



The Scottish  
Parliament

**TECHNICAL ANNEX  
LETTER TO FINANCE COMMITTEE, AUGUST 2003**

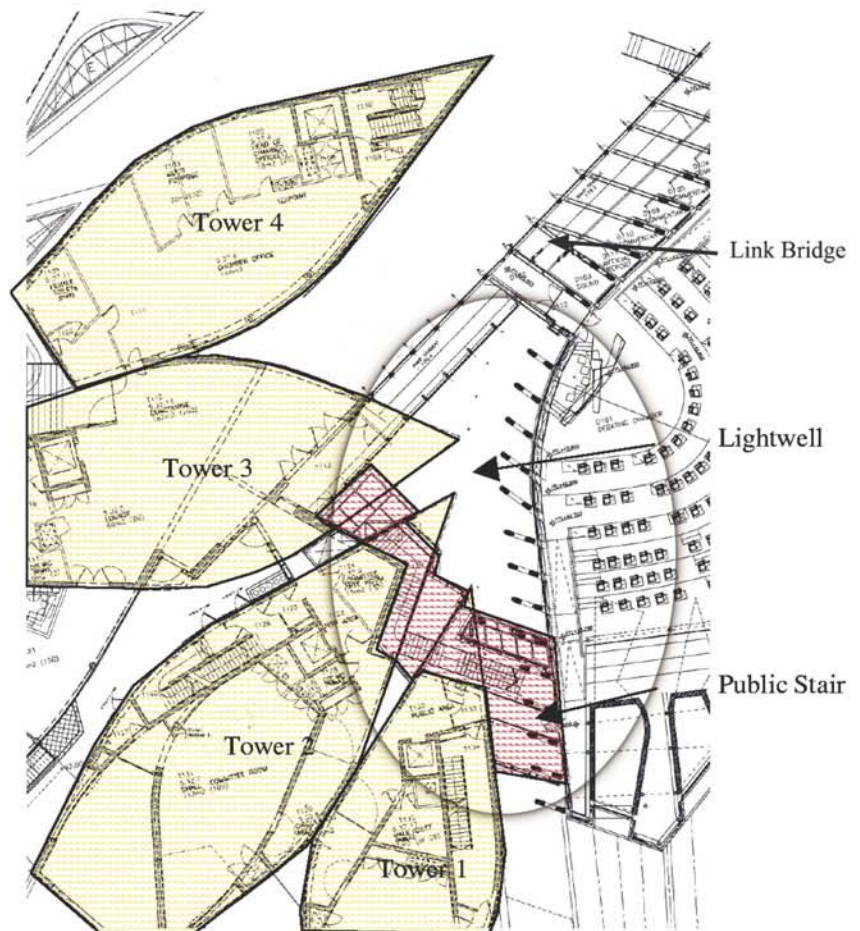
This technical report has been produced, at the request of the Presiding Officer, to enable those without a detailed knowledge of the Holyrood site to understand the complexities of the lightwell area and their impact upon completion of the project.

**Location**

The north lightwell is situated at the east side of the site and is enshrouded by Towers 1 to 4 on its western side and the Debating Chamber on the east.

The public stair to the south and the link bridge from the Main Stair at the MSP Foyer to the Black and White Lobby are located immediately above.

The Construction Manager reports that finishing the north lightwell and the elements of buildings which interface with it are "critical to achieving construction completion".



*The Lightwell area: central to the completion of Holyrood, but a highly complex and constrained space in which all activities have to be completed one at a time sequentially.*

## Technical Difficulties with Window Installation:

The blast windows have proved considerably more complex than initially envisaged when the concrete structure for the Towers was designed and erected. Window openings were cast into the structure with fixings to support the windows using the design team's best knowledge. This all took place before the heightened awareness of security issues.

The complexity of the three dimensional geometry and the tolerance encountered in casting the building's concrete structure 300 – 400mm deep to achieve the blast loading criteria further compounded the complex technical requirements of the blast window design.

As the window design was developed with the trade contractor, the calculations and the destructive blast test undertaken dictated that the supporting structural steelwork necessary to sustain the blast loads was significantly in excess of that considered when the concrete structure was cast. The additional steel structure significantly reduced the designed tolerance zone cast into the structural openings which when coupled with the already minimal tolerance of the basic concrete structure resulted in a limited capacity to adjust the alignment of the windows during installation.

This resulted in many of the cast-in fixings and window supports being insufficient in structural capacity and location and required them to be replaced with alternative fixings.

Approximately 75% of the window fixings to some 350 windows have been replaced with each fixing of a bespoke design due to the complexity of the structure's geometry and blast loadings. These challenges to window design were increased by the need to align the windows into the building so that they are flush with the surface.

Each of the above factors have resulted in the window installation being significantly more arduous than envisaged. The consequence is that the trade package contractor has been unable to achieve the output which previous construction programmes reflected.



*Blast Window Installation: problems with installation to meet blast proofing requirements mean that the installation rate has been cut from a projected 24 per week to 12 per week*

## Construction Sequence and Site Logistics:

The complex design and geometry of the buildings has restricted the design team's ability to develop flexible construction methods and has resulted in the design dictating the sequence of construction.

Construction in the north lightwell is further constrained by the logistics of the site which impose severe access restrictions — with the overhanging structure of the Towers (which range in height from three to seven stories) and the location of the link bridge preventing the use of tower cranes.

Health and safety of the site operatives is of primary importance and with complex construction operations being undertaken in a relatively confined environment, the construction sequence has consequently had to be limited to one activity at a time.

The access limitations are such that construction works are required to follow on from preceding or adjacent works – it is not possible for contractors to work side by side in the restricted area of the lightwell. The resultant construction programme reflects a sequence of works from Towers 1 to 4 with trade packages running concurrently. The main difficulty here is the completion of the external façade which is sequential from Tower 1 to Tower 4. Each of the Towers themselves have a similar sequential construction sequence with each trade package depending on the completion of its predecessor.

Completion of the external façade on the Towers is dependent on the installation of blast windows. Once installed, the stone cladding, trigger panels and precast concrete soffit panels can then be completed. Only then can the external scaffold can be dropped. The lightwell logistics determine that the scaffold from Towers 1 to 3 must be removed before the construction of the public stair can proceed.



*Aerial view of lightwell highlighting access restrictions from adjacent structures.*



*Tower scaffolding preventing current access to lightwell.*



*View from link bridge depicting access restrictions into lightwell.*



*Stone trigger panel can only be installed when blast windows are complete.*



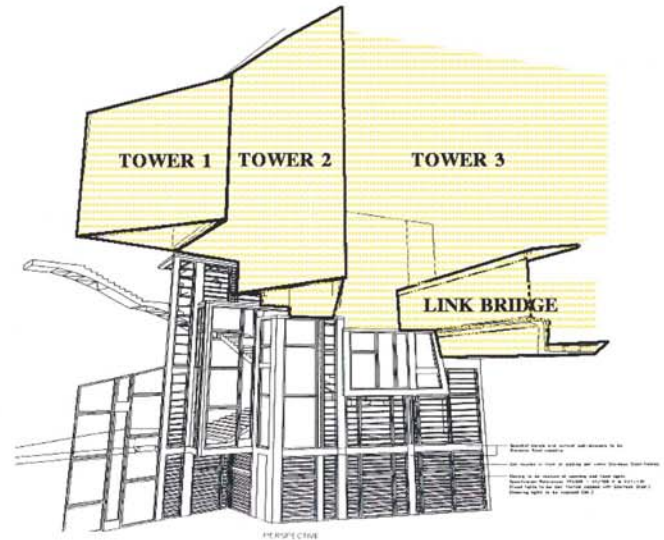
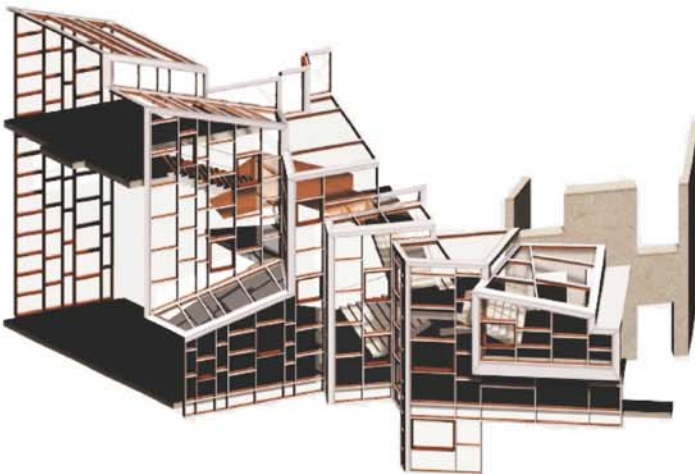
*Existing scaffolding preventing construction of public stair.*

## Public Stair and Works Post Stair Completion:

As explained earlier, the construction of the public stair cannot commence until the scaffold from Towers 1, 2 and 3 has been removed from the lightwell.

The public stair itself has a complex geometry which when coupled with the stair's location beneath the soffits of Towers 1 and 2 and its proximity to the oversailing link bridge means that access is restricted and it is not possible to use traditional cranes. This has added to the extended timetable for completion.

*The Public Stair: a highly complex structure that threads its way through buildings over three levels.*



*Sectional Diagram: Towers 1, 2 and 3 are situated above the link bridge and public stair. Beneath them are several hundred individual components of glass, steel, timber and pre-cast concrete which have still to be completed.*

The glazing and cladding to the Debating Chamber west elevation, public foyer, link bridge and basement facades facing into the open lightwell are all also affected by the restrictions on access. Due to the necessity to undertake construction activities sequentially, only after the Public Stair structure has been completed can installation of the upper and lower basement louvres, precast cladding panels, tension rods to the Glulam roof structure, structural grill across the lightwell, elements of landscaping and the internal fit-out / services to the public stair be undertaken.

## Summary:

The development of the blast windows, their installation and subsequent delay to the interfacing stone cladding surrounds has culminated in a more complex and onerous installation than envisaged. This in turn, has impacted upon anticipated completion dates of ensuing trade packages and resulted in a sequence of construction which concentrates a significant extent of the remaining works around the north lightwell. The lightwell itself is constrained by the site geometry which substantially reduces access capabilities. Because of these constraints, and a consequent construction sequence limited to one activity at a time, it is not possible to reduce delay through increased use of resources.