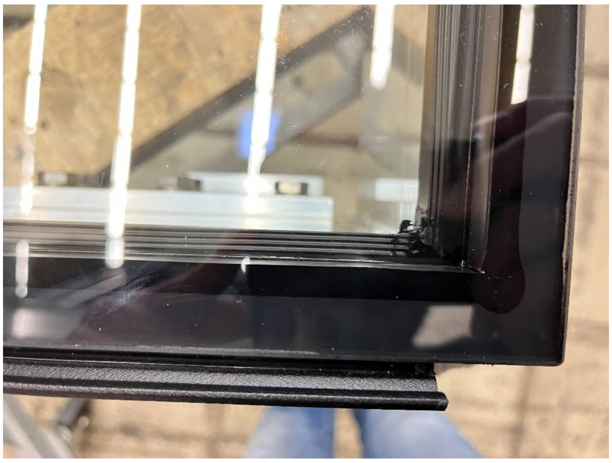


Fig. 16: Detail of one of the units corner.

No evidence of chemical interaction between the polyurethane adhesive SikaForce®-930 L15 and the structural silicone Sikasil® SG-500 was observed during the visual inspection (Figure 17). Both materials maintained their original appearance and integrity, with no visible signs of discoloration, degradation, or incompatibility at the interface:

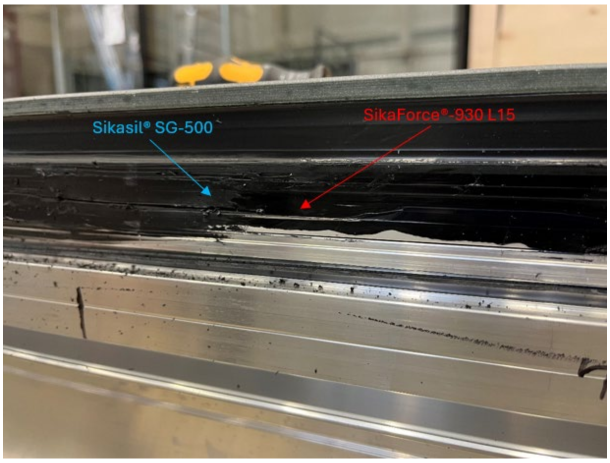


Fig. 17: Detail of one of the units showing the connection between the SikaForce®-930 L15 and the Sikasil® SG-500.

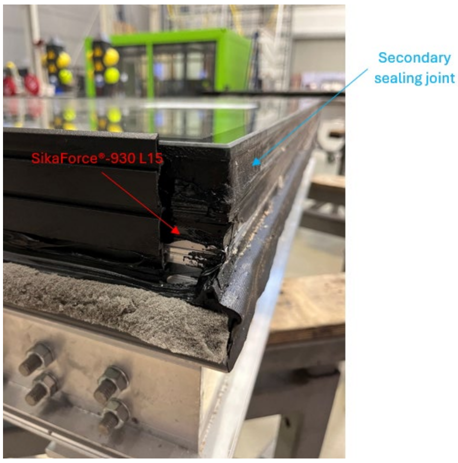


Fig. 18: Detail of one of the units showing the SikaForce®-930 L15 joint located at the corner.

b. Deglazing

The units were deglazed using an oscillating electrical multi-cutter, specifically the Fein MM 500 PLUS TOP. Oscillating multi-tools allow precise cutting in confined interfaces due to their small oscillation angle and controlled motion, which enables the separation of bonded components without inducing significant additional stress in adjacent materials. Both the polyurethane adhesive SikaForce®-930 L15 and the structural silicone Sikasil® SG-500 were successfully cut using the same tool and blade configuration (Figure 19). The cutting process allowed the glass panes to be separated from the aluminium frame without damaging the surrounding components, enabling subsequent inspection of the adhesive layers and bonding interfaces.

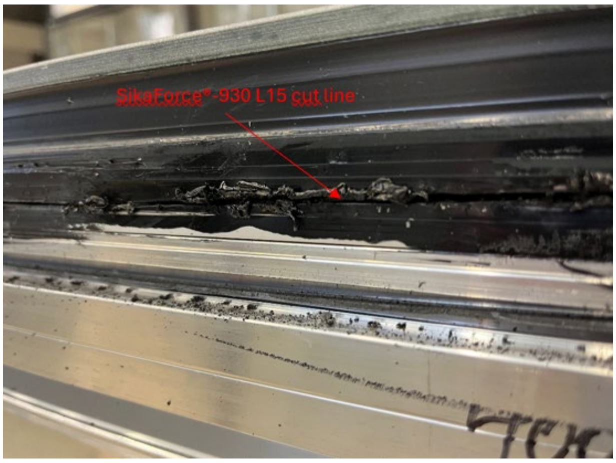


Fig. 19: SikaForce®-930 L15 cut line.

Once the adhesive joints along the entire perimeter had been cut, the glass panes were separated from the aluminium frame using suction cups (Figure 20). This method allowed the controlled removal of the glass elements without introducing additional mechanical stresses or causing damage to the glass, frame, or remaining adhesive layers.

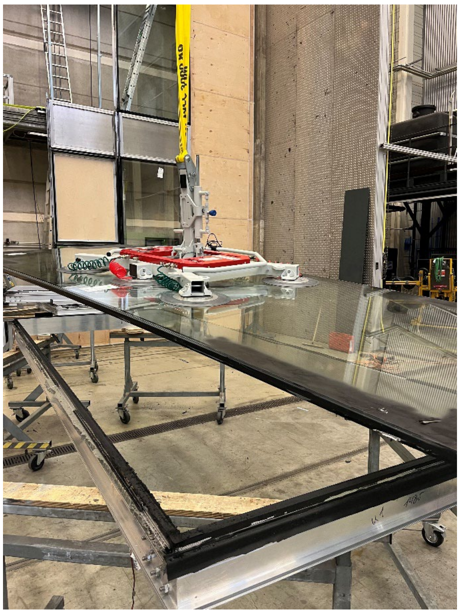


Fig. 20: Suction cups used to remove the glass pane from the aluminium frame.

c. Visual inspection of adhesive joints after deglazing

The joints made with the structural silicone Sikasil® SG-500 were sectioned by performing bead adhesion tests according to Sika internal Corporate Quality Procedure (CQP033-3 – Bead adhesion test for Industry silicones) using a manual cutter. . The bead is held with one hand and pulled away from the surface so maximum tension is maintained manually. Simultaneously a cut is placed every few millimeters at an angle of around 45°, ensuring that each cut goes completely through the bead to the substrate. This test is used to judge the adhesion of elastic sealants and adhesives in combination with specific surface treatments on various substrates when exposed to a peeling force. The cutting process resulted in pure cohesive failure within the silicone material (Figure 21), indicating that the adhesion to the substrates remained intact and that the failure occurred within the body of the sealant rather than at the interface with the bonded surfaces.

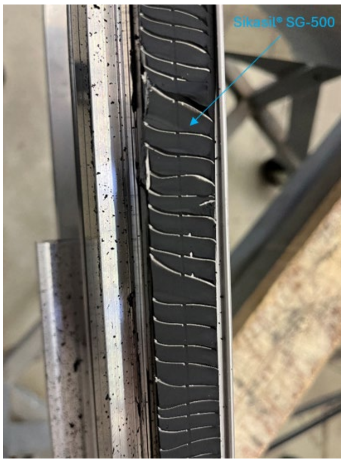


Fig. 21: Sikasil® SG-500 joints after bead adhesion tests showing purely cohesive failure.

With regard to the polyurethane adhesive SikaForce®-930 L15, its relatively high stiffness makes the application of standard bead adhesion tests, such as those performed for the structural silicone Sikasil® SG-500, not feasible. Consequently, the adhesive joints were sectioned using an oscillating electrical multi-cutter.

During the cutting process, the adhesive exhibited a very strong bond to both the glass and the aluminium frame, indicating robust adhesion to the substrates and no evidence of interfacial debonding at the glass–adhesive or aluminium–adhesive interfaces (Figure 22).

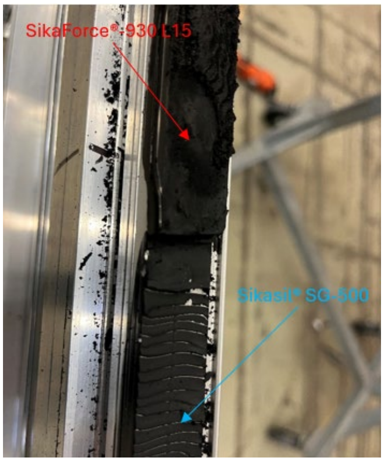


Fig. 22: SikaForce®-930 L15 and the Sikasil® SG-500 cut joints.

Proper application is a critical factor in the performance of the system. Application works on Minimal Wall projects should, therefore, be carried out by personnel with the appropriate training and experience.

During the inspection process, some application-related imperfections were identified (Figure 23). In some areas, the effective adhesive joints were smaller than the designed dimensions of 19 mm × 6 mm (bite × thickness). These deviations were attributed to installation variability during the bonding process.

Despite these localized discrepancies, all tested units successfully withstood the applied test conditions without exhibiting any signs of structural failure, indicating a certain level of robustness of the system even when minor application defects are present.

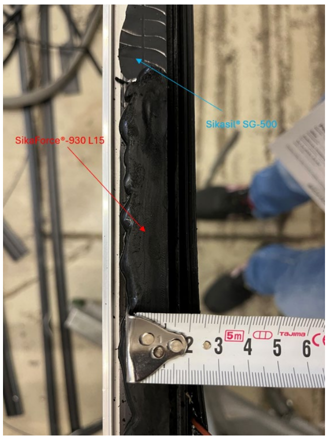


Fig. 23: SikaForce®-930 L15 and Sikasil® SG-500 smaller defective joints.

4. Conclusions

This study presented the experimental testing and results obtained from a large-scale mock-up developed to validate the Minimal Wall concept on full-scale unitised façade modules.

The results demonstrate that, in a context where sustainable construction is becoming an increasingly critical challenge, further advancements in the engineering of SSG façades, combined with the use of advanced computational tools, are essential to reduce material consumption. While increasing recycling rates remains important, it is becoming evident that this measure alone will not be sufficient to meet future sustainability targets, particularly in light of the growing global demand for construction materials.

The experimental results show that standard SSG units fabricated with structural silicone Sikasil® SG-500 perform significantly better in practice than predicted by simplified design calculations, exhibiting deflections more than 40% lower than those estimated computationally. Furthermore, by applying the proposed Minimal Wall concept and locally introducing the stiffer polyurethane adhesive SikaForce®-930 L15, the overall rigidity of the assembly can be further increased by up to 20%. This improvement opens new opportunities for material optimisation and more resource-efficient façade systems by reducing the aluminium frame required to achieve equal performance of current solutions.

During the experimental campaign, the mock-up was tested beyond the design wind load and under additional conditions including elevated temperature, increased wind pressure and impact loading, following a comprehensive and rigorous testing programme. The positive results obtained demonstrate the robustness and technical feasibility of the concept. These tests build upon previous experimental investigations aimed at characterising the mechanical behaviour of the polyurethane adhesive, including its performance under varying temperatures and fatigue cycles, as well as its compatibility with structural silicone. Together, these studies provide an important basis for ensuring the long-term durability, reliability, and safety of the assembled system and support the future implementation of this technology in real projects.

The development and validation of finite element models and associated design procedures will be necessary for successful implementation in practice. This work is already underway with the support of external expert engineers from SGS GmbH. The experimental data obtained in this study will be used to compare with numerically derived results and to support the validation of these models.

Looking ahead, façade systems incorporating this technology offer strong potential for large-scale office and commercial developments. By reducing façade depth, they can increase the available leasable floor area and, therefore, improve the rentable yield per floor for investors. At the same time, they enable design teams to achieve highly refined architectural aesthetics while supporting improved sustainability performance and innovative engineering solutions.

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