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Bespoke Solid Oak Rooflight in a London Listed Building

Francesc Sánchez [a], Núria Guitart [b]

a Bellapart, Spain, fsanchez@bellapart.com
b Bellapart, Spain, nguitart@bellapart.com

Abstract

In 2026, RH will open its first gallery in London, in 7 Burlington Gardens, a grade II* Georgian Mansion. The project, designed by Foster + Partners, involved the renovation of a historic building, including the installation of several bespoke glass rooflights and a scenic lift shaft. Bellapart was in charge of the detailed design and engineering of these specialist works, as well as its fabrication and site assembly. The main rooflight consists of a hipped roof, with a central section composed of triangular insulating glass panels supported by a framework that includes solid oak timber beams and flitch beams. All used timber was visually graded solid oak, rather than laminated, as it is common practice, in order to achieve the natural aesthetics required by the client. The dimensions of the central glazed area are 24.4 × 4.2 m, while the overall dimensions of the rooflight are 27.9 × 10.9 m, with a total height of 4.8 m. Beneath the main rooflight lies the "Oculus" — a walkable glass floor composed of a single laminated glass panel with an elliptical shape, measuring 3.4 × 2.4 m. Additionally, four more rooflights are installed on the terrace of the building. Each features a circular insulating glass panel at the top and a mirror-polished stainless steel inverted funnel at the bottom, consisting in a cylinder on top of a quarter of a torus, which reflects the natural sunlight throughout the entire space. The rooflight set is completed by on composed of six fire-resistant insulating glass panels supported by a steel frame. The insulating glass panels from all rooflights were tested according to CWCT standards, achieving fragility classes 1 and 2. Beyond the rooflights, the scenic lift shaft is constructed from flat and curved laminated glass panels, structurally bonded to a powder painted steel structure.

Keywords

Glazed rooflight, timber structure, renovation project, historic building

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1. Project overview

7 Burlington Gardens, formerly known as Queensberry House and Uxbridge House, is a Grade II* Georgian Mansion located in the Mayfair district in London, between Savile Row, Burlington Gardens and Old Burlington street. This historical building has undergone a massive renovation in order to host, starting this 2026, the first RH gallery in London, for which Bellapart was in charge of the detailed design and execution of the several new rooflights of the building as well as the glass shaft of the new scenic lift.

The main rooflight (Fig. 1A), located in the southernmost part of the building, consists of a four-sided hinged roof. It features a central glazed area of 24.4 m by 4.4 m, with overall dimensions of 27.9 m by 11.1 m. The rooflight combines the use of solid oak timber beams, flitch beams and steel profiles, giving the supporting framework a classic yet renovated look.

Beneath the main rooflight lies the “Oculus”, a former skylight from the original building, converted into a walkable glass floor composed of a single multi-laminated glass panel with an elliptical shape, measuring 3.4 m by 2.4 m. Adjacent to the “Oculus” is the new scenic lift (Fig. 1B), which serves all gallery floors and offers a panoramic view through its fully glazed lift shaft. The shaft is composed of both flat and curved laminated glass panels, supported by a painted steel structure.

On the second-level terrace, four new small rooflights have been installed, each covered by a single circular insulating glass panel with a diameter of 1.3 m. Beneath each rooflight, a mirror-polished stainless steel inverted funnel has been installed to reflect the natural sunlight throughout the entire space. This feature makes them one of the most eye-catching parts of the project.

The rooflight package is completed by a fire-rated rooflight installed above the kitchen on the first floor, consisting of six fire-resistant insulating glass panels supported by a steel frame.

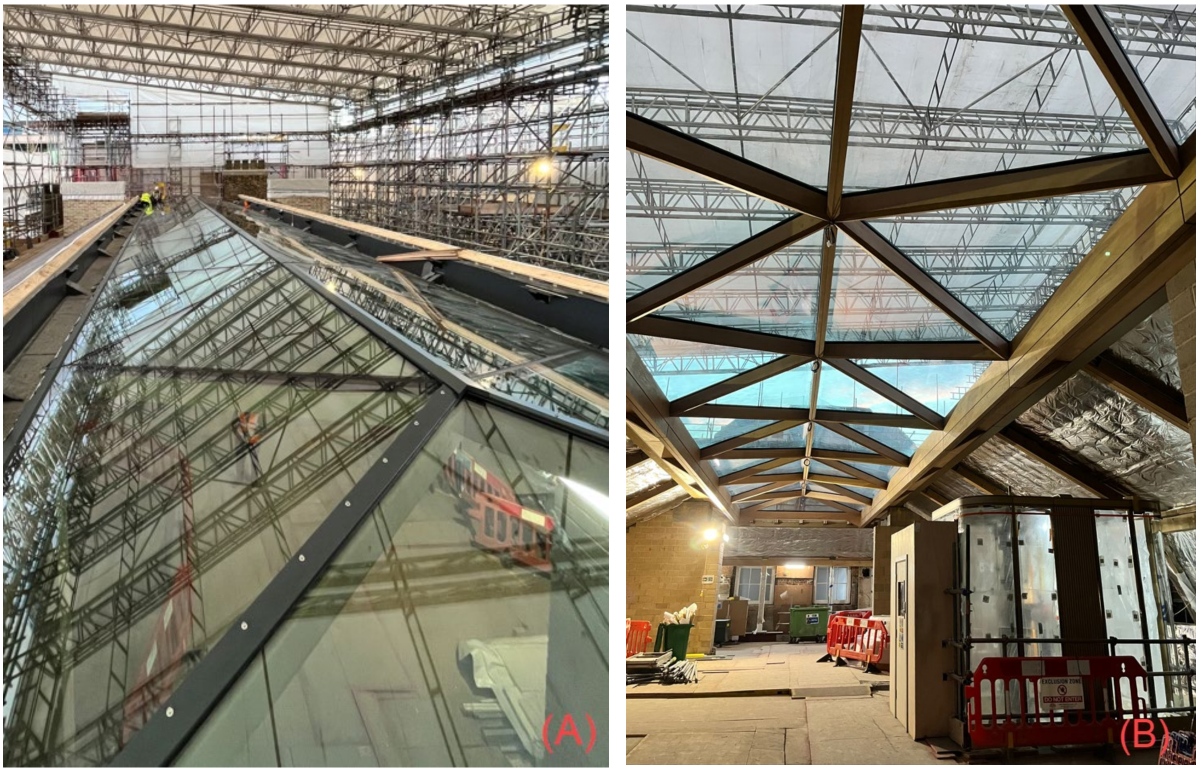

Fig. 1: Main rooflight during the installation.
(A) View from the top. (B) View from the 3rd level, including the top of the lift shaft.

2. Main rooflight

The main rooflight forms a new roof constructed over the existing structure on the southern side, facing Burlington Gardens. It is positioned at third floor, creating a new space within the renovated building. It consists of a four-sided hipped roof, with a central section composed of triangular insulating glass panels supported by a framework that combines solid oak timber beams, flitch beams and steel columns.

This rooflight is divided in two parts: a central area with a glazed surface over a standard thermally broken RAICO system, and the perimeter, which features a traditional roofing, installed by a third party (Fig. 2). The glazed area is 24.4 m long and 4.2 m wide, while the whole roof including the perimeter has a total dimension of 27.9 m by 10.9 m. The height of the structure, from floor level to the ridge, is 4.8 m.

The central area framework is made with solid timber beams on the diagonals and a longitudinal flitch beam (ridge profile), forming a triangulated truss structure (Fig. 3). The perimeter structure is composed of multiple flitch beams, combined with concealed steel profiles where those elements are not architecturally exposed. The flitch beams are made of a core steel T section with solid oak members fixed at both sides of the web. Perimeter steel columns, rigidly connected at the primary structure at third-floor level, support all these elements.

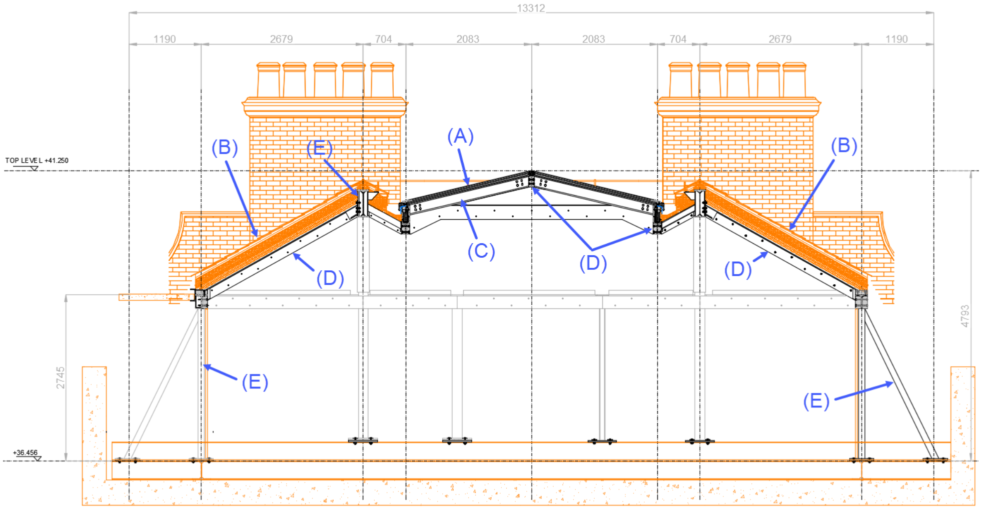

Fig. 2: Main roof section.
(A) Central glazed area. (B) Perimeter with traditional roofing. (C) Solid oak beams. (D) Flitch beams. (E) Steel profiles.

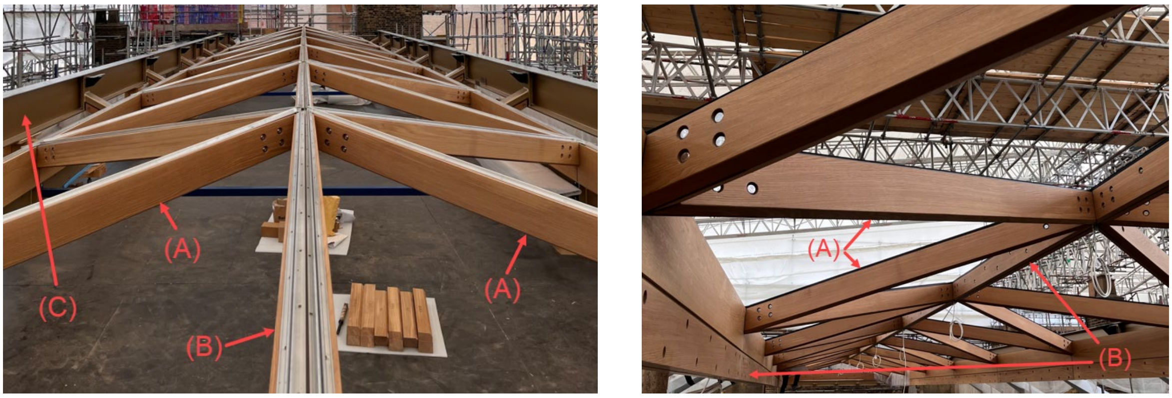

Fig. 3: Combination of the solid timber and flitch beams. (A) Solid timber beams. (B) Flitch beams. (C) Steel beams.

The use of the timber profiles for this project has been particularly challenging. All structural members, including both the solid timber and the flitch beams, were manufactured from solid oak rather than laminated timber, which would be typically adopted for applications of this nature. The specification of solid oak was an architectural requirement from the client. In addition, the timber was required to be free of visible knots, imposing further constraints on material selection, grading, and procurement.

For this purpose, the timber supplier was required to visually grade all timber sections in order to determine its strength class, and to pre-select each section according to the client specification, ensuring that all visible knots were excluded. Furthermore, the quantity of timber procured was intentionally increased to allow for rigorous selection of members exhibiting the most uniform grain and appearance, thereby meeting the stringent aesthetic requirements of the project.

The glass composition for the main rooflight is 8.8 mm (0.76 mm PVB) heat strengthened (HS) with Cool Lite Xtreme 61/29 II coating on face #4 / 16 mm 90% argon chamber / 8.8 mm (0.76 mm PVB) HS. All glass panels are triangular and continuously supported on the three sides by the RAICO system. The maximum dimensions are 2.96 m x 2.04 m and 4.01 m x 1.56 m (base x height).

2.1. Design and verifications

All elements of the rooflight have been carefully detailed and verified, with particular attention paid to the connections between the steel and timber profiles.

For the verification of the glass panels, a numerical simulation according to BS-EN 16612 (BSI, 2019) has been carried out, modelling all elements of the insulating glass unit (IGU), including the glass plies, the PVB interlayer and the gas cavity. Moreover, an impact test (Fig. 4) in accordance with CWCT TN 67 (CWCT, 2010) has been performed in order to obtain the fragility class of the glazed roof, achieving a fragility class 2.

Fig. 4: Impact test on the rooflights. (A) Main rooflight. (B) Terrace rooflights. (C) Fire-rated rooflights.

The supporting structure has been verified through a finite element (FE) model, combining steel and timber elements. All timber section have been visually graded according to UNE-EN 14081 (AENOR, 2020), and the strength class according to UNE-EN 338 (AENOR, 2016b) where the corresponding strength properties are determined.

A key aspect on the verification of the timber elements is to account for the dependence on time and moisture content on their behaviour. This has been taken into account using different FE models with different stiffness properties of the timber materials, so that the verifications can be performed at any stage in the process. For instance, the final deformation of the timber elements is obtained as the superposition of the instantaneous deformation, obtained for the characteristic load combination at serviceability limit state (SLS) with the mean values for the stiffness coefficients, and the creep deformation, obtained for the quasi-permanent load combination at SLS, as stated in UNE-EN 1995-1-1 (AENOR, 2016a).

Another key point on the numerical analysis of the timber elements, especially when combined with steel elements, is the slip resistance at the joints. When designing steel joints it is common practice to assume that there is no slip between the connected pieces, i.e. the connection is infinitely stiff. However, this is not the case in timber joints, where the stiffness of the connection is controlled by the slip modulus, depending on the mean density of the timber and the bolt diameter. Further analysis has been carried out for the timber-to-steel connections, where the slip modulus has been considered as two times that of a timber-to-timber connection, as stated in UNE-EN 1995-1-1 (AENOR, 2016a). A detailed analysis of each connection has been performed in order to assign the appropriate stiffness on the FE model. Fig. 5 shows the global FE model used for the verification of the supporting structure, showing the maximum vertical deformation under SLS loads.

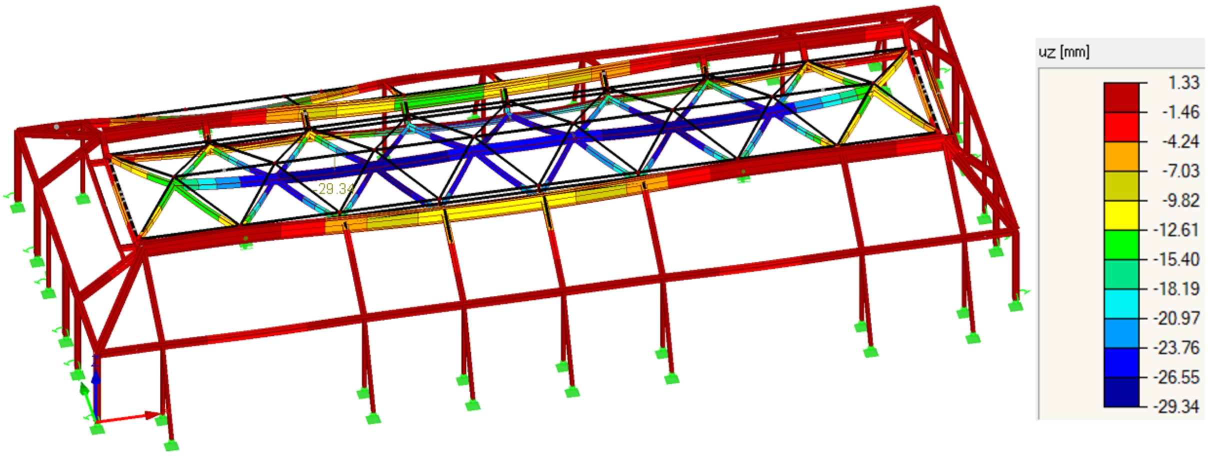

Fig. 5: FE model of the supporting structure.
Vertical deflection [mm] for the worst SLS load combination (factor of deformations: 22).

An example of the combination between connection types is shown in Fig. 6. This figure shows a standard connection at the ridge of the roof, where the ridge profile (flitch beam) and the diagonals (solid timber beams) meet. A 6-point steel “star” made from welded steel plates is placed at the centre, with all profiles are connected to one of its ends. For the diagonals (solid timber beams), this connection is of the timber-to-steel type, however for the ridge profile (flitch beam) only the steel web is connected to the “star”, and so the connection is of the steel-to-steel type.

Finally, a full thermal analysis of the rooflight was carried out to demonstrate compliance with the thermal requirements of the project. This analysis was performed through detailed FE models, which provided an overall U-value of the rooflight of 1.8 W/m^{2}K, and showed that there was no risk of condensation on any of the details.

Fig. 6: Detail of different connection during the pre-assembly.
(A) 6-point steel “star”. (B) Steel-to-steel connection. (C) Timber-to-steel connection.

2.2. Pre-assembly and installation

A key aspect for the installation of the main rooflight lies in the difference between the dimensional tolerances of the steel profiles and those of the timber elements. The steel profiles have been manufactured by Bellapart to tighter tolerances than the supplied timber elements.

Due to the natural anisotropic behaviour of the wood, solid timber elements (chosen for aesthetic reasons) are more susceptible to dimensional variations caused by moisture content changes, internal stresses, and natural growth characteristics (knots, grain deviation, etc.). Although kiln drying significantly enhances the dimensional stability of solid oak, it remains less predictable than engineered laminated timber, particularly in large cross-sections or in assemblies requiring strict alignment with components such as steel connections.

The inherent lower dimensional stability of solid oak, combined with natural variations, resulted in deviations that needed to be reconciled with the geometric precision of the steel. Consequently, each beam required individual manual adjustment, such as final cutting of each individual piece to its exact dimension, to align properly with the various steel connections, ensuring correct assembly and overall structural alignment.

For this reason, all elements were pre-assembled in the workshop (Fig. 7), with final adjustments made to the entire rooflight. Following pre-assembly, all elements, especially the timber members, were accurately labelled with their designated positions within the rooflight in order to ensure a precise and efficient on site installation, minimizing the need for further adjustments.

For the on-site installation (Fig. 8), a temporary roof has sheltered all elements, especially the timber profiles, during the works. The pre-assembly has resulted in a shorter installation time, better tolerances, and a high quality finished job.

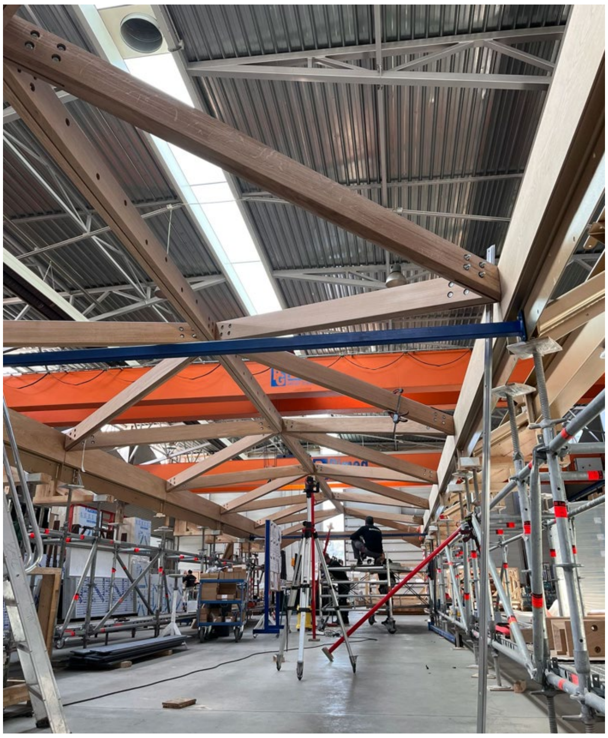

Fig. 7: Pre-assembly of the main roof at Bellapart's workshop.

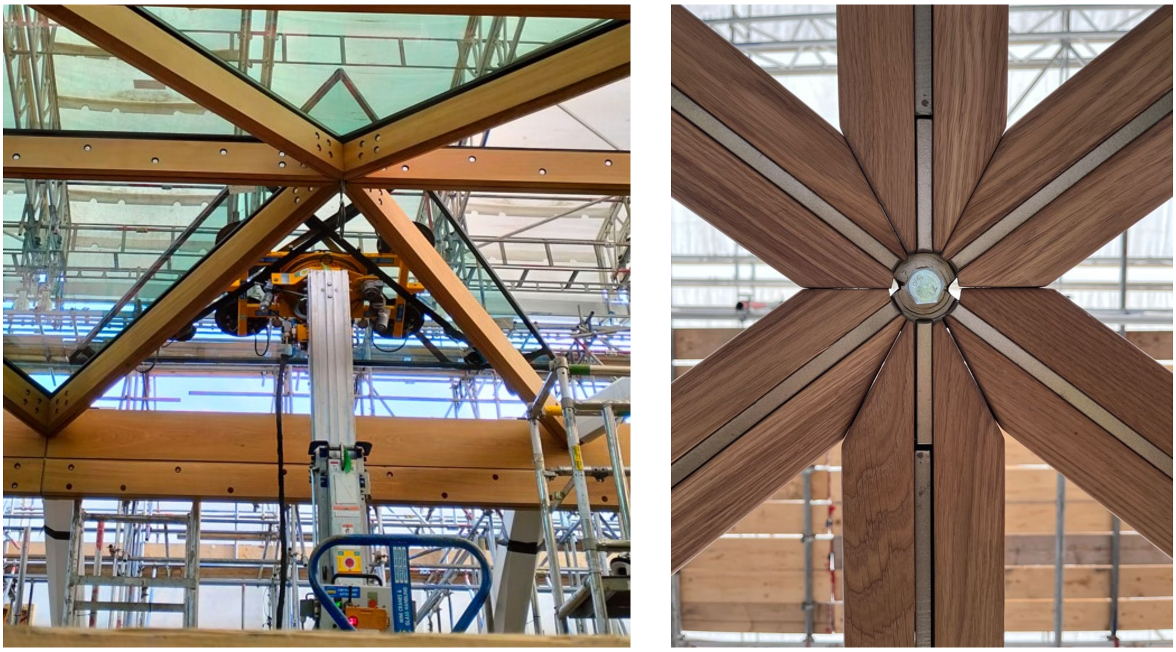

Fig. 8: Installation of the main roof.

3. Terrace rooflights

The terrace rooflights (Fig. 9) are four identical units located on the 2nd floor terrace, above the restaurant on the ground floor. Each rooflight features a double insulating glass unit (DGU) mounted on top of an inverted stainless steel funnel to reflect natural daylight into the interior space.

The supporting structure is made of welded stainless steel RHS profiles, all covered with mineral wool to achieve the proper thermal insulation. The supporting structure is crowned by a flat circular DGU, measuring 1.3 m in diameter. The glass composition for these units is 6.6 mm (1.52 mm SentryGlass (SG)) HS with Cool Lite Xtreme 61/29 II coating on face #4 / 16 mm 90% argon chamber / 6.6 mm (1.52 mm SG) HS.

At the interior, the supporting structure is lined with the inverted funnel, which represents the most challenging aspect of these rooflights due to its unique shape and finish. The shape of this "funnel" consists of a cylinder with a diameter of 774 mm on top of a quarter of a torus, with top diameter of 774 mm and a bottom diameter of 3340 mm. Each funnel is made by 3 mm thick welded stainless steel plates. The interior finish of the inverted funnel is mirror polished in order to achieve the desired appearance and light reflection at the restaurant below.

Finally, four circular 10mm stainless steel plates are added at the bottom of the supporting structure, below the lower perimeter of the inverted funnel to support a chandelier, with a total weight of 1000 kg, which will be later hung from each rooflight.

Fig. 9: Terrace rooflight. (A) Supporting structure. (B) Mineral wool insulation. (C) DGU. (D) Inverted funnel. (E) Support plates for the chandeliers. (F) Lifting eye. (G) Detachable supports.

All elements of the rooflight, that is, the supporting structure, the glass panel, the inverted funnel and the plates supporting the chandelier, have been accurately verified through detailed FE models in order to ensure the structural robustness of the design. Moreover, even though the glass panels are not accessible, they have been tested in order to determine their fragility class according to CWCT TN

67 (CWCT, 2010). A fragility class 1 has been achieved (Fig. 4 (B)), which is the highest class considered by the guides, apart from glass floors.

Finally, a full thermal analysis of the rooflight has been carried out, in order to prove compliance with the thermal requirements of the project. The analysis has been performed through detailed FE models, showing an overall U-value of the rooflight of 1.6 W/m^{2}K, smaller than the project requirement (1.8 W/m^{2}K), and showing no risk of condensation on any of the details.

3.1. Assembly, transportation and installation

The most challenging aspect of the terrace rooflights was the on-site installation, particularly due to the delicate nature of the inverted funnels. The mirror-polished finish, combined with the complex geometry, made handling intricate and potentially hazardous.

In light of this, the design of these rooflights was made so that all elements were assembled at Bellapart's workshop and sent on site as a single unit. A bespoke supporting structure was designed to hold the rooflight in a horizontal position (tilted 90º), ensuring that the unit rested securely on the stainless steel structure, while preventing any contact and possible damage to the inverted funnel.

Since the whole structure needed to be tilted, two lifting eyes were welded to the supporting structure (Fig. 9 (F)). These lifting eyes were carefully placed aligned with the centre of gravity of the unit. Detachable supports (Fig. 9 (G)) were designed in order to optimise the dimensions of the units and its transportation. The overall dimensions of each unit were 3.7 m (length) x 2.65 m (width) x 3.55 m (height). The assembled units were loaded in special transports and shipped to London. Once on site, the only operations performed on the pre-assembled units were to attach the supports, lift them on site and fix them to the primary structure of the building (Fig. 10). This ensured a high quality result.

Fig. 10: Transport and installation of the terrace rooflights. (A) Transportation of the pre-assembled units. (B) Lifting and turning the pre-assembled rooflight on site.

4. “Oculus”

The “Oculus” (Fig. 11) is a former skylight of the old building, converted into an internal glass floor under the new main roof. The old structure has been entirely replaced by a new system, including a single multi-laminated glass panel with elliptical shape, a steel supporting structure, and a powder painted stainless steel cladding. A later addition by the architect includes a small glass balustrade made of curved laminated glass panels. Nevertheless, the elliptical panel remains classified as a walkable glass floor, as the balustrade height is limited to 450 mm.

The supporting structure is made by 8 mm thick laser cut and welded steel plates. This structure has been verified through detailed FE models, considering all loads acting on it: its self-weight and the dead load of the glass panels, the weight of a 750 kg chandelier, which will be later on hung from it, the live loads acting on the glass floor, and the occasional horizontal load on the balustrade.

The central panel, with elliptical shape and overall dimensions 3.4 m by 2.4 m, has been carefully designed in order to provide the sufficient robustness for a glass floor. This glass panel is composed by three 12 mm heat strengthened glass plies, laminated with 1.52 mm translucent SG between each ply. The use of a three ply laminated glass ensures sufficient robustness, even in an accidental case with some of the glass plies broken.

For the structural verification of the glass floor, two different scenarios have been considered: the first one with the glass panel undamaged, and a second one with the top ply broken. Both scenarios have been carefully analyzed through detailed FE models under the design loads, especially the live load both uniformly distributed and concentrated. The first scenario provided compliance with both the serviceability and ultimate limit states, while the second scenario provided compliance with the post-fracture limit state, according to the Eurocodes and to BS-EN 16612 (BSI, 2019).

Fig. 11: Oculus.

The installation of the elliptical glass panel was particularly challenging, as this element needed to be installed after the main roof. Therefore, it could not be lifted from above and it had to be moved inside the building and lifted from the ground floor, as shown in Fig. 12. Once the elliptical panel was in place, the installation was completed with the curved glass panels of the balustrade and the cladding.

Fig. 12: Oculus. (A) Lifting of the glass panel from the floor below. (B) Installation of the glass panels.

5. Fire rated kitchen rooflight

Another improvement to the old building has been the installation of a new rooflight over the kitchen (Fig. 13), located on the first floor to the north side of the building. In this case, a fire-rated (EI 60) rooflight has been designed by adapting a certified JANSEN VISS Fire system to the project particularities.

The overall dimensions of this rooflight are 1.80 m by 4.68 m, composed by 6 glass panels with maximum dimensions 0.78 m by 1.73 m, in compliance with the certified system. The glass composition for these units is 6.6 mm (1.52 mm PVB) HS with Cool Lite Xtreme 61/29 II coating on face #4 / 16 mm 90% argon chamber / 33mm PYROBEL 33H. The adaptation of the system to the project has required the addition of fireboards at the bottom of the supporting structure. These fire boards protect both the anchors of the rooflight and the primary structure of the building. With these modifications, an expert assessment from EFECTIS UK has certified the fire performance of the assembly.

The supporting steel structure, as well as the anchors to the primary structure, have been verified through detailed FE models. Moreover, even though the glass panels are not accessible, they have been tested in order to determine their fragility class according to CWCT TN 67 (CWCT, 2010), achieving a fragility class 1 (Fig. 4 (C)).

Fig. 13: Fire-rated rooflight.

6. Scenic lift shaft

A new scenic lift has been installed during the renovation of the building, covering all floors from ground level up to the third level. The lift shaft is composed of transparent glass panels supported by a painted steel structure. The horizontal section of this structure has a rectangular shape with round corners, measuring 2.9 m by 2.42 m. This new scenic lift gives a panoramic view of the gallery from within the lift.

The supporting structure consists of three main parts: the columns, the ring beams, and the mullions. The columns (Fig. 14A) are placed at two sides of the lift, and support the whole shaft, transferring all its weight to the concrete pit at the bottom. These columns are made with HEB 160 profiles with a maximum length of 5.1 m each, and a total height of 21.7 m. The ring beams (Fig. 14B), made with C-shaped profiles, are placed at each slab. These profiles are rigidly fixed to the HEB columns and connected laterally to the primary structure. The joints of the HEB columns are placed on top of each ring beam in order for the installation to be done sequentially from floor to floor. Finally, the mullions (Fig. 14C) are vertical T-shaped profiles that are fixed between the ring beams and support horizontally the glass panels.

A particular feature of the design of this lift shaft is the vertical disconnection between the shaft and the slabs of the primary structure. The vertical deformations of the slabs were considered excessive for the lift operational tolerances. Therefore, the lift shaft is solely supported by the HEB columns, which are rigidly supported at the concrete pit at the bottom. For this reason, the anchors of the ring beams are laterally restrained but vertically free with slotted holes. The weight of the glass panels, which are supported by the ring beams, is not transferred to the slabs but to the HEB columns, which then transfer it to the concrete pit.

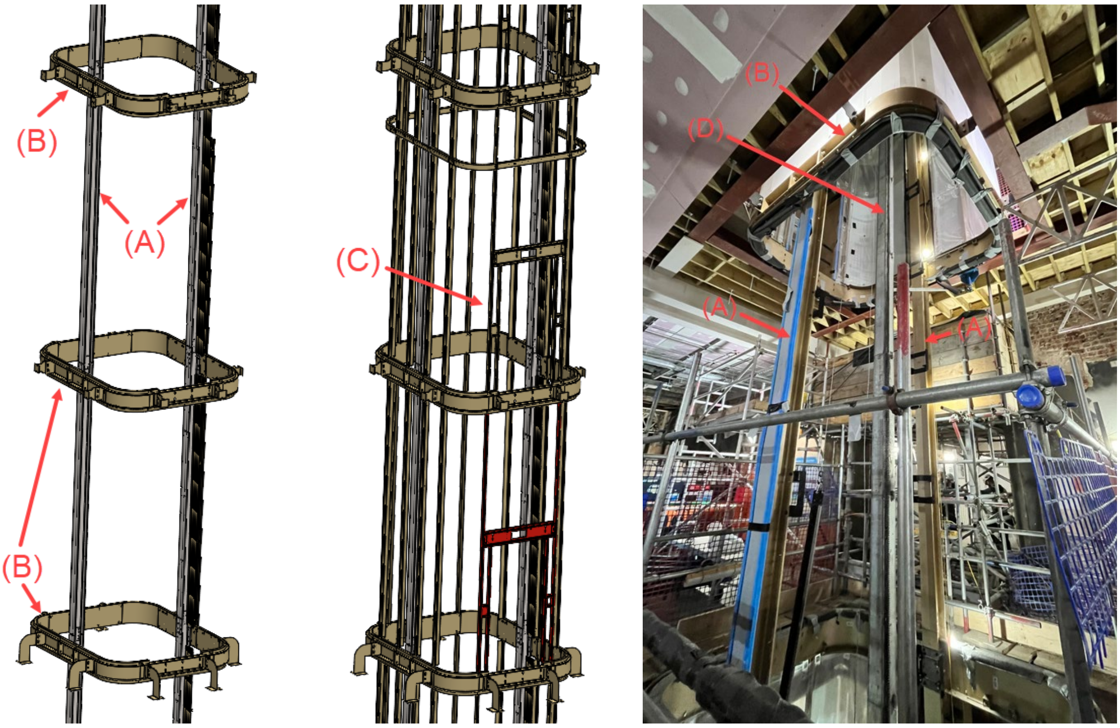

Fig. 14: Scenic Lift Shaft. Schematic detail of the supporting structure (left) and the mullions (middle) and installation (right). (A) HEB columns. (B) Ring beams. (C) Mullions. (D) Mast climber.

The glass panels of the shaft are made with laminated glass: 12.12 mm (1.52 mm SG). They are annealed low-iron glass in order to maximize the transparency and avoid any kind of anisotropy that could interfere with the vision from the lift. The geometry of the shaft combines flat panels on each side and curved panels at the corners, being the later hot bend. The glass panels are mechanically supported at the top and the bottom by the ring beams, and are bonded with structural silicone to the mullions at the vertical edges. Additionally, a mirror coating was applied to the perimeter of the glass panels, concealing the structural silicone and the mullion supports.

All elements of the lift shaft, including the glass panels (flat and curved), the structural silicone, the supporting structure and the anchors have been carefully verified through FE models according to the relevant standards, ensuring the structural safety and robustness of the design. The design takes advantage of the higher stiffness of the curved panels, structurally bonded to the mullions, thus allowing for the optimization of the mullions cross section (Fig. 15).

To facilitate the installation of all lift shaft elements, a mast climber (Fig. 14D) was installed at the centre of the lift pit. The installation then proceeded sequentially starting at the pit level and continuing upward through all floors:

1. Installation of the supporting structure at the pit, including the first HEB columns.
2. Installation of all the lateral anchors for the ring beams, at all floors.
3. Installation of the ring beam at the ground floor, rigidly fixing it at the HEB column.
4. Connection of the ring beam to the anchors to the main structure (laterally restrained and vertically free connection).
5. Installation of the HEB columns above the installed ring beam.
6. Repetition of steps 3 to 5 until reaching the top floor.
7. Installation of the top ring beam, only fixed to the HEB columns.
8. Installation of the glass panels.

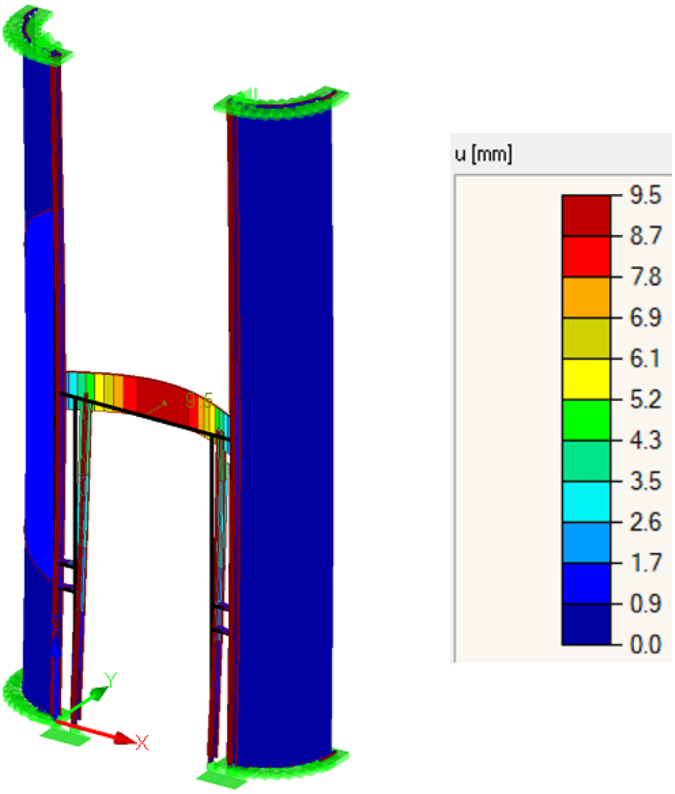

Fig. 15: Detailed FE model for the lift shaft showing the combined performance of the curved glass panels and the mullions. Maximum deflections [mm] for the worst SLS load combination (factor of deformations: 28).

Special care was required for the installation of the glass panels, especially the curved ones, given the limited available space. The glass panels were stored horizontally at each floor, lifted and turned using the mast climber, and finally installed in its position, as shown in Fig. 16. All glass panels were installed except for the on the first floor, which was left open in order to take away the mast climber and install the lift. These glass panels were later installed once the lift was complete.

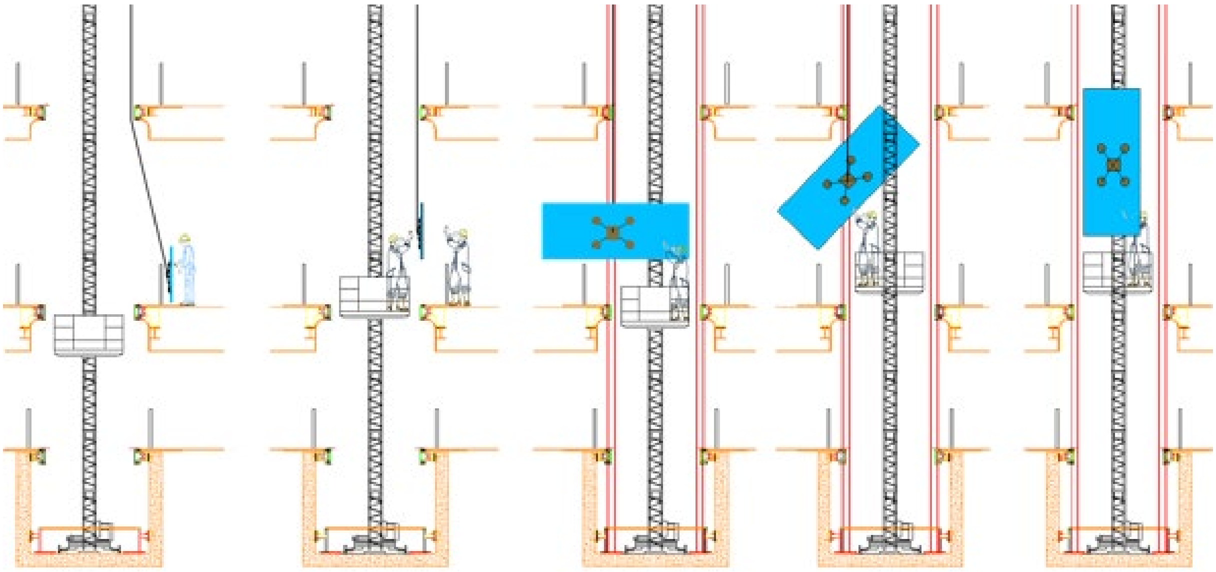

Fig. 16: Sequence for the installation of the glass panels.

7. Conclusions

7 Burlington Gardens has been a particularly complex project, involving a number of different bespoke solutions.

The main rooflight is a fine example of the integration of multiple materials in architecture, seamlessly combining glass, solid oak and steel.

The terrace rooflights highlight the challenges of dealing with delicate elements on site, demonstrating how a carefully planned assembly and installation methodology can streamline on-site operations and ensure a high-quality outcome.

The fire-rated rooflight, completing the roof set, proves Bellapart's adaptability to site conditions, and shows how a well-considered design can avoid additional testing, thereby reducing project costs.

Finally, both the "Oculus" and the glass lift shaft shift the works from an external envelope to internal elements, with a walkable glass floor and a glass lift shaft that provides a panoramic view from the new scenic lift.

The variability in the systems installed has tested Bellapart's versatility and adaptability from the design, workshop and on site installation teams. The high quality results achieved validate the design approach and installation methodology, meeting the stringent quality standards required for this project.

Acknowledgements

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