



Bruce Castle: West Boundary Wall Final Report on the Condition and Repairs

April 2024

James Barnett
Project Manager
Corporate Landlord



Housing, Regeneration and Planning
Haringey Council, River Park House, London, N22 8HQ

BUTLER
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ARCHITECTS

BRUCE CASTLE: West Boundary Wall

Final Report on the Condition and Repair

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Appendix A: Structural Engineer's Statement by Hockley and Dawson

BHA Drawings

Note: this report accompanies the Listed Building Consent application and Heritage Statement submitted by BHA, which includes the following drawings:

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- Su01 External Wall Existing Photo Collage
- Su02 Internal Wall Existing Photo Collage
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- Sk08 Bruce Castle West Boundary Wall Proposed Internal Elevation



Image 1: Minor area of collapse

1.0 Summary and Introduction

- 1.1 This report on Bruce Castle West Boundary Wall is a more comprehensive statement about the wall and repair proposals following the earlier initial and interim reports dated March 2023 and October 2023 respectively, subsequent propping (currently in place), plumb survey and opening up investigations carried out in August 2023.
- 1.2 We first inspected the wall in August 2022. The second inspection of the wall took place on 10 March 2023 with the structural engineer Clive Dawson of Hockley and Dawson (see Hockley and Dawson report attached). The earlier report pointed out the rapidly deteriorating condition of the wall. The wall remains in a perilous condition: it has subsequently been propped as suggested in the earlier report, and there has been a minor area of collapse (see Image 1). This report is to accompany the Listed Building Consent application for the long-term repair of the wall.
- 1.3 The photographs presented in the first report provided clear visual evidence that the wall was deteriorating rapidly over a relatively short period. Action was taken to prop the wall and total collapse has been temporarily avoided at the expense of closing the footpath. Since the propping was installed, a number of investigations have been carried out to help establish a more comprehensive understanding of the wall. The wall has deteriorated further.
- 1.4 The investigation carried out in August 2023 deepened our understanding of the wall and has informed this revised statement and report on its condition. However, there is a complex array of likely causes of decay contributing to the current condition of the wall. It is apparent that the conditions that are causing the decay of the wall are interlinked and there is no simple solution to the multitude of issues that affect the wall or that might be relevant when considering how best to intervene and stabilize the wall in the long term.
- 1.5 **Pre-app discussion and planning**
The interim report dated October 2023 was shared with the Haringey's Conservation Team and the Historic England Inspector who came to visit the site in December 2024. The findings and issues concerning the repair of the wall, as set out in the interim report of October 2023, were discussed on site with both parties. The proposed repairs that form this application were outlined and the outcome of the meeting was the current Listed Building Consent application.

2.0 History and relevance of the wall

- 2.1 The Heritage Statement accompanying the application assesses and sets out the significance of the wall in some detail. The history includes recent archival research and documentation of the West Boundary Wall at Bruce Castle. This in turn has highlighted the likely heritage significance of the wall as part of the Bruce Castle site.
- 2.2 The wall is generally considered to be 17th century. The brickwork includes a range of bricks: the earliest might date from the late 17th century. There is some limited documentary evidence that supports such a date. It is possible that the wall was first built in relationship to the development of Bruce Castle by Henry Hare, the second Lord Coleraine, who carried out extensive works between 1682 and 1684. The earliest documentary evidence for a west boundary wall is that it is shown in a 19th century engraving of the 1686 Wolridge painting of the house and grounds, and this image shows a western boundary wall possibly with buildings along its length, enclosing a courtyard (see image 2).

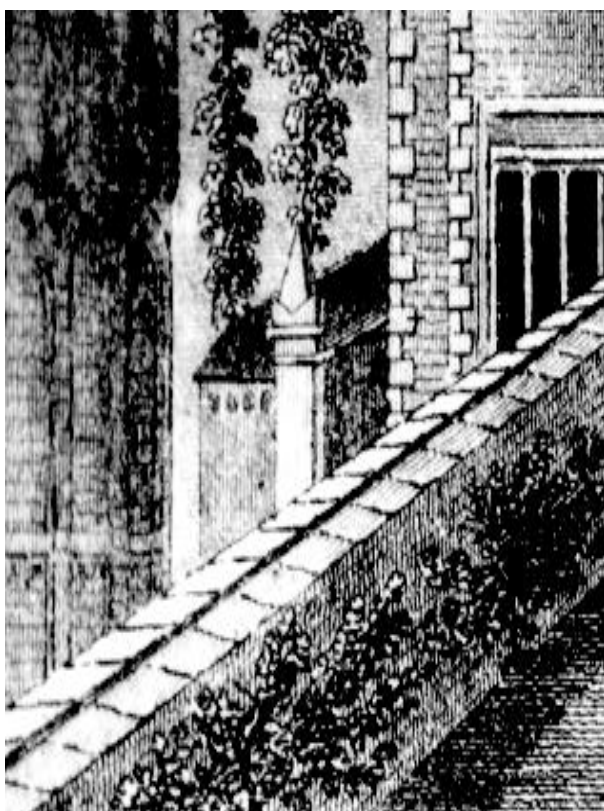


Image 2: Extract from 1686 Wolridge painting of the house and grounds



Image 3: Revealed battered profile

- 2.3 The Western Boundary Wall also comprises of later material, most of which is likely to be 18th century. At the north end of the wall, there remains a small section of wall alongside where it has been lowered and rebuilt in the 20th century, (see image 3) revealing a battered profile. This comprises of a one and half brick wall with a battered internal face to reduce its dimension at the top to one brick wide. This is typical of the form of a garden wall of the 18th century, and the brickwork is consistent with such a date. The full extent of this boundary wall is unknown.
- 2.4 There is considerable documentary evidence in the form of engravings and maps that show that the wall, during the latter part of the 18th century, had a number of building structures along its eastern side. These structures, which could have been latter additions to an earlier wall or built as an integral part of the wall, formed the western edge of what is likely to be a service courtyard to the west side of Bruce Castle. The buildings along the site boundary are likely to have contained stabling and ancillary service

accommodation. These buildings are shown on both the 1865 and the 1894 OS maps which confirms that they were extant up until the very end of the 19th century. These buildings have been demolished by the 20th century OS mapping.

- 2.5 The fact that the wall is the remnant of buildings that once formed a service courtyard accommodation and that it also can be associated with the earliest phase of building that survives at Bruce Castle, elevates its heritage contribution significantly. The wall is therefore extant evidence of the broader Bruce Castle site and provides a better understanding of the heritage asset beyond that normally associated with a simple structure enclosing the site boundary.

3.0 Description of the current condition of the wall

3.1 East elevation

The vast majority of the east face of the wall, to the south of the change of height at the northern end, is flat in profile with regular buttress piers forming bays. The buttress piers are approximately 225 (one brick) x 450 (two bricks wide) in Flemish bond. They are not fully coursed or bonded with the wall, with areas where bricks are butted and straight jointed to the wall. The piers are a later addition to the wall. The buttress piers are in a lighter stock slightly larger brick than the main wall and have been laid in cement mortar (see image 4). This suggests that the piers were additions to the east face of the wall and at the earliest date from the beginning of the 20th century. The piers therefore are likely to be added at a time when the buildings along the eastern face of the wall were demolished. Alternatively, they could be a later 20th century repair to a wall that was failing. Documentary evidence confirms that the buildings were removed from the west boundary sometime between the 1913/15 and the 1935 OS mapping of the site. The buildings are still shown along this boundary (see image 5) on the 1913/15 OS maps, and their removal is related to the Local Authority early 20th century alterations and remodeling of the site.



Image 4: Buttress piers along east elevation

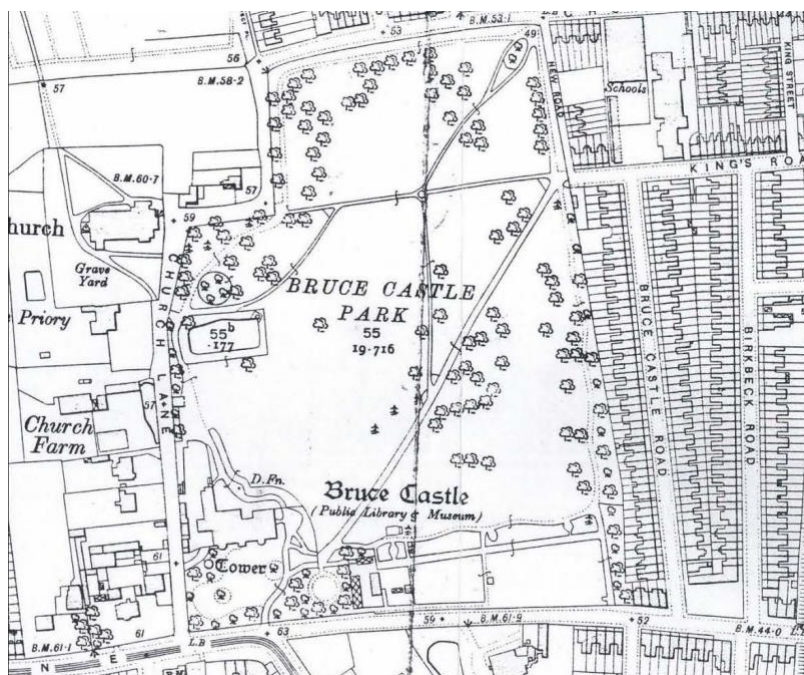


Image 5: 1913/15 OS Map showing Bruce Castle west boundary wall without buildings along its length forming a west courtyard to the house

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- 3.2 At some point in the 20th century, a cement render was added to the east face of the wall in the panels between the piers. The render is lined to represent stone ashlar work and to the southern end there are a number of plaques and artifacts from the museum collection fixed to the rendered surface. The header bricks forming the coping to the wall have been adjusted to sit flush with this rendered face. The cement render at high level is heavily water-stained throughout the length of the wall. The render has a horizontal crack at approximately half its height to all bays of the wall (see Image 6). In some areas, the cement render is no longer bonded to the wall.



Image 6: Horizontal crack on render at approximately half its height to all bays of the wall.



Image 2: The revealed condition of the core brickwork of the wall

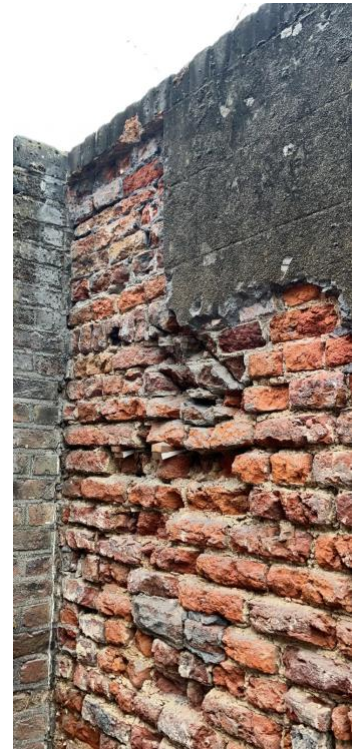


Image 8: Hybrid bonding pattern, common in 18th century garden walls

- 3.3 Investigation to explore the feasibility of removing the render has revealed the condition of the core brickwork of the wall (see image 7). The wall at low level is in a lime mortar and is built in a loose English Garden Wall bond comprising of header and stretcher courses, sometimes alternating, and sometimes mixed with three courses of Flemish bond brickwork. Such a hybrid bonding pattern is common in 18th century garden walls (see image 8). The cement render is failing in places and inducing moisture ingress into the wall. The cement render traps any moisture that has entered through cracks in the render in the core brickwork.
- 3.4 The wall is one and a half brick wide with voids between the skins. The wall's dimension is 400mm wide at its midpoint. This dimension has been taken where a brick has been removed for investigation purposes. This investigation also revealed that there are larger voids in the centre of the wall. This suggests that the wall was possibly laid in two skins with scant attention paid to the bond or fill brickwork. This separation of the bond situation has been exaggerated over time by the snapping of the header that at one time bonded the walls together. This can be seen on the attached photo where there has been an area of collapse (see image 9). In addition, the wall was part of a building and originally the eastern face was an internal face to now demolished buildings, thus setting up significant differential conditions between inner and outer skins of the wall. The result is that the outer skin of brickwork forming the wall has, over a period, separated from the inner skin and course of the wall. This is evidenced by the considerable bulging of the wall in its height at numerous places along its lengths.



Image 9: Snapping of header causing an area of collapse



Image 10: The foundation of the wall

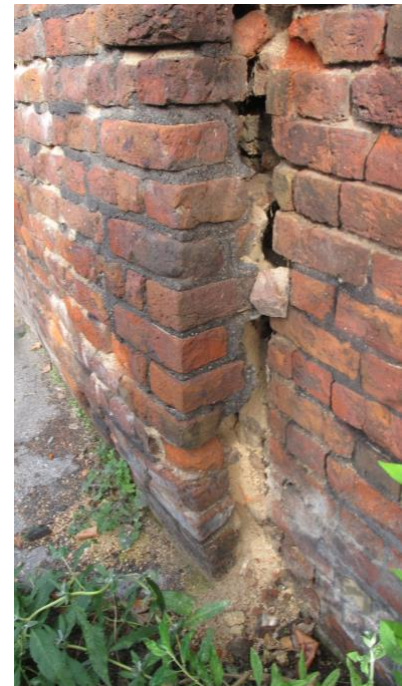


Image 11: Image of bowed offset prior to collapse

- 3.5 A plumb survey record has been made of both faces of the wall. This is recorded on BHA drawings Sk06, Sk07, Sk08 of west wall). The plumb survey indicates that the wall is bowing at its midpoint. In some places this is up to approximately 100mm on the western side. Nevertheless, the head and foot of the wall remain tolerably aligned on the west side. The plumb survey of the east side of the wall generally shows that it deviates slightly from plumb, but given its height, this is generally within acceptable tolerances and is not unexpected. The result of the plumb survey is indicative, therefore, that the wall is not overturning or suffering significantly from any rotation, either from ground movement or above ground forces. This observation is upheld by the coherent nature of the foundation of the wall (see image 10).
- 3.6 A trial pit has been dug on the eastern side of the wall to explore the depth of the foundations and generally this has revealed foundations in rather better condition and more consistent than most garden walls. The foundation depth is recorded as 900mm below the existing courtyard level. The foundations have one offset step of 100mm at a depth of 450mm. From the trial pit, it would appear that the foundations of the wall are in extremely good condition (see image 10). Foundations of this depth, and regularity, are possibly a further indicator of the fact that the wall was formerly the western elevation of buildings along its length.
- 3.7 The bowing of the wall at its maximum on the west side of the wall corresponds to where very sandy loose mortar is being washed out through the brickwork perpend from the wall core. This occurs most profusely at the offset in plan, where the wall bowing is at it worse and where there has recently been a small collapse of the wall. In addition, in this area of the wall, there is considerable cracking of bricks and open vertical perpend and mortar missing from the bedding joints (see image 11).

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Image 12: Photographic elevation showing water damage.

- 3.8 The photographic record elevation of the wall has also revealed an important aspect that is contributing to the current problems of the wall: the photographs of the west side of the wall reveal a wide band in the wall at a mid-height that is considerably wetter than the top or bottom of the wall (see image 12). This indicates that moisture is entering either the top of the wall or through the cracks in the cement render on the east face and migrating through the core of the wall to the western face. The wall has buddleia growing from its top and in other places along the wall. Removing some of the internal render has revealed an extensive matrix of fine roots at the top of the wall that is contributing to moisture entering the course of the wall.
- 3.9 In addition, the wall, at an earlier date, was lower in height, and there is a clear set of header bricks at approx. seven courses down from the current headers forming the top of the wall. These headers can only be seen where the render has been removed on the eastern face of the wall. This is likely to explain the rather odd coursing on the western face, where the bedding courses generally run down to the north end and contains cut bricks forming a made-up course approximately in line with the header course on the east side. The top courses of the wall, above the former header course have been rebuilt in cement mortar using imported later bricks in the 20th century.

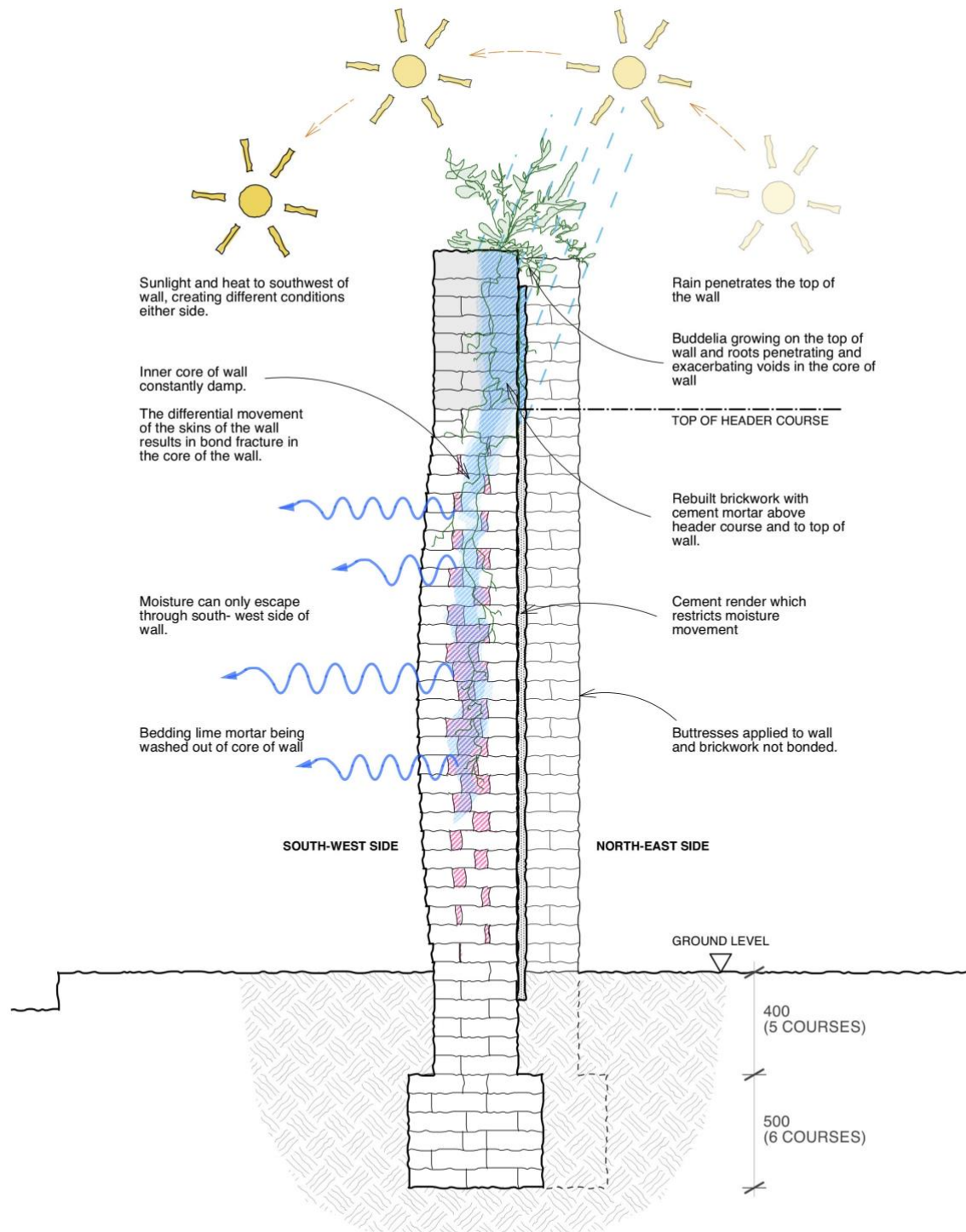
4.0 Causes of Decay of the Wall

4.1 There are several factors that are contributing to the current condition of the wall. The diagram attached below (see image 13) summaries the issues that might be detrimentally affecting the wall and these can be described as follows:

- east west orientation creating differential micro environmental conditions either side of the wall
- the east side of the wall was once an internal face of earlier buildings. These buildings have now been demolished, and the wall and its brickwork are likely to reflect the different conditions
- in the 20th century, the cement render has been applied to the east face of the wall, exacerbating the variety of the conditions on either side of the wall
- the cement render to the east face of the wall has horizontal cracks at approx. half height, allowing water to enter the core of the wall
- the cement render is not moisture permeable, forcing any moisture that has entered the wall to its west face
- an open and inconsistent brick bond pattern through the thickness of the wall creates voids within the wall
- the wall is one and half brickwork, and the outer western 'skin' of facing bricks has not been particularly well bonded to the rest of the wall, which was built with central voids filled with mortar, rather than a coherent bonded mass of brickwork
- the top of the wall has been rebuilt
- the top of the wall to the east side has a considerable area of brickwork in cement mortar
- the top of the cement render to the east side show signs of excessive water staining
- the top of the wall has a large amount of buddleia growing through the mortar, with an extensive root system embedded through the wall and behind the render which allows water to enter the wall
- the lime mortar of the wall has deteriorated and is now being washed out of the core of the wall to the west side
- the west side of the wall has throughout its length, a middle third band of damp brickwork

4.2 The issues above, describing the condition of the wall, are combining to create the observable distortion and current deterioration of the wall. The west side of the wall is now significantly bowed in several places at its lower middle third point. This bowing is caused by the outer west facing bricks separating from the core of the wall. The wall now requires a comprehensive approach to its repair and the extent of the intervention and remedial works to stabilize and conserve it as a heritage asset is now considerable.

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**BRUCE CASTLE WEST BOUNDARY WALL
SECTION ANALYTICAL SECTION**

0 0.4m 2m 1:20

Butler Hegarty Architects
Unit 3.2, Islington Studios, 159-163 Marlborough Road, London, N19 4NF
tel: 020 72638933 email: mail@butlerhegartyarchitects.co.uk

Bruce Castle
Title: Bruce Castle West Boundary Wall Section
Analytical Drawing
Drawing No: 0722422-Su11 Scale: 1:20 @ A3

Image 13: Bruce Castle West Boundary Wall Analytical Section

5.0 Explanation of the progressive worsening of the wall's conditions, in light of its recent collapse

5.1 The current problems and recent collapse of a small section of the wall have been caused by the facing brick skin, (west side) of the wall becoming detached from the core of wall. The wall is poorly bonded throughout its thickness and length - a fact exacerbated once the headers within the wall have snapped, which has occurred over a considerable timespan. As a result, the outer skin of brickwork is effectively a free-standing thin wall approx. 110mm or ½ brick thick. The subsequent failure and recent collapse of the wall is the result of a combination of issues that can be summarized as:

- the effective slenderness ratio of the west skin of brickwork, which is now problematic,
- the wall is susceptible to movement from external forces, such as wind load and vibration from the adjacent carriage way
- differential conditions either side of the wall
- the moisture and thermal movement within the wall
- material degradation within the core of the wall.

5.2 Moisture within the wall

Differential environmental conditions either side of the wall, together with the fact that the internal face of the wall is rendered with cement mortar, forces all moisture that enters the wall out through its west face. The top of the wall has been rebuilt several times in cement mortar, which restricts moisture movement and now has extensive buddleia growth in fissures and cracks. The buddleia makes the top of the wall susceptible to moisture ingress. Moisture ingress is exacerbated by water that affects the wall through the cracks in the cement render that encourage moisture to enter into the wall but effectively block moisture evaporation through its cement rendered covered surface.

5.3 Brickwork practice

The brickwork of the wall of this ilk, location and date was typically built of bricks that were, to varying degrees, selected for purpose. In this case, the bricks used for the external west face of the wall were typically better-quality facing bricks, while the inner face and core of the wall were secondary or inferior 'place' bricks. The outer face would have been laid by a bricklayer, while the inner face of the wall and any fill was often carried out by an apprentice who followed the work of the master craftsman. In addition, a one and a half brick wall built from either side results in the use of a considerable number of snapped headers, often used, as in this case, to reduce the quantity of top-quality bricks required. These differences in material and workmanship contribute to a lack of coherence to the brick bonding of the wall and contribute to the voids that are now evident in the core of the wall.

5.4 Mortar

The moisture in the wall core has saturated the mortar used to fill voids. In so doing, it has degraded the mortar, and this has affected the lime binder in the mortar. The result has reduced the mortar, over a long period of time, to its loose constituent parts, and sandy particles have gradually been 'washed' out of the open mortar perpendicular joints between the bricks, creating bigger voids within the wall core, that in turn have further exacerbated the disengagement of the outer skin of the wall (its west side) from its core.

5.5 This array of interrelated issues, are all contributing to the current problems. There is no apparent simply solution. The wall is approximately 50.0 M long to its west elevation and almost 3.0 M tall. The whole wall is affected by the conditions described above, so the potential work to rectify the problem is extensive. The range of defects that exist within the wall and that affect it, can only result in the progressive worsening of the wall's condition. Not intervening is no longer an option, as is evident by the recent collapse of a small section of the wall. Similarly, a process of pinning the bowing west face back to the core of the wall is no longer a viable repair as the voids in the core of the wall are excessive.

6.0 Detailed repair proposal description and report

- 6.1 The proposals within this application are to repair and rebuild the damaged West Boundary Wall, which is currently starting to collapse in parts. This will include the replacement of brickwork where the existing bricks have been damaged or broken, and the removal of cement render to the internal face of the wall. As much of the existing brickwork, where possible, will be retained. Where it is necessary to dismantle the brickwork, the bricks will be salvaged and reused in the rebuilding of the wall. The wall will be rebuilt to bond and pattern to match existing and to the existing height of the wall. The proposed works will remove the current health and safety risks to the public that are posed by the potential collapse of the wall. The likely scope of rebuilding and repointing of the wall are shown on the drawings (accompanying this application). The assessment shown on the drawings is based upon the visual and plumb survey.
- 6.2 A primary consideration in the repair of the works is to reduce the differential conditions between the east and west sides of the wall. The proposal is therefore to remove the cement render to the east face of the wall: this is a critical intervention to stabilizing the wall. Once the render is removed, the revealed brickwork can be repaired using salvaged and imported new bricks to leave as a brick face.
- 6.3 The removal of the cement render to the wall will be carried out using hand tools. From our inspection of the wall, some areas of the render have cracked and de-bonded and tapping tests suggest that some areas of the render are hollow and have de-bonded. Areas of render that has de-bonded, that account for approx. 35% of the render surface, are normally relatively easily removed without excessive damage to the bricks. The investigation and sample area of render removal demonstrate that removal of the cement render will have a varying effect on the brickwork forming the wall. Therefore, the extent of the brick repairs will remain uncertain at the outset. The aim is to retain as much historic brickwork as possible and salvage, wherever possible, historic fabric, to leave a coherent wall face. It should be noted that this approach will result, on completion, in some areas of brickwork, once repaired, having damaged brick faces and surfaces.
- 6.4 Once the render has been removed from an area, a judgment will be made, and broken or heavily damaged bricks will be marked before being individually drilled, cut out, removed and replaced with salvaged or imported bricks laid in bond pattern to match the existing. It should be noted that the removal of a brick can often reveal hidden damage to adjoining bricks, which extends the amount of brick repairs. On the completion of the repair of an area of brickwork, the wall will be raked out and repointed with lime mortar with a flush stippled finish to approved samples.
- 6.5 The repair process of the inner east face of the wall can be summarized as follows:
- remove the cement render one bay at time in a hit and miss pattern, using hand tools only
 - leave brick piers in place
 - remove header coping and take down top course of brickwork and salvage as many bricks as possible
 - inspect and mark up brickwork where render has been removed
 - cut out individual bricks or small patches of brickwork using short timber props and wedges to hold bricks in places
 - replace individual bricks to original bond pattern to match existing
 - complete repair of brickwork to one bay and rebuild top course as removed using salvage and imported new bricks
 - rake out and repoint brickwork using a lime mortar with flush stippled finish

This does not resolve the bulging to the outer west face of the wall.

6.6 West face of the wall

The core of the wall is very fragile and uncertain so a process of pinning and dowelling of the bowed brick skin, back to the core of the wall, is not a viable alternative, therefore the removal and dismantling of excessively bulged areas of the wall and rebuilding the west face in section is the only viable option. This will inevitably include rebuilding sections of the wall from ground level up, although the full extent

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of the rebuild is difficult to closely define before works starts. The very nature of the proposed careful piecing in and conservation repair works is notoriously difficult to fully define before work starts. It is recognized that there remains a risk that the work will result in larger interventions and associated potential loss of fabric than is desirable. This nevertheless offers the best opportunity to retain and conserve the remaining historic fabric. The methodology outline below has been designed to minimize the loss of fabric and ensure that as much as possible of the wall is retained.

- 6.7 Top of wall and buddleia
- take down approx. top 10 courses of brickwork, including 1 and 1/2 brick on edge coping
 - salvage bricks and rebuild in lime mortar
 - remove as much buddleia as possible and treat the top of the retained brickwork with pesticide
 - fill all voids in retained brickwork with lime mortar
 - the external west face of the wall has several 'pigs' in the coursing which are difficult to reproduce when rebuilding these will be carefully recorded and the brickwork will be rebuilt to line not level.
- 6.8 The current application seeks to establish the acceptability of carrying out the works to the west boundary wall as described above and in the following methodology.

7.0 Methodology

7.1 General Overview of Works

The repair of the wall will be carried out in the following sequence.

- record west face of wall
- remove render to East side of wall in hit and miss bays
- take down top of wall in sections
- repair brickwork to east side
- mark up west side of wall to be dismantled
- rebuild west side of wall in small areas, bonding into core
- rebuild top of wall
- repeat above to missed sections of wall to complete repair
- repoint wall to both faces

7.2 The full methodology is as follows:

A Record west face of wall bond and pattern using photographs drawings and gauge rods

Before dismantling damaged brickwork, carefully inspect wall to anticipate full scope of works. Record wall bond and pattern using photographs and drawings, noting bond pattern on drawings and producing a gauge rod marking all bricks and joints. Provide copies of material produced to the architect before dismantling continues.

B Remove cement render using hand tools only in alternating bays, leaving piers in position.

C Record revealed brick wall where render removed and mark up repairs to east face of wall.

D Take down top of wall in short lengths including brick on edge coping, salvaging bricks for reuse where possible.

E Mark bricks to be removed to east face where render removed.

F Repair internal face of brickwork using new and salvaged bricks.

G Identify areas of brickwork to west face of wall to be taken down and carefully take down area of bowing and dislodged brickwork to west face of wall as agreed with architect.

H Rebuild west face of wall to line, using salvaged and new bricks to line to remove bulges.

Rebuild brickwork bonded to core of wall using new and salvaged brick to match colour, texture and size of original brick. New bricks will be handmade bricks produced by Bulmer Brick and Tile to match existing bricks in size, colour and texture and initial samples have been sourced (see image 14). New bricks will be mixed with existing bricks in any area of rebuilding.

All brickwork to be rebuilt to bond to match existing wall and to existing height.

Areas of rebuilt brickwork to west face will be tied to the east wall using header bricks and stainless-steel ties and the core of wall will be consolidated with lime mortar.

K Leave rebuilt areas of west wall toothed to be integrated with next section of wall repair.

L Rebuild top courses of brickwork and coping to line, retaining position of 'pigs' and cut bricks to west face of wall to be repeated (note: brickwork rebuilt to line not level).

M Repoint wall in lime mortar

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All brickwork along wall and piers to be repointed using 'hot lime' mortar in a mix to match existing and agreed with architect. Existing mortar should be cut out using a plugging chisel and hand tools only to a minimum depth of 25mm, leaving square cut recess to receive new pointing.

Pointing to have tamped and stipple finish to match existing and to sample agreed with architect.



Image 14: Initial sample handmade bricks produced by Bulmer Brick and Tile to match existing

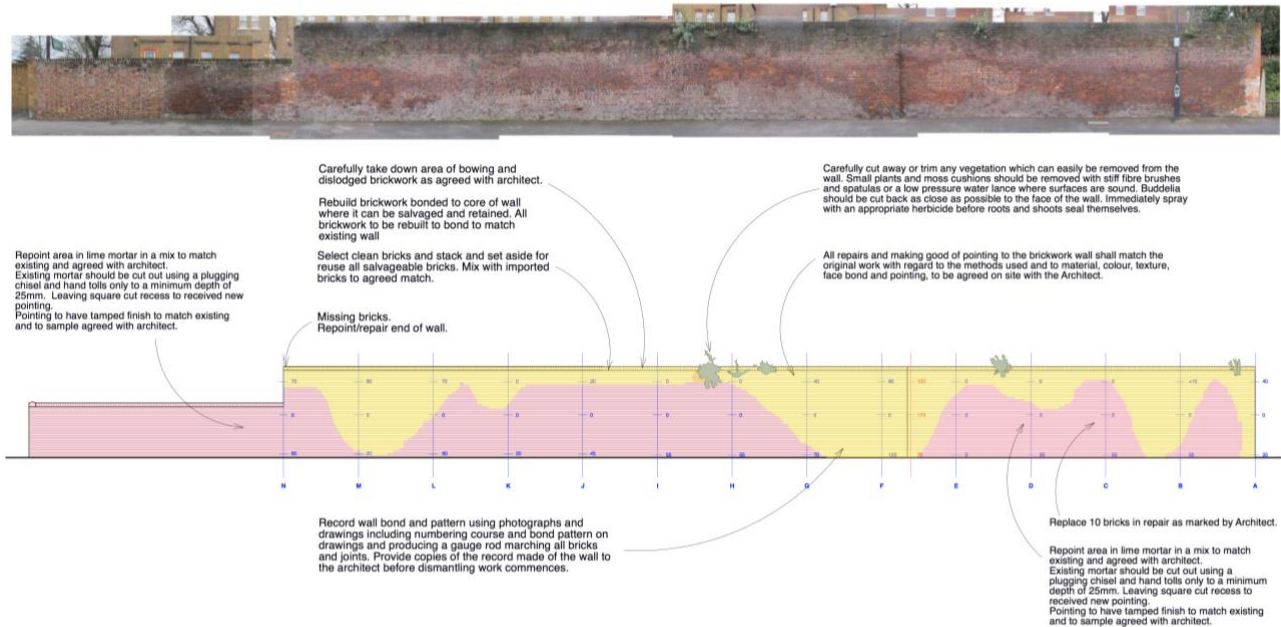


Image 15: Existing External Wall Photo Collage and Indicative Repairs to External Elevation

5 Birtley Courtyard
Bramley
Surrey
GU5 0 LA

Tel: 01483 548784
Fax: 01483 268765
Email:
admin@hockleyanddawson.co.uk

HOCKLEY & DAWSON
CONSULTING ENGINEERS

21645
Bruce Castle
Lordship Lane
N17 8NU

West boundary wall, southern junction.

Inspected 10th March 2023.



Bulged and delaminating section with visible void and loose bricks. This section is considered to be dangerous with the possibility of failure resulting in uncontained collapse. It is particularly vulnerable to impact damage.



View looking south along the wall showing bulging masonry and a batter to the brickwork.

Missing and inappropriate pointing is also evident.

5 Birtley Courtyard Tel: 01483 548784
Bramley Fax: 01483 268765
Surrey Email:
GU5 0 LA admin@hockleyanddawson.co.uk

HOCKLEY & DAWSON
CONSULTING ENGINEERS



Separation at southern junction showing void to core of the wall and a lack of bond to the facework.

The verticality of the west face varies considerably, some sections being significantly out of plumb..

The opposing face is less out of plumb.

The bulged and delaminating section is considered to be dangerous and has the potential to fail suddenly and in an uncontained manner. It is also vulnerable to impact damage again leading to uncontained failure.

We feel the pavement should be closed and temporary buttresses erected to contain any failure of the wall.
This should be carried out as a matter of urgency.

Comment on the remainder of the wall will follow in due course.

Hockley & Dawson
10th March 2023