

Essential Repairs including Replacement Wagon Arch Glazing 1830 Warehouse, Science & Industry Museum

275 Design Note 26.06.2023

Source documents:

SDA DAS

SDA Appendix 4

Deloitte Q&A clarifications

Source documents: EXTRACTS

Appendix 4

/ page 3:

Considerations for type of glazing:

2 Replace as is (like for like) with planar glazed system. Not recommended due to defects/condition, does not adequately manage rainwater away from weak interfaces which will lead to future decay in historic fabric. Not viable.

• Developing the preferred approach

• The proposed structural glazing system is an aluminium frame with new sill and integrated upstand details. The interface design will manage rainwater away from interfaces.

/ page 8:

The visual approach to the replacement glazed infill to the wagon arches of Bay 1, Bay 2 and Bay 3 will set a consistent approach. The approach considers the functionality of the space behind, understanding its current and future planned use to determine the level of specification (for example single or double glazed, thermal performance, UV exclusion). The structural glazing to the wagon arches in Bay 1-Bay 3 are part of the external enclosure (weathertight, maximising daylight, minimising ultraviolet light penetration to the collection, etc) and also provide a visual connection from inside the museum to the viaduct, the trackbed, and the 1830 Station.

/ page 10:

The existing system is 12mm thick toughened glass with 6mm tolerance each side in a 24mm internal width channel cut into the stone reveal. The interface detail is flawed and has enabled the glazing to slip and provide a risk to the fabric, the collection and to staff and visitors.

• Specification of replacement glazing:

- Following technical consultation with glazing specialists, the glass thickness should be designed to site specific criteria (e.g. wind loads, barrier loads, etc.) to ensure the glass does not over stress or deflect. The recommendations from glazing specialists propose the use of 24.5mm to 25.5mm thick toughened laminated glazing with PVB interlayer. They do not recommend the use of an 11.5mm thick toughened laminated glazed panel for use in this application to the wagon arches due to the size and arched profile.
- The Saflex Poly Vinyl Butyral (PVB) interlayer is 0.76mm thick and this thickness is included within the 24.5mm to 25.5mm thick toughened laminated glazing panel.
- Manufacturers advise that the maximum dimension for toughening sheets of glazing is 4500mm x 2500mm. To achieve a toughened laminated glass panel, a jointline between two adjacent panels will be required.

Essential Repairs including Replacement Wagon Arch Glazing 1830 Warehouse, Science & Industry Museum

/ page 11:

- The new glazing is required to be toughened laminated glass with a PVB layer. In a frameless system the PVB interlayer may absorb water at a maximum distance of 15 mm from the edge, which may change the tone of PVB.
- Replacement with a like for like frameless system to re-use the existing interface detail is not feasible without further change to the historical stonework which will cause potential harm to the stonework.
- The 24.5mm to 25.5mm glass would not fit into the existing channel without adjustment and widening of the existing channel and would require further intervention into the stonework.
- The intervention would involve chasing a wider channel, a minimum 15-20 mm wider than existing. Even with due skill and care from an experienced craftsman, the chasing will cause vibration and resultant harm to the stonework. The process will also create extensive dust, posing a risk to operatives and occupants.
- The harm caused by installing the frameless system includes:
 - Material loss at the ariss,
 - Loosening of mortars and risk of movement in blocks,
 - Inducing cracking or widen existing fissures leading to further water ingress into the stone units and the risk of future loss of stone face.
- The future installation of double glazing is not feasible within the recessed channel detail.
- Inserting glass into the historic fabric poses a future maintenance issue should there be a need to repair the stone fabric surround.
- Maintenance issues include:
 - Any building settlement could result in the cracking of the glass.
 - The recessed frameless detail conceals degradation of seals from regular visual inspection. The result is that defects can go unnoticed until they develop into damage to, or loss of, the surrounding fabric or failure of the embedment to the glazing.
 - The recessed channel precludes the installation of double glazed units and so reduces future adaptation.
- Repairs needed include:
 - Mortar joints require repointing from time to time. Raking out may cause damage to adjacent seals to the glazing system.
 - Spalling of stonework due to inherent defects requires stone masonry indent repair. The vibration of this can dislodge or damage seals to the recessed frameless detail.
 - Inadvertent damage from repairs can cause water ingress and failure of the support for the glazing.
- Reason why working with defective installation is not feasible for long term sustainability:
 - The marginal tolerances of the frameless system have failed.
 - The position of wood sills has made them inaccessible to regular inspection and vulnerable to water ingress and water damage due to flawed detail and insufficient preventative maintenance due to the lack of adequate access to inspect and to carry out repairs.
 - The intolerance of the frameless glazing system has meant that any minor repairs have not been cost effective to undertake given the risk of movement or fracturing in the frameless glazing.
 - As a result of previous urgent repairs with the benefit of extensive temporary works access, the defects in the glazing system were identified and the installation of anti-shatter film and

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bracing to the joints was undertaken - but these are only temporary safety measures and a long term detailed solution is required.

/ Page 12:

- **Summary:**

- The like for like installation is not feasible without further harm to the stonework. The frame system provides adaptability to future adaptation and ease of long term maintenance, and is a more sustainable approach with an aluminium frame to provide a better long term weatherproof detail and lower maintenance.

SUPPLEMENTARY NOTES:

Conisbee:

Allow a wind load of 1kN/m² (1000N/m²).

With reference to BS 6180 and other guidance, as there is no other barrier in front of the glazing it will need to be designed in accordance with Table 2 and meet the following requirement:

- Horizontal uniformly distributed line load: 3.0 kN/m
- UDL applied to glass generally: 1.5kN/m²
- Point load applied to glass: 1.5kN

In addition, the requirements of Part K4 will need to be met and the supplier/designer will need to provide confirmation. but Pilkington will be able to advise on panel size/thickness and frame requirements.

Saint Gobain:

It won't be a single layer of glass, the specification would be for a toughened and laminated glass with UV protection . *17.5mm Toughened laminated glass – [*this thickness did not include barrier loads which need to be applied] thickness would be subject to fixing method, size and any barrier loads.

Saint Gobain Different project extract:

This report considers the resistance of full height glazing to combined imposed barrier, dead weight and climatic loads. Calculations are provided for guidance and are based upon the glazing specification and load requirements provided. All calculations are strictly based on SGGPLANICLEAR float glass and SGGSTADIP laminated glass where applicable. Barrier load calculation based on a size of 2414 x 2000 using the proposed glass construction. I have applied a 1.5kN/m line load and used a 1.5kN wind & Suction load, and as you can see this meets these requirements. Calculations are based on glazing being simply and linearly supported on all 4 edges. Inner: 10 mm Float Glass, Thermally Toughened / Cavity: / Outer: 17.5 mm (88.4) PVB Standard Laminated Float Glass, Heat Strengthened = min 27.5mm.

Pilkington:

The glazing thickness of the toughened laminated would be determined by any applied loading criteria such as wind loads, barrier loads etc... to ensure glass proposal doesn't over stress or deflect mechanically speaking...In terms of glass tolerance's, [consider] production tolerances on cutting sizes, squareness of the laminate edge etc... [to be] agreed with the processor of the finished glass panel. .a minimum of 25.52mm toughened laminated glass comprising 12mm toughened Pilkington **Optifloat™** + 1.52mm PVB interlayer + 12mm toughened Pilkington **Optifloat™**

The existing glazing system doesn't appear to be Pilkington **Planar™** ,... It may potentially have been installed by one of our previous accredited installers but using a slightly different set-up. Pilkington no longer manufacture or supply the Pilkington Planar™ system.