Challenging Glass Conference Proceedings – Volume 10 – June 2026 – Louter, Bos & Belis (Eds.)
International Conference on the Architectural and Structural Application of Glass
Challenging Glass Conference 10 – 15-17 June 2026 – TU Delft – The Netherlands

Vitroplena's Glass Quarters: Transparent by Design

Bert Van Lancker[a,b], Kenny Martens[a]

a Vitroplena, Belgium, bert.vanlancker@vitroplena.com
b Ghent University, Belgium, Bert.VanLancker@UGent.be

Abstract

Vitroplena has designed and engineered the *Glass Quarters*, its new headquarters dedicated to commercial operations and research in structural glass applications. The architectural concept is defined by a transparent, see-through volume enclosed by opaque side walls and roof elements, with fully glazed front and rear façades. The front façade consists of 6 m-high insulated glass units (IGUs) structurally bonded to 260 mm-deep glass fins. The rear façade employs a conventional aluminium curtain wall system with IGU infills. The interior features an open-plan office supported by all-glass structural frames composed of laminated glass beams and columns made from four plies of 12 mm thermally toughened glass combined with SentryGlas® interlayers. These two-span frames have a height of approximately 3.1 m and span a total length of almost 9 m. The space between the individual frames equals 3.85 m. These elements are extended to the outdoor environment with frames supporting a terrace that is accessible from the first floor. The design required the consideration of fracture and post-fracture limit states in addition to ultimate and serviceability limit state design to ensure robust structural performance. All glass components and connections were analysed using finite element modelling, accounting for the viscoelastic behaviour of interlayers, stability challenges associated with the slenderness of the members, and local stress concentrations near connection details. This paper presents the architectural vision, structural design philosophy, and installation methodology of the glass components used in the *Glass Quarters*. The project demonstrates the potential of structural glass as a primary load-bearing material in architecture.

Keywords

Vitroplena, Glass Quarters, glass, structural, adhesives

Article Information

- Digital Object Identifier (DOI): 10.47982/cgc.10.702
- Published by Challenging Glass, on behalf of the author(s), at Stichting OpenAccess.
- Published as part of the peer-reviewed Challenging Glass Conference Proceedings, Volume 10, June 2026, 10.47982/cgc.10
- Editors: Christian Louter, Freek Bos & Jan Belis

1. Introduction

Vitroplena is a design and engineering office specialised in classic and structural glass applications and adhesive connections. Established in 2018 as a Ghent University spin-off (Martens 2018, Van Lancker 2020), the company has since focused on advancing the engineering, design, and safe implementation of structural glass in contemporary architecture (Van Lancker and Martens, 2022; 2024). Vitroplena is involved in a broad range of projects, including façades, balustrades, and bespoke all-glass structural solutions. In parallel, the company collaborates closely with Ghent University on research activities. Vitroplena is also active in standardisation as chair of the Belgian mirror committee E250/SC11 for the forthcoming Eurocode on glass structures.

In 2023, plans were initiated for the construction of the new company headquarters—*the Vitroplena's Glass Quarters*—located near Roeselare, Belgium. The architectural concept, developed by local architect Steven De Jaeghere, envisioned a highly transparent, see-through volume measuring 18 m by 11.25 m with a height of 7.15 m. The design features a fully glazed front façade composed of 6 m-high insulated glass units (IGUs) supported by exterior glass fins with fixation inserts, while the rear façade adopts a more conventional aluminium curtain wall system with IGU infills.

The building integrates several structural glass components that collectively showcase the capabilities in structural glass engineering. At the heart of the building lies an open-plan office floor supported by all-glass structural frames made from laminated glass beams and columns. At the rear façade, a terrace accessible from the first floor is supported by all-glass frames as well. The interior structural glass features are extended to the outdoor environment as such. All structural glass features are intended to demonstrate the potential of glass as primary load-bearing material. The *Glass Quarters* were officially inaugurated in the spring of 2026. Fig. 1 provides an exterior view of the building's front façade during construction phase.

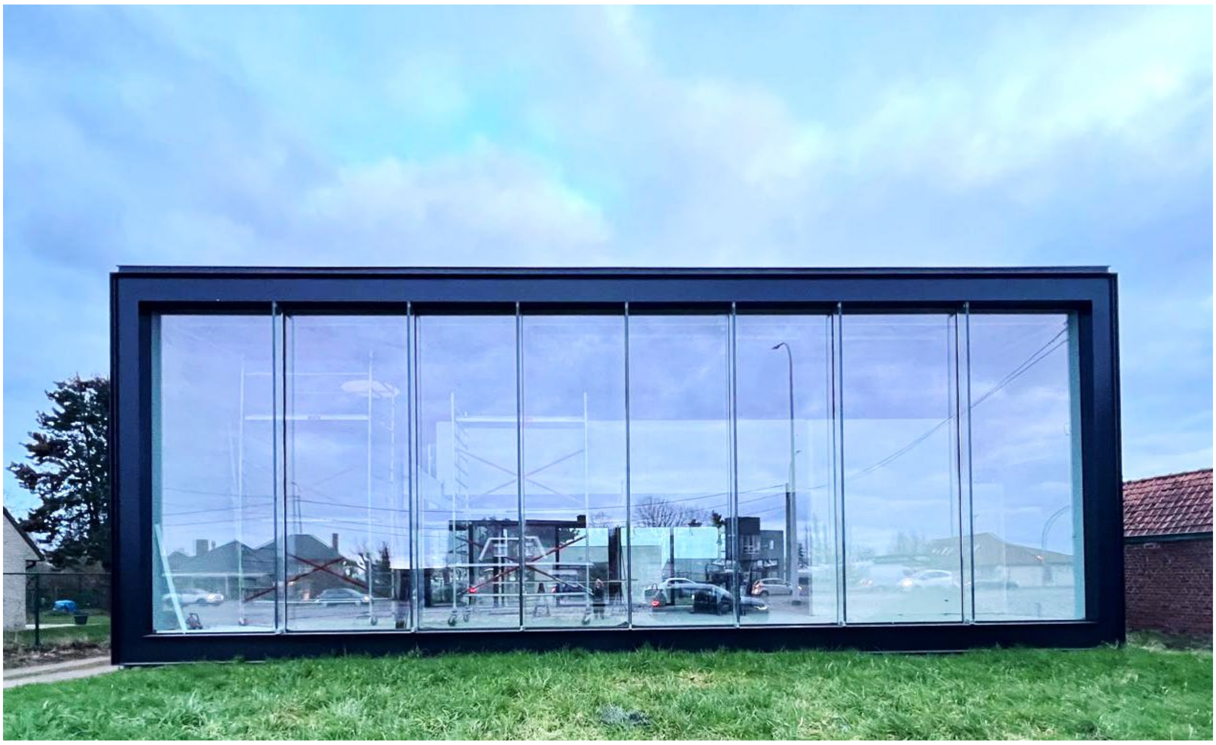


Fig. 1: Vitroplena's Glass Quarters.

This paper presents the architectural vision underlying the conceptual design and examines the challenges associated with using glass as a structural material throughout the project. The structural design philosophy is discussed with reference to the forthcoming Eurocode 10 for glass structures. Details of the construction process and the installation of the various glass components are also provided. As a whole, the project illustrates the potential of glass as a safe and reliable structural material in construction and serves as such as a demonstrator "in use".

2. Architectural design

2.1. Vision

The architectural vision for the *Glass Quarters* is grounded in the ambition to create a building that is transparent by design—both in its material expression and in the way it communicates the company's identity. The floor plan is deliberately trapezoidal, with a fully transparent front façade measuring 18 m in width and a narrower rear façade of 14.1 m. This geometry subtly directs the view inward: the broad glass front opens the building toward the street, while the tapering plan guides the perspective toward the interior. Although the front façade is entirely glazed, the rear façade is constructed as a traditional aluminium curtain wall with insulated glass infill panels. This intentional contrast interrupts the view through the building much like a picture tube or display window.

The architect conceived the building as a see-through box, a large transparent volume positioned alongside the road. The fully glazed front façade reveals the interior to passers-by, while the opaque side walls and the dark, slender steel I-beams that frame the volume give the building the recognisable outline of a viewing box. This composition transforms the building into a communicative object: it showcases what is possible when glass is used not only as a façade material but as a structural element, and it simultaneously reveals the mission and vision of Vitroplena within.

By maximising transparency and minimising visual obstructions, the design allows the building to function as a full-scale demonstration of structural glass engineering. The structural glass components therefore serve a dual purpose: they carry loads as part of the primary structure, and they embody the company's mission to push the boundaries of glass in construction. The building becomes both workspace and exhibition—an architectural statement that makes the engineering behind it visible.

2.2. Features

Realising the architectural vision resulted in the presence of several structural glass features in the construction as depicted in Fig. 2. The building without front and rear façade is a structural entity, equipped with a lateral stabilisation system (moment-resisting connections and braces in roof and side walls). The front and rear façades are non-load-bearing infills, except the exterior glass fins that support the front façade. The front façade is composed of 6 m-high and 1.8 m-wide insulated glass units (IGUs) with a 88.2(ANG,PVB)/15(Ar)/66.2(ANG,PVB) composition (i.e. annealed glass (ANG), standard polyvinylbutryal (PVB) interlayers, an Argon (Ar) filled cavity). Additional coatings ensure the optimal thermal, energetic, light and visual properties for optimal comfort inside the building. The front façade is supported by exterior glass fins with a depth of 260 mm made of 12121212.4(TTG,SG) laminates using thermally toughened glass (TTG) in combination with SentryGlas® (SG) interlayers. At the bottom and the top, the fins are mechanically connected to the steel framework using adhesively bonded metal inserts. The fins are structurally bonded to the IGUs using a structural silicone adhesive, providing four-sided, simply supported boundary conditions to the IGUs while maintaining the desired level of transparency. The rear façade, which incorporates the main entrance, adopts a more conventional construction approach: an aluminium curtain wall system by with insulated glass infills.

At the core of the building lies an open-plan office floor supported by all-glass structural frames, which form the flagship structural feature of the *Glass Quarters*. Each frame consists of beams and columns composed of 12121212.4(TTG,SG) laminated glass. The beams have a structural height of 500 mm, while the columns measure 400 mm in width. At the front façade, each beam is supported by a glass column and spans 5.47 m to the central column, after which it continues for another 3.28 m to the rear façade, where it is supported by steel shoes integrated into the façade structure. As the beams have to appear to extend through the rear façade into the outdoor environment, an additional set of glass beams—each spanning 2.23 m—is installed outside. These exterior beams are supported by steel shoes at the façade line and by glass columns connected to the steel framework at the back of the building. The interior glass frames carry the open-plan office floor, while the exterior frames support a terrace accessible from the first-floor office space. Visitors approaching the entrance walk through the exterior glass frames a, experiencing the structural capabilities of glass at firsthand, even before entering the building.

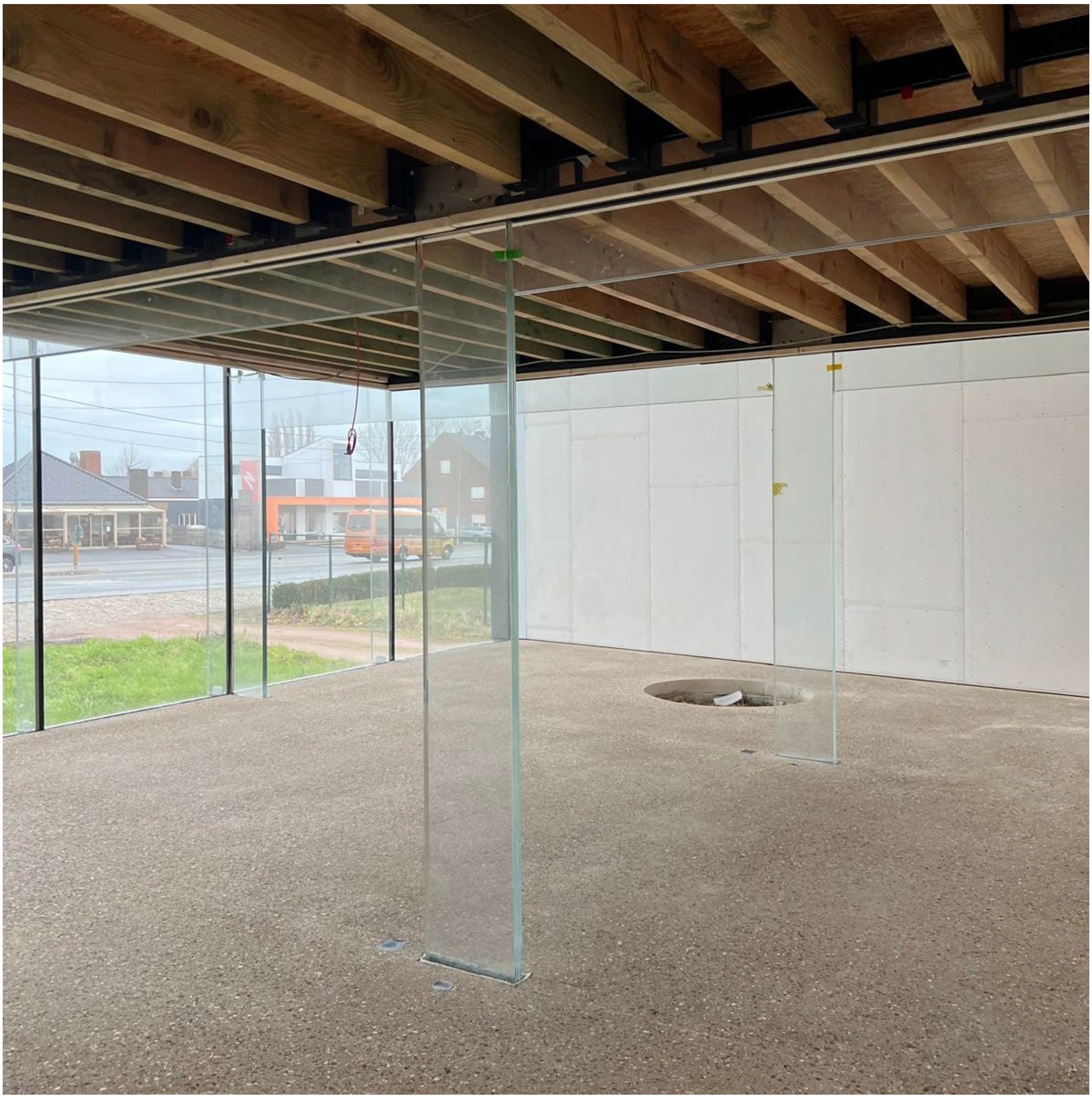


Fig. 2: Structural glass features in the *Glass Quarters*.

2.3. Challenges

The design and construction of the *Glass Quarters* involved several challenges arising from the combination of ambitious architectural intentions and demanding structural requirements:

- **Aesthetic requirements and optical quality:** as the building serves as a flagship for structural glass, aesthetics were critical. Production tolerances were minimised and optical quality maximised. Requirements for roller-wave distortions (bow), dimensional deviations (rectangularity), laminate alignment (shift or edge offset) and interlayer defects (shrinkage and delamination) were coordinated with the manufacturers and critically assessed. Strict quality control after production, after transportation to the construction site, and after installation were essential.
- **Material behaviour and structural modelling:** the inherent characteristics of materials and slenderness of structural elements introduce a certain design complexity. Glass is a brittle material without plastic deformation capacity, making not only ultimate and serviceability limit state calculations necessary, but also fracture limit state and post-fracture limit state assessments. A careful evaluation of local stress concentrations was required as well. As interlayers demonstrate viscoelastic material behaviour, time-and temperature dependent material models were implemented in finite element models to perform structural design calculations. Furthermore, glass beams and columns or fins are slender elements susceptible to structural stability issues such as buckling or lateral torsional buckling - phenomena to be considered as well.
- **Handling and installation of large-sized glass elements:** size and weight of the structural components in combination with the fragile nature of glass posed logistical challenges. Specialised equipment, such as vacuum lifters, were required for transporting, lifting and positioning 6 m long glass beams and fins and 6 m high by 1.8 m wide infill elements. Precise sequencing was required to avoid unnecessary actions and movements of the glass elements, and as such to minimise the risks of glass fracture during handling or installation. As many glass elements were installed early in the construction process of the *Glass Quarters*, protective measures during subsequent building phases were crucial (e.g. polishing the concrete floor, etc.).
- **On-site adhesive bonding:** several components required structural bonding on site, inherently sensitive to environmental conditions and inherently requiring adequate quality control. Temperature, humidity, surface preparation, curing time, etc. needed to be controlled throughout the entire bonding procedure. Rigorous protocols were elaborated and applied to ensure qualitative bonding. Quality control and regular inspection in the future need to ensure long-term durable structural performance.
- **Coordination between glass, steel and aluminium systems:** maximising transparency does not allow for conventional detailing and requires innovative connections. Fixings, clamps or other mechanical connections needed to be concealed or minimised without compromising structural performance. Steel and aluminium elements required precise alignment with glass tolerances. Coordinating and monitoring different contractors (specialised in different materials) was essential to preserve the architectural purity of the design.

3. Structural design

3.1. Design philosophy

The structural design of the *Glass Quarters* followed the fundamental principles of the Eurocodes complemented by the methodology introduced in EN 16612 (CEN 2019) and CEN/TS 19100 (CEN 2021).

The latter being the document on which the Eurocode on the design of glass structures, i.e. Eurocode 10, is based. The design comprises the verification of multiple limit states relevant to structures in general as described in EN 1990 (CEN 2002) and relevant to glass structures as specifically described in CEN/TS 19100 (CEN 2021):

- **Ultimate limit state (ULS)**: unfractured (intact) structural glass elements and their connections should possess sufficient strength to resist the acting load combinations without failure.
- **Serviceability limit state (SLS)**: deflections and vibrations of unfractured (intact) structural glass elements should be limited to maintain aesthetics, functionality and comfort.
- **Fracture limit state (FLS)**: safety during the event of fracture of a part or of the entire glass component is ensured under the action of a dynamic impact, together with static permanent and variable loadings during impact.
- **Post-fracture limit state (PFLS)**: safety after the event of fracture of a part or the entire glass component is ensured under the action of static permanent and variable loading likely to occur for the considered limited time period.

For the glass infill panels of the front and rear façade, a limit state scenario LSS-1 was selected in accordance with CEN/TS 19100 (CEN 2021). This implies verifications of the components in the ULS, SLS and FLS, but not considering PFLS. For the exterior glass fins supporting the front façade and the interior all-glass frames consisting of glass beams and columns, a limit state scenario LSS-3 was selected because of the primary load-bearing nature of the structural components and as such a higher consequence class. This implies verifications of all limit states, i.e. including a post-fracture limit state in which one or more glass components are considered to be broken, but still capable of transferring a certain amount of loads for a certain amount of time.

3.2. Front and rear façade

The rear façade (Fig. 3) was assessed using traditional calculation methods for curtain wall systems in accordance with EN 13810 (CEN 2015). More advanced analyses were required for the front façade (Fig. 3) due to the large dimensions and presence of structurally bonded glass fins. To achieve a realistic representation of the façade behaviour, the design incorporated:

- **Geometrically nonlinear calculations:** to consider large deflections and to capture second-order effects.
- **Viscoelastic modelling:** to account for time- and temperature dependent stiffness of the interlayers of laminated glass and structural silicone adhesive for structural joints.
- **Local stress evaluation:** to ensure structural performance of the adhesive joints between exterior fins and insulated glass infill panels.
- **Boundary condition verifications:** to assess the validity of the assumption of four-sided simply supported insulated glass infill panels.

As such, the gap between simplified design assumptions and actual structural response of the façade was reduced, resulting in a cost-effective glass design, maximised transparency and structural reliability in accordance with the Eurocode principles.

Fig. 3: Front and rear façade.

3.3. All-glass frames

The all-glass frames (Fig. 2) supporting the open-office floor and the exterior terrace were designed as a primary load-bearing structure, requiring a more comprehensive verification strategy including fracture and post-fracture limit state verifications. The design combined analytical calculations with detailed three-dimensional finite element modelling. Key aspects of the design included:

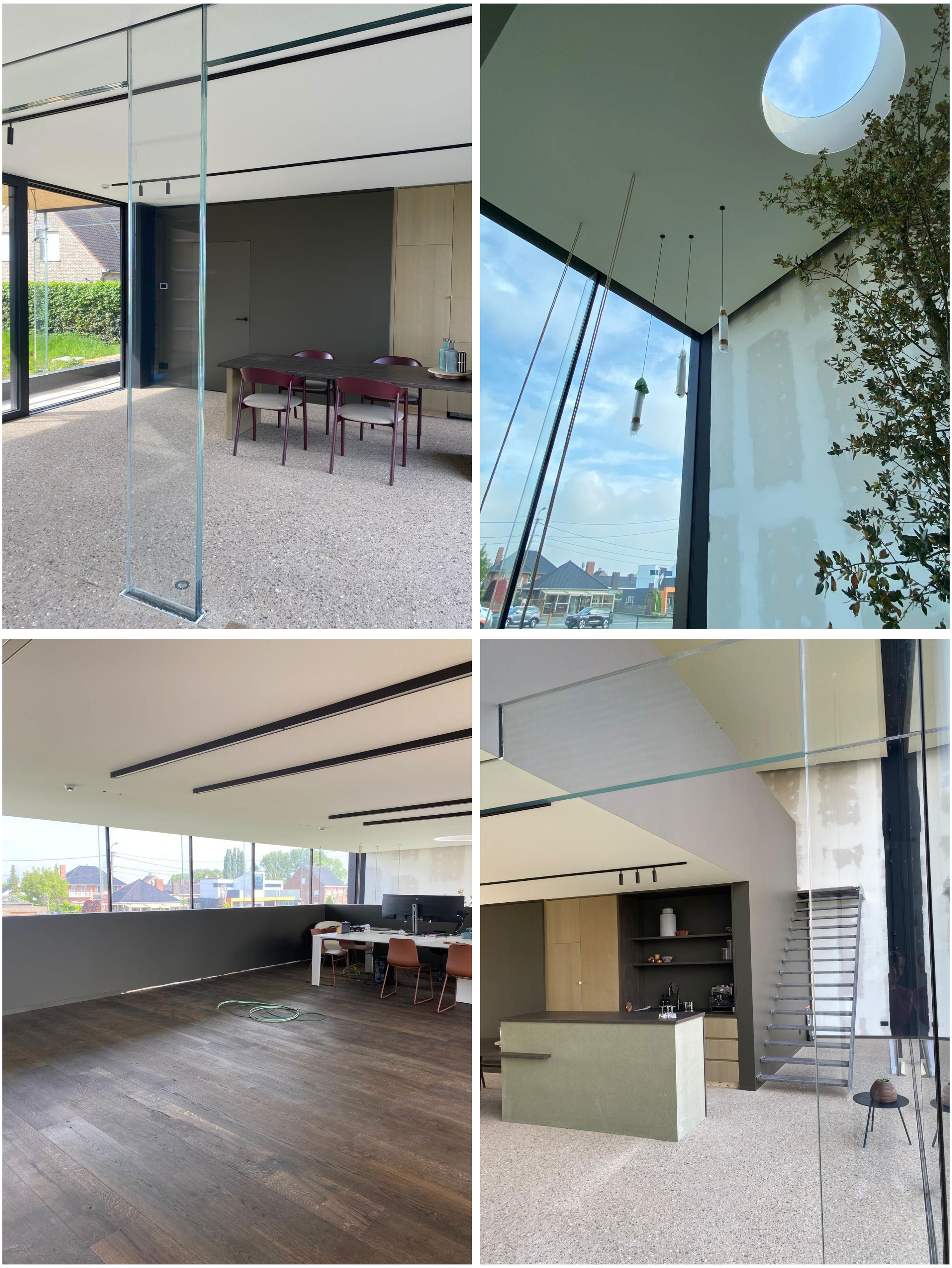
- **Geometrically nonlinear calculations with global and local imperfections:** to consider large deflections, to capture second-order effects and to account for production (local imperfections - bow) and installation (global imperfections - sway) tolerances. High slenderness ratios of the beams and columns required stability calculations accounting for the mentioned imperfections.
- **Viscoelastic modelling:** to account for time- and temperature dependent stiffness of the SentryGlas® interlayer of the 12121212.4(TTG,SG) beams and columns.
- **Fracture and post-fracture limit state:** to be in line with Eurocode 10 principles, the frames were verified for safety during the event of fracture (dynamic impact in combination with static loads) and for post-fracture load-bearing capacity (safety after fracture). For the latter, fracture of one of the four individual 12 mm thick thermally toughened glass plates was considered and the residual load-bearing capacity in an accidental load case scenario was assessed by finite element modelling. An experimental test (static loading in combination with impact loading) on a spare beam is currently being prepared to validate the results.
- **Connection detailing and local stress evaluation:** to ensure a safe and durable load transfer from the structural glass elements to the underlying load-bearing structure. Steel shoes and inserts, beam-column connections, column supports, etc. were designed to minimise stress concentrations in the glass elements. Local stresses in the structural glass components were assessed considering three-dimensional finite element models.

The combination of multi-state verification, careful detailing and advanced modelling ensured that the all-glass frames met the performance criteria associated with the structural role. The general design approach reflects the design philosophy of Eurocode 10 with emphasis on realistic material modelling, stability calculations, system robustness and explicit consideration of a fracture limit state and a post-fracture limit state.

4. Construction

The construction and installation of the glass components required careful coordination and precise sequencing. Many of the structural glass elements — particularly the beams, columns, and façade fins—were installed early in the building process, which demanded strict handling procedures and immediate protection to prevent damage during later construction phases. The large-scale laminated elements were transported and lifted using specialised equipment, with close attention to edge protection, surface cleanliness, and alignment tolerances.

On-site adhesive bonding for the connections between the façade fins and the insulated glass units formed an important part of the assembly. Bonding operations were carried out under environmentally stable conditions, considering proper surface preparation and accounting for adequate curing times. The installation of the interior and exterior glass frames required precise positioning of all structural elements, i.e. supports and glass components. Finally, the assembly of exterior glass beams and columns completed the installation sequence and demonstrated the integration possibilities of structural glass both inside and outside the building envelope. Fig. 4 depicts the *Vitroplena's Glass Quarters* just before completion.



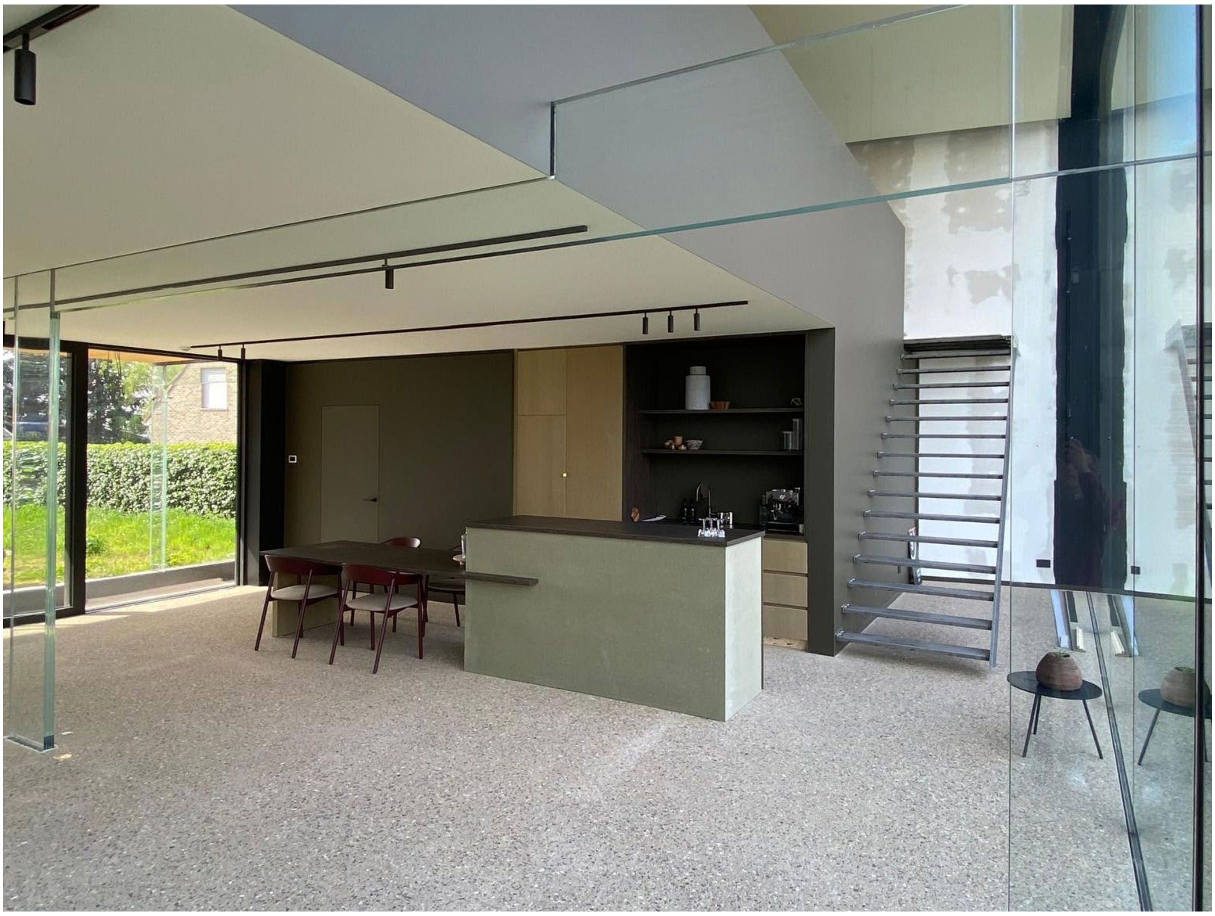


Fig. 4: Vitroplena’s Glass Quarters.

5. Conclusions

The *Vitroplena’s Glass Quarters* demonstrate the use of structural glass as a primary load-bearing material in a contemporary building, simultaneously serving as an architectural statement. The project brings together architectural ambition, advanced engineering, and practical construction expertise to create a highly transparent see-through box that communicates the company’s identity and showcases the possibilities of structural glass in real-world applications.

The project revealed the challenges inherent to structural glass construction. Achieving the required optical quality demanded strict production tolerances and rigorous quality control. The brittle behaviour of glass, the viscoelastic response of interlayers, and the slenderness of the structural elements required advanced modelling techniques and verification across multiple limit states, including fracture and post-fracture limit state. Handling and installing large glass components required specialised equipment and careful sequencing, while the coordination between glass, steel, and aluminium systems was essential to preserve the architectural purity of the design.

The structural design approach followed the principles of the Eurocodes and the methodology of the forthcoming Eurocode 10, incorporating ultimate, serviceability, fracture, and post-fracture limit states. For the façades, geometrically nonlinear analyses and viscoelastic modelling enabled a realistic representation of the structural behaviour and an optimisation of the glass compositions. For the all-glass frames supporting the office floor and terrace, detailed three-dimensional finite element modelling was essential to address stability, fracture behaviour, and residual load-bearing capacity.

These design strategies ensured that the structural glass components met the safety and robustness requirements associated with their primary load-bearing role.

The successful construction of the *Glass Quarters* demonstrates the feasibility of using glass as a reliable structural material in complex building applications. The project contributes to the ongoing development of structural glass design practice and provides a new example of how to push the boundaries of transparent construction, perfectly sound with Vitroplena's vision.

References

CEN/TS 19100:2021: Design of Glass Structures, European Committee for Standardisation, CEN (2021).

EN 13830: Curtain walling – Product standard, European Committee for Standardisation, CEN (2015).

EN 16612:2019: Glass in building – Determination of the lateral load resistance of glass panes by calculation, CEN (2019).

EN 1990:2002: Eurocode 0 – Basis of structural design. European Committee for Standardisation, CEN (2002).

EN 1991:2002: Eurocode 1 – Actions on structures. European Committee for Standardisation, CEN (2002).

Martens, K.: Statically indeterminate reinforced glass beams. Doctoral dissertation, Ghent University, Belgium, ISBN 9789463551328 (2018).

Van Lancker, B.: Experimental and numerical investigation of two-sided bonded glass-steel façade units. Doctoral dissertation, Ghent University, Belgium, ISBN 9789463554282 (2020).

Van Lancker, B., Martens, K.: Design of a curved duplex façade for a 67 m high residential tower at the Belgian coast. Proceedings of Challenging Glass Conference 8, 23-24 June, Ghent, Belgium (2022).

Van Lancker, B., Martens, K.: Design of a 5m span all-glass walkway. Proceedings of Challenging Glass Conference 9, 20-21 June, Delft, The Netherlands (2024).

Challenging Glass Conference Proceedings – Volume 10 – June 2026 – Louter, Bos & Belis (Eds.)
International Conference on the Architectural and Structural Application of Glass
Challenging Glass Conference 10 – 15-17 June 2026 – TU Delft – The Netherlands

Platinum Sponsor

SAINT-GOBAIN

Gold Sponsors

EASTMAN

kuraray

NorthGlass

sedak

seele

Silver Sponsors

DOW

octatube

PERMASTEELISA GROUP

SEEN

Organisation

TU Delft

Technische Universität München

GHENT UNIVERSITY