



**Richard Tant Associates**  
Consulting Civil & Structural Engineers

# 175A Nightingale Lane

## Structural Methodology Statement

Job Number: 5230

Date: October/2023

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## 1.0 Richard Tant Associates

Richard Tant Associates are consulting Civil and Structural Engineers comprising a number of chartered engineers. We have experience in post basement construction and have successfully carried out a number of basements in the Borough of Haringey from the Basement Impact Assessment stage through to construction on site.

## 2.0 Brief

This document is the Structural Methodology Statement carried out for the purposes of the planning application for the proposals at no. 175A Nightingale Lane. It should be noted that this report outlines and suggests the assumed construction at this stage. It should also be noted that, as is standard for works of this type, the main contractor will be fully responsible for construction methodology and the design and erection of all temporary works.

The purpose of the report, together with the Basement Impact Assessment prepared by LBHGEO, is to demonstrate that a subterranean development can be safely constructed on the particular site having regard to the sites existing structural conditions and geology.

The Basement Impact Assessment prepared by LBHGEO references the relevant stages set out in the Haringey Development Management DPD document.

## 3.0 Proposed Architectural Works

### 3.1 Outline

Proposed works include a new residential dwelling adjacent to the existing building at 175 Nightingale Lane (hereinafter referred to as No. 175), the new dwelling hereinafter referred to as No. 175A.

The proposed dwelling is a two bedroom semi-detached house comprising two stories above ground level, and a proposed habitable basement level, approximately 2.8m below the existing ground level, which extends beyond the floors above to create a rear outdoor patio space.

Please refer to the following drawings prepared by the Architect, Office S&M:

- 23510-99A, 100A, 101A, 102A, 120A, 121A, 122A, 123A, 124A and 130A

## 4.0 Proposed Structural Works

### 4.1 Outline

Our proposal is to underpin the existing north side flank wall of No. 175 with mass concrete, thickness and footing projection to suit the existing wall including any existing chimney breasts, with a new reinforced concrete cantilever retaining wall constructed immediately adjacent. The new retaining wall will comprise reinforced concrete footing thickenings which will help stabilise the construction, in addition to the temporary works, in the temporary condition.

In line with recommendations within the Basement Impact Assessment by LBHGEO, the front retaining wall will also be constructed in a hit and miss manner, which we propose will be constructed in two



stages; first installing a 1m deep continuous reinforced concrete strip footing at ground level, and subsequently underpinned in a hit and miss manner. We propose that trench sheeting will be used to allow the remaining excavation to be safely carried out to install the remaining reinforced concrete retaining walls; the contractor may wish to reevaluate this during works.

Installation of a new reinforced concrete basement slab will tie the retaining wall footings together to form a raft with local thickenings in the permanent condition.

We propose support for the new and existing superstructure will be provided by a combination of new a braced steel frame and a rigid steel frame, which will be supported off the new reinforced concrete basement slab and footings.

Please refer to our drawings 5230-SM01B and 5230-SM02B for the suggested construction methodology showing temporary and permanent works.

## 4.2 Site Investigation

A geotechnical assessment and hydrogeological and hydrological impact assessment have been carried out by LBHGEO within their Basement Impact Assessment. We confirm the trial holes and boreholes show a limited thickness of made ground underlain by the London Clay formation comprising typical firm brown mottled bluish grey silty clay.

No shallow groundwater table was found beneath the site.

Based on this geotechnical information, the new basement construction is to comprise reinforced concrete underpinned retaining walls with an internal cavity drain system.

Trial holes have been completed and inspected, summarised in the Geotechnical Investigation report by Your Environment:

- YEX3069 - 175a Nightingale Lane, Hornsey, N8 7LJ \_Ph2 Geotech Report FINA Apps.pdf

The trial hole information is shown on drawing 5230-SM01B.

## 4.3 Supporting the Proposed Loads

The vertical loads from the proposed structure will be supported via the reinforced concrete retaining walls into the basement reinforced concrete raft slab. Lateral and vertical ground pressures and possible accidental water pressures will be resisted by reinforced concrete retaining walls, refer to the calculation sheets for justification of the retaining walls found in Appendix A of this report.

The loads from the superstructure will be supported via the new steel frame in turn supported via the new raft slab. A combination of a braced steel frame and a rigid steel frame are proposed to support lateral wind and theoretical equivalent horizontal forces, transferring forces via bending and shear action into the new raft slab.



## 5.0 Structural Integrity of Existing Structures and Utilities

### 5.1 Existing Structures

The existing north flank wall of No. 175 will be underpinned with mass concrete in a hit and miss manner, depth to be greater than the adjacent proposed reinforced concrete thickenings to minimise structural movement and any surcharge loading onto the proposed basement. The front retaining wall will also be constructed in a hit and miss manner to minimise ground movement close to the nearby public highway. The reinforced concrete retaining walls will be designed to retain the ground pressures and possible accidental water pressures and distribute the vertical and lateral load into the raft slab and into the ground.

Refer to calculation sheets for justification of the retaining walls in Appendix A of this report.

Refer to the impact assessment section of the LBHGEO report confirming the proposed development will have a 'very slight' Burland Category with respect to possible damage to neighbouring structures.

### 5.2 Utilities

Refer to the ground movement assessment section of the LBHGEO report confirming that, with reasonable workmanship and a hit and miss construction methodology for the front retaining wall, negligible movement is anticipated and hence a negligible impact is expected on any potential utilities present beneath the highway. We assume an asset search will be carried out prior to construction to confirm the presence of any public utilities, tunnels etc.

## 6.0 Construction Methodology

### 6.1 Sequence of Construction

Please refer to our drawings 5230-SM01B and 5230-SM02B for the suggested methodology showing temporary and permanent works.

The proposal is to construct the walls in stages that will be temporarily propped until the final base is constructed and cured. Where battering back is proposed, temporary trench sheeting will be installed to retain ground until the permanent structure has gained adequate strength and stability. We refer to the LBHGEO Basement Impact Assessment where the risk of slope instability is addressed and discharged.

### 6.2 Temporary Works

Please refer to our proposed drawings 5230-SM01B and 5230-SM02B for details of the suggested temporary works. When the contractor is appointed, they will be fully responsible for the temporary works including the design and erection.



## 7.0 Other Considerations

### 7.1 Impact on Drainage and Surface Water

We do not expect there to be any existing public drainage within the area of influence of the proposed basement works. We acknowledge that there may be a need for a Sustainable Drainage Systems (SuDS) report to address the increase in impermeable area on the site.

### 7.2 Geological & Hydrological Concerns

The application is informed and supplemented by the hydrological section of the geotechnical report carried out by LBHGEO and identified in their Basement Impact Assessment report.

### 7.3 Impact on Trees

We understand an arboricultural survey and a soft and hard landscaping scheme will accompany the planning submission and expect that a tree management strategy will be provided, particularly with reference to the assumed root protection zone at the rear of the proposed basement.

We confirm the new foundations will be designed in accordance with the guidance provided by the NHBC with regards to building near trees.

This report has been produced for the sole use of Haringey Council and for their use only and should not be relied upon by any third party. No responsibility is undertaken to any third party without the prior written consent of Richard Tant Associates.

Richard Tant BEng(Hons) CEng MStructE for Richard Tant Associates.



## APPENDIX A: Basement Calculations

### A1.0 General

175 Nightingale Lane is a 2-storey semi-detached house in sound structural condition.

Proposed works include a new residential dwelling adjacent to the existing building at 175 Nightingale Lane (hereinafter referred to as No. 175), the new dwelling hereinafter referred to as No. 175A.

The proposed dwelling is a two bedroom semi-detached house comprising two stories above ground level, and a proposed habitable basement level, approximately 2.8m below the existing ground level, which extends beyond the floors above to create a rear outdoor patio space.

We propose underpinning the existing north side flank wall of No. 175 with mass concrete, thickness and footing projection to suit the existing wall including any existing chimney breasts, with a new reinforced concrete cantilever retaining wall constructed immediately adjacent. The new retaining wall will comprise reinforced concrete footing thickenings which will help stabilise the construction, in addition to the temporary works, in the temporary condition.

Installation of a new reinforced concrete basement slab will tie the retaining wall footings together to form a raft with local thickenings in the permanent condition.

We propose support for the new and existing superstructure will be provided by a combination of new a braced steel frame and a rigid steel frame, which will be supported off the new reinforced concrete basement slab and footings.

The following report is justification for our preliminary proposal for the basement design.

**These calculations are not to be relied on by any third party without prior written consent from RTA.**



## A2.0 Loadings

The below table outlines typical assumed loads used for our load takedown.

| Load Type                       | Element              | kN/m <sup>2</sup> |
|---------------------------------|----------------------|-------------------|
| <b>Sloping Roof</b>             |                      |                   |
| <b>Dead Load</b>                | Tiles                | 0.7               |
|                                 | Battens/Felt         | 0.1               |
|                                 | Rafters              | 0.2               |
|                                 | Insulation           | 0.1               |
|                                 | Plaster/Skim         | 0.1               |
|                                 | Total $\Sigma$       | 1.2 (1.6 on plan) |
| <b>Live Load</b>                | Access               | 0.75              |
| <b>Flat Roof</b>                |                      |                   |
| <b>Dead Load</b>                | Chipping and Bitumen | 0.6               |
|                                 | Boards/Felt          | 0.2               |
|                                 | Joists               | 0.2               |
|                                 | Insulation           | 0.1               |
|                                 | Plaster/Skim         | 0.1               |
|                                 | Total $\Sigma$       | 1.2               |
| <b>Live Load</b>                | Access               | 0.75              |
| <b>Timber Floor</b>             |                      |                   |
| <b>Dead Load</b>                | Boards               | 0.2               |
|                                 | Joists               | 0.2               |
|                                 | Insulation           | 0.1               |
|                                 | Plaster/Skim         | 0.1               |
|                                 | Total $\Sigma$       | 0.6               |
| <b>Live Load</b>                | Imposed              | 1.5               |
|                                 | Imposed + Partitions | 2.5               |
| <b>Loft Floor (Access only)</b> |                      |                   |
| <b>Dead Load</b>                | Joists               | 0.2               |
|                                 | Insulation           | 0.1               |
|                                 | Plaster/Skim         | 0.1               |
|                                 | Total $\Sigma$       | 0.4               |
| <b>Live Load</b>                | Access               | 0.75              |
| <b>Timber Stairs</b>            |                      |                   |
| <b>Dead Load</b>                | Timber stairs        | 0.6               |
| <b>Live Load</b>                | Imposed              | 1.5               |



|                     |                                    |      |
|---------------------|------------------------------------|------|
| <b>Walls</b>        |                                    |      |
| <b>Dead Load</b>    | 100thk solid masonry               | 2.5  |
|                     | 215thk solid masonry               | 5.0  |
|                     | 327thk solid masonry               | 7.5  |
|                     | 440thk solid masonry               | 10.0 |
|                     | 300thk brick and block cavity wall | 4.5  |
|                     | External timber stud wall (tiled)  | 1.2  |
|                     | Internal timber stud wall          | 0.5  |
|                     | Chimney breast (typical)           | 4.0  |
| <b>Wind</b>         |                                    |      |
| <b>Wind Lateral</b> | External                           | 0.8  |
|                     | Internal                           | 0.4  |
| <b>Other</b>        |                                    |      |
| <b>Dead Load</b>    | Balustrading (Triple Glazed Glass) | 1.0  |
|                     | Glazing                            | 1.0  |



## A3.0 Load Takedown

A load takedown has been carried out for the proposed load bearing walls and using the typical loadings outlined previously as well as BS EN 1991-1-1:2002. The governing load bearing wall in this case will be the footing adjacent to the party wall.

Although the basement slab is designed as a raft, the loads will be distributed into the ground in the temporary condition by local thickenings at the base of the underpinning.

### A3.1 Vertical Loads

Each UDL in the tables below is a product of the pressure loads attracted by each element multiplied by the load width (for elements on plan) or load height (for elements on elevation):

$$\text{Load width/height (m)} * \text{Load pressure (kN/m}^2\text{)} = \text{Applied UDL (kN/m)}$$

| Element | Attracts Load Type                 | Load Width/<br>Height (m) | Load press.<br>(kN/m <sup>2</sup> ) | Applied UDL<br>(kN/m) |
|---------|------------------------------------|---------------------------|-------------------------------------|-----------------------|
| PW      | DL                                 |                           |                                     |                       |
| footing | 350thk RC Wall                     | 2.8                       | 11.3                                | 31.64                 |
|         | 300thk brick abd block cavity wall | 3                         | 5                                   | 15                    |
| B       | 425thk RC Footing                  | 1                         | 10.6                                | 10.6                  |
| GF      | Timber Floor                       | 2.3                       | 0.6                                 | 1.38                  |
| R       | Flat Roof                          | 2.3                       | 1.2                                 | 2.76                  |
|         |                                    |                           |                                     |                       |
|         | LL                                 |                           |                                     |                       |
| B       | Domestic Floor                     | 1                         | 1.5                                 | 1.5                   |
| GF      | Domestic Floor                     | 2.3                       | 1.5                                 | 3.45                  |
| R       | Access                             | 2.3                       | 0.75                                | 1.73                  |

For the purpose of designing our retaining wall and footing, we will consider a 1m length.

Total DL = 62kN

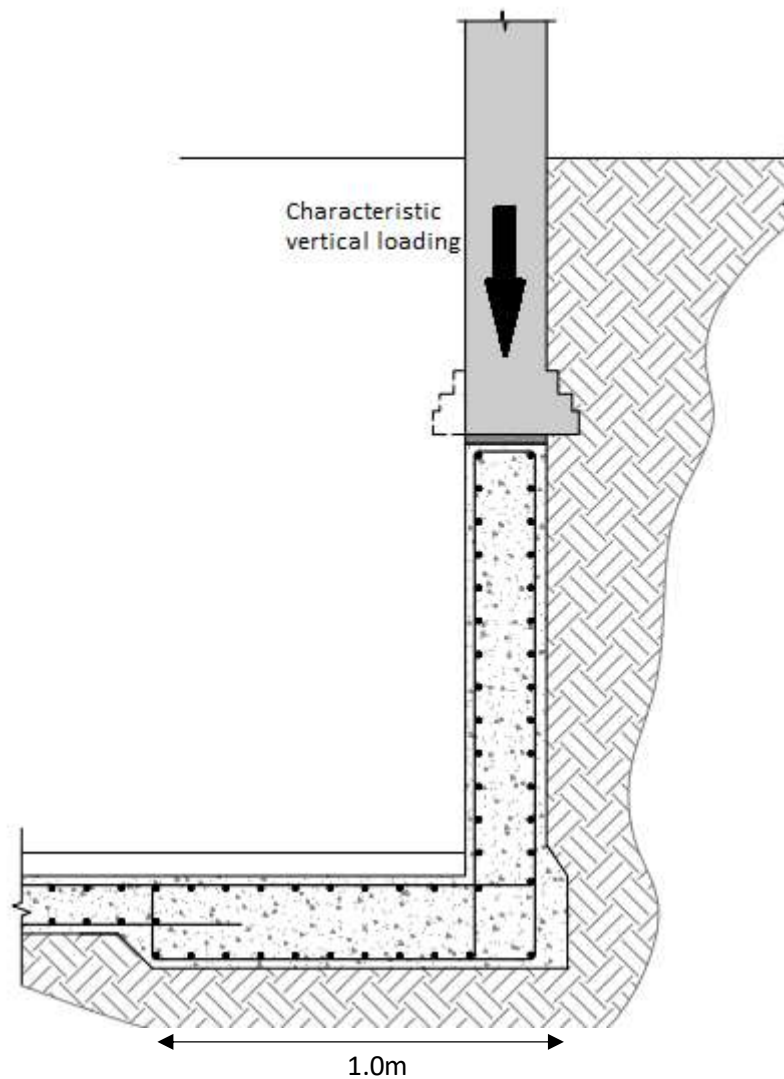
Total LL = 7kN

Characteristic vertical loading = 62kN + 7kN = 69kN

Allowable stress = 150kPa – as provided in the geotechnical assessment section of the Basement Impact Assessment report by LBHGEO

**Provide 1.0m wide footings; bearing pressure = 69kPa**





Typical Party Wall Section N.T.S.

### A3.2 Lateral Loads

Lateral loads acting on the proposed basement walls may be caused by earth pressure, water pressure and surcharge loading. For this design we conservatively consider water loading to act at ground level to consider a flood load case. To minimise structural movement of adjacent existing structures, the lateral pressures are designed to a  $k_o$  “at rest” condition. Where no adjacent structure is present, the lateral pressures are designed to a  $k_a$  “active” condition.

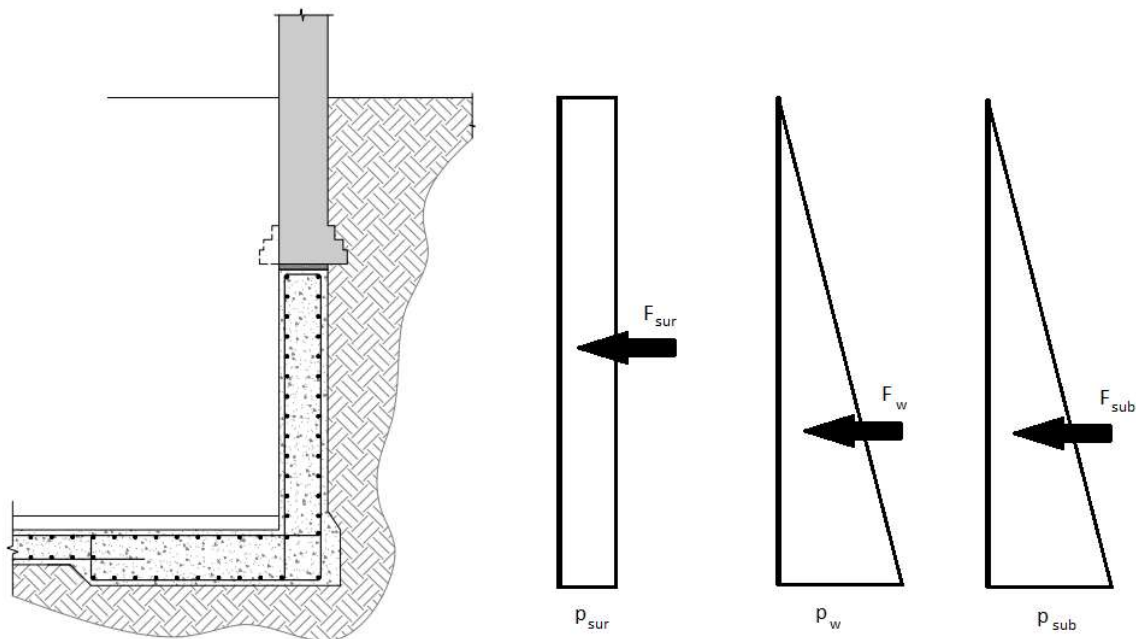
Theoretical equivalent horizontal forces and wind loads will be supported by the proposed steel frame so will not be considered for the design of the reinforced concrete basement retaining wall at this time.

The loading diagrams used to identify lateral earth pressures acting on the proposed retaining walls are shown for each design below.

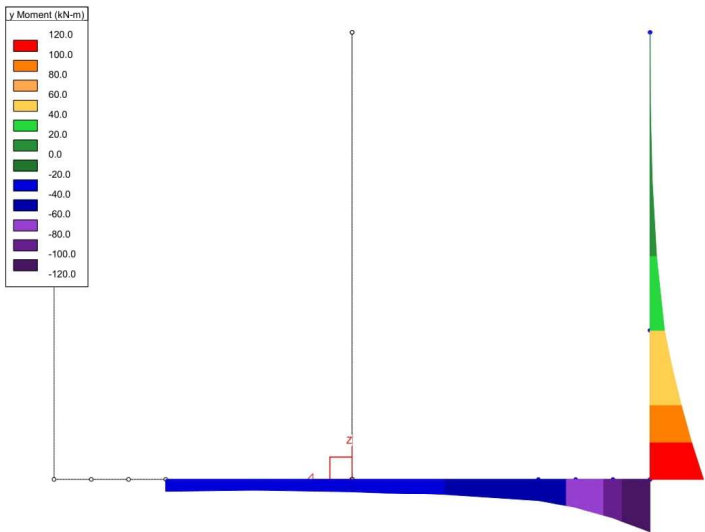


A3.2.1 Party Wall Retaining Wall

A summary of the maximum lateral earth pressures expected to act on the proposed reinforced concrete basement party wall is provided below.



|                                                                        |                                                                                                                                                                              |                     |
|------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| <p><b>Richard Tant Associates</b><br/>54 Lisson Street<br/>London,</p> | <p><b>Steel</b><br/>Filename: basement walls.TEL<br/>GRAPHICAL RESULTS - Ld Comb 2 1.2D + 1.2L + 1.2L + 1.2Sur + 1.2Soil + 1.2Water-&gt;y Moment (kN-m)<br/>Engineer: DW</p> | <p>Page: 1 of 1</p> |
|------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|

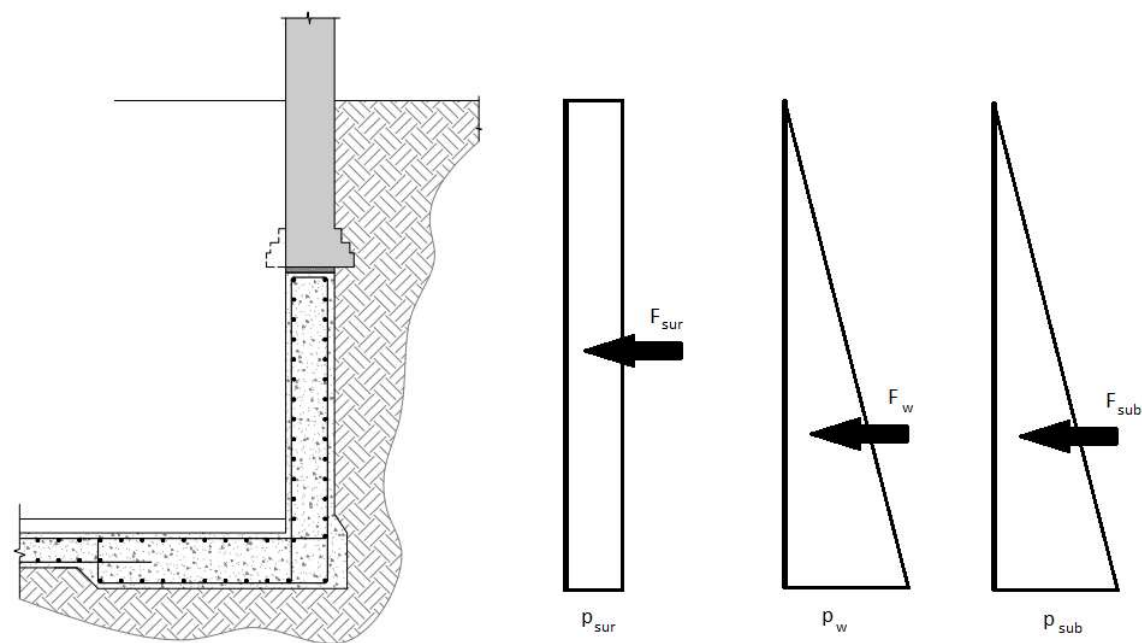


A summary of the reinforced concrete design check is provided below.

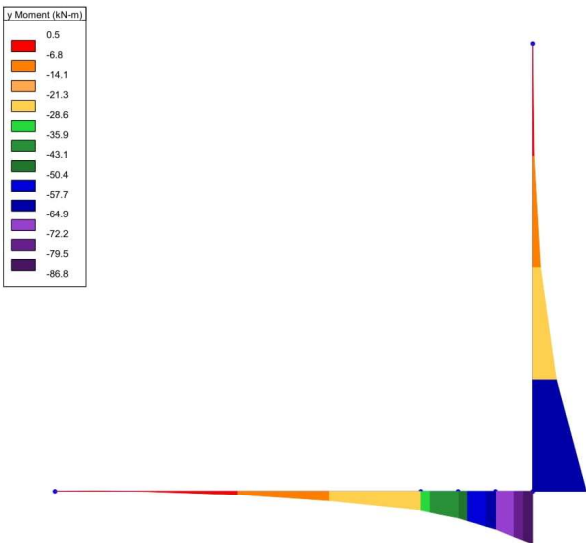
| Concrete Design Check to BS8110                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  | Job no:                                                                                                                                                                                                                                                                                                                                              | 5230       |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  | Date:                                                                                                                                                                                                                                                                                                                                                | 26/10/2021 |
| Party Wall Retaining Wall                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |  | By:                                                                                                                                                                                                                                                                                                                                                  | DW         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  | Page:                                                                                                                                                                                                                                                                                                                                                |            |
| <b>Design Parameters</b><br>Free body diagram: Cantilever<br>Element: Slab/Wall<br>Span: L = 3 m<br>Section depth: D = 350 mm<br>Screenshot: = 0 mm<br>Clear cover (tension face): = 50 mm<br>Link size: = 0 mm<br>Bar diameter: $\phi$ = 20 mm<br>Concrete strength: $F_{cu}$ = 35 MPa<br>Steel yield stress: $F_y$ = 500 MPa<br>Effective depth: d = 290 mm<br>Breadth: b = 1000 mm                                                                                                                                                                                                                               |  | <b>Loading</b><br>Uniformly distributed loads<br>Self weight: $w_{sw}$ = 8.75 kN/m<br>Live load: $w_{LL}$ = kN/m<br>Additional dead load: $w_{DL}$ = kN/m<br>Total UDL (ULT): $w^*$ = kN/m<br>Point loads<br>Dead point load: $P_{DL}$ = kN<br>Live point load: $P_{LL}$ = kN<br>Total Point load (ULT): $P^*$ = kN<br>Input Point loads (even if 0) |            |
| <b>Bending</b><br>Maximum moment: $M^*$ = 120.00 kNm<br>(Calculated or input)<br>Compressive capacity: $M_{uL}$ = 459.19 kNm<br><b>No compression reinforcement required</b><br>K = 0.0408<br>K' =<br>Lever arm: z = 275.50 mm<br>Depth to NA: x = mm<br>Clear cover (comp face): = mm<br>Comp bar diameter: $\phi'$ = mm<br>Depth to comp steel: d' = mm<br>Area defl steel req: $A_{sc req}$ =<br>Area defl steel provided: $A_{sc prov}$ = mm <sup>2</sup><br>Area steel required: $A_{st req}$ = 1001.31 mm <sup>2</sup><br>Provide B 20 @ 150 c/c<br>Area steel provided: $A_{st prov}$ = 2090 mm <sup>2</sup> |  | <b>Shear</b><br>Max shear force: $V^*$ = 86.00 kN<br>Shear stress: v = 0.30 MPa<br>100A <sub>s</sub> /bd = 0.72<br>Concrete shear stress: $v_c$ = 0.69 MPa<br><b>No shear reinforcement required</b><br>Link spacing: $s_v$ = mm<br>Shear steel required: $A_{sv req}$ = mm <sup>2</sup><br>Shear steel provided: $A_{sv prov}$ = mm <sup>2</sup>    |            |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  | <b>Deflection</b><br>Steel stress: $f_s$ = 149.72 MPa<br>Modification factor: MF = 1.72<br>Modification factor: MF' =<br>Min effective depth: $d_{min}$ = 248.86 mm<br><b>Deflection check OK</b>                                                                                                                                                    |            |

A3.2.2 Front Retaining Wall

A summary of the maximum lateral earth pressures expected to act on the proposed reinforced concrete front lightwell basement retaining wall is provided below.



|                                                               |                                                                                                                                                          |              |
|---------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>Richard Tant Associates</b><br>54 Lisson Street<br>London, | <b>Steel</b><br>Filename: basement walls.TEL<br>GRAPHICAL RESULTS - Ld Comb 2 1.2D + 1.2L + 1.2Sur + 1.2Soil + 1.2Water->y Moment (kN-m)<br>Engineer: DW | Page: 1 of 1 |
|---------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|

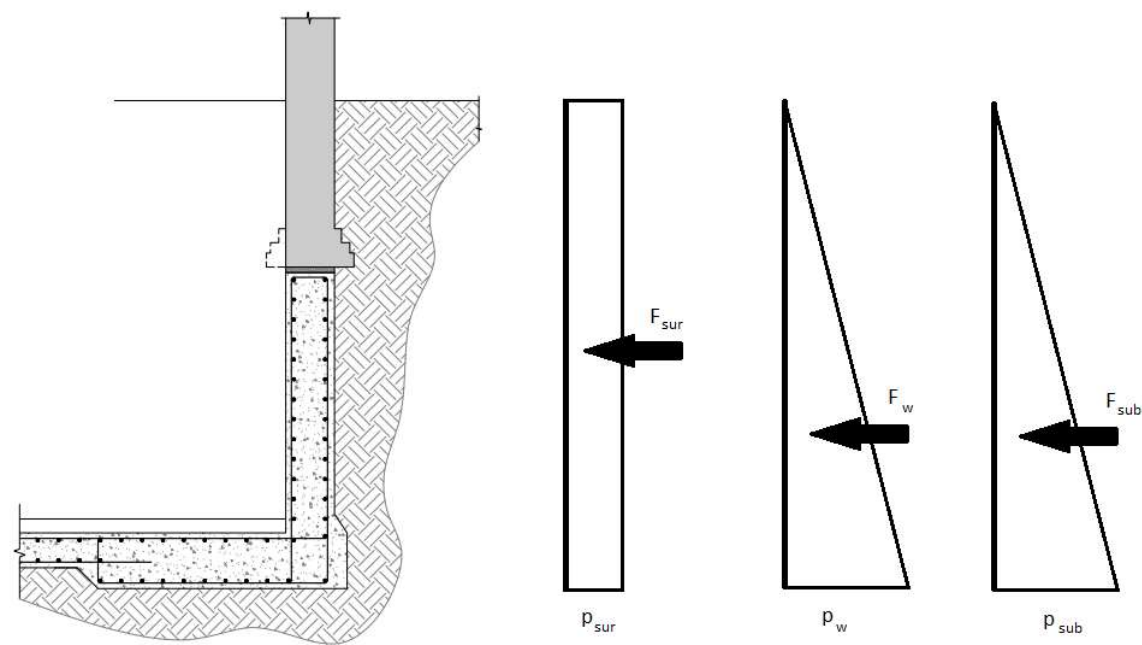


A summary of the reinforced concrete design check provided below.

| Concrete Design Check to BS8110                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |  | Job no:                                                                                                                                                                                                                                                                                                                                              | 5230       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |  | Date:                                                                                                                                                                                                                                                                                                                                                | 26/10/2021 |
| Front Retaining Wall                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  | By:                                                                                                                                                                                                                                                                                                                                                  | DW         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |  | Page:                                                                                                                                                                                                                                                                                                                                                |            |
| <b>Design Parameters</b><br>Free body diagram: Cantilever<br>Element: Slab/Wall<br>Span: L = 3 m<br>Section depth: D = 325 mm<br>Scream: = 0 mm<br>Clear cover (tension face): = 50 mm<br>Link size: = 0 mm<br>Bar diameter: $\phi$ = 16 mm<br>Concrete strength: $F_{cu}$ = 35 MPa<br>Steel yield stress: $F_y$ = 500 MPa<br>Effective depth: d = 267 mm<br>Breadth: b = 1000 mm                                                                                                                                                                                                                                     |  | <b>Loading</b><br>Uniformly distributed loads<br>Self weight: $w_{sw}$ = 8.13 kN/m<br>Live load: $w_{LL}$ = kN/m<br>Additional dead load: $w_{DL}$ = kN/m<br>Total UDL (ULT): $w^*$ = kN/m<br>Point loads<br>Dead point load: $P_{DL}$ = kN<br>Live point load: $P_{LL}$ = kN<br>Total Point load (ULT): $P^*$ = kN<br>Input Point loads (even if 0) |            |
| <b>Bending</b><br>Maximum moment: $M^*$ = 90.00 kNm<br>(Calculated or input)<br>Compressive capacity: $M_u$ = 389.24 kNm<br><b>No compression reinforcement required</b><br>K = 0.0361<br>K' =<br>Lever arm: z = 253.65 mm<br>Depth to NA: x = mm<br>Clear cover (comp face): = mm<br>Comp bar diameter: $\phi'$ = mm<br>Depth to comp steel: d' = mm<br>Area defl steel req: $A_{sc req}$ =<br>Area defl steel provided: $A_{sc prov}$ = mm <sup>2</sup><br>Area steel required: $A_{st req}$ = 815.68 mm <sup>2</sup><br><b>Provide B 16 @ 150 c/c</b><br>Area steel provided: $A_{st prov}$ = 1340 mm <sup>2</sup> |  | <b>Shear</b><br>Max shear force: $V^*$ = 86.00 kN<br>Shear stress: $v$ = 0.32 MPa<br>100 $A_s/bd$ = 0.50<br>Concrete shear stress: $v_c$ = 0.62 MPa<br><b>No shear reinforcement required</b><br>Link spacing: $s_v$ = mm<br>Shear steel required: $A_{sv req}$ = mm <sup>2</sup><br>Shear steel provided: $A_{sv prov}$ = mm <sup>2</sup>           |            |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |  | <b>Deflection</b><br>Steel stress: $f_s$ = 190.22 MPa<br>Modification factor: MF = 1.66<br>Modification factor: MF' =<br>Min effective depth: $d_{min}$ = 258.94 mm<br><b>Deflection check OK</b>                                                                                                                                                    |            |

A3.2.3 Flank Wall Retaining Wall

A summary of the maximum lateral earth pressures expected to act on the proposed reinforced concrete front lightwell basement retaining wall is provided below.

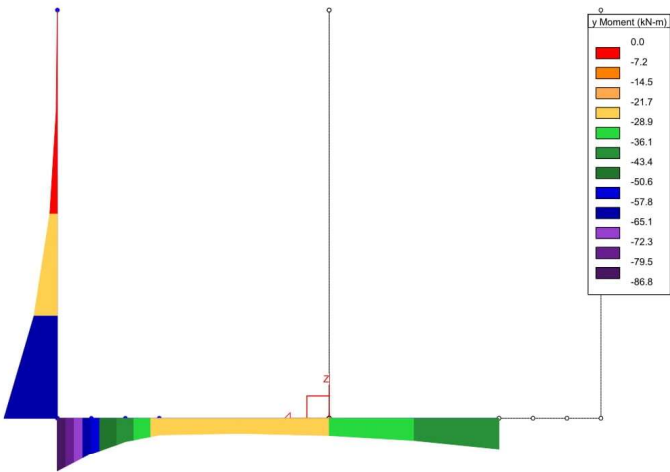


Richard Tant Associates  
54 Lisson Street  
London,

Steel

Filename: basement walls.TEL  
GRAPHICAL RESULTS - Ld Comb 2 1.2D + 1.2L + 1.2L + 1.2Sur + 1.2Soil + 1.2Water->y Moment (kN-m)  
Engineer: DW

Page: 1 of 1



A summary of the reinforced concrete design check provided below.

| Concrete Design Check to BS8110                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  | Job no:                                                                                                                                                                                                                                                                                                                                               | 5230       |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  | Date:                                                                                                                                                                                                                                                                                                                                                 | 26/10/2021 |
| Flank Retaining Wall                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |  | By:                                                                                                                                                                                                                                                                                                                                                   | DW         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  | Page:                                                                                                                                                                                                                                                                                                                                                 |            |
| <b>Design Parameters</b><br>Free body diagram: Cantilever<br>Element: Slab/Wall<br>Span: L = 3 m<br>Section depth: D = 325 mm<br>Scream: = 0 mm<br>Clear cover (tension face): = 50 mm<br>Link size: = 0 mm<br>Bar diameter: $\phi$ = 16 mm<br>Concrete strength: $F_{cu}$ = 35 MPa<br>Steel yield stress: $F_y$ = 500 MPa<br>Effective depth: d = 267 mm<br>Breadth: b = 1000 mm                                                                                                                                                                                                                                          |  | <b>Loading</b><br>Uniformly distributed loads<br>Self weight: $w_{sw}$ = 8.13 kN/m<br>Live load: $w_{LL}$ = kN/m<br>Additional dead load: $w_{DL}$ = kN/m<br>Total UDL (ULT): $w^*$ = kN/m<br>Point loads<br>Dead point load: $P_{DL}$ = kN<br>Live point load: $P_{LL}$ = kN<br>Total Point load (ULT): $p^*$ = kN<br>Input Point loads (even if 0)  |            |
| <b>Bending</b><br>Maximum moment: $M^*$ = 90.00 kNm<br>(Calculated or input)<br>Compressive capacity: $M_{uc}$ = 389.24 kNm<br><b>No compression reinforcement required</b><br>K = 0.0361<br>K' =<br>Lever arm: z = 253.65 mm<br>Depth to NA: x = mm<br>Clear cover (comp face): = mm<br>Comp bar diameter: $\phi'$ = mm<br>Depth to comp steel: d' = mm<br>Area defl steel req: $A_{s, req}$ =<br>Area defl steel provided: $A_{s, prov}$ = mm <sup>2</sup><br>Area steel required: $A_{st, req}$ = 815.68 mm <sup>2</sup><br><b>Provide B 16 @ 150 c/c</b><br>Area steel provided: $A_{st, prov}$ = 1340 mm <sup>2</sup> |  | <b>Shear</b><br>Max shear force: $V^*$ = 86.00 kN<br>Shear stress: $v$ = 0.32 MPa<br>100A <sub>s</sub> /bd = 0.50<br>Concrete shear stress: $v_c$ = 0.62 MPa<br><b>No shear reinforcement required</b><br>Link spacing: $s_v$ = mm<br>Shear steel required: $A_{sv, req}$ = mm <sup>2</sup><br>Shear steel provided: $A_{sv, prov}$ = mm <sup>2</sup> |            |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  | <b>Deflection</b><br>Steel stress: $f_s$ = 190.22 MPa<br>Modification factor: MF = 1.66<br>Modification factor: MF' =<br>Min effective depth: $d_{min}$ = 258.94 mm<br><b>Deflection check OK</b>                                                                                                                                                     |            |