PRICE & MYERS

Consulting Engineers

30 Newman Street
London W1T 1LT
T 020 7631 5128
F 020 7462 1390
E mail@pricemyers.com
www.pricemyers.com

Alan Power
Alan Power Architects Ltd
13 Needham Road
London
W11 2RP

26th April 2013

Ref: 21605/4/MM

Dear Alan,

The Elms, Fitzroy Park, N6 6HS

Further to our review of the as-built structure of the existing building, conducted in January 2013, Price & Myers have undertaken a further investigation of the structural design approach to the Winter Garden Roof.

The current structure consists of a diagrid roof layout of slender 60mm tubes, spanning onto a perimeter "ring beam" of 150mm deep rectangular hollow sections supported on masonry walls and steel columns, without the use of horizontal ties.

Our review has focussed on the possible alternative framing arrangements that are structurally feasible for this roof, to determine whether a less visually intrusive design could practicably be achieved.

In addition to the design options considered by the original design engineers, which included ribbed framing arrangements of various structural depths to support a glass roof, we have investigated the following;

- "Structurally efficient" arrangement of steel beams
- Steel frame using shallow/thin sections
- Glass beams supporting a glass roof
- Lightweight cable truss system

Our design solutions were governed by a requirement to provide support to not only the glass roof itself, but also to allow for the weight of drifting snow and to provide safe access for maintenance. A further limitation on structural performance was provided by the requirement to limit deflection of the structure supporting the glass, in order to prevent flexural cracking of the panels.

Structurally efficient beams

The “efficient” steel solution (option 3 on SK1) used an orthogonal framing arrangement with beams sized to achieve an economical balance between weight and strength. This option produced typical minor beam depths of 150mm spanning across the atrium. These sections require the use of a major beam where width of the roof is increased at the top landing area, which due to its length and the weight of roof it needs to support, needed to increase in depth to 200mm.

Shallow section beams

Using the same framing arrangement as the “efficient” design, the steel section sizes were reduced in depth (and increased in weight) to achieve the shallowest section that still complied with the governing deflection criteria of the glass (option 2 on SK1). The result was to produce typical minor beam sections of 120mm deep, however the major beam again needed to be 200mm deep but could consist of a slim section of bundled steel plates.

Glass beams

Glass has inherently different strength characteristics to steel, but it can be used for similar structural purposes. To compensate for the different strength of section when of using glass as a beam, the depth of a given element will need to be deeper than its steel equivalent. This was proved by calculation, where the same structural arrangement for the roof produced 350mm deep glass sections (option 1 on SK1).

Cable truss

A radically different structural solution consisting of an arrangement of lightweight cable lattice trusses was also investigated (refer to SK2), with 60mm tubes acting in compression and cables providing the tension elements. To make this type of system work, it is necessary to offset the bottom chord of cables a sufficient distance down from the top chord of tubes, so that respective tension and compression forces within the truss can be balanced. This design produced sections with slender steel elements, but the overall structural depth was 300mm.

Conclusion

The original design brief was to make the new glazed roof to this area as structurally minimal as possible. We are confident that the as-built solution of a curved tubular lattice roof complies with this requirement and produces a roof of minimum structural section depth in comparison to alternative structural solutions.

Yours sincerely,
for Price & Myers

Mark T. Mawby CEng MIStructE
mmawby@pricemyers.com

Enc. SK1 & SK2