Structural Design and Method Statement

J1240 St. Luke’s Road, London W11

Ref: J1240-Doc-01
Revision: X2
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GENERAL NOTES

Only construction status documentation is to be constructed from. If you do not have a construction issue document and you are about to build something, please contact Webb Yates Engineers. Ensure that you have the latest revision prior to construction.

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# REVISION HISTORY

Revisions indicated with line in margin.

Revision status: P = Preliminary, T = Tender, C = Construction, X = For Information

<table>
<thead>
<tr>
<th>Revision</th>
<th>Date</th>
<th>Author</th>
<th>Reviewer</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>X1</td>
<td>23-03-12</td>
<td>RAC</td>
<td>SW</td>
<td>First issue</td>
</tr>
<tr>
<td>X2</td>
<td>02-04-12</td>
<td>RAC</td>
<td>SW</td>
<td>Location area added</td>
</tr>
</tbody>
</table>
1 INTRODUCTION
The existing building is an end property on the corner of St Luke’s Road & Lancaster Road and comprises of a ground floor, two upper floors and a roof terrace behind parapet walls with a lower ground floor below the full footprint of the house.

The current proposal is to provide a new level of basement accommodation below the existing side garden and car park area providing minor alterations to the existing layout of the building.

This report outlines the current state of site and property, the proposed construction works and their method of construction, the pertinent design considerations and the notable factors affecting construction, and is completed with our summary and conclusions regarding the above.

The proposed approach is based on Webb Yates experience of designing and overseeing construction of a number of similar refurbishment projects that include basement installations beneath and adjacent to existing buildings in confined situations.

Certain aspects of the design proposals may be refined or modified during development of the scheme, while ensuring that the principal requirements for stability of the surrounding ground and avoidance of unacceptable movements or other distress to existing structures are adhered to.

2 TERMS OF REFERENCE
We have discussed the planning proposals with Hill Mitchell Berry Architects, on behalf of the client, to prepare a report to outline the impact of the structural alterations and the appropriate methods for the construction of a basement extension and minor alterations to the existing building at 14 St Luke’s Road, London W11 1DB.

The principal purpose of this report is to address the concerns of the Planning Authority with respect to the practicality of executing the works and to the effect of the development on adjoining properties.

This report should be read in conjunction with the following documentation:
1. General arrangement drawings as existing prepared by Hill Mitchell Berry Architects;
2. General arrangement drawings as proposed prepared by Hill Mitchell Berry Architects;
3 THE SITE

The existing site, marked on the street map below, is located St Luke’s Road, in the Westbourne Park area of London.

![Site Location – Extract from Google Maps.](image)

14 St Luke’s Road is located on the corner of St Luke’s Road and Lancaster Road. The proposed basement construction extends to the boundary of the gardens of No. 14a Lancaster Road.

3.1 EXISTING GROUND CONDITIONS

Ground Investigations have been carried out on site by “Chelmer Site Investigations” company, report of which is appended to this document, and involved borehole excavations.

Geological mapping and Webb Yates knowledge of the area indicates the site to be underlain by London clay with a layer of made ground above. A 10m deep borehole confirmed that the site is underlain by the London Clay.

Ground water was not encountered during the borehole installation.

3.2 EXISTING BUILDINGS

The property comprises approximately 6m by 11m three storey terraced house with a lower ground floor underneath the full footprint of the building. A two storey house with pitched roof has been built within the original rear gardens of the property which is now No. 14a Lancaster Road.

The underground rail tunnel of the Circle and Hammersmith & City lines is located approximately 180m north from the site and sufficiently far from the site to have no impact on excavations. There are no underground rivers in the vicinity of the site.
4 PROPOSALS

It is intended to create a new enclosure underneath the side garden to accommodate a new bedroom with en-suite bathroom, a utility and a plantroom. The plantroom will be at a slightly higher level than the new enclosure to suit the level of the existing lower garden.

The plan area of the proposed side basement extension is set to the boundary along Lancaster road and the boundary wall of the gardens of 14a Lancaster Road. A new reinforced concrete retaining wall will be formed in an underpinning sequence using steel trench sheeting as temporary earth support.

There will be a small new staircase from the proposed basement enclosure to the existing lower ground floor. Because of the depth of the new extension the floors to the existing vault rooms will need to be lowered and the existing side walls will require underpinning.

The proposal for the upper floors includes general alterations involving relocation of partitions and doorways, new openings in existing walls and partitions and a new staircase to the lower ground floor. These alterations will involve local floor strengthening, repairs and creation of new openings using steel beams for support where load bearing walls are removed.

4.1 BUILDING SHELL

There will be very little alterations to the east elevation of the property facing onto St. Luke’s Road. The proposed amendments will take place to the north and east of the house where there are new windows to the lower ground and ground floors.

4.2 SUBTERRANEAN VOLUME

Creation of the new subterranean volume will require a well planned, coordinated and sequenced operation to be undertaken. The sensitivity of the existing adjacent building and party fence wall to movement and settlement and the risk of collapse if the permanent horizontal support provided by the ground is removed will be the primary concern in the selection of a foundation solution. The permanent works will be constructed in a manner that ensures that the existing adjacent masonry structure and the ground surrounding the site is continuously supported both vertically and horizontally without undue movement as the works progress.

A desire to maximise the habitable space in the new basement extension means that the extension is tight up against the boundary on two sides. It is therefore proposed to adopt a conventional retaining wall construction carried out in an underpinning sequence to restrict any movement of the soil along the boundaries. This “underpinning” will need to be carried out in two stages. Each stage must be completed for the full length and propped before starting the next stage. Temporary steel trench sheeting will be used for earth support during this work.

The retaining wall will be carried out in a controlled sequence, each section being of limited length and being allowed to cure adequately before work commences on adjacent sections. Pins will be reinforced individually and designed to
span vertically between the new garden slab and a new basement slab. Excavations for each pin will be propped to ensure stability during the remainder of the underpinning work.

On completion of the retaining wall, the top of the pins will be linked together and propped across the excavations. During bulk excavation, an additional level of propping will be installed above the final lower ground floor slab level to prevent unacceptable inward deflection of the wall. Excavation will be carried out using small mechanical excavators and a hoist or conveyor to remove the spoil. Spoil will be transferred immediately to road vehicles for disposal.

Our investigations have shown that it is unlikely that there is significant free ground water within the excavation depth. However, provision is to be made to collect and dispose of any water that does enter the excavation and to provide adequate water-proofing to the completed basement.

A reinforced concrete basement slab will be cast on concrete blinding directly onto the clay formation. Internal vertical structural elements will then be constructed and the new garden reinforced concrete slab completed. The sequence of casting the slabs and of removing temporary propping will be tightly controlled to prevent unacceptable lateral movement of the ground and of the structures.

Although the final sequence and methodology of construction will be subject to the final design and the contractor’s preferred methods of construction, based on our previous experience we anticipate the construction sequence for the subterranean volume to be as summarised below:

<table>
<thead>
<tr>
<th>TASK</th>
<th>DESCRIPTION</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Install underpinning to underside of existing vault walls adjacent proposed basement structure.</td>
<td>Underpinning is to be carried out in a hit one miss three sequence with a maximum of 1.0m excavated at any one location. Underpinning concrete and semi-dry concrete pack to be a minimum of 24 hours old prior to excavating adjacent sections. The underpinning is to be positioned full width beneath the existing foundations.</td>
</tr>
<tr>
<td>2</td>
<td>Excavate down to underside of proposed basement slab up to 1m from boundaries to which the ground should be raked up to existing levels forming a 1 in 3 bank.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Form the basement slab, incorporating drainage pipes and sumps as required.</td>
<td>This provides the permanent prop to the base of the perimeter RC wall.</td>
</tr>
<tr>
<td>4</td>
<td>Begin new RC retaining wall in an “underpinning” sequence from existing vault to Lancaster Road – Stage 1 (2.9m deep).</td>
<td>“Underpinning” to be formed in continuous reinforced concrete. 1.2m max bay width, non adjacent bays to be excavated and cast in a typical underpinning sequence. No more than 25% of the wall to be left unsupported at any time.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Construct external wall to new basement adjacent lower garden.</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Begin new RC retaining wall in an “underpinning” sequence inboard of the party wall to No 14a Lancaster Road – Stage 2 (2.9m deep). “Underpinning” to be formed in continuous reinforced concrete. 1.2m max bay width, non adjacent bays to be excavated and cast in a typical underpinning sequence. No more than 25% of the wall to be left unsupported at any time.</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Stage 1 &amp; 2 of the RC retaining wall complete. Install temporary props across at mid height of the walls.</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Continue new RC retaining wall along the boundary along Lancaster Road – Stage 2 “Underpinning” to be formed in continuous reinforced concrete. 1.2m max bay width, non adjacent bays to be excavated and cast in a typical underpinning sequence. No more than 25% of the wall to be left unsupported at any time.</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Construct new internal structure and shear walls.</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Cast new garden slab, incorporating spine wall steel beam within slab. This capping slab forms the permanent prop to the base of the existing party walls.</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Cast plantroom slab at higher level.</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Waterproof and finish</td>
<td></td>
</tr>
</tbody>
</table>

Figure 6: Construction sequence notes: see also Webb Yates sequencing drawings.

### 4.3 SUPERSTRUCTURE

The proposed works at the upper floors are of very minor nature and involve relocation of existing door openings, demolition of non-load bearing partitions and local strengthening of the floors.

The proposed new stair from Lower Ground Floor to Ground Floor level will involve careful detailing of both the temporary and permanent works to ensure that adequate support is provided to the existing stair at all stages of the refurbishment.
5 DESIGN CONSIDERATIONS

5.1 ADJACENT STRUCTURES

One of the principal requirements for these works are that they should not undermine the performance or risk unacceptable movement of adjacent structures, adjacent roads, or buried services. Principal stages during which this requirement must be taken into account is demolition, excavation of the subterranean volume, and any transfer of load between temporary and permanent supports.

5.2 WATERTIGHT CONSTRUCTION

As indicated above, the risk of significant inflow of free water into the excavation or the completed basement is considered to be low. Minor inflows during excavation are to be managed by directing them to sumps and pumping the water away or by locally applying a render to the piled wall.

However, it will be necessary to prevent seepages and water vapour transmission into the completed structure. The final choice of the waterproofing system is to be specified by the architect. A drained cavity system or proprietary waterproofing additive to the reinforced concrete (for example Pudlo or Caltite) could be used. The final design and detailing of such systems is carried out by specialist suppliers who also provide a construction monitoring service to ensure the proper application of the materials.

5.3 STABILITY

Lateral stability will be provided by the floors and partitions acting as horizontal structures tied with the perimeter walls or concrete framing. Stability down to the new foundation level will be provided by a combination of cores and shear walls; these will be formed by a combination of RC and blockwork. Temporary structures will be installed to resist the lateral loads applied to the building where not covered by top-down construction.

5.4 DURABILITY

The design life of the new building will be a minimum period of 50 years. This falls into category 4 in Table 2.1 of BS EN 1990:2002 (and as per the National Annex), which covers non-monumental structures.

5.5 HEAVE AND SETTLEMENT

Installation of the underpinned walls and the excavation within the newly created space will potentially cause some inward lateral movement of the surrounding ground and associated settlement of the adjacent buildings and installations. Careful propping will limit the magnitude of these movements. In addition, suitable monitoring will be arranged and specified to ensure that movements are maintained within acceptable limits and that early action can be taken in the event of unexpected deflection. Particular attention will be paid to stages where loading is transferred from one system of support to another.

Although the basement excavation inevitably reduces the vertical stress in the ground beneath, the depth to the London Clay and the modest site dimensions mean that heave of the clay is unlikely to exceed a few millimetres or to have any discernible effect outside the site boundaries. Any movement that does occur will be monitored carefully and
appropriate action taken as necessary. From our experience these movements would be small and again we would expect any damage resulting from these would be very minor (category 0 to 1, Table 2.5 of the CIRIA report C580).

Underpinning involves transferring the local foundation pressures to lower strata and inevitably leads to some settlement. Some movement of the existing fabric will also be caused by the sequential transfer of load between different parts of the structure. The quality of the London Clay materials underlying the building and careful control on underpinning sequence and methods will keep such movements to a practicable minimum. To minimise this works will be carried out in accordance with current good practice. The minimal type of cosmetic damage that might occur is classified as category 0 to 1, Table 2.5 of the CIRIA report C580.

5.6 GROUND STABILITY
The ground at the side of the property (entrance) is terraced in two levels, the high level paving with parking bay and low level paving by approximately 1m difference. With the new subterranean volume in place the garden will be reinstated to form the high level paving with parking bay and low level paving very similar to the existing. The sloping flower beds to the front and side will be replaced with paving and terraced planters, we believe that the overall stability of the earth will be unaffected by the works and a sustainable garden will be re-established. As mentioned early in the report we also believe that the trees adjacent to these works will be unaffected.

6 FACTORS AFFECTING CONSTRUCTION
6.1 TEMPORARY WORKS
There will be a requirement for temporary works to ensure the safety and stability of the existing and adjacent properties whilst the proposed structural alterations are being carried out. Adequate restraint will be provided to the excavations and party wall structures at all times by the provision of temporary bracing.

6.2 CONSTRUCTION HAZARDS
The proposed building works are standard and standard materials will be utilised. Although a hazard assessment is to be produced and amended as the design is developed, no unusual hazards have been identified within our proposals to date.

6.3 SITE MANAGEMENT
Obstructions and inconvenience to residents of the area and the general public is to be kept to a reasonable minimum and noisy works to be carried out within normal weekday working hours.
6.4 ACCESS AND STORAGE

Vehicular access is available to the site from the Lancaster Road.

There is an approximately 9x2m sloping flower bed at the front of the property that could be used for the storage of materials.

7 PROTECTION OF BUILDINGS DURING CONSTRUCTION

i. Earthwork: Small scale track mounted earth moving equipment, “diggers”, will be utilized, common in this type of work, these diggers can access via the entrance on Lancaster Road on a protected route. The diggers can load directly into skips.

ii. Concrete Works: For concreting, a concrete pump will be set up in the street and pumped through a small bore pipe, approx. 250mm.

iii. Underpinning, part of the existing vault: There is a short section of “traditional underpinning” to the existing property under the entrance steps. The remainder of the basement will have a new reinforced concrete wall cast within the boundaries. In section 4.2 we explain that this will be carried out in a series of short “underpinning” sections. This is done to minimise the disturbance to the boundary and protect the existing elements along the boundary. It is referred to as “underpinning” as it will be carried out under the rules of “traditional underpinning”. That is the lengths excavated and cast will not be more than 1m long, they will be cast in a 1 to 5 sequence that ensures that no more than 20% of the boundary is without permanent support at any one time. During the formation of the short lengths of wall the perimeter earth surface will be continually supported with temporary works to allow the operatives to form the wall.

8 SUMMARY AND CONCLUSIONS

The new basement extension construction and minor internal alterations are considered to be straight-forward modifications to the existing property. Using current good practice in executing the works, it is considered that the proposed development can be realised while maintaining adequate temporary vertical and horizontal support to the ground and to the surrounding masonry structures.

Detailed specifications will be prepared and method statements procured to ensure that good practice is followed. An adequate supervision and monitoring will be provided throughout the works.
9 APPENDIX A

Site Investigation Report by “Chelmer Site Investigations”
A Factual Report on the Site Investigation undertaken for Hill Mitchell Berry at 14 St Lukes Road Ladbroke Grove London W11

CSI Ref: 3083

Dated: 14th March 2012
### Client:
Hill Mitchell Berry

### Location:
14 St Lukes Road
Landbroke Grove, London W11

### Job No.:
3083

### Weather:
Fine

### Sheet:
1 of 1

### Date:
14.3.12

### Drawn by:
MM

### Checked by:
ME

---

**Notes:**

*On site tree identification for guidance only. Not authenticated.*

---

**Key:**

- Tree/Shrub
- Borehole
- Trial Pit
- Gully
- Tree Stump
- Rain Water/Soil Pipe
- Manhole

---

**Diagram:**

- FOUR STOREY
  - NO.14
- DOUBLE STOREY
- LAND OF NO. 16
- LIGHT WELL
- DOUBLE STOREY PORCH
- TRELLIS FENCE
- YORK STONE / BASEMENT ROOM UNDER
- FRONT
- FOOTPATH
- LANCASTER ROAD
- GATED ENTRANCE
- WATER/SEWER Main

---

**Dimensions:**

- **BHI:** 3.2m
- **2m**
- **6.2m**
<table>
<thead>
<tr>
<th>Depth Mtrs.</th>
<th>Description of Strata</th>
<th>Thickness</th>
<th>Legend</th>
<th>Sample</th>
<th>Test Type</th>
<th>Result</th>
<th>Root Information</th>
<th>Depth to Water</th>
<th>Depth Mtrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.75</td>
<td>NEW COBBLES / BLOCKS</td>
<td>0.75</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.125</td>
<td>SHARP SAND</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.175</td>
<td>CONCRETE</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.3</td>
<td>MADE GROUND: soft dark brown gravelly very silty clay with numerous concrete and brick fragments.</td>
<td>0.125</td>
<td>D</td>
<td>150</td>
<td>CPT 04, 04, 03, 04</td>
<td>N = 14</td>
<td>Roots of live appearance to 1mm Ø to 4.2m</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>0.8</td>
<td>MADE GROUND: soft moist dark brown/black gravel very silty clay with numerous brick fragments.</td>
<td>0.5</td>
<td>D</td>
<td>150</td>
<td>SPT 07, 04, 04, 04</td>
<td>N = 16</td>
<td></td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>2.2</td>
<td>MADE GROUND: medium compact mid brown silty clay with numerous fine gravel and brick fragments.</td>
<td>1.4</td>
<td>D</td>
<td>150</td>
<td>SPT 12, 06, 06, 05, 07</td>
<td>N = 24</td>
<td></td>
<td>2.0</td>
<td></td>
</tr>
<tr>
<td>2.8</td>
<td>MADE GROUND: medium compact moist dark brown gravelly silty clay with occasional brick fragments.</td>
<td>0.6</td>
<td>D</td>
<td>150</td>
<td>SPT 14, 07, 07, 07</td>
<td>N = 28</td>
<td></td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stiff mid brown grey veined silty CLAY with partings of orange and brown silt and fine sand occasional claystone nodules and crystals.</td>
<td>4.0</td>
<td>D</td>
<td>150</td>
<td>SPT 18, 08, 09, 09, 09</td>
<td>N = 35</td>
<td></td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td>6.8</td>
<td>Stiff mid to dark brown mottled grey silty CLAY with partings of grey and brown silt and fine sand and occasional crystals.</td>
<td>0.6</td>
<td>D</td>
<td>150</td>
<td>SPT 20, 09, 09, 10, 10</td>
<td>N = 38</td>
<td></td>
<td>3.5</td>
<td></td>
</tr>
<tr>
<td>7.4</td>
<td>Very stiff mid grey silty CLAY with partings of grey silt and fine sand and occasional crystals.</td>
<td>2.6</td>
<td>D</td>
<td>150</td>
<td>SPT 20, 09, 09, 10, 10</td>
<td>N = 38</td>
<td></td>
<td>4.0</td>
<td></td>
</tr>
<tr>
<td>10.0</td>
<td>Borehole ends at 10.0m</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.5</td>
<td></td>
</tr>
</tbody>
</table>

**Remarks:** Borehole dry and open on completion.

**Key:**
- T.D.T.D. = Too Dense to Drive
- D = Small Disturbed Sample
- J = Jar Sample
- B = Bulk Disturbed Sample
- V = Penetrometer Vane (kPa)
- U = Undisturbed Sample (U100)
- M = Mackintosh Probe
- W = Water Sample
- N = Standard Penetration Test Blow Count

**Chelmer Site Investigations**
Unit 15 East Hanningfield Industrial Estate
Old Church Road, East Hanningfield, Essex CM3 8AB

**Email:** info@siteinvestigations.co.uk **Website:** www.siteinvestigations.co.uk
REPORT NOTES

Equipment Used

Hand tools, Mechanical Concrete Breaker and Spade, Hand Augers, 100mm/150mm diameter Mechanical Flight Auger Rig, GEO205 Flight Auger Rig, Window Sampling Rig, and Large or Limited Access Shell & Auger Rig upon request and/or access permitting.

On Site Tests

By Pilcon Shear-Vane Tester (Kn/m²) in clay soils, and/or Mackintosh Probe in granular soils or made ground and/or upon request Continuous Dynamic Probe Testing and Standard Penetration Testing.

Note:

Details reported in trial-pits and boreholes relate to positions investigated only as instructed by the client or engineer on the date shown.

We are therefore unable to accept any responsibility for changes in soil conditions not investigated i.e. variations due to climate, season, vegetation and varying ground water levels.

Full terms and conditions are available upon request.
10  APPENDIX B

Webb Yates Engineers Calculations
LOADINGS - 200 T.C. RC SLAB

- Panel RC Slab 9.4 x 0.1 = 0.94
- Column 8.4 x 0.3 = 2.52
- Ceiling 6.0 x 0.05 = 0.3
- 0.25

\[ \text{10.10 kN/m}^2 \]

- Rackings = 2.50 kN/m

SPAN = 4.8 m

\[ 1800 \times \frac{1}{2} \leq 20 \text{ kN} \]

\[ \text{M} = (10.10 \times 1.4 + 2.5 \times 1.6) \times 4.8 = 52.25 \text{kNm} \]

\[ \text{M} = \frac{52.25 \times 10^6}{1000 \times 240} = 0.91 \text{ kN} \]

\[ \text{AS} = 0.3 \times 1000 \times 200 = 6000 \text{mm}^2 \]

\[ \text{1:16 @ 200 CRS Built Uprights} \]

\[ (1005) \]
Port of structure: RETAINING WALLS

\[ w_{\text{wall}} = \frac{(87 \times 1.6) \times 1.7}{2} = 118 \text{ kNm} \]

\[ \frac{Wd^2}{k} = \frac{118 \times 10^6}{1000 \times 240^2} = 2.05 \]

\[ w_{\text{as}} = 0.58\% \]

\[ A_s = \frac{0.58 \times 1000 \times 300}{100} = 1740 \text{ mm}^2 \]

1/20 A + 175 c/s

(11/35)
CHECK OVERTURNING
TEMP CONDITION - NO PROPPING

$$\begin{align*}
(1) &= 0.3 \times 2.9 \times 21 = 20.87 \times 2.0 = 41.74 \\
(2) &= 0.3 \times 2.0 \times 24 = 21.60 \times 1.0 = 21.60 \\
\text{DOS OVERTURNING} &= 63.36 = 1.54 \\
\text{OK AS TEMP PROPP + FINAL CONDITION -}
\end{align*}$$

BEARING PRESSURE - TEMP CONDITION

$$\frac{42.48 + 41.19 \times 6}{2} = \frac{21.24 + 123.57}{1} = 144.78 \text{ kN/m}^2$$

$$21.24 - 123.57 = -102.30 \text{ kN/m}^2$$

FINAL CONDITION -

$$\begin{align*}
(3) &= 0.4 \times 1.7 \times 24 = 16.32 \times 0.85 = 13.87 \\
(4) &= 2.5 \times 1.7 \times 24 = 4.05 \times 0.85 = 3.41 \\
(5) &= 1.5 \times 1.7 \times 24 = 2.55 \times 0.85 = 2.17 \\
\text{DOS OVERTURNING} &= 28.12 \text{ kN/m}^2 \\
\text{BASE INTO BASEMENT SLAB} + \text{PROOF USING TOP SLAB} \\
\text{TEMPORARY PROPPING REQUIRED}
\end{align*}$$
TRY 300 kN stem

\[
\frac{M}{100^2} = \frac{65.89 \times 10^6}{1000 \times 240^2} = 1.14
\]

\[
\frac{W}{80} = 0.3\%
\]

\[
W = 0.2 \times 1000 \times 300 = 600 \text{ mm}^2
\]

H16 AT 200 CRS

\[
(1.005)
\]

SHEAR:

\[
V = (22.33 + 18.85) \times 1.6 = 65.69 \text{ kN}
\]

\[
V = 65.69 \times 10^2 \div 1000 \times 240 = 0.27 \text{ N/mm}^2 = 0.1
\]

BASE SIZE SW = 300 kN x 2000 Width

HORIZONTAL FORCES:

DUE TO LOAD = \( \left( 0.3 \times 19 \times 3.2 \div 2 \right) \times 3.20 = 31.13 \text{ kN/m} \)

DUE TO SURCHARGE = \( \left( 0.3 \times 15 \times 3.20 \div 2 \right) \times 3.20 = 23.04 \text{ kN/m} \)

TOTAL BM = 31.13 + 23.04 = 54.17 \text{ kNm}
Active Pressure at Btm of Stem

Due to soil \( P_a = 0.3 \times 19 \times 2.9 = 16.5 \text{ kN/m}^2 \)

Due to surcharge \( k_{aw} = 0.3 \times 15 = 4.5 \text{ kN/m}^2 \)

Active Forces

Due to soil \( = 16.5 \times 2.8 = 23.1 \text{ kN} \)

Due to surcharge \( = 4.5 \times 2.9 = 13.0 \text{ kN} \)

Max at Base of Wall

Due to soil \( = \frac{23.1 \times 2.9}{2} = 22.33 \text{ kN/m} \)

Due to surcharge \( = \frac{13.0 \times 2.9}{2} = 18.85 \text{ kN/m} \)

Max Max = 41.18 kN

ULT Max = 41.18 \times 1.6 = 65.89 \text{ kN/m}
APPENDIX C

Webb Yates Engineers drawings
J1240-S-301 to 303 inclusive