STRUCTURAL NOTE ON EXISTING FLOOR STRUCTURE, PROVIDED BY ALAN BAXTER & ASSOCIATES, STRUCTURAL ENGINEERS

Introduction

1 This note summarises the structural engineering issues associated with the feasibility of placing a temporary exhibition floor on the existing Round Reading Room floor structure. The notes are based on a desk study and observations made during visits to site. No physical opening up works have been carried out to date. These notes should be read in conjunction with drawings 699/301/10 to 14.

The Existing Floor Structure

2 The floor dates from 1857, forming part of the design for the Round Reading Room by Sydney Smirke.

3 The lower part of the floor structure comprises brick barrel vaulting that spans between load-bearing walls within the 'Spider', which forms the basement space below the Round Reading Room (see drawings 10 and 11). The arrangement of these walls is not entirely repetitive but is principally defined by 18 corridors that are set out radially within the Spider, as shown on drawings 10 and 12. During a recent visit to the Spider, a brick had been removed in two locations within the vaulting and this showed the vaulting to be a half-brick thick (i.e. about 100mm).

4 As regards the upper part of the floor structure, the evidence supports the view that most of the floor above the vaulting consists of mass concrete and a screed finish. The main sources of information supporting this view are as follows:

A Purcell Miller Tritton's Conservation Plan dated 2006 mentions a concrete floor. Purcell Miller Tritton have confirmed this reference comes from a previous British Museum Conservation Plan which quotes:

"The floor was raised on brick arches filled out with Portland cement, smoothed over with Bellman's Parian cement."

and

"The floor was constructed of 'camptulicon' – a mixture of rubber, gutta percha and cork on a canvas backing....The floor was relaid with cork carpeting in 1907."

B Where the two bricks in the vaulting had been removed, concrete was seen immediately above.

C Recent conversations with Graham Allen, the Clerk of Works at the British Museum. Graham has confirmed the carpets within the Round Reading Room were lifted as part of the Great Court Project in the late 1990s and this exposed a screed floor. This is consistent with the description in the conservation plan.

5 The survey drawings suggest the thickness of the floor is only about 180mm at the crown of the vaulting. This seems mean given the robustness of the rest of the structure of the Round Reading Room, which Sydney Smirke designed.

6 Where there is a raised podium centrally within the Round Reading Room, and which ramps down to the general floor level at the north end, the floor construction above the vaulting appears to comprise raised stone pavers supported on brick sleeper walls. This is apparent from the Spider.

7 It therefore seems there are two types of floor to the Round Reading Room above the vaulting: over most of the floor space there is a mass concrete fill; and where the raised podium and ramp exist, suspended stone pavers are supported off brick sleeper walls over the vaulting. A summary of the likely floor build up where the mass concrete fill appears to exist is shown on drawing 12.

8 Given that no drawings of the existing floor build up have been uncovered, there remains a very small risk that the floor structure is not as is currently assumed. It is therefore prudent to allow for drilling some very small diameter holes in to the floors from below to confirm the floor build up as part of the next stage of the project.

How the floor has been loaded historically

9 To help assess the acceptable floor loads that can be imposed by a temporary exhibition a review of the how the existing floor has been loaded historically has been carried out. This is summarised on drawing 12.

10 Considering Smirke's original concept, he designed the Round Reading Room to be used essentially as a library. The earliest known published guidance on imposed loads came in the Encyclopaedia of Architecture in 1881 which suggests public halls where people could congregate should be designed for an imposed load of 128lbs/sq foot (i.e. about 6.1kN/m2). It seems likely that Smirke used a figure close to this.

11 The Round Reading Room has been used as a library since it was constructed in 1857, with short periods when it has been out of use for refurbishment. The floor however does not appear to have been used for storing large volumes of books and so the imposed load on the floors has probably not exceeded 3.0kN/m2.

12 The latest refurbishment of the Round Reading Room occurred during the late 1990s when the internal finishes were redecorated as part of the Great Court Project. These works involved the erection of an access scaffold, designed by SGB. The drawings and calculations that SGB prepared have been reviewed and these show the scaffold generated point loads below the uprights of up to 16kN (about 1.6tonnes). The uprights were placed on steel beams that spread the load on to the lines of the load bearing walls below to prevent the floor being punctured by these concentrated loads.

Implications for the Proposed Temporary Exhibition

13 The current proposal is to create a temporary exhibition space on a raised temporary lightweight floor structure that will sit above the level of the desks of the Round Reading Room. This is to enable the desks to be retained in position during the exhibition. The temporary floor structure will be supported off posts that need to sit on the existing Round Reading Room floor.

14 In overall terms, allowing for a dead load of 1.0kN/m2 for the temporary structure plus 5.0kN/m2 for imposed loading from the exhibits and visitors to the exhibition, the loads on the existing floor structure will be acceptable. The key issue structurally is how the loads from the temporary exhibition floor get transferred in to the existing structure.

15 Given the relatively mean thickness of the vaulted structure and mass concrete fill that appears to exist, the floor is not able to support significant point loads. Point loads of up to 3kN appear to be appropriate but no more, as shown on drawing 13. Given the posts supporting the temporary exhibition will probably generate loads in the region of 20 to 30kN, this raises two options of how the loads can be supported.

Option 1: Position the temporary floor props on the lines of the load bearing walls under. Given the arrangement of the load bearing walls is not entirely repetitive and they are set out to approximately a radial pattern, this approach is likely to mean the temporary stage structure will need to be especially adapted. Some form of timber spreader would be needed on the existing floor to spreader the loads locally.

Option 2: Introduce more substantial spreaders, such as steel beams, across the floor to enable a more regular grid to the temporary floor props.

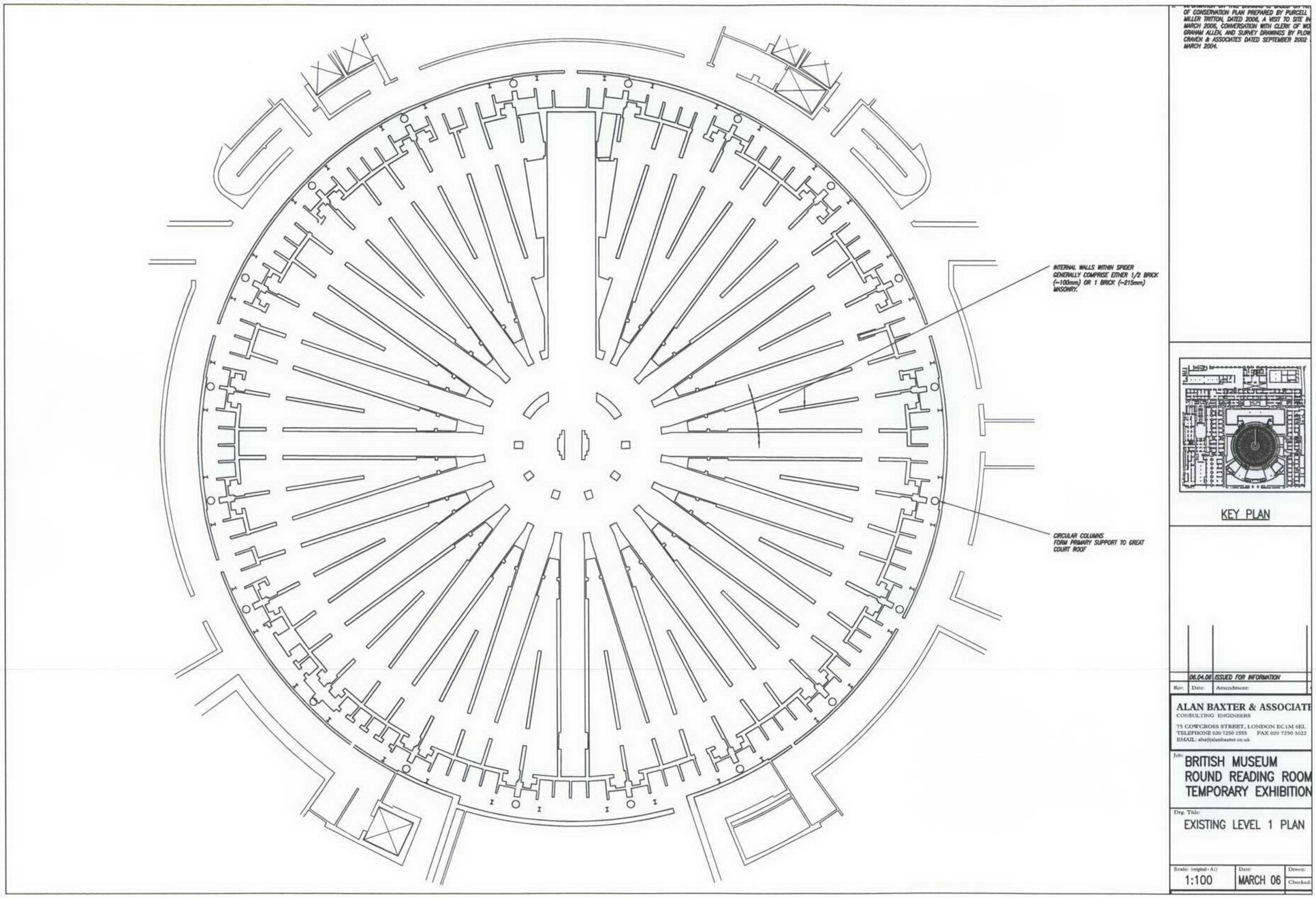
16 With both these options there are three separate layers of structure to consider:

i. The temporary lightweight floor structure
ii. The spreaders
iii. The existing floor structure

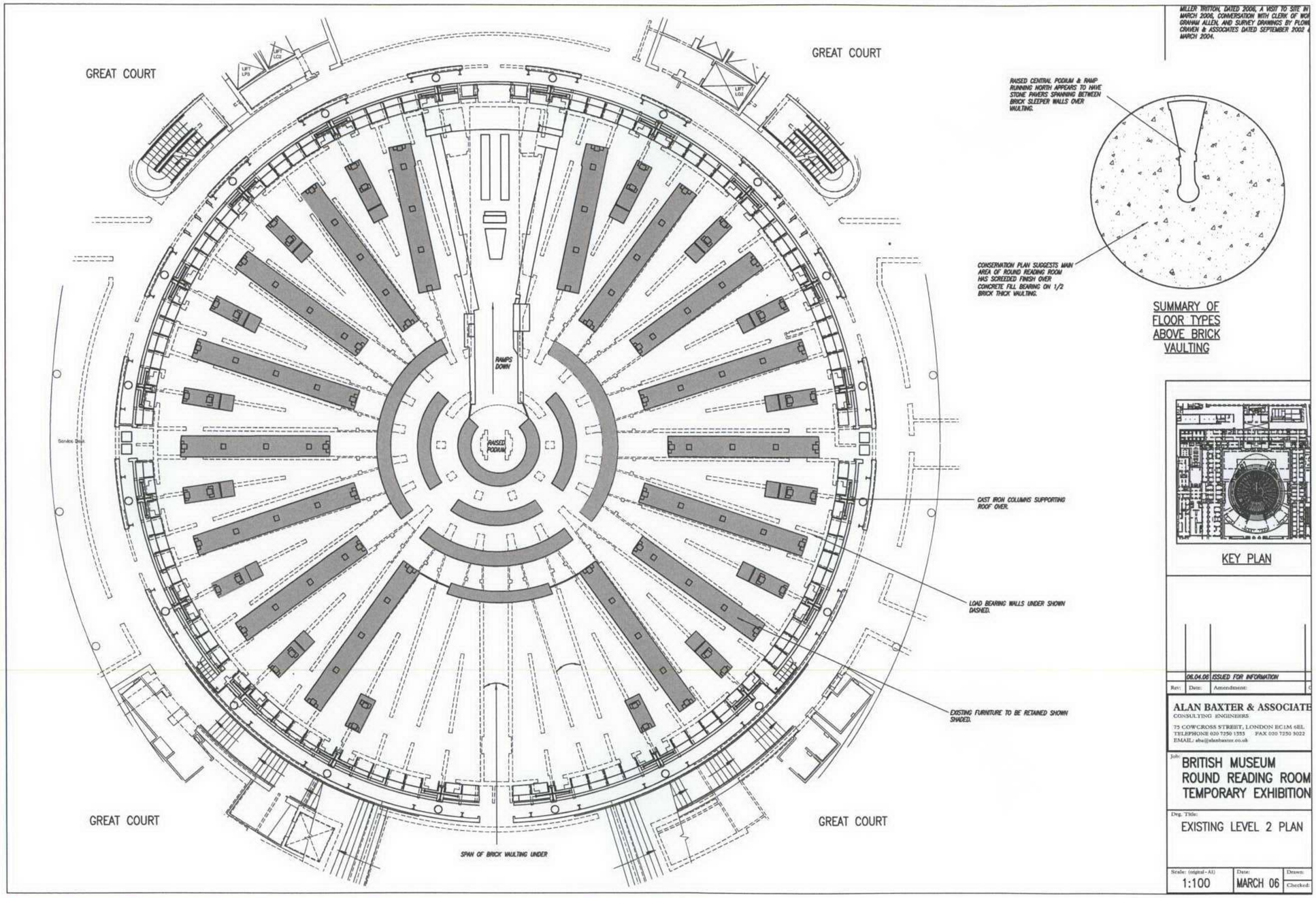
As the third level is fixed, only the first and second levels of structure can be influenced by the design. The lightweight floor will form a much more substantial part of the works, both in extent and cost, and so it may be more appropriate to adopt Option 2. This is illustrated on drawing 14 and is something that will be explored further as the design develops.

William Hosking's proposal dated 1850 for a domed rotunda in the Courtyard

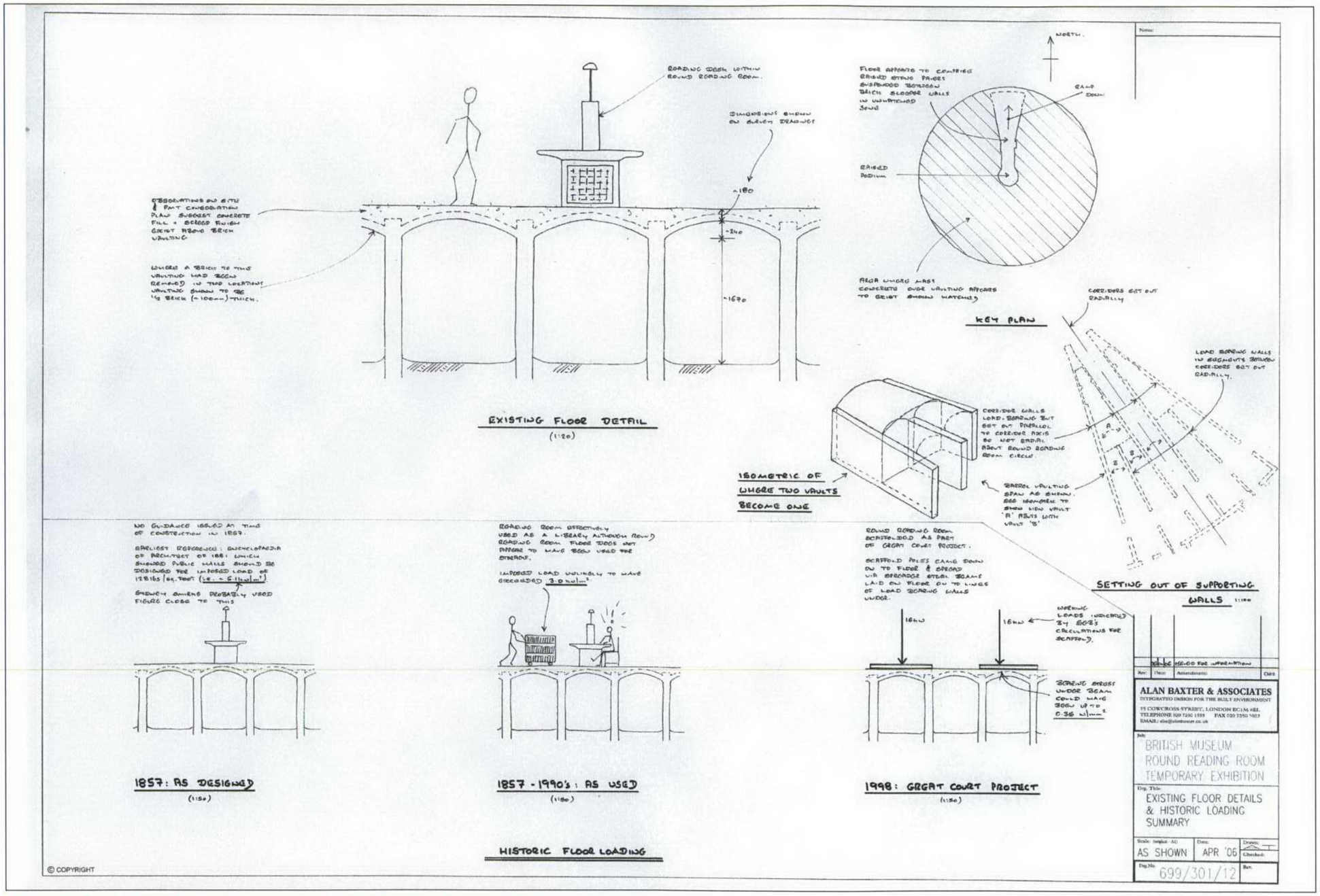
Robert Smirke's plan of the proposed new British Museum 1827



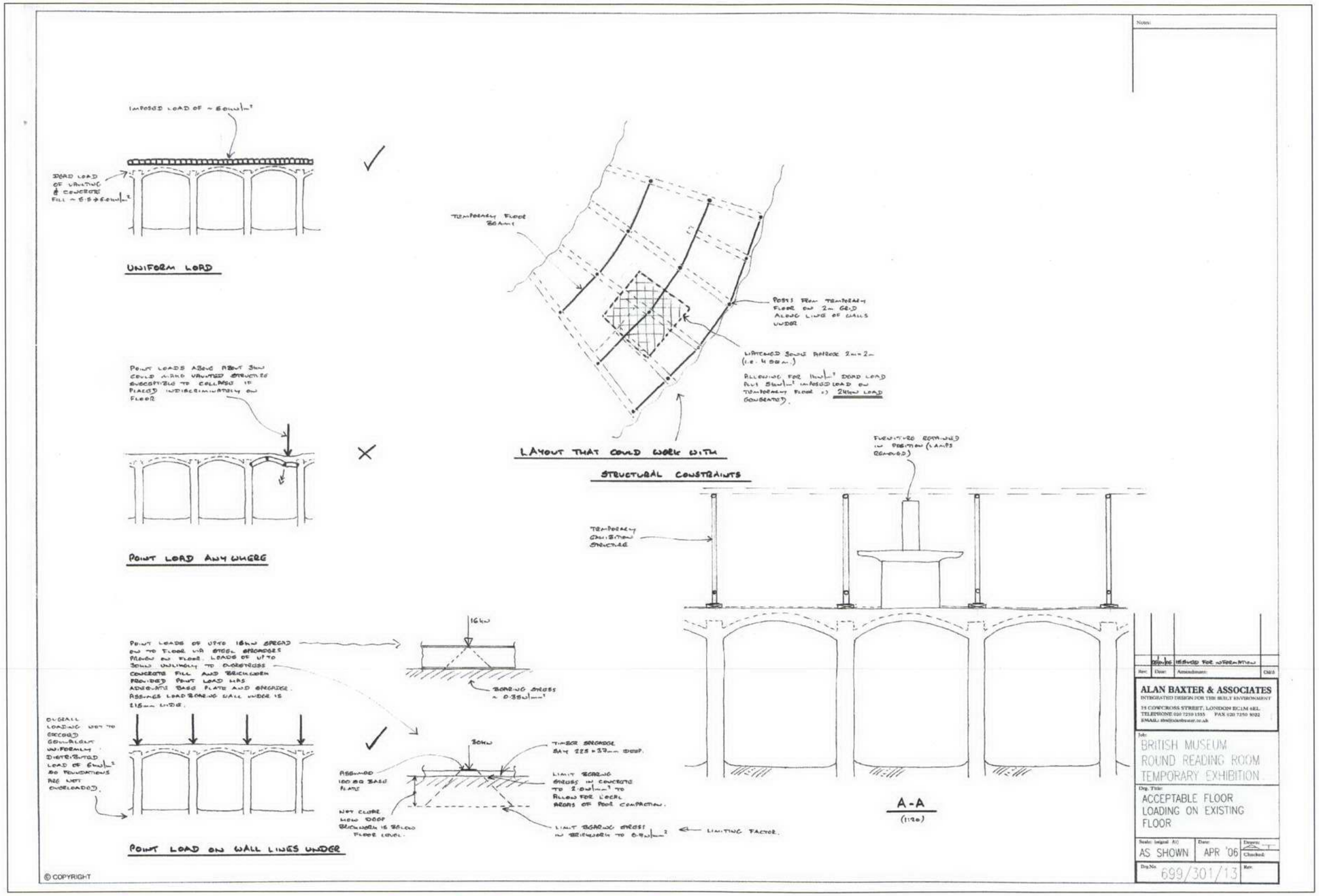
Plan of the ventilation ducts 'The Spider' at Level One below the Round Reading Room



Plan at Ground Floor Level (Level 2) showing the fixed desks in relation to the 'Spider' walls below



Sketch by Alan Baxter Associates showing historic floor loading conditions



Sketch by Alan Baxter Associates showing possible floor loadings for the inserted raised floor