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Structural Appraisal

of

31, South Hill Park, Hampstead Heath, London

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Quality Assurance Page

Issue	Date	Prepared By	Checked By	Approved By	Remarks
P01	12/04/2024	Tim Sheath	MS	MK	

Limitations

This report has been prepared for the sole use of The Client by Paul Owen Associates Limited (POA) and may not be relied upon by any third party without the express written permission of POA.

This report concerns the condition of the structure comprising the existing building only. The report does not make comment on the original design of the structure comprising the existing building, nor its adequacy as installed.

1.0 Introduction

Paul Owen Associates were commissioned by The Client, Mr Mark Sutcliffe, to undertake an appraisal of the property at 31 South Hill Park, Hampstead, London NW3 2ST.

The brief for the appraisal was as follows.

- Undertake a visual inspection of the property
- Consider the condition of the timber mullions on the east and west elevations
- Consider the structural condition of the timber bridge in the rear garden
- Provide an assessment on the current structural condition of the property
- Provide advice on the requirements for further investigations
- Provide a written report of our findings.

The appraisal was undertaken on 22 November 2024 and comprised a visual inspection only without the removal of finishes or any exploratory surveys.

This report should be read in conjunction with the Timber Condition Survey, produced by Six Heritage, Reference SH-1124-01, Dated 7 November 2024[1].

2.0 Site Location and Surroundings

Site address: 31 South Hill Park, Hampstead, London NW3 2ST

Figure 1 – Site Location Plan

3.0 Site Geology

With reference to British Geological Survey maps, the site is underlain by bedrock geology of the London Clay formation.

4.0 Description

The property is a three storey house, constructed in 1959-1960. The property is Grade II listed. The house occupies a steeply sloping plot of land with levels rising from the north-west to south-east. It is constructed with loadbearing masonry walls supporting reinforced concrete floor slabs at ground and first floor. Existing drawing records show mass concrete strip foundations with a 100mm thick groundbearing ground floor slab. The roof is understood to be constructed with timber joists which span the full width of the property, supported on the external walls. The roof is mono-pitched, falling to the west (front) elevation.

Access to the property is via external concrete steps to the street frontage. A steeply sloping embankment is located to the rear of the property.

External walls are constructed in cavity brickwork which is predominantly exposed on the internal elevations. The bricks appear to be calcium silicate and are assumed to be in a sand/cement mortar. The building is built tight to the property on the south elevation, although is understood to have been constructed separately from and at a later date to its neighbour. As a result, the southern external wall is not considered to be a party wall.

The first and second floor slabs are constructed in reinforced concrete. Record drawings indicate that the slabs were precast, although evidence of some in situ elements of concrete were noted on site, in particular around slab edges and steps. There is a step in the first floor slab of approximately 380mm.

The east and west elevations have full height glazing, supported on timber mullions. The timber mullions are substantially decayed, particularly on the rear elevation. It is understood that the east and west timber mullions will be replaced, with new toughened glass, double glazed panels being installed. The condition of the timber mullions and recommendations for their replacement are covered in detail in the Timber Condition Survey (Ref. 1).

Oriel Windows are constructed at ground floor level on the rear (east) elevation at ground floor. These windows are constructed with 100mm concrete slabs at the top and bottom, built into 150mm deep concrete lintels, 285mm wide. The oriel windows project 565mm from the face of the brickwork and the kitchen and kitchen/bathroom combined windows are 813mm and 1385mm wide respectively. The latter has a brick dividing wall between the top and bottom slabs.

An access bridge spans from the rear elevation, across the recessed part of the garden, supported on a concrete foundation at the top of the rear embankment. The bridge is constructed with 4No. timber beams, each constructed as 2No. 47x180 timbers, bolted together. These beams in turn support the timber decking. A timber handrail is constructed, fixed to timber beams spanning in the orthogonal direction to the main bridge beams. The bridge appears to be built in to the masonry on the rear elevation of the house.

The embankment to the rear garden is estimated to be at a slope of around 70^0. There is no visible form of retaining structure.

5.0 Observations and Defects Noted

5.1 Hairline raking cracking was noted in the top corner on the external wall on the northern elevation, close to the western elevation.

5.2 A displaced brick was noted on the rear (east) elevation at the bottom of a projecting pier, on the southern side wall to the property.

5.3 Displaced bricks were noted at the top of the ground floor brick wall on the rear (east) elevation. The brickwork was displaced along the bed joint. Related radial cracking was noted to the left and right of the concrete lintels at the top of the oriel windows.

5.4 The timber mullions to the rear elevation glazing were decayed in a number of locations. Refer to the Timber Condition Survey (1) for a detailed discussion on the defects for external timber. In general, the mullions on the front elevation were in reasonable condition, with more localised areas of decay.

5.5 The timber bridge to the rear of the property was significantly decayed. Refer to the Timber Condition Survey (1) for a detailed description of the defects.

5.6 The concrete supporting foundation to the timber bridge at the top of the embankment appeared to have moved and settled.

5.7 There was no obvious form of engineered retention of the embankment in the rear garden. Stability is believed to be achieved informally through soil cohesion, a covering of loose bricks and the presence of ivy overgrowth.

5.8 There is limited cross-wall stability in the north-south direction above first floor level.

6.0 Discussion and Recommendations

The building appears to be in reasonable condition for its age and construction, notwithstanding the timber defects noted in the Timber Condition Survey (1).

Minor cracking noted on the northern external wall may be due to moisture ingress from the gutter spout in the vicinity of the cracking. The cracks may be repointed internally. The external elevation should be checked for cracking in the same location. Loose brickwork at the base of the pier (5.2) should be re-built in bricks to match existing.

It should be noted that the bricks are believed to be calcium silicate which are considered to be a deleterious material due to their propensity to crack under thermal and shrinkage movements. As the bricks appear to have been used throughout the property it would be reasonable to replace with ‘like-for-like’ bricks where brickwork repairs need to be made.

The cracking noted in 5.3 was considered to have two possible causes: the rotation of the cantilevered concrete slabs to the oriel windows causing movement of the masonry and movement of the timber bridge relative to the masonry support. Both potential causes are considered, as follows.

Oriel Windows

The stability of the oriel windows has been considered. The cantilevered slabs are assumed to be supported by the concrete lintel. The resultant rotation of the lintel is assumed to provide vertical reactions in the centre of each leaf, with the reaction acting downwards on the outer leaf and upwards on the inner leaf. Neglecting any imposed load on the roof slab to the oriel window, the maximum upwards force on the inner leaf is calculated as being 6.3kN. This upwards force needs to be resisted by the self-weight of the brickwork and the concrete slab. There are only 3 courses of brickwork above the top slab of the oriel windows, so mobilisation of the self-weight of the concrete slab is required to provide sufficient stability. Assuming that a 1m strip of concrete slab contributes to the loading, the rotation is resisted with a factor of safety of 1.19. Refer to Appendix A for the calculations.

The Oriel windows should be stable in their current condition, therefore, providing that the brickwork is built tight to the underside of the slab and the deadload of the slab is mobilised. It should be noted that the original architectural details do not show the slab being built into the masonry (Fig 2). Further investigations are required to determine the construction at this point. Remedial measures may be required to provide sufficient resistance to the overturning forces from the oriel windows.

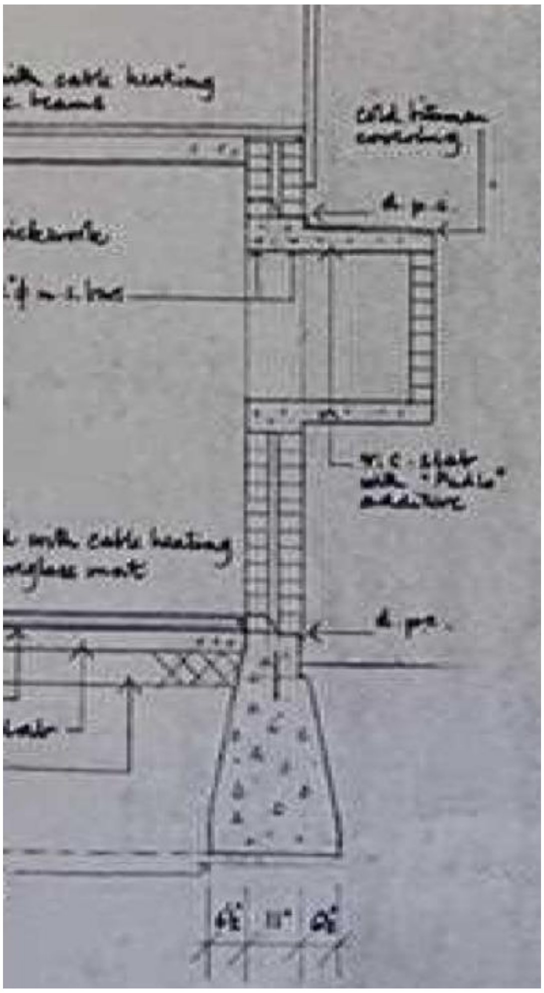


Figure 2 – Detail of Oriel Window Construction

Bridge Bearing

The bearing of the bridge onto the masonry could not be examined. However, it is assumed that the timber beams of the bridge bear directly onto the top of the outer leaf of the ground floor wall.

The cracking and displacement of the masonry may be due to lateral forces applied to the masonry through the bridge bearing. It is quite possible that the embankment which supports the far end of the bridge will move over time, bringing with it the bridge foundation and as a result, applying lateral forces into the brickwork, causing it to crack. It is considered that this is the most likely cause of the cracking, although there may be some additional contribution from the rotational forces arising from the cantilevered oriel windows.

Masonry Repairs

Further investigations will be required to determine the relationship of the concrete slab to the masonry. However, given the extent of the displacement of the masonry, it is envisaged that the top courses of the ground floor wall on the rear elevation will need to be rebuilt. It is envisaged that the new bridge will bear onto the outer leaf of the brickwork and the masonry may be repaired after the new bridge beams have been installed. The brickwork should be re-built re-using the existing bricks where possible and bricks to match existing if additional bricks are required. Bed joint reinforcement may be utilised as a mitigation against future movement.

In order to limit the application of lateral forces to the relatively weak masonry in the future, it would be prudent to provide a movement joint at one end of the bridge bearing and to provide a direct transfer of lateral forces from the bridge bearing into the diaphragm of the concrete floor slab.

Timber Mullions

Based on the recommendations of the Timber Condition Survey, it is expected that the timber mullions will be replaced in full on both the east and west elevations. A hardwood such as teak or iroko may be specified. The members will need to be sized to resist lateral forces arising from wind loading and also to support the additional vertical loading from the heavier replacement glazing.

Timber Bridge

It is understood that the timber bridge will be replaced. The design of the timber bridge is expected to closely match the existing, although hardwoods may be used for enhanced durability.

The bearing of the bridge at the top of the embankments should be improved to limit the settlement and lateral movement that are apparent in the existing. The settlement of the existing base is thought to be related to the instability of the embankment. To avoid such movement in the future, it is recommended to take the foundations supporting the bridge down to a level which will not surcharge the embankment.

A potential solution is shown Figure 3. Mass concrete strip footings are dug to a level below the bottom of the embankment. It is proposed to set the footings back from the face of the embankment so that they can be safely excavated. A reinforced concrete slab would be cast on top of the strip footings which would cantilever beyond the footings to support the bridge bearing. As previously discussed, an articulated sliding joint to the bridge bearings would be provided to limit the lateral forces that can be applied to the house through the bridge beams. The bearing of the bridge at the house end is proposed to bear directly onto the outer leaf of the brick wall. Restraint details may be provided between the bridge beams and the concrete slab to transfer lateral forces into the diaphragm of the first floor slab.

An alternative, concrete piles may replace the concrete strip footings. However, access from the street is complicated which will place restrictions on the type of rig which may be used. Hand augered screw piles may be considered but these will need to be designed for tension forces arising from the cantilevered action of the slab. If screw piles are used, a warranty should be obtained from the piling contractor for the design of the piles.

Embankment Stability

The embankment at the rear of the property is at an estimated 70^0 incline to the horizontal. It is unlikely that it is able to be considered to be stable in its current form and consequently, it is advised that some form of engineered slope stability or retention is implemented. It is understood that an engineered retaining wall is not wanted for aesthetic reasons. Other potential options are as follows.

Soil nailing
Reinforced earth embankment
Gabion walls

These options are discussed in more detail in Section 7.0.

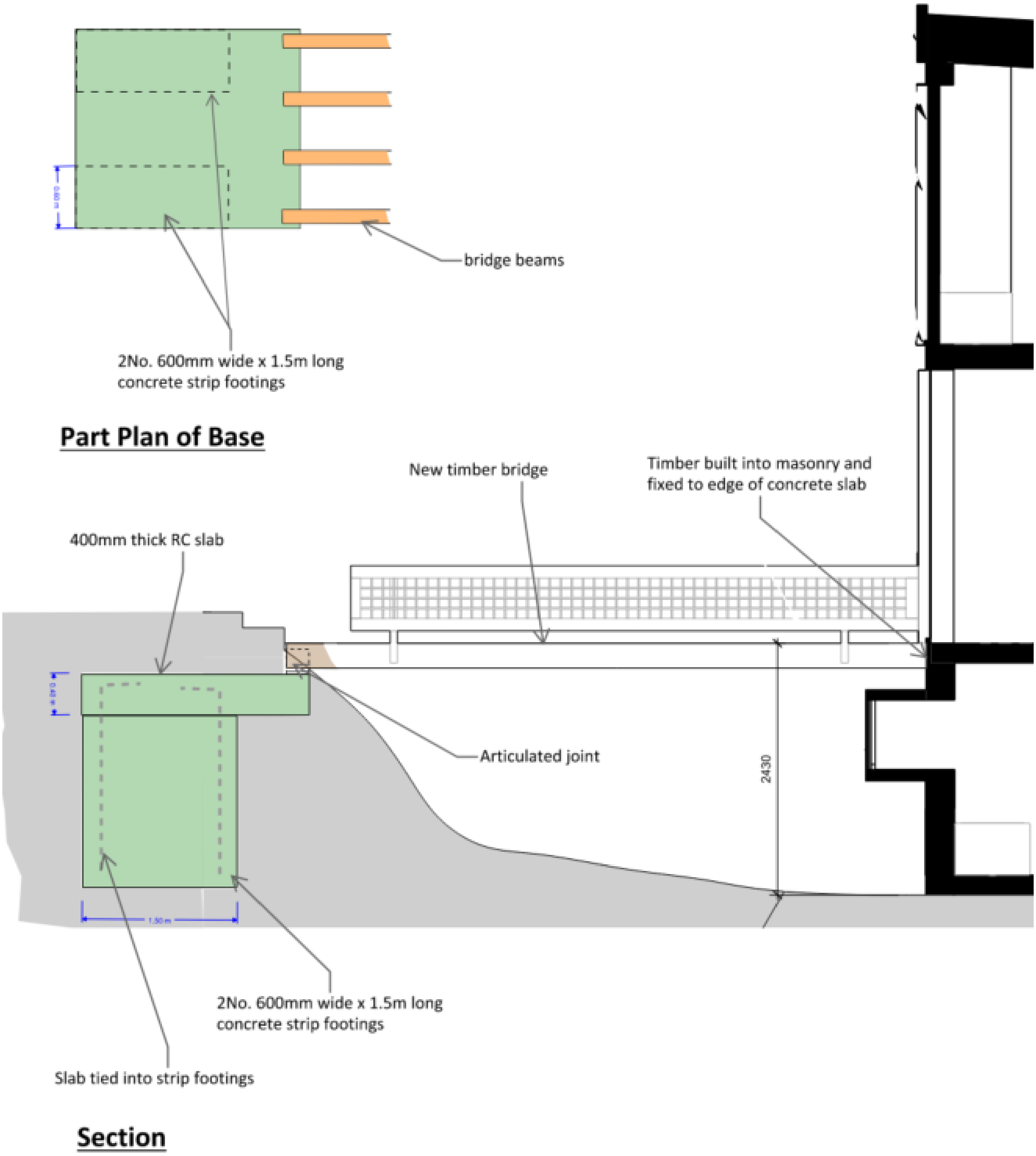


Figure 3 – Proposed Foundations for New Bridge

Condition of concrete

No significant defects were noted in the exposed concrete floor slabs. There are no significant changes to the loading or usage of the property. As a result, at this stage it is considered that concrete testing is not required. The concrete oriel windows are in a more exposed environment and at 100mm thick, will be providing limited cover to the reinforcement. However, these elements may be classed as minor structural elements and as such, it is not considered necessary to undertake concrete tests. Additionally, there is no visible evidence of corrosion of the reinforcement or spalling of the concrete.

Crosswall stability

Due to the presence of full height glazing on the front and rear elevations there is limited crosswall stability to the building above ground floor on the rear elevation and above first floor on the front. However, the presence of relatively stiff concrete floors to provide diaphragm action at first and second floor, transferring the lateral loads into the walls that are present. Some degree of lateral stiffness is thought to be provided by the internal partitions at first floor. There was no evidence of movement that could be attributed to lack of lateral stability noted during the visit.

Given that the building has remained stable since its construction there is no reason to undertake any strengthening works. Care should be taken when re-modelling the first floor partitions to maintain the perceived contribution to stability of the internal walls.

7.0 Remedial Solutions

Masonry repairs

Raking cracking in front top of north external wall – rake out and re-point. Check external elevation and re-point any damaged masonry. Check rainwater outfall.

Dislodged brickwork at base of pier on rear elevation – re-build in bricks to match existing.

Displaced bricks under bridge at ground floor level. Re-build brickwork in bricks to match existing. Place Ancon bed joint reinforcement in the bed joints to strengthen. Re-build and re-point cracked brickwork around the lintels to the oriel windows.

Bridge repairs

Re-construct the timber bridge and handrails in hardwood timber with a structure to match the existing.

Re-support the timber bridge on the ground floor wall of the house. Provide direct fixings to the slab edge to enable any lateral forces to be transferred into the diaphragm of the ground floor slab.

Re-construct the bridge bearing on the garden side with foundations that do not rely upon the stability of the embankment. At this stage, assume mass concrete strip footings supporting a cantilevered reinforced concrete slab, with the detail to be developed at a later design stage.

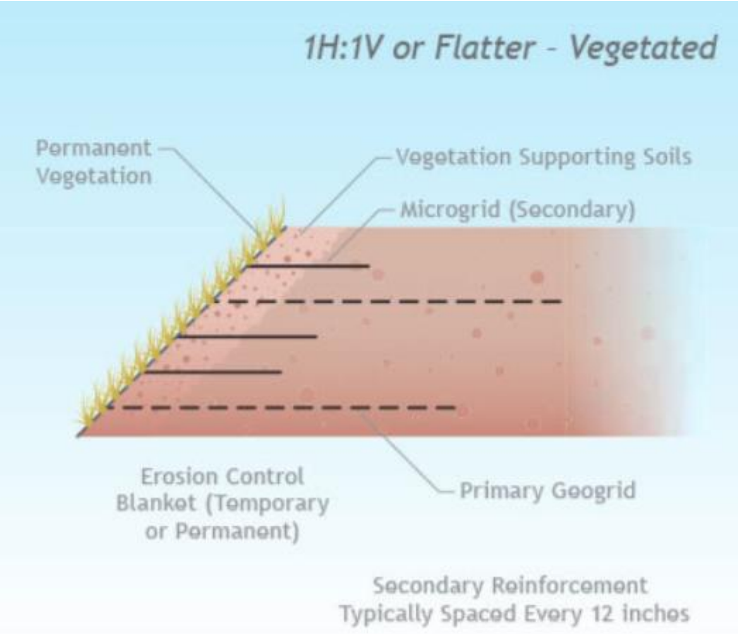
Façade timber repairs

Replace timber mullions with hardwood members (species to be specified by the architect). Match sizes to the original as closely as possible. Check existing base and head connections and replicate as closely as possible. Check timber members for wind loading and increased weight from the new glazing.

Bank stabilisation

The following are options for the stabilisation of the embankment

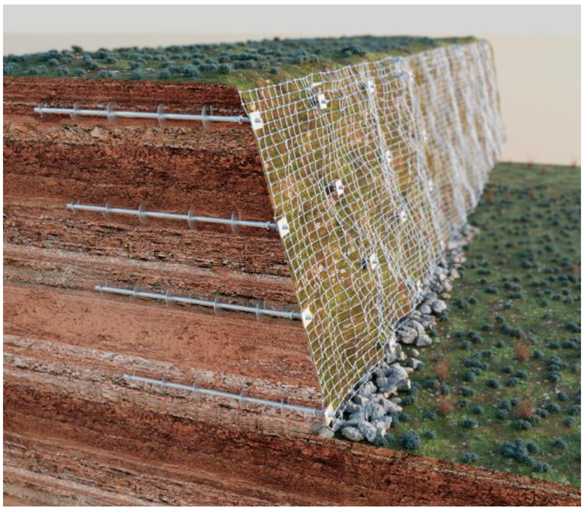
Reinforced earth embankment



Provide Tensar geogrid in layers, with a geogrid face to the embankment. The final design of the reinforced earth embankment would be by Tensar.

This option would require excavation and earthworks in the confined space of the garden, although the material would be kept on site and limited additional material would be required. Care would need to be taken with excavations close to the boundaries with the neighbouring properties.

Soil nailing



Steel screws are grouted into the ground, with a geogrid fixed to the face. This option would minimise the required earthworks. However, it needs to be checked that plant and equipment can be got into position and safely operated in the confined space.

Gabion walls

Rock filled steel baskets that could be stacked in front of the existing retaining wall. Would require the stone infill to be brought onto the site.

8.0 Further Investigations Required

Locally remove brickwork at the top of the ground floor wall on the rear elevation in the vicinity of the bridge. Expose the junction between the slab and the brickwork. Expose the connection between the timber mullion and the slab/masonry.

On the rear elevation at first floor, remove finishes to expose the connection between the timber mullion and the concrete slab.

A site investigation may be required to determine the ground conditions, depending on which slope stabilisation method is adopted.

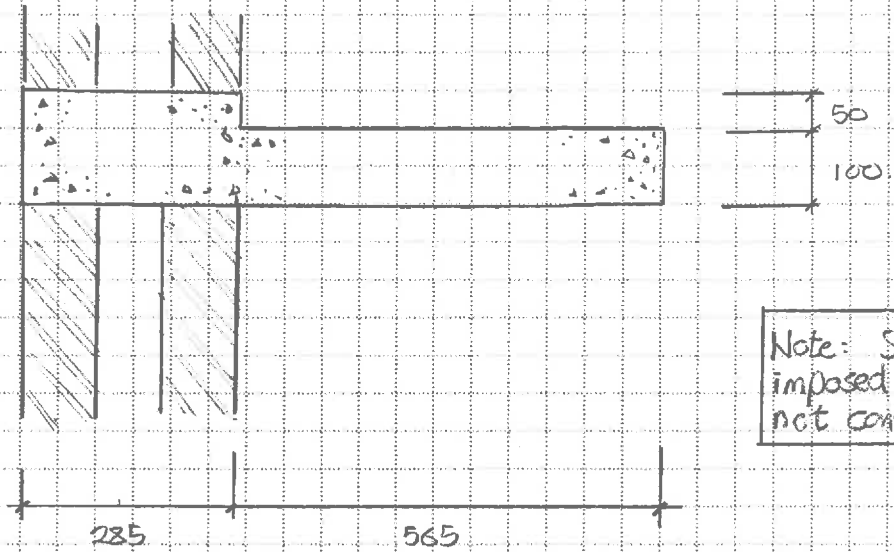
A more detailed topographical survey of the rear garden is recommended to facilitate the design of embankment strengthening.

9.0 References

(1) - Timber Condition Survey Ref SH-1124-01 by Six Heritage
(2) – Appraisal of Existing Structures Third Edition – Institution of Structural Engineers

Appendix A - Calculations

Roof Slab.

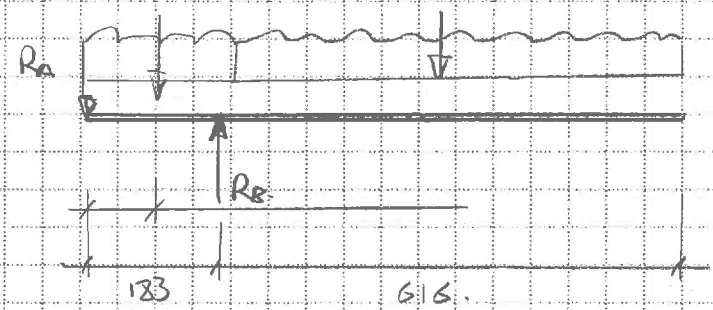


Note: Snow or other imposed loads are not considered.

Loading.

Swt slab = 24 × 0.1 × 0.565 × 1.39 = 1.88 kN.
Swt Lintel = 24 × 0.15 × 0.285 × 1.86 = 1.91 kN

Check rotation about centre of outer leaf



$R_B = \frac{1.88 \times 0.517 + 1.91 \times 0.092}{0.183} = 6.3$ kN

$R_A = -6.3$ kN

Stability.

Assume 1m 1st floor slab plus 3 courses brick above lintel.

Slab = 24 × 0.15 × 1.0 × 1.86 = 6.7 kN.
Bwk = 2.0 × 0.225 × 1.86 = 0.8 kN
= 7.5 kN.

$FOS = \frac{7.5}{6.3} = 1.19$ < allowable.

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Project	Job No.
31 South Hill Park	224057
	Date. NOV 24.
Title	Sheet No.
Oriel Window Checks.	Engineer
	Checked

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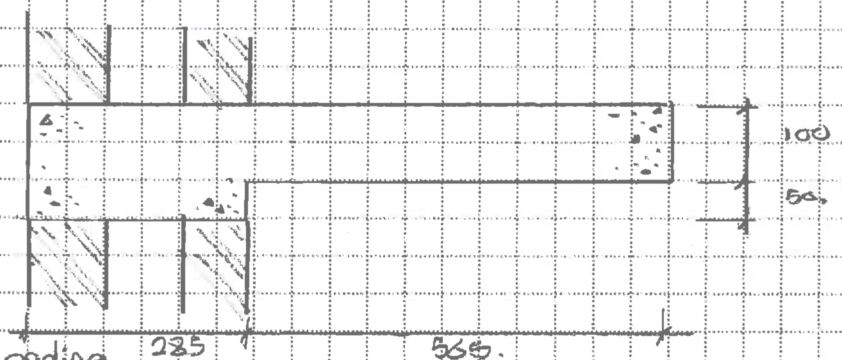
Cill Level Slab.



Loading

			= 1.88 KN
S/W slab	=	Same as roof slab	
S/W Lintel	=	Same as roof slab	= 1.91 KN.
Brick work	=	2.0 × 0.85 × 0.70	= 1.19 KN

Reactions.

$R_B = \frac{1.88 \times 0.517 + 1.91 \times 0.092 + 1.19 \times 0.374}{0.183} = 8.7$ KN.

$R_A = -8.7$ KN.

Check Bearings.

Bearings 235mm wide. Assume equal sharing of loads between bearings.

$R = -\frac{8.7}{2} = -4.35$ KN.

Area of bearing = $0.235 \times 0.102 = 0.024\ m^2$

Apply FoS γ = 1.35 ⇒ $-4.35 \times 1.35 = 5.87$ KN.

Bearing stress = $\frac{5.87}{0.024} \times 10^{-3} = 0.24\ N/mm^2$.

By inspection, bearing stress is less than capacity of masonry providing that there is sufficient dead load on the inner leaf to provide stability.