

The Fernery at The Acacias, University of Reading

Structural Engineer's Report for the Fernery



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Prepared by: Mike Wilford BEng CEng MSc MIStructE
Conservation Accredited Structural Engineer

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1	Feb 2024	For Information
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3	Aug 2025	For Information

1 Introduction

Will Holborow of Purcell on behalf of The University of Reading asked Mike Wilford Associates to inspect the Fernery building at Acacia, University of Reading RG1 5BG to review the structural condition of the building. The Fernery was visited on Wednesday 31st January 2024. Access was possible at ground level both internally and externally. Ladders were provided for high level inspection around the buildings eaves. The inspection was limited to the visible parts of the buildings.

No damp meter readings were taken and no timber was inspected for rot or worm. If you need a report on these matters you should contact a timber and/or damp proofing specialist (eg. Joe Lovelock at Hutton & Rostron tel: 01483 203221 or Tim Floyd at Floyd Consulting tel: 01562 885 806).

2 Historical Background

The Fernery is a single storey purpose built glass roofed conservatory building to the rear of the Acacias and is listed as Grade II as part of the listing for that building. The Acacias villa is of bath stone and dates to the early C19. The Fernery is a later Victorian addition dating to around the late C19. The Fernery is not shown on the 1883 OS Map but then is indicated on the later 1900 OS Map.

The Historic England List Entry Number 1113511 states-

LONDON ROAD 1. 5128 (South Side) No 44 (The Acacias) and Railings to street SU 7272 9/162 II GV 2. Before 1840 (shewn on Weller map). A detached 2 storey and basement villa of Bath stone with hipped slate roof. Moulded eaves cornice. 3 windows 1st floor, 2 on ground floor, glazing bar sashes with flanking full height pilaster strips. Central door with segmental patterned fanlight. Plain Greek Doric porch on stone steps. East return has 2 ground floor bows which have been attributed to Waterhouse as alterations for William Isaac Palmer (of Huntley and Palmers) who lived there - one has stairs to basement. Good conservatory at rear with an extensive rockery. Linked to Greenbank by 3+3 window 3 storey extension with 2 storey pavilion to right. The interior has a number of reeded features (front door surround, ground floor back room fireplace etc). Excellent contemporary ironwork to street - spearhead railings box panel standards and double gates.



Figure 1 – Extract from 1883 OS map showing the Acacias without the Fernery

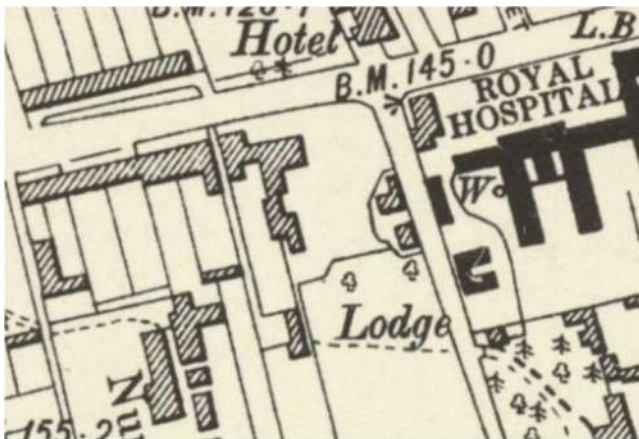


Figure 2 – Extract from 1900 OS map showing the Fernery

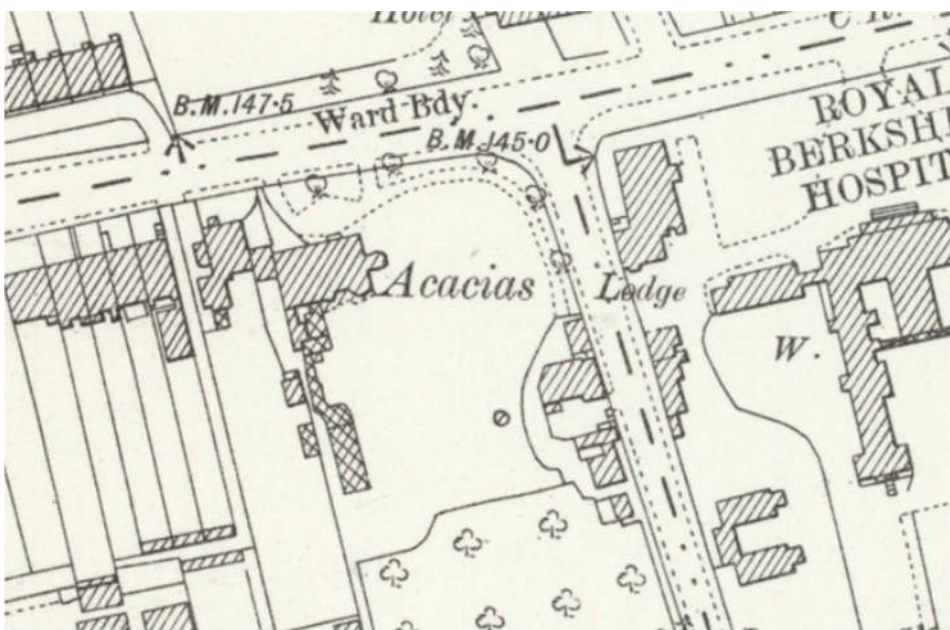


Figure 3 – Extract from 1912 OS map showing the Fernery

3 Description of the Existing Site & Drainage

The Fernery is located to the rear of the Acacias withing the original gardens of the early C19 villa. The ground is generally level with a gentle fall to the north towards London Road.

British Geological Survey maps suggest that the Fernery is within an area of Taplow Gravel Member of sand and gravel over the Seaford Chalk Formation and Newhaven Chalk Formation.

Rainwater should be collected in gutters around the perimeter however the whole Fernery glass roof is missing and has been removed and the structure is now open to the elements. There are several pools built with the floor of the Fernery as part of the original design and these are currently filled with rainwater.

There are 9 cast iron grills fixed into the floor of the Fernery with visible pipework. This is thought to be part of the heating and water management system for the original Victorian Fernery. These and the two pools inside the Fernery are assumed to be part of this original recirculation water management system although the exact below ground details of this is unknown and outside the scope of this investigation.

There are various trees around the building including a very large and mature London Plane to the south beside the corridor. The tree trunk diameter is around 2.3m and is only 500mm from the corridor wall.



Figure 4 – Location plan from Historic England listing

4 Description of the Existing Structure

The Fernery is a single storey glazed conservatory building with loadbearing brick masonry walls originally supporting a glazed timber framed roof. An originally glazed corridor leads to the south. However the roof throughout is in a derelict condition with the original glazing removed throughout. The fernery is L shaped on plan with overall dimensions 9.1m x 7.4m

Brick masonry walls

The brick masonry walls appear to be half brick thick (100mm) with a Pulhamite internal face although it is difficult to determine the brick thickness of the full height wall without further intrusive investigation. The wall to the west is around 2.9m high up to eaves level and is half level to the east up to cill level of the glazed windows.

The Pulhamite is non loadbearing although does add to the stiffness of the brick masonry walls. Pulhamite is thought to be a conglomerate of sand, cement and clinker laid in situ over a core of rubble and crushed brick although its precise mix was not published. It was invented by James Pulham (1820–1898) and is found in many Victorian rock gardens and grottos.

The brick walls around the Fernery are largely true and vertical and show no signs of structural movement despite being so near to the London Plane. There is evidence of severe structural movement to the corridor walls however and this is discussed later.

Glazed timber walls

Originally the Fernery had glazed walls above the half height walls along the Fernery and corridor. The glazed wall in the Fernery has now been covered and protected with plywood sheeting to the outside. The glazing and timber framework has been removed entirely along the corridor.

The timber posts along the wall are connected to the principal rafters by decorative cast iron brackets at the eaves. These posts and brackets are integral to the overall stability of the structure.

There is some outwards lean to the tops of the timber posts along the wall at eaves level due to the movement in the roof rafters and the loss of support.

Roof frames

The Fernery roof is pitched at an incline of around 27 degrees. Primary timber roof frames are set at 1.28m centres and span 4.5m. The frames are stiffened at the ridge and the eaves by a decorative cast iron bracket which provides the principal stiffness to the frame. Principal rafters are 95mm x 60mm and are of softwood.

Many of the original glazing bars are missing and have decayed. The principal rafters are of varying condition with some significant decay at their ends where they meet the wall plate. Several are propped with remedial timber posts to prevent collapse.

Timber wall plates

The timber wall plates are in very poor condition. The wall plate along the full height masonry wall has severely decayed and in parts has decayed entirely.

The timber wall plate along the plinth wall supporting the timber posts within the glazed wall are also in poor condition and have some areas of significant timber decay.

Floor and existing water distribution

The floor of the Fernery is insitu terrazzo concrete with a central duct cast below the slab running through centre the Fernery. The floor is generally true and level although with some surface cracking.

Below the floor is a system of water pipes with the duct, presumably part of the original heating system of the Fernery. There are 9 round cast iron grilles along the duct set into the concrete floor.

The Pulhamite walls have what appears to be water channels cast into them at various locations along all the walls. These appear to be part of some recirculatory watering system and may be tied in with the floor grills and the below ground duct.

Corridor

The corridor is to the south of the Fernery and is around 1.5m wide and 8.2m long. There is an original designed splay in the wall around the London Plane indicating that the tree predates the Fernery.

There is severe movement to the half height brick masonry wall beside the London Plane. The lean over the 1400m height of the wall is between 90-150mm.

There is similar westwards movement to the full height wall or around 5mm and a 5mm vertical crack in the corner where the corridor wall meets the southern wall of the Fernery.

A remedial iron tie bar has been installed at the southern end of the corridor to try to restrain earlier movement. There is some historic cracking to the masonry arch here with evidence of previous repair.

The floor of the corridor has cracked and shows significant upwards movement around the tree roots.

5 Discussion

Current condition of the structural timber

The Fernery is roof is L shaped of 8 bays framed up with principal frames originally supporting glazing and glazing bars. The principal timber frames are stiffened by cast iron brackets at the ridge and eaves on one side along the glazed wall to provide a stiff 'moment frame' to prevent the usual roof spread. Severe decay has occurred to the principal rafter ends where they connect to the eaves brackets on three of the frames and this has comprised the structural stability of the frames.

There is extensive decay to the timber structure and glazing bars. The decay is predominant at the ends of the principal rafters where they bear onto the timber wall plates. The gutters and lowest parts of the roof are difficult to access so more prone to timber decay.

Remedial timber props have been installed to prevent collapse. Without the current props the roof structure would collapse.

Wall plates along the top of the high level western wall have entirely perished from decay. The wall plates still remain along this high level wall can be crumbled by hand and have no structural strength.

This decay and loss of support to the roof frames has resulted in some sway and lean to the glazed wall along the east.

Decay

Decay has affected almost all of the principal timber components including the principal frames and wall plates. Many of the smaller size timber and glazing bars are beyond repair but depending on the architectural proposals some principal timber can be reused and repaired by traditional scarfing, although consideration should be given to full replacement of the principal timber frames. It is recommended that each element is checked in turn during the refurbishment and only repaired or replaced if required.

Masonry walls and Pulhamite

Generally the masonry walls around the Fernery, except the corridor wall, are in good structural condition with no significant movement. The walls are generally half and full brick solid construction with cast insitu Pulhamite of various thicknesses between 150 and 450mm depth. The Pulhamite is essentially a variation of a concrete type conglomerate built up of cement and ballast on a brick core and is fixed directly to the brick masonry wall. This adds significant stiffness to the brick walls and essentially forms a layer of structural reinforcement to the brick masonry adding very significantly to the stiffness of the walls.

Corridor structure

The masonry plinth wall nearest the tree has suffered very severe movement due to the London Plane tree and has probably been leaning for many years due to the growth of the tree. The plinth wall is beyond the usual allowable limits of lean.

The wall displacement is due to the growth of the tree and possibly tree roots along the sides of the wall. It is understood that radial trunk growth can be anything up to 10mm per year and that the tree is at least 120 years old.

The wall at the south end of the corridor has also moved significantly in the past and an iron tie bar has been previously installed above the doorway. The tie bar has been partly successful although ground movement continues due to the tree.

Further investigations

If future remedial works are proposed to the corridor wall then trial pits should be carried out along the corridor plinth wall to investigate the tree roots in more detail. The trial pits should be carried out carefully by hand with the University arboriculturist in attendance to avoid damage to the tree roots. Allow for 450mm x 450mm x 600mm deep pits.

Recommendations for repair

Masonry walls

The brick masonry walls to the Fernery are generally in good condition and can remaining without significant structural repair.

The brick plinth wall beside the London Plane has suffered some very severe movement from the actions of the tree roots. Various options have been considered and these are included in the appendix. The Essential Works option will be implemented at this stage.

Existing cracks should be stitched with remedial stainless steel ties such as Helibar by Helifix and the fracture infilled with new masonry in a suitable mortar to match the existing.

The crack in the western corridor wall should be stitched with a debonded tie to allow for future thermal movements. Stitch cracks with stainless steel debonded ties at 300mm vertical centres. Fill crack with lime mortar.

The southern wall and doorway to the corridor has similarly suffered movement due to tree roots. Cracking should be stitched and repaired and the iron tie should remain.

The cracks in the uneven corridor floor should be filled with repair mortar to prevent future rainwater ingress through the slab.

These repair solutions do not prevent further movement occurring and some future cracking may occur in the masonry. An allowance should be made for future inspections and repair as part of the maintenance programme.

Roof repair

The timber roof is in poor condition and requires very significant repair or replacement. The timber roof should be carefully dismantled and the principal frames assessed for repair. An allowance for replacement of at least 50% of the principal timber structure should be allowed for. This may include scarfing of decayed ends or full element replacement with similar materials to the original profile.

Allow for the full replacement of all timber wall plates throughout supported onto a new brick masonry upstand to raise the roof by around 150mm.

The original cast iron brackets should be cleaned, repainted and reused.

6 Conclusions / Recommendations

The roof structure of the Fernery is in very poor condition and should be repaired and replaced however the masonry walls appear to be generally good condition. The roof should be repaired and reinstated, or carefully taken down to prevent further collapse.

The walls along the corridor nearest the London Plane tree have obviously suffered from significant movement. Cracks should be stitched with stainless steel remedial bars and the walls monitored for future movement and cracking.

All work should be done by an experienced conservation contractor and to the approval of the Conservation Officer.

This report has been prepared for the University of Reading and their advisors, for the purposes noted in Section 1, using the information available to us at the time. It should not be relied upon by anyone else or used for any other purpose. This report is confidential to our Client; it should only be shown to others with their permission. We retain copyright of this report which should only be reproduced with our permission.

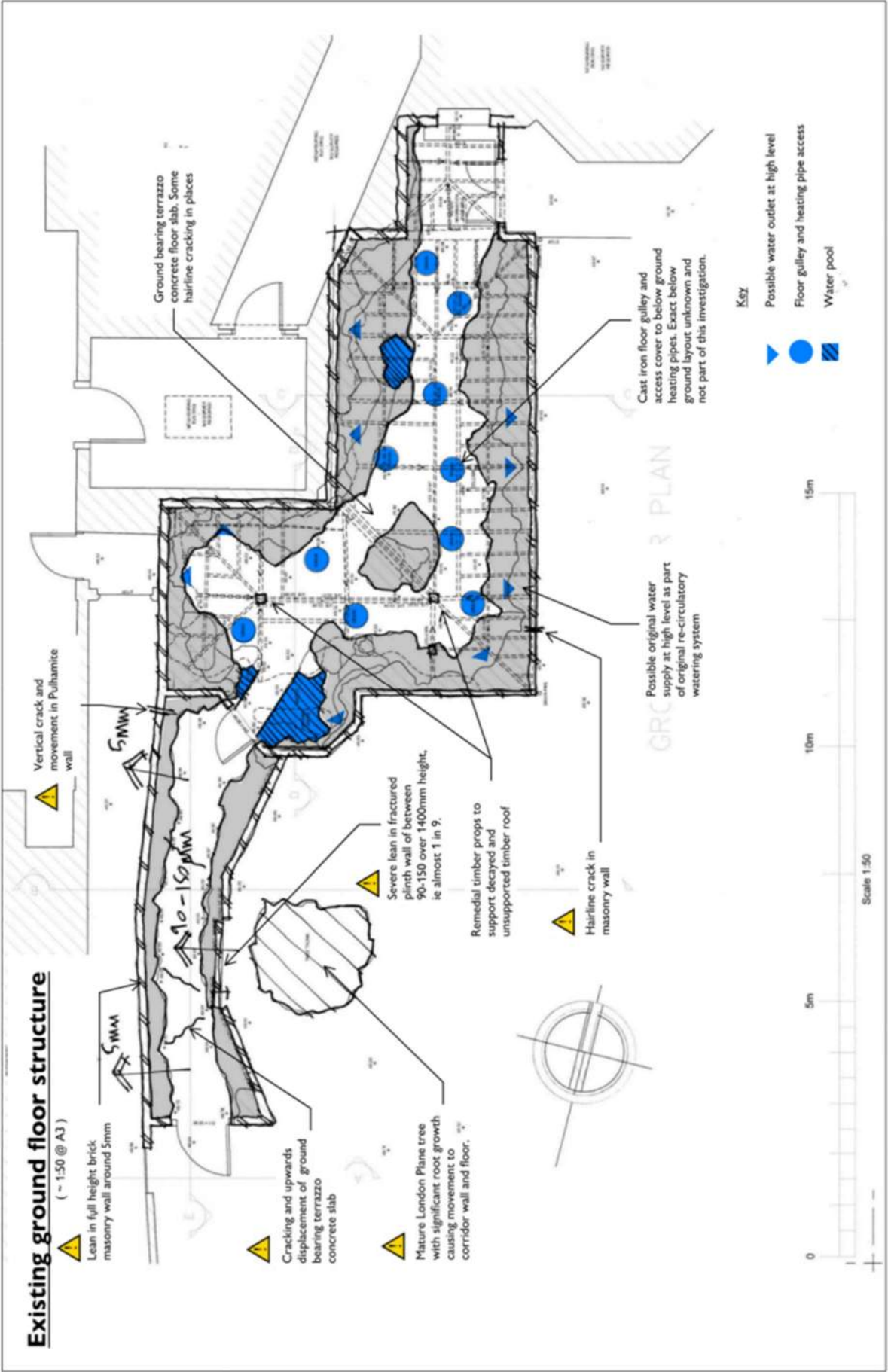
Appendix A: Options for the Repair of the Corridor Structure

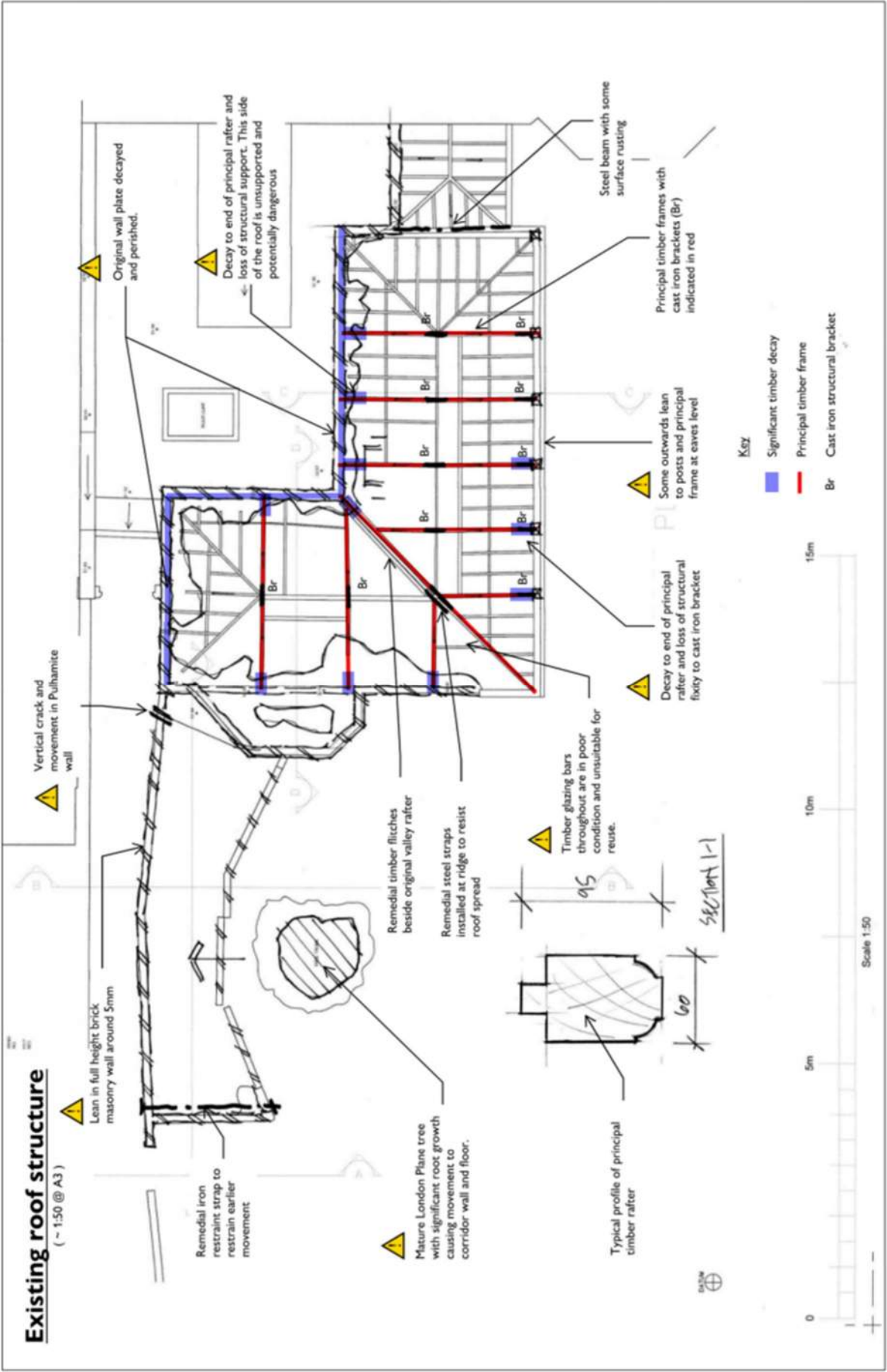
The Fernery, University of Reading

Options for Repair of Corridor Structure

	Works	Dwarf wall	Western wall	Corridor floor
Option A	Essential works. Remove roof structure and cap walls.	Leave leaning and cracked wall as existing. Stitch cracked and displaced brickwork with stainless steel remedial ties. Fill fracture with brickwork in lime mortar. Cap existing dwarf wall. Allow for future regular inspections and maintenance to fill and repair future cracking.	Stitch cracks with stainless steel debonded ties at 300mm vertical centres. Fill crack with lime mortar.	Fill cracks and leave as existing.
Option B	Intermediate option. Leave corridor open.	Carefully take down and rebuild on new 300mm dp x 600mm wide RC ground beam on 150mm dia bored mini-piles, 2 no. every 600mm. Assume 5m long with sleeve for first 1.5m. Wall to be rebuilt with 190mm thick reinforced block wall with root membrane along tree roots.	Underpin wall with 300mm dp x 600mm wide x 1200mm long RC underpin needle caps on 150mm dia bored mini-piles each side every 900mm.	Remove slab and install new 175mm RC slab on void former. Slab connected to wall each side with H12 bars at 200mm centres resin fixed into masonry walls and cast into slab.
Option C	Full refurbishment including new roof over corridor.	Carefully take down and rebuild on new 300mm dp x 600mm wide RC ground beam on 150mm dia bored mini-piles, 2 no. every 600mm. Assume 5m long with sleeve for first 1.5m. Wall to be rebuilt with 190mm thick reinforced block wall with root membrane along tree roots.	Underpin wall with 300mm dp x 600mm wide x 1200mm long RC underpin needle caps on 150mm dia bored mini-piles each side every 900mm.	Remove slab and install new 175mm RC slab on void former. Slab connected to wall each side with H12 bars at 200mm centres resin fixed into masonry walls and cast into slab.

Appendix B: Sketches





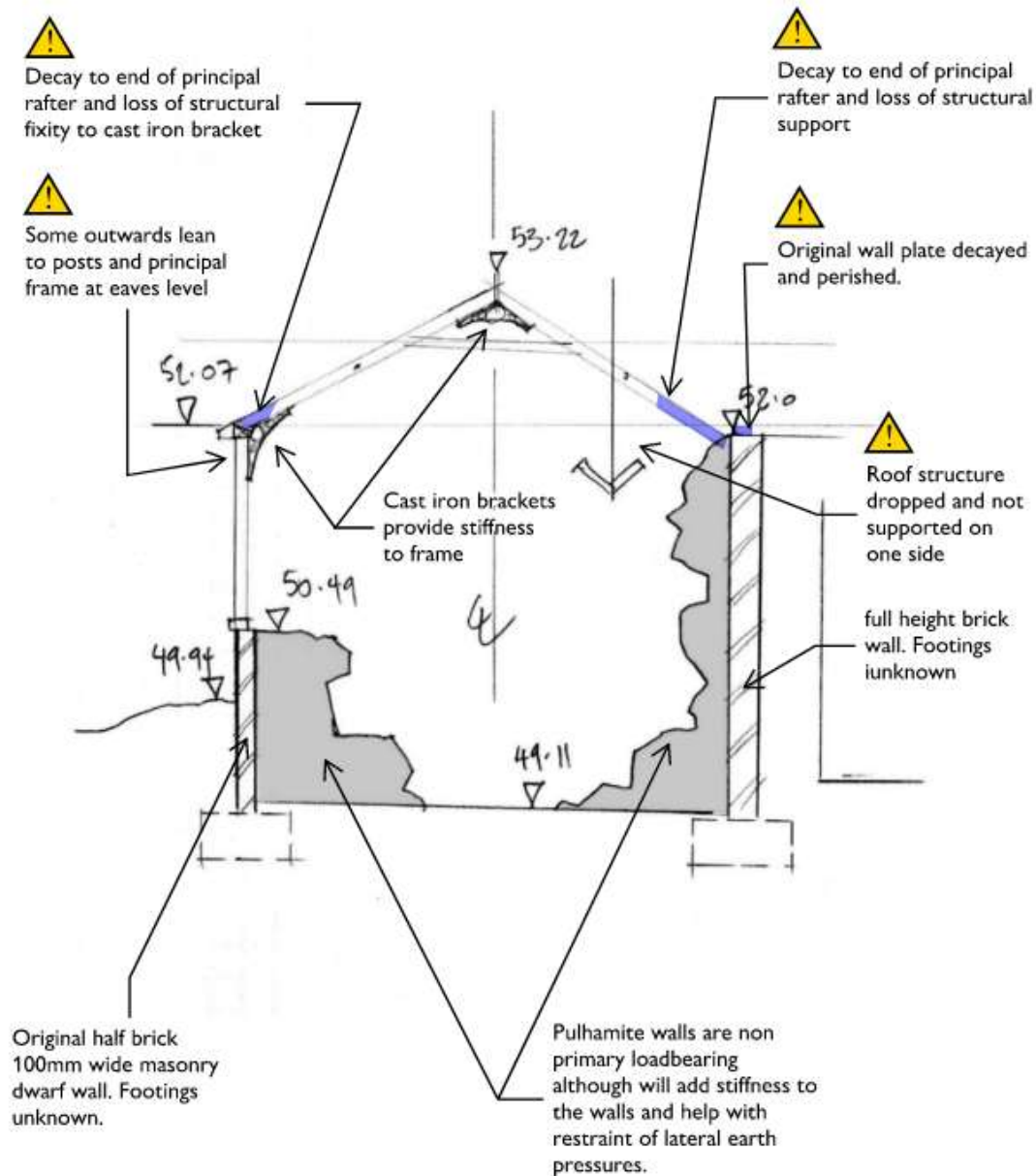
Mike Wilford Associates
Consulting Engineers

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Job The Fernery at Acacias

Cross section through existing structure



Appendix C: Photographs



Photograph 1 – East facing wall to the Fernery. Note original glazed wall now protected with temporary boarding.



Photograph 2 – Southern wall and mature London Plane around 4.0m away.



Photograph 3 – Internal view of the Fernery facing south. Note temporary central prop for hip frame.



Photograph 4 – Fernery floor with cast iron duct within the terrazzo concrete slab.



Photograph 5 – Cast iron floor duct part of the original heating and water management system.



Photograph 6 – Temporary timber prop



Photograph 7 – Pulhamite arch over walkway. No signs of distress.



Photograph 8 – Pitched roof structure looking north towards the villa. All glazing has been removed.



Photograph 9 – Porch structure to the north with glazing still in place but protected by plywood soffit below.



Photograph 10 – Severe decay at end of principal rafter



Photograph 11 – Severe decay to glazing bar and loss of support.



Photograph 12 – Timber wall plate above the west wall has limited access and traps water easily.



Photograph 13 – Wall plate above west wall is perished.



Photograph 14 – High level wall plates hidden behind Pulhamite walls.



Photograph 15 – Temporary timber prop supporting end principal frame.



Photograph 16 – Temporary timber prop and face fixed steel straps each side of principal rafter.



Photograph 17 - Decayed ends to principal rafters and lack of support.



Photograph 18 – Decayed ends to principal above cast iron eaves brackets.



Photograph 19 – Several decayed ends to principal rafters at junction with cast iron brackets. Note glass protected by plywood.



Photograph 20 – Several decayed ends to principal rafters and decayed glazing bars



Photograph 21 – Glazing bars previously removed from western pitch



Photograph 22 – Pulhamite wall cast along western wall.



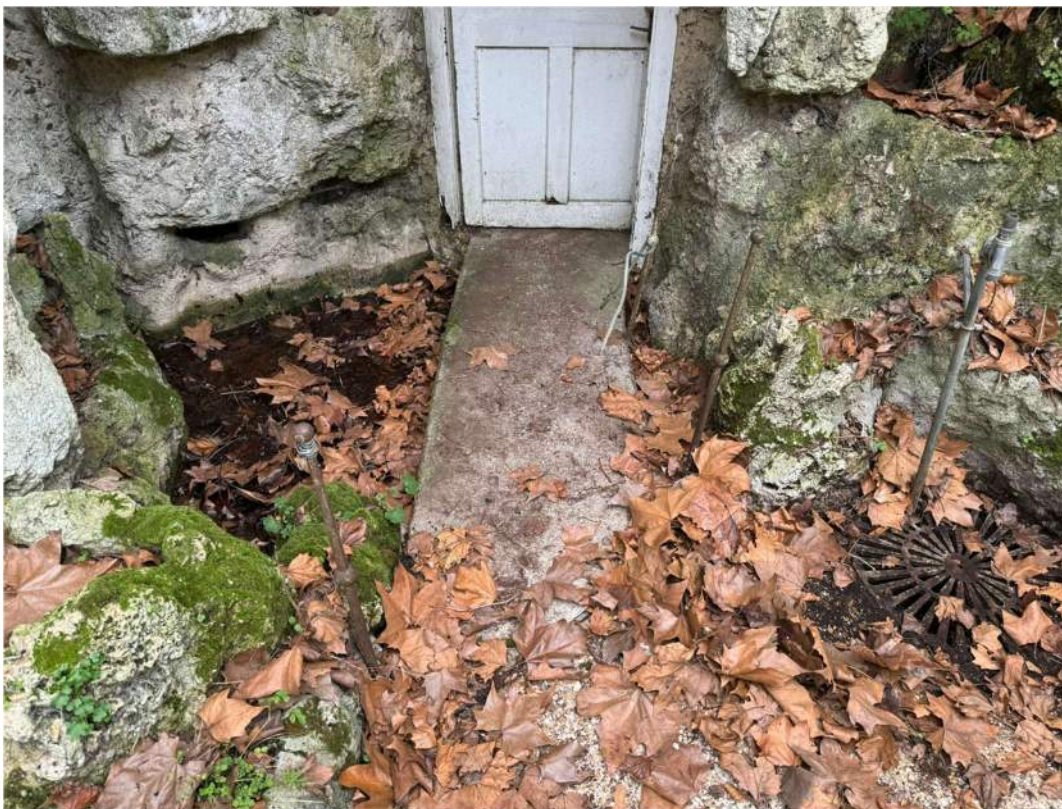
Photograph 23 – Vertical channel formed in Pulhamite wall. Potential location of high level water supply.



Photograph 24 – Base of vertical channel leading to water pool, part of original recirculation system.



Photograph 25 – Pulamhite arch across door with hidden wall plate above



Photograph 26 – Path beside water pool



Photograph 27 – Channel for water distribution within Pulhamite and brick wall and supporting structure beyond/



Photograph 28 – Brick supporting structure with Pulhamite and brick wall beyond.



Photograph 29 – Channell in Pulhamite from high level



Photograph 30 – Boxed in steel beam along valley gutter



Photograph 31 – Boxed in steel beam and ply timber soffit crash deck



Photograph 32 – Some surface rusting to steel valley beam



Photograph 33 – Ply crash deck with glazing and glazing bars above. Some glass panels missing.



Photograph 34 – Damp and fractured render to plinth wall.



Photograph 35 – Glass wall above brick plinth protected by ply sheeting



Photograph 36 – Outwards lean to timber posts and frame.



Photograph 37 – Perished cast iron gutters.



Photograph 38 – Perished timber wall plate along brick plinth wall



Photograph 39 – Brick cheek wall, Remnant of earlier removed glazed wall along corridor.



Photograph 40 – Pulhamite wall in corner of corridor and location of 5mm vertical crack



Photograph 41 – Detail of 5mm vertical crack in Pulhamite wall.



Photograph 42 – 90 – 150mm displacement in wall over 1400mm height.



Photograph 43 – Proximity of London Plane tree and severe displacement of plinth wall.



Photograph 44 – Cracking and movement in ground bearing concrete slab beside London Plane.



Photograph 45 – Cracking above entrance arch to corridor.



Photograph 46 – Historic and repaired cracking above entrance arch.



Photograph 47 – Earlier remedial tie bar above entrance arch.



Photograph 48 – Channel for missing timber wall plate above entrance arch. Remnant of earlier glazed roof.



Photograph 49 – Rear corridor wall has some minor lean of around 5mm.



Photograph 50 – Large and mature London Plane tree very close to the corridor wall.



Photograph 51 – Render rear to the corridor wall and some hairline cracking.