Appendix B: Basement Construction Method Statement

This information is provided for Planning use only and is not to be used for Building control submissions.

1.1. This method statement provides an approach which will allow the basement design to be correctly considered during construction, and the temporary support to be provided during the works. The Contractor is responsible for the works on site and the final temporary works methodology and design on this site and any adjacent sites.

1.2. This method statement for 41 Coleville Mews has been written by a Chartered Engineer. The sequencing has been developed considering guidance from ASUC.

1.3. This method has been produced to allow for improved costings and for inclusion in the party wall Award. Should the contractor provide alternative methodology the changes shall be at their own costs, and an Addendum to the Party Wall Award will be required.

1.4. Contact party wall surveyors to inform them of any changes to this method statement.

1.5. The approach followed in this design is; to remove load from above and place loads onto supporting steelwork, then to cast cantilever retaining walls in underpin sections at the new basement level.

1.6. The cantilever pins are designed to be inherently stable during the construction stage without temporary propping to the head. The base benefits from propping, this is provided in the final condition by the ground slab. In the temporary condition the edge of the slab is buttressed against the soil in the middle of the property, also the skin friction between the concrete base and the soil provides further resistance. The central slab is to be poured in a maximum of a 1/3 of the floor area.

1.7. A soil investigation has been undertaken. In general made ground was found to a depth of 0.9m BGL. Below that a stiff, mid brown, silty clay with partings of brown silt and fine sand were found to a depth of 3.6m BGL. Below this a 200mm thick layer of claystone was found sitting on top of a very stiff, brown, silty clay with parting of brown and orange silt and find sand to the bottom of the borehole. The borehole was dry and no water was encountered.

1.8. The bearing pressures have been limited to 100kN/m². This is standard loadings for local ground conditions and acceptable to building control and their approvals.

1.9. No water was found and the borehole at the rear of the property was dry at 6m BGL.

2. Enabling Works

2.1. The site is to be hoarded with ply sheet to 2.2m to prevent unauthorised public access.

2.2. Licenses for Skips and conveyors to be posted on hoarding

2.3. Provide protection to public where conveyor extends over footpath. Depending on the requirements of the local authority, construct a plywood bulkhead onto the pavement. Hoarding to have a plywood roof covering, night-lights and safety notices.
2.4. On commencement of construction the contractor will determine the foundation type, width and depth. Any discrepancies will be reported to the structural engineer in order that the detailed design may be modified as necessary.

3. Basement Sequencing

3.1. Begin by placing cantilevered walls 1 to 7 noted on plans. (Cantilevered walls to be placed in accordance with section 4.)

3.2. Needle & prop the ground floor/ walls over.

3.3. Insert steel over and sit on cantilevered walls.
   
   3.3.1. Beams over 6m to be jacked on site to reduce deflections of floors.
   
   3.3.2. Dry pack to steelwork. Ensure a minimum of 24 hours from casting cantilevered walls to dry packing. Grout column bases

3.4. Needle and prop front wall. Insert support

3.5. Excavate out first 1.2m around front opening prop floor and erect conveyor.

3.6. Continue cantilevered wall formation around perimeter of basement following the numbering sequence on the drawings.
   
   3.6.1. Excavation for the next numbered sequential sections of underpinning shall not commence until at least 8 hours after drypacking of previous works. Excavation of adjacent pin to not commence until 48 hours after drypacking. (24 hours possible due to inclusion of Conbextra 100 cement accelerator to dry pack mix). No more than
   
   3.6.2. Floor over to be propped as excavations progress. Steelwork to support floor to be inserted as works progress.

3.7. Cast base to internal wall. Construct wall to provide support to floor and steels as works progress.

3.8. Excavate a maximum of a 1/3 of the middle section of basement floor. Place reinforcement to central section of ground bearing slab and pour concrete. Excavate next third and cast slab. Excavate and cast final third and cast.

3.9. Provide structure to ground floor and water proofing to retaining walls as required.

4. Underpinning and Cantilevered Walls

4.1. Prior to installation of new structural beams in the superstructure, the contractor may undertake the local exploration of specific areas in the superstructure. This will confirm the exact form and location of the temporary works that are required. The permanent structural work can then be undertaken whilst ensuring that the full integrity of the structure above is maintained.

4.2. Provide propping to floor where necessary.
4.3. Excavate first section of retaining wall (no more than 1200mm wide). Where excavation is greater than 1.2m deep provide temporary propping to sides of excavation to prevent earth collapse (Health and Safety). A 1200mm width wall has a lower risk of collapse to the heel face.

Figure 23 – Schematic Plan view of Soil Propping

Figure 24 Propping
4.4. Backpropping of rear face. Rear face to be propped in the temporary conditions with a minimum of 2 Trench sheets. Trench sheets are to extend over entire height of excavation. Trench sheets can be placed in short sections as the excavation progresses.

4.4.1. If the ground is stable, trench sheets can be removed as the wall reinforcement is placed and the shuttering is constructed.

4.4.2. Where soft spots are encountered leave in trench sheets or alternatively back prop with Precast lintels or trench sheeting. (If the soil support to the ends of the lintels is insufficient then brace the ends of the PC lintels with 150x150 C24 Timbers and prop with Acrows diagonally back to the floor.)

4.4.3. Where voids are present behind the lintels or trench sheeting, Grout voids behind sacrificial propping; Grout to be 3:1 sand cement packed into voids.

4.4.4. Prior to casting place layer of DPM between trench sheeting (or PC lintels) and new concrete. The lintels are to be cut into the soil by 150mm either side of the pin. A site stock of a minimum of 10 lintels to be present for to prevent delays due to ordering.

4.5. If cut face is not straight, or sacrificial boards noted have been used, place a 15mm cement particle board between sacrificial sheets and or soil prior to casting. Cement particle board is to line up with the adjacent owners face of wall. The method adopted to prevent localised collapse of the soil is to install these progressively one at a time. Cement particle board must be used to in any condition where overspill onto the adjacent owners land is possible.

4.6. Underpinnings can be completed in Segmental lifts (eg top section of wall followed by bottom section of wall).

Croft's recommendation is that walls with high vertical loads or susceptible to settlement, and all party walls, should be completed as first pin top first pin bottom, next pin top next pin bottom. **We do not recommend** for such conditions that all the top sections for every pin followed by all the lower pins are completed; such a sequencing can result in the existing wall being left on a narrower section than the original footing for too long resulting in settlement.

4.6.1. Place reinforcement for retaining wall segmental lift
4.6.1.1. At lift sections reinforcement needs to be driven in. This is to be completed by pre drilling holes and inserting the reinforcement into the predrilled hole.

4.6.1.2. Underside of the wall to be cast with chamfer to allow concrete for lower lift to be cast and no packing to be required.

4.7. Excavate base. Mass concrete heels to be excavated. If soil over unstable prop top with PC lintel and sacrificial prop.

4.8. Visually inspect the footings and provide propping to local brickwork, if necessary sacrificial acrow, or pit props, to be sacrificial and cast into the retaining wall.

4.9. Clear underside of existing footing.

4.10. Local authority inspection to be carried for approval of excavation base.

4.11. Place reinforcement for retaining wall base & toe. Site supervisor to inspect and sign off works for proceeding to next stage.

4.12. Cast base. (on short stems it is possible to cast base and wall at same time)

4.13. Take 2 cubes of concrete and store for testing. Test one at 28 days if result is low test second cube. Provide results to client and design team on request or if values are below those required.

4.15. Place reinforcement for retaining wall stem. Site supervisor to inspect and sign off works for proceeding to next stage.

4.16. Drive H16 Bars UBars into soil along centre line of stem to act as shear ties to adjacent wall.

4.17. Place shuttering & pour concrete for retaining wall. Stop a minimum of 75mm from the underside of existing footing.

4.18. 24 hours after pouring the concrete pin the gap shall be filled using a dry pack mortar. Ram in drypack between retaining wall and existing masonry.

4.19. After 24 hours the temporary wall shutters are removed.

4.20. Trim back existing masonry corbel and concrete on internal face.

4.21. Site supervisor to inspect and sign off for proceeding to the next stage. A record will be kept of the sequence of construction, which will be in strict accordance with recognised industry procedures.

5. Floor Support

Concrete Ground bearing slabs

5.1. The support of the existing concrete floor will be undertaken in conjunction with the underpinning process. Two opposite pins are constructed and allowed to cure as described elsewhere.

5.2. Locally prop concrete floors with Acros at 2m centres with timbers between. If the underside is found be in poor condition then temporary boarding and props are to be introduced.

5.3. Insert Steelwork and dry pack to underside of floor

5.4. Between steelwork place 215wide x 65dp PC lintels at a maximum spacing of 600mm

5.5. If necessary Brick up to the 50mm below underside of floor

5.6. Dry pack between lintel/brickwork to underside of slab.

5.7. Remove props

5.8. This process is to continue one pin width at a time.

6. Supporting existing walls above basement excavation

6.1. Where steel beams need to be installed directly under load bearing walls, temporary works will be required to enable this work. Support comprises the installation of steel needle beams at high level, supported on vertical props, to enable safe removal of brickwork below, and installation of the new beams and columns.
6.1.1. The condition of the brickworks must be inspected by the foreman to determine its condition and to assess the centres of needles. The foreman must inspect upstairs to consider where loads are greatest. Point loads and between windows should be given greater consideration.

6.1.2. Needles are to be spaced to prevent the brickwork above “saw toothing”. Where brickwork is good needles must be placed at a maximum of 1100mm centres. Lighter needles or strong boys should be placed at tighter centres under door thresholds.

6.2. Props are to be placed on Sleepers of firm ground or if necessary temporary footings will be cast.

6.3. Once the props are fully tightened, the brickwork will be broken out carefully by hand. All necessary platforms and crash decks will be provided during this operation.

6.4. Decking and support platforms to enable handling of steel beams and columns will be provided as required.

6.5. Once full structural bearing is provided via beams and columns down to the new basement floor level. The temporary works will be redundant and can be safely removed.

6.6. Any voids between the top of the permanent steel beams and the underside of the existing walls will be packed out as necessary. Voids will be dry packed with a 1:3 (cement: sharp sand) dry pack layer, between the top of the steel and underside of brickwork above.

6.7. Any voids in the brickwork left after removal of needle beams can at this point be repaired by bricking up and/or dry packing, to ensure continuity of the structural fabric.

7. Approval

7.1. Building control officer/approved inspector to inspect pin bases and reinforcement prior to casting concrete.

7.2. Contractor to keep list of dates pins inspected & cast

7.3. One month after work completed the contractor is to contact adjacent party wall surveyor to attend site and complete final condition survey and to sign off works.
8. Trench sheet design and temporary prop Calculations

This calculation has been provided for the trench sheet and prop design of standard underpins in the temporary condition. There are gaps left between the sheeting and as such no water pressure will occur. Any water present will flow through the gaps between the sheeting and will be required to pump out.

Trench sheets should be placed at centres to deal with the ground. It is expected that the soil between the trench sheeting will arch. Looser soil will require tighter centres. It is typical for underpins to be placed at 1200c/c, in this condition the highest load on a trench sheet is when 2 no’s trench sheets are used. It is for this design that these calculations have been provided.

Soil and ground conditions are variable. Typically one finds that in the temporary condition clays are more stable and the C_u (cohesive) values in clay reduce the risk of collapse. It is this cohesive nature that allows clays to be cut into a vertical slope. For these calculations weak sand and gravels have been assumed. The soil properties are:

- **Surcharge**: 
  \[ \text{sur} = 10. \text{kN/m}^2 \]

- **Soil density**: 
  \[ \delta = 20 \text{kN/m}^3 \]

- **Angle of friction**: 
  \[ \phi = 25^\circ \]

- **Soil depth**: 
  \[ D_{\text{soil}} = 3000.000 \text{ mm} \]

\[
ka = \frac{1 - \sin(\phi)}{1 + \sin(\phi)} = 0.406 \\
k_p = \frac{1}{ka} = 2.464
\]

- **Soil Pressure bottom**: 
  \[ \text{soil} = k_a \times \delta \times D_{\text{soil}} = 21.916 \text{kN/m}^2 \]

- **Surcharge pressure**: 
  \[ \text{surcharge} = \text{sur} \times k_a = 4.059 \text{kN/m}^2 \]
STANDARD LAP TRENCH SHEETING

STANDARD LAP

The overlapping trench sheeting profile is designed primarily for construction work and also temporary deployment.

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<thead>
<tr>
<th>Technical Information</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Effective width per sheet (mm)</td>
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<td>Thickness (mm)</td>
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<td>Depth (mm)</td>
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<td>Weight per linear metre (kg/m)</td>
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<tr>
<td>Weight per m² (kg)</td>
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<td>Section modulus per metre width (cm²)</td>
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<td>Section modulus per sheet (cm²)</td>
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<td>I value per metre width (cm⁴)</td>
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<tr>
<td>I value per sheet (cm⁴)</td>
<td>26.9</td>
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<tr>
<td>Total rolled metres per tonne</td>
<td>92.1</td>
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\[ S_{xx} = 15.9 \text{ cm}^3 \]
\[ p_y = 275 \text{ N/mm}^2 \]
\[ I_{xx} = 26.9 \text{ cm}^4 \]

\[ A = \frac{(1 \text{ m}^2 \times 32.9 \text{ kg/m}^2)}{(330 \text{ mm} \times 7750 \text{ kg/m}^3)} = 12864.125 \text{ mm}^2 \]
Length a  
Length b bottom  
Length c Middle  
Length d top  

\[ a = 2.600 \text{ m} \]  
\[ b = 0.700 \text{ m} \]  
\[ c = a - b = 1.900 \text{ m} \]  
\[ d = D_{\text{soil}} - a = 0.400 \text{ m} \]  

CONTINUOUS BEAM ANALYSIS - INPUT

BEAM DETAILS

Number of spans = 3

Material Properties:

Modulus of elasticity = 205 kN/mm²  
Material density = 7860 kg/m³

Support Conditions:

Support A  Vertically "Restrained"  Rotationally "Free"  
Support B  Vertically "Restrained"  Rotationally "Free"  
Support C  Vertically "Restrained"  Rotationally "Free"
Support D  Vertically "Free"  Rotationally "Free"

**Span Definitions:**

<table>
<thead>
<tr>
<th>Span</th>
<th>Length (mm)</th>
<th>Cross-sectional area (mm²)</th>
<th>Moment of inertia (mm⁴)</th>
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<tbody>
<tr>
<td>Span 1</td>
<td>700</td>
<td>12864</td>
<td>269 \times 10³</td>
</tr>
<tr>
<td>Span 2</td>
<td>1900</td>
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<td>269 \times 10³</td>
</tr>
<tr>
<td>Span 3</td>
<td>400</td>
<td>12864</td>
<td>269 \times 10³</td>
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**LOADING DETAILS**

**Beam Loads:**

- Load 1  UDL Dead load 4.1 kN/m
- Load 2  VDL Dead load 21.9 kN/m to 0.0 kN/m

**LOAD COMBINATIONS**

<table>
<thead>
<tr>
<th>Load combination 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Span 1 1×Dead</td>
</tr>
<tr>
<td>Span 2 1×Dead</td>
</tr>
<tr>
<td>Span 3 1×Dead</td>
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</table>

**CONTINUOUS BEAM ANALYSIS - RESULTS**

_unfactored support reactions_

<table>
<thead>
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<th>Support</th>
<th>Dead (kN)</th>
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<tr>
<td>A</td>
<td>-1.4 0.0 0.0 0.0 0.0 0.0 0.0 0.0</td>
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<tr>
<td>B</td>
<td>-32.8 0.0 0.0 0.0 0.0 0.0 0.0 0.0</td>
</tr>
<tr>
<td>C</td>
<td>-10.8 0.0 0.0 0.0 0.0 0.0 0.0 0.0</td>
</tr>
<tr>
<td>D</td>
<td>0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0</td>
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**Support Reactions - Combination Summary**

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<th>Support</th>
<th>Max react = -1.4 kN</th>
<th>Min react = -1.4 kN</th>
<th>Max mom = 0.0 kNm</th>
<th>Min mom = 0.0 kNm</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Max react = -32.8 kN</td>
<td>Min react = -32.8 kN</td>
<td>Max mom = 0.0 kNm</td>
<td>Min mom = 0.0 kNm</td>
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<tr>
<td>C</td>
<td>Max react = -10.8 kN</td>
<td>Min react = -10.8 kN</td>
<td>Max mom = 0.0 kNm</td>
<td>Min mom = 0.0 kNm</td>
</tr>
<tr>
<td>D</td>
<td>Max react = 0.0 kN</td>
<td>Min react = 0.0 kN</td>
<td>Max mom = 0.0 kNm</td>
<td>Min mom = 0.0 kNm</td>
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**Beam Max/Min results - Combination Summary**

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<tr>
<th></th>
<th>Minimum shear</th>
<th>Minimum moment</th>
<th>Minimum deflection</th>
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<tr>
<td>Maximum shear</td>
<td>17.8 kN</td>
<td>3.7 kNm</td>
<td>21.0 mm</td>
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<tr>
<td>Maximum moment</td>
<td>-15.0 kNm</td>
<td>-5.0 kNm</td>
<td>-14.3 mm</td>
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</tbody>
</table>

**Bending Moment Envelope**

**Graphical representation**

- kNm units
- mm units
- Bending Moment Envelope
- Points: A, 700, 1, B, 1900, 2, C, 400, D
- Peaks and troughs indicated
- Scale: 3.654 kNm, -4.970 kNm, 0.0 kNm
Number of sheets Nos = 2

Mallowable = Sxx * py * Nos = 8.745kNm

Shear V = (14.6kN + 13.4kN) /2 = 14.000kN

Any Acro Prop is acceptable
**KD4 SHEETS**

**KD4**

The overlapping trench sheeting profile is a heavier version of the Standard Lap, with a wider gauge and width coverage, designed in large for construction work.

**Technical Information**

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<th>Effective width per sheet (mm)</th>
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<tr>
<td>Depth (mm)</td>
<td>50</td>
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<td>Weight per linear metre (kg/m)</td>
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<td>Weight per m² (kg)</td>
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<td>Section modulus per metre width (cm²)</td>
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<td>Section modulus per sheet (cm²)</td>
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<td>Exhale per metre width (cm³)</td>
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<tr>
<td>Exhale per sheet (cm³)</td>
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<tr>
<td>Total rolled metres per tonne</td>
<td>45,650</td>
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\[
S_{xx} = 48.3 \text{cm}^3
\]
\[
p_y = 275 \text{N/mm}^2
\]
\[
l_{xx} = 26.9 \text{cm}^4
\]

\[
A = \left(1 \text{m}^2 \times 55.2 \text{kg/m}^2 \right) / \left(400 \text{mm} \times 7750 \text{kg/m}^3 \right) = 17806.452 \text{mm}^2
\]
Length a \( a = 2.700 \) m
Length b bottom \( b = 1.100 \) m
Length c Middle \( c = a - b = 1.600 \) m
Length d top \( d = D_{soil} - a = 0.300 \) m

CONTINUOUS BEAM ANALYSIS - INPUT

**BEAM DETAILS**

Number of spans = 3

**Material Properties:**
- Modulus of elasticity = 205 kN/mm\(^2\)
- Material density = 7860 kg/m\(^3\)

**Support Conditions:**
- Support A: Vertically "Restrained" Rotationally "Free"
- Support B: Vertically "Restrained" Rotationally "Free"
- Support C: Vertically "Restrained" Rotationally "Free"
- Support D: Vertically "Free" Rotationally "Free"

**Span Definitions:**
- Span 1: Length = 1100 mm Cross-sectional area = 17806 mm\(^2\) Moment of inertia = 269.\(\times10^3\) mm\(^4\)
- Span 2: Length = 1600 mm Cross-sectional area = 17806 mm\(^2\) Moment of inertia = 269.\(\times10^3\) mm\(^4\)
Span 3

Length = 300 mm

Cross-sectional area = 17806 mm²

Moment of inertia = 269.10³ mm⁴

LOADING DETAILS

Beam Loads:

Load 1  VDL Dead load 21.9 kN/m to 0.0 kN/m
Load 2  UDL Dead load 4.1 kN/m

LOAD COMBINATIONS

Load combination 1

Span 1  1 x Dead
Span 2  1 x Dead
Span 3  1 x Dead

CONTINUOUS BEAM ANALYSIS - RESULTS

Support Reactions - Combination Summary

Support A  Max react = -9.5 kN  Min react = -9.5 kN  Max mom = 0.0 kNm  Min mom = 0.0 kNm
Support B  Max react = -28.0 kN  Min react = -28.0 kN  Max mom = 0.0 kNm  Min mom = 0.0 kNm
Support C  Max react = -7.5 kN  Min react = -7.5 kN  Max mom = 0.0 kNm  Min mom = 0.0 kNm
Support D  Max react = 0.0 kN  Min react = 0.0 kN  Max mom = 0.0 kNm  Min mom = 0.0 kNm

Beam Max/Min results - Combination Summary

Maximum shear = 13.4 kN

Minimum shear = -14.6 kN

Maximum moment = 2.0 kNm

Minimum moment = -3.6 kNm

Maximum deflection = 7.7 mm

Minimum deflection = -4.9 mm

Number of sheets Nos = 2

Mallowable = Sxx * py * Nos = 26.565 kNm
Shear $V = \frac{(14.6kN + 13.4kN)}{2} = 14.000kN$

Any Acro Prop is acceptable
Sheeting requirements

Full sheeting

Half sheeting shown for 1.5 m deep trench
Sheeting requirements

Design to CIRIA 97

Note:
- For standard Speedshores hydraulic screw and seating or equivalent use the curve for 229 x 89 RSC.
- Heavy-duty Speedshores have a capacity of 3.5 kN/m per unit at 1.3 m horizontal strut spacing.

Any proprietary system should be checked against manufacturer’s latest information.

Use for:
- Granular soils
- Mixed soils
- Short term trenches in clay
- Presence of ripping

<table>
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<tr>
<th>Load on strut (kN)</th>
<th>Maximum vertical spacing of struts (m)</th>
<th>Maximum horizontal spacing (m)</th>
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<tbody>
<tr>
<td>150 x 75 timber</td>
<td>200 x 150 timber</td>
<td>200 x 150 timber</td>
</tr>
<tr>
<td>225 x 75 timber</td>
<td>200 x 150 timber</td>
<td>200 x 150 timber</td>
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<td>150 x 100 timber</td>
<td>200 x 150 timber</td>
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<td>150 x 150 timber</td>
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<tr>
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<tr>
<td>275 x 75 timber</td>
<td>200 x 150 timber</td>
<td>200 x 150 timber</td>
</tr>
</tbody>
</table>

Flooding depth of excavation (m)

10 20 30 40 50

1 2 3 4 5

0 10 20 30 40 50

Example 1

Example 2

Example 3
Appendix C: Basement Movement Monitoring Statement

This information is provided for Planning use only and is not to be used for Building control submissions.
9. Introduction
Basement works are intended to the above address. To undertake these works, structural works will be undertaken that require party wall awards.

10. Risk assessment
The purpose of this risk assessment is to consider the impact of the proposed works and how they impact the party wall. There are varying levels of inspection that can be undertaken and not all works, soil conditions and properties require the same level of protection.

<table>
<thead>
<tr>
<th>Monitoring Level proposed</th>
<th>Type of Works</th>
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</thead>
<tbody>
<tr>
<td></td>
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</table>
11. Scheme Details

This document has been prepared by Croft Structural Engineers Ltd. It covers the proposed construction of a new basement underneath the existing structure at No. 41 Coleville Mews.

Scope of Works

The works comprise:

- Visual Monitoring of the party wall
- Attachment of Tell tales or Demec Studs to accurately record movement of significant cracks.
- Attachment of levelling targets to monitor settlement.
- The monitoring of the above instrumentation is in accordance with Appendix A. The number and precise locations of instrumentation may change during the works; this shall be subject to agreement with the Principal Contractor (PC).
- All instruments are to be adequately protected against any damage from construction plant or private vehicles using clearly visible markings and suitable head protection e.g. manhole rings or similar. Any damaged instruments are to be immediately replaced or repaired at the contractors own cost.
- Reporting of all data in a manner easily understood by all interested parties.
- Co-ordination of these monitoring works with other site operations to ensure that all instruments can be read and can be reviewed against specified trigger values both during and post construction.
- Regular site meetings by the Principal Contractor (PC) and the Monitoring Surveyor (MS) to review the data and their implications.
- Review of data by Croft Structural Engineers

In addition, the PC will have responsibility for the following:

- Review of methods of working/operations to limit movements, and
- Implementation of any emergency remedial measures if deemed necessary by the results of the monitoring.
The Monitoring Surveyor shall allow for settlement and crack monitoring measures to be installed and monitored on various parts of the structure described in Table 1 as directed by the PC and Party Wall Surveyor (PWS) for the Client.

<table>
<thead>
<tr>
<th>Item</th>
<th>Instrumentation Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Party Wall Brickwork</td>
<td></td>
</tr>
<tr>
<td>Settlement monitoring</td>
<td>Levelling equipment &amp; targets</td>
</tr>
<tr>
<td>Crack monitoring</td>
<td>Visual inspection of cracking, Demec studs where necessary</td>
</tr>
</tbody>
</table>

Table 1: Instrumentation

General

The site excavations and substructure works up to finished ground slab stage have the potential to cause vibration and ground movements in the vicinity of the site due to the following:

a) Removal of any existing redundant foundations / obstructions;
b) Installation of reinforced concrete retaining walls under the existing footings;
c) Excavations within the site

The purpose of the Monitoring is a check to confirm building movements are not excessive.

This Specification is aimed at providing a strategy for monitoring of potential ground and building movements at the site.

This Specification is intended to define a background level of monitoring. The PC may choose to carry out additional monitoring during critical operations. Monitoring that is to be carried out is as follows:

a) Visual inspection of the party wall and any pre-existing cracking
b) Settlement of Party Wall

All instruments are to be protected from interference and damage as part of these works.

Access to all instrumentation or monitoring points for reading shall be the responsibility of the Monitoring Surveyor (MS). The MS shall be in sole charge for ensuring that all instruments or monitoring points can be read at each visit and for reporting of the data in a form to be agreed with the PWS. He shall inform the PC if access is not available to certain instruments and the PC will, wherever possible, arrange for access. He shall immediately report to the PC any damage. The Monitoring Surveyor and the Principal Contractor will be responsible for ensuring that all the instruments that fall under their respective remits as specified are fully operational at all times and any defective or damaged instruments are immediately identified and replaced.

The PC shall be fully responsible for reviewing the monitoring data with the MS, before passing onto the Croft Structural Engineers, determining its accuracy and assessing whether immediate action is to be taken by him and/or other contractors on site to prevent damage to instrumentation or to
ensure safety of the site and personnel. All work shall comply with the relevant legislation, regulations and manufacturer's instructions for installation and monitoring of instrumentation.

Applicable Standards and References

The following British Standards and civil engineering industry references are applicable to the monitoring of ground movements related to activities on construction works sites:

5. CIRIA SP 201 - Response of buildings to excavation-induced ground movements, CIRIA 2001.

SPECIFICATION FOR INSTRUMENTATION

General
The Monitoring Contractor is required to monitor, protect and reinstall instruments as described. The readings are to be recorded and reported. The following instruments are defined:

a) Automatic level and targets: A device which allows the measurement of settlement in the vertical axis. To be installed by the MS.

b) Tell-tales and 3 stud sets: A device which allows measurement of movement to be made in two axes perpendicular to each other. To be installed by the MS.

Monitoring of existing cracks
The locations of tell-tales or Demec studs to monitor existing cracks shall be agreed with Croft Structural Engineers.

Instrument Installation Records and Reports

Where instrumentation is to be installed or reinstalled, the Monitoring Surveyor, or the Principal Contractor, as may be applicable, shall make a complete record of the work, including the position and level of each instrument. The records shall include base readings and measurements taken during each monitoring visit. Both tables and graphical outputs of these measurements shall be presented in a format to be agreed with the CM. The report shall include photographs of each type of instrumentation installed and clear scaled sections and plans of each instrument installed. This report shall also include the supplier's technical fact sheet on the type of instrument used and instructions on monitoring.
Two signed copies of the report shall be supplied to the PWS within one week of completion of site measurements for approval.

**Installation**

All instruments shall be installed to the satisfaction of the PC. No loosening or disturbance of the instrument with use or time shall be acceptable. All instruments are to be clearly marked to avoid damage.

All setting out shall be undertaken by the Monitoring Surveyor or the Principal Contractor as may be applicable. The precise locations will be agreed by the PC prior to installation of the instrument.

The installations are to be managed and supervised by the Instrumentation Engineer or the Measurement Surveyor as may be applicable.

**Monitoring**

The frequencies of monitoring for each Section of the Works are given in Appendix A.

The following accuracies/ tolerances shall be achieved:

<table>
<thead>
<tr>
<th>Party Wall settlement</th>
<th>+1.5mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crack monitoring</td>
<td>+0.75mm</td>
</tr>
</tbody>
</table>
REPORT OF RESULTS AND TRIGGER LEVELS

General
Within 24 hours of taking the readings, the Monitoring Surveyor will submit a single page summary of the recorded movements. All readings shall be immediately reviewed by Croft Structural Engineers prior to reporting to the PWS.

Within one working day of taking the readings the Monitoring Contractor shall produce a full report (see below).

The following system of control shall be employed by the PC and appropriate contractors for each section of the works. The Trigger value, at which the appropriate action shall be taken, for each section, is given in Table 2, below.

The method of construction by use of sequential underpins limits the deflections in the party wall. The maximum movement across the length of the party wall must not exceed 5 mm.

Between the trigger points, which are no greater than 2 m apart, there should be no more than 3 mm movement.

During works measurements are taken, these are compared with the limits set out below:

<table>
<thead>
<tr>
<th>Movement</th>
<th>CATEGORY</th>
<th>ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0mm-7mm</td>
<td>Green</td>
<td>No action required</td>
</tr>
<tr>
<td>7mm-12mm</td>
<td>AMBER</td>
<td>Crack Monitoring:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Carry out a local structural review;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Preparation for the implementation of remedial measures should be required.</td>
</tr>
<tr>
<td>&gt;12mm</td>
<td>RED</td>
<td>Crack Monitoring:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Implement structural support as required;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cease works with the exception of necessary works for the safety and stability of the structure and personnel;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Review monitoring data and implement revised method of works</td>
</tr>
</tbody>
</table>

Table 2 – Movement limits between adjacent sets of Tell-tales or stud sets

Any movements which exceed the individual amber trigger levels for a monitoring measure given in Table 2 shall be immediately reported to the PWS, and a review of all of the current monitoring data for all monitoring measures must be implemented to determine the possible causes of the trigger level being exceeded. Monitoring of the affected location must be increased and the actions described above implemented. Assessment of exceeded trigger levels must not be carried out in isolation from an assessment of the entire monitoring regime as the monitoring measures are
inter-related. Where required, measures may be implemented or prepared as determined by the specific situation and combination of observed monitoring measurement data.

Appendix B is explaining how these values are within the allowable and follows the theory from Skempton and MacDonald (1956).

Standard Reporting

1 No. electronic copy of the report in PDF format shall be submitted to the PWS.

The Monitoring Surveyor shall report whether the movements are within (or otherwise) the Trigger Levels indicated in Table 2. A summary of the extent of completion of any of the elements of works and any other significant events shall be given. These works shall be shown in the form of annotated plans (and sections) for each survey visit both local to the instrumentation and over a wider area. The associated changes to readings at each survey or monitoring point shall be then regulated to the construction activity so that the cause of any change, if it occurs, can be determined.

The Monitoring Surveyor shall also give details of any events on site which in his opinion could affect the validity of the results of any of the surveys.

The report shall contain as a minimum, for each survey visit the following information:

a) The date and time of each reading;
b) The weather on the day:
c) The name of the person recording the data on site and the person analysing the readings together with their company affiliations;
d) Any damage to the instrumentation or difficulties in reading;
e) Tables comparing the latest reading with the last reading and the base reading and the changes between these recorded data;
f) Graphs showing variations in crack width with time for the crack measuring gauges; and
g) Construction activity as described. It is very important that each set of readings is associated with the extent of excavation and construction at that time. Readings shall be accompanied by information describing the extent of works at the time of readings. This shall be agreed with the PC.

Spread-sheet columns of numbers should be clearly labelled together with units. Numbers should not be reported to a greater accuracy than is appropriate. Graph axis should be linear and clearly labelled together with units. The axis scales are to be agreed with the PC before the start of monitoring and are to remain constant for the duration of the job unless agreed otherwise. The specified trigger values are also to be plotted on all graphs.

The reports are to include progress photographs of the works both general to the area of each instrument and globally to the main Works. In particular, these are to supplement annotated plans/sections described above. Wherever possible the global photographs are to be taken from approximately the same spot on each occasion. The locations of these points on site are to be Croft Structural Engineers drawing SD-01.

Erroneous Data

All data shall be checked for errors by the Monitoring Surveyor prior to submission. If a reading that appears to be erroneous (i.e. it shows a trend which is not supported by the surrounding instrumentation), he shall notify the PC immediately, resurvey the point in question and the neighbouring points and if the error is repeated, he shall attempt to identify the cause of the error. Both sets of readings shall be processed and submitted, together with the reasons for the errors and details of remedial works. If the error persists at subsequent survey visits, the Monitoring Surveyor
shall agree with the PC how the data should be corrected. Correction could be achieved by correcting the readings subsequent to the error first being identified to a new base reading.

The Monitoring Surveyor shall rectify any faults found in or damage caused to the instrumentation system for the duration of the specified monitoring period, irrespective of cause, at his own cost.

Trigger Values

Trigger values for maximum movements as listed in Table 2. If the movement exceeds these values then action may be required to limit further movement. The PC should be immediately advised of the movements in order to implement the necessary works.

It is important that all neighbouring points (not necessarily a single survey point) should be used in assessing the impact of any movements which exceed the trigger values, and that rechecks are carried out to ensure the data is not erroneous. A detailed record of all activities in the area of the survey point will also be required as specified elsewhere.

Responsibility for Instrumentation

The Monitoring Surveyor shall be responsible for: managing the installation of the instruments or measuring points, reporting of the results in a format which is user friendly to all parties; and immediately reporting to all parties any damage. The Monitoring Surveyor shall be responsible for informing the PC of any movements which exceed the specified trigger values listed in Table 2 so that the PC can implement appropriate procedures. He shall immediately inform the PWS of any decisions taken.
APPENDIX A
MONITORING FREQUENCY

<table>
<thead>
<tr>
<th>INSTRUMENT</th>
<th>FREQUENCY OF READING</th>
</tr>
</thead>
</table>
| Settlement monitoring and Monitoring existing cracks | **Pre-construction**  
Monitored once.  

**During construction**  
Monitored after every pin is cast for first 4 no. pins to gauge effect of underpinning. If all is well, monitor after every other pin.  

**Post construction works**  
Monitored once. |
APPENDIX B

An Analysis on allowable settlements of structures (Skempton and MacDonald (1956))

The most comprehensive studies linking self-weight settlements of buildings to structural damage were carried out in the 1950’s by Skempton and MacDonald (1956) and Polshin and Tokar. These studies show that damage is most often caused by differential steelments rather than absolute settlements. More recently, similar empirical studies by Boscardin and Cording (1989) and Boone (1996) have linked structural damage to ground movements induced by excavations and tunnelling activities.

In 1955 Skempton and MacDonald identified the parameter $\delta P/L$ as the fundamental element on which to judge maximum admissible settlements for structures. This criterion was later confirmed in the works of Grant et al. [1975] and Walsh [1981]. Another important approach to the problem was that of Burland and Wroth [1974], based on the criterion of maximum tensile strains.

Figure 2.1 – Diagram illustrating the definitions of maximum angular distortion, $\delta P$, maximum settlement, $P_{\text{max}}$, and greatest differential settlement, $\Delta$, for a building with no tilt (Skempton and MacDonald, 1956).
The differential settlement is defined as the greatest vertical distance between two points on the foundation of a structure that has settled, while the angular distortion, is the difference in elevation between two points, divided by the distance between those points.

Data from Skempton and MacDonald’s work suggest that the limiting value of angular distortion is 1/300. Angular distortion, greater than 1/300 produced visible cracking in the majority of buildings studied, regardless of whether it was a load bearing or a frame structure. As shown in the figure 2.

Other key findings by Skempton and MacDonald include limiting values of $\delta/l$ for structure, and a relationship between maximum settlement, $\rho_{\text{max}}$ and $\delta/l$ for structures founded on sands and clays. The charts below show these relations for raft foundations and isolated footings.

Figure 26: Skempton and MacDonald’s analysis of field evidence of damage on traditional frame buildings and loadbearing brick walls
**Table I**

<table>
<thead>
<tr>
<th>Angular distorsion</th>
<th>Characteristic situation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/300</td>
<td>Cracking of the panels in frame buildings of the traditional type, or of the walls in load-bearing wall buildings;</td>
</tr>
<tr>
<td>1/150</td>
<td>Structural damage to the stanchions and beams;</td>
</tr>
<tr>
<td>1/500</td>
<td>Design limit to avoid cracking;</td>
</tr>
<tr>
<td>1/1000</td>
<td>Design limit to avoid any settlement damage.</td>
</tr>
</tbody>
</table>
Appendix D: Structural Scheme Drawings

This information is provided for Planning use only and is not to be used for Building control submissions.
Appendix E: Soil Investigation Report

This information is provided for Planning use only and is not to be used for Building control submissions.
Factual Report

Client: The Basement Design Studio
Site: 41 Colville Mews, London, W11 2DA
CSI Ref: FACT/4906
Dated: 23rd October 2014
Client: The Basement Design Studio
Location: 41 Colville Mews, London, W11 2DA
Job No: 4906
Weather: Overcast
Date: 23.10.14

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

Notes: On site tree identification for guidance only. Not authenticated.
<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>
<th>Weather</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.02</td>
<td>TILE</td>
<td>0.02</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>No roots observed.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.1</td>
<td>CONCRETE</td>
<td>0.08</td>
<td></td>
<td></td>
<td>D</td>
<td></td>
<td></td>
<td></td>
<td>0.5</td>
<td>Overcast</td>
<td>13.10.14</td>
</tr>
<tr>
<td></td>
<td>MADE GROUND: medium compact, dark brown, gravelly sandy silty clay with brick fragments.</td>
<td>0.8</td>
<td></td>
<td></td>
<td>D</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.9</td>
<td>Stiff, mid brown, silty CLAY with partings of brown silt and fine sand.</td>
<td>2.7</td>
<td></td>
<td></td>
<td>D</td>
<td>V</td>
<td>86, 88</td>
<td>1.0</td>
<td>1.0</td>
<td>Overcast</td>
<td>13.10.14</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>D</td>
<td></td>
<td></td>
<td></td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>D</td>
<td>V</td>
<td>90, 92</td>
<td>2.0</td>
<td>2.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>D</td>
<td></td>
<td></td>
<td></td>
<td>2.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>D</td>
<td>V</td>
<td>94, 100</td>
<td>3.0</td>
<td>3.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.6</td>
<td>CLAYSTONE</td>
<td>0.2</td>
<td></td>
<td></td>
<td>D</td>
<td></td>
<td></td>
<td>3.5</td>
<td>3.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>D</td>
<td>V</td>
<td>140+, 140+</td>
<td>4.0</td>
<td>4.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>D</td>
<td></td>
<td></td>
<td></td>
<td>4.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Very stiff, brown, silty CLAY with partings of brown and orange silt and fine sand.</td>
<td>2.2</td>
<td></td>
<td></td>
<td>D</td>
<td>V</td>
<td>140+, 140+</td>
<td>5.0</td>
<td>5.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>D</td>
<td></td>
<td></td>
<td></td>
<td>5.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.0</td>
<td>Borehole ends at 6.0m</td>
<td></td>
<td></td>
<td></td>
<td>D</td>
<td>V</td>
<td>140+, 140+</td>
<td>6.0</td>
<td>6.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

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