GROUND MOVEMENT ASSESSMENT REPORT

10 Glenmore Road
London
NW3 4DB

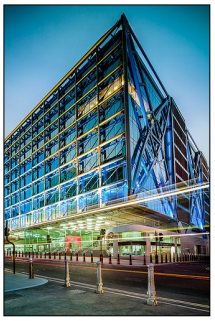
Client: Mr B and Mrs L Walford

Engineer: Structure Workshop

J20005

February 2020



GEA

Document Control

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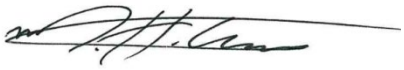
Report prepared by			
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Issue No	Status	Amendment Details	Date	Approved for Issue
1	Final		17 February 2020	

This report has been issued by the GEA office indicated below. Any enquiries regarding the report should be directed to the project engineer at the office indicated below or to Steve Branch in our main Herts office.

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CONTENTS

Part 1: INVESTIGATION REPORT

1.0 INTRODUCTION

Geotechnical and Environmental Associates (GEA) has been commissioned by Mr and Mrs Walford, to carry out a Ground Movement Analysis (GMA) of the proposed basement structure at 10 Glenmore Road, London NW3 4DB. Structure Workshop are the structural engineers for the project.

The site has been the subject of a ground investigation by Connaughts Site Investigation Ltd (report ref: 0762, dated August 2019), which is referred to where appropriate within this report.

1.1 Proposed Development

It is understood that it is proposed to extend and deepen the existing single level basement below the footprint of the existing house. Formation level for the basement is understood to be 62.70 m AOD, which will require an excavation of 1.50 m and 2.71 m, with the basement retaining walls being constructed through the conventional underpinning of existing foundations.

This report is specific to the proposed development and the advice herein should be reviewed if the development proposals are amended.

1.2 Purpose of Work

The principal technical objectives of the work carried out were as follows:

- to review and assess the ground conditions and hydrogeological regime; and
- to assess the possible impact of the proposed development on the surrounding structures.

1.3 Limitations

The conclusions and recommendations made in this report are limited to those that can be made on the basis of the investigation. The results of the work should be viewed in the context of the range of data sources consulted, the number of locations where the ground was sampled and the number of soil, gas or groundwater samples tested; no liability can be accepted for information in other data sources or conditions not revealed by the sampling or testing. Any comments made on the basis of information obtained from the client or other third parties are given in good faith on the assumption that the information is accurate; no independent validation of such information has been made by GEA.

2.0 THE SITE

2.1 Site Description

The site is located in the area of Hampstead within the London Borough of Camden, northwest London, approximately 320 m southwest of Belsize Park London Underground station. It may be additionally located by National Grid Reference (NGR) 527199,184911.

The site forms a rectangular shaped area with maximum dimensions of approximately 20 m east-west by 6 m north-south and is occupied by a three-storey terraced property with a partial basement below the front third of the building footprint and a small courtyard garden in the

west of the site. It is bordered to the north and south by Nos 8 and 12 Glenmore Road respectively, which are of similar construction to the house occupying the site and it is understood that both include similar basements. The site is bordered to the west by private gardens of properties fronting Glenloch Road.

2.2 Geology

The Geological Survey map of the area (sheet 256) indicates that the site is directly underlain by the London Clay Formation.

The Connaughts investigation comprised a number of manually excavated trial pits adjacent to existing elevations, to determine the configuration of existing foundations, and a single window sample borehole advanced to a depth of 5.1 m within the rear garden. The borehole encountered made ground to a depth of 1.6 m, whereupon London Clay was encountered and was described as comprising firm becoming stiff medium strength brown with some light grey veining. The borehole was terminated at 5.1 m on a claystone.

GEA has previously carried out a number of investigations close to the site, which confirmed the expected ground conditions and the findings of the Connaughts investigation, in that below a generally moderate thickness of made ground, the London Clay was encountered and extended to the maximum depth investigated, of 25.0 m.

2.3 Hydrogeology

The London Clay Formation is classified as an Unproductive Stratum and non-aquifer with negligible significance for water supply or river base flow. This means that a continuous groundwater table will not exist below the site.

Groundwater was not encountered during the previous investigation and although a groundwater monitoring standpipe was installed, it is understood that no monitoring has been undertaken to date.

3.0 GROUND MOVEMENT ANALYSIS

The sides of a basement excavation will move to some extent regardless of how they are supported. The movement will typically be both horizontal and vertical and will be influenced by the engineering properties of the ground, groundwater level and flow, the efficiency of the various support systems employed during underpinning and the efficiency or stiffness of any support structures used.

An analysis has been carried out of the likely movements arising from the proposed basement excavation and the results of this analysis have been used to predict the effect of these movements on surrounding structures.

3.1 Basis of Ground Movement Assessment

3.1.1 Nearby Sensitive Structures

Sensitive structures relevant to this assessment are the neighbouring Nos 8 and 12 Glenmore Road to the north and south respectively. Based on the proposed size and depth of excavation, all other surrounding buildings and structures are considered to be outside of the zone of influence of the proposed basement.

A plan showing the locations of the site and neighbouring buildings is included in the appendix, which also indicates the individual elevations assessed for associated building damage and the referencing used within the analysis.

The founding levels of the party walls with the two neighbouring properties were determined in part by the previous investigation and provided by Structure Workshop within their Basement Impact Assessment (BIA) document (ref: 19029.R01.P2, dated November 2019). Therefore, it is understood that No 8 Glenmore is bearing at a level of 63.71 m AOD, whilst No 12 is bearing at a level of 63.09 m AOD and these levels have been adopted for the analysis. Survey drawings for the existing house indicates varying eave levels due to the shape of the roof. Therefore, a conservative worst-case building height (foundation to top of eaves) of 9m has been adopted for each of the neighbouring elevations.

The following drawings have been referred to, where relevant, to model the sensitive structures and proposed excavation.

Drawing Reference	Drawing Title
19029.SK02 (undated)	Foundation Loads
18495 – 10 Glenmore Road – G, dated November 2018	Measured Survey – Ground Floor
18495 – 10 Glenmore Road – B, dated November 2018	Measured Survey – Basement
18495 – 10 Glenmore Road – S, dated December 2018	Measured Survey – Sections

3.2 Construction Sequence

The following sequence of operations is detailed in Structure Workshop BIA document:

1. Install sacrificial sheet piles to support existing lightwell;
2. Underpin front elevation;
3. Install RC retaining wall against sheet piles for lightwell;
4. Prop existing ground floor structure;
5. Underpin party walls and rear elevation using a ‘hit and miss’ method of panel widths no more than 1 m;
6. Excavate rear area of extended basement;
7. Remove rear retaining wall of existing basement;
8. Excavate whole basement to new founding level;
9. Install new drainage runs followed by basement slab;
10. Install new load bearing walls in basement and box frames; and
11. Remove temporary propping.

The underpins will be adequately laterally propped and sufficiently dowelled together, and the concrete will be cast and adequately cured prior to excavation of the basement and removal of the formwork and supports. It is assumed that the corners of the excavation will be locally stiffened by cross-bracing or similar and that the new retaining walls will not be cantilevered at any stage during the construction process. It is assumed that adequate temporary propping of the new retaining walls, particularly at the top level, will occur at all times prior to the construction of permanent concrete floor slabs.

4.0 GROUND MOVEMENTS

An assessment of ground movements within and surrounding the excavation has been undertaken using the P-Disp Version 20.0 – Build 12 and X-Disp Version 20.0 software packages licensed from the OASYS suite of geotechnical modelling software from Arup. This program is commonly used within the ground engineering industry and is considered to be an appropriate tool for this analysis. The use of the P-Disp program is based on the assumption that the soils behave elastically, which provides a reasonable approximation of soil behaviour at small strains.

For the purpose of these analyses, the corners have been defined by x and y coordinates, with the x-direction orientated approximately northeast-southwest, whilst the y-direction is orientated approximately northwest-southeast. Vertical movement is in the z-direction. Wall lengths of less than 10 m have been modelled as 1 m long structural elements, while walls greater than 10 m in length have been modelled as 2 m elements to reflect their greater stiffness.

It is assumed that suitable propping will be provided during the construction of the basement and in the permanent condition, such that the walls can be considered to be stiff for the purpose of the ground movement modelling.

The full outputs of all the analyses can be provided on request but samples of the output movement contour plots and the tables of movements are included within the appendix.

4.1 Model Used

Published data for ground movements associated with underpinned retaining walls and the subsequent excavation of a new basement is limited compared to other types of retaining wall discussed above. It is possible to use the well-documented predictions and movement curves for embedded retaining walls contained within CIRIA C760, although this approach is considered to be conservative, particularly given the small scale of the proposed excavation.

As the existing building will be in place during the construction of the proposed basement extension, the walls being underpinned, in addition to the use of temporary propping, will provide a level of restraint to the underpins, which would generally be expected to result in negligible movement. The magnitude of the any movement will also be controlled to a large extent by the quality of workmanship. For this analysis, a ground movement curve assuming that horizontal settlement behind the wall will be equivalent to 0.15% of the retained height, with movement that diminishes with distance from the wall according to the trend line set by a wall within clay (see Fig 6.15a of CIRIA C760[1]).

[1] Gaba, A, Hardy, S, Powrie, W, Doughty, L and Selemetas, D (2017) *Embedded retaining walls – guidance for economic design* CIRIA Report C760.

Vertical movement, in the form of heave, will arise from the unloading of the London Clay due to the reduction of vertical stress, at least in the short-term. Undrained soil parameters have been used to estimate the potential short-term movements, which include the "immediate" or elastic movements as a result of the basement excavation. Drained parameters have been used to provide an estimate of the total movement, which includes long term swelling or creep that will continue for a number of years.

The elastic analysis requires values of soil stiffness at various levels to calculate displacements. Values of stiffness for the soils at this site are readily available from published data and we have used a well-established method to provide our estimates. Published data[2] indicates stiffness values of 750 x Cu for the London Clay and a ratio of E' to Eu of 0.75, and it is considered that this provides a sensible approach. The profile of the underlying ground conditions used in the analysis has been interpolated from the results of aforementioned nearby GEA site investigations, with a design line of $C_u = 5z + 45$ kN/m^2 adopted for the London Clay.

The soil parameters used in this analysis are tabulated below, which have been estimated from the information contained within the Connaughts Site Investigation Ltd report and assumed parameters interpreted from archive boreholes on the GEA database.

Stratum	Level range (m AOD)	Eu (MPa)	E' (MPa)
Made Ground	65.4 to 63.8	15	11.2
London Clay	63.8 to 25.4	33.75 to 201	25.2 to 150

A rigid boundary for the analysis has been set at 25.4 m AOD, which equates to 40 m below ground level. Below this depth the London Clay is not considered to be affected by the scale of the development and the soils are considered to be essentially incompressible.

The existing basement that will be lowered will result in unloading of approximately 30 kN/m², whilst the proposed single level basement extension will comprise a maximum excavation depth of approximately 2.70 m below the existing ground floor level, which will result in a net unloading of about 50 kN/m².

Proposed line loads have been provided by Structure Workshop, with foundation pressures equating to 57 kPa and 116 kPa, whilst a slab loading of 7.2 kPa will also exist across the area of the basement extension, as indicated by the appended foundation load mark-up. These loads have been taken into account in analysing the vertical movements.

4.2 Results

The full predicted movements are summarised in the contour plots and tables within appendix; the results are presented to the degree of accuracy required to allow predicted variations in ground movements around the structure(s) to be illustrated, but may not reflect the anticipated accuracy of the predictions.

The P-Disp analysis indicates that less 5mm of heave can be expected at the centre of the proposed basement excavation, whilst along a number of the underpinned elevations, settlements of less than 5mm can be expected to occur due to the proposed loadings.

2 Burland JB, Standing, JR, and Jardine, FM (2001) *Building response to tunnelling, case studies from construction of the Jubilee Line Extension* CIRIA Special Publication 200

If a compressible material is used beneath the slab, it will need to be designed to be able to resist the potential uplift forces generated by the ground movements. In this respect, potential heave pressures are typically taken to equate to around 40% of the total unloading pressure.

5.0 BUILDING DAMAGE ASSESSMENT

In order to address the potential impact of the proposed underpinning, the vertical movements obtained from the P-Disp analysis have been imported into X-Disp to enable a damage assessment to be undertaken of all the potential movements. For the purpose of this analysis, the total movements have been adopted as the most critical case in terms of potential damage to the neighbouring properties.

5.1 Damage to Neighbouring Structures

The Camden Planning Guidance for Basements and Lightwells (CPG Basements; March 2018) states that "applicant must demonstrate in the Basement Impact Assessment that the basement scheme has a risk of damage to neighbouring properties no higher than Burland Scale 1'very slight."

As a result of the limited movements expected to arise from the relatively small-scale excavation, the assessment has indicated that the predicted damage to all of the neighbouring elevations will fall within Category 0 and Negligible building damage and is therefore within allowable limits.

5.2 Monitoring of Ground Movements

The predictions of ground movement based on the ground movement analysis should be checked by monitoring of adjacent properties and structures. The structures to be monitored during the construction stages should include all of the sensitive structures included within the assessment.

The precise monitoring strategy will be developed at a later stage and it will be subject to discussions and agreements with the owners of the adjacent properties and structures. Contingency measures will be implemented if movements of the adjacent structures exceed predefined trigger levels. Both contingency measures and trigger levels will need to be developed within a future monitoring specification for the works.

6.0 CONCLUSIONS

The analysis has concluded that the predicted damage to the neighbouring properties from the construction of the underpins and excavations would be 'Negligible' or less and therefore the damage that would occur would fall within the acceptable limits.

Whilst it is recommended that movement monitoring is carried out on all structures prior to and during the proposed excavation and construction, it is unlikely that specification of these works will be required as part of the planning conditions, but may be required in order to satisfy party wall awards.

APPENDIX

Proposed Foundation Loads

Plan of proposed basement and sensitive structures

P-DISP ANALYSIS:

Input Data

Short Term Movement Plot

Total Movement Plot

X-DISP ANALYSIS

Input Data

Contour Plots of Horizontal Movements (underpinning)

BUILDING DAMAGE ASSESSMENT – RESULTS TABLE

NOTES:

This drawing is to be read in conjunction with all other Architects and Engineers drawings, details and specifications.

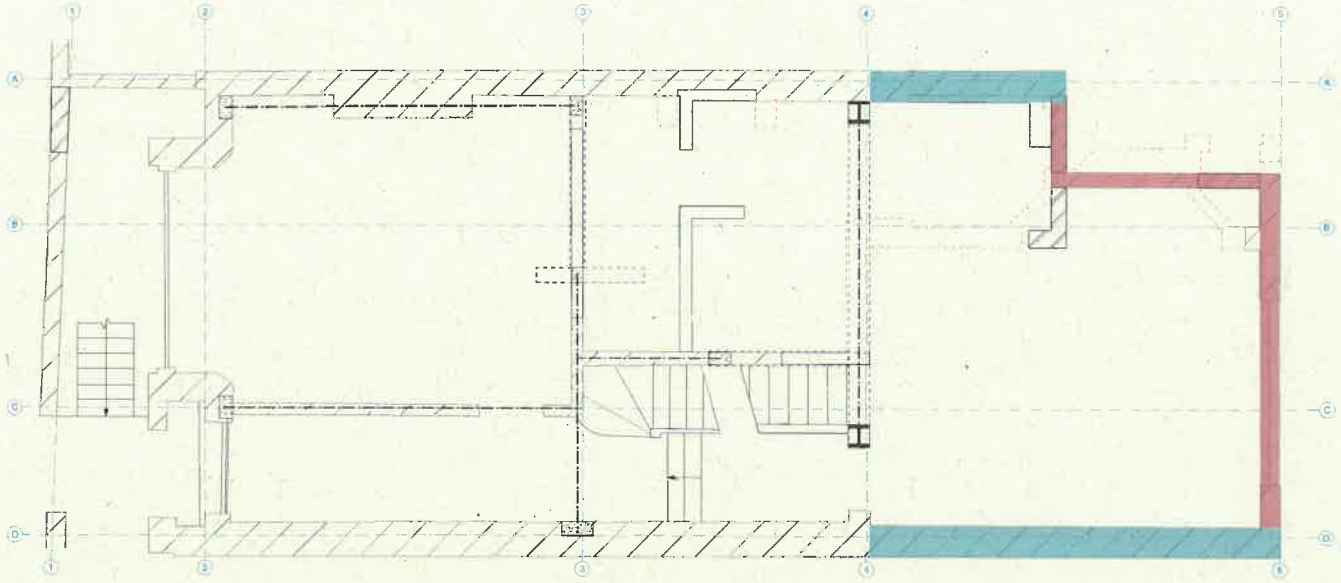
Any discrepancies in the arrangement and details discovered on site, or otherwise, are to be reported to the Architect or Engineer immediately.

All dimensions in mm.

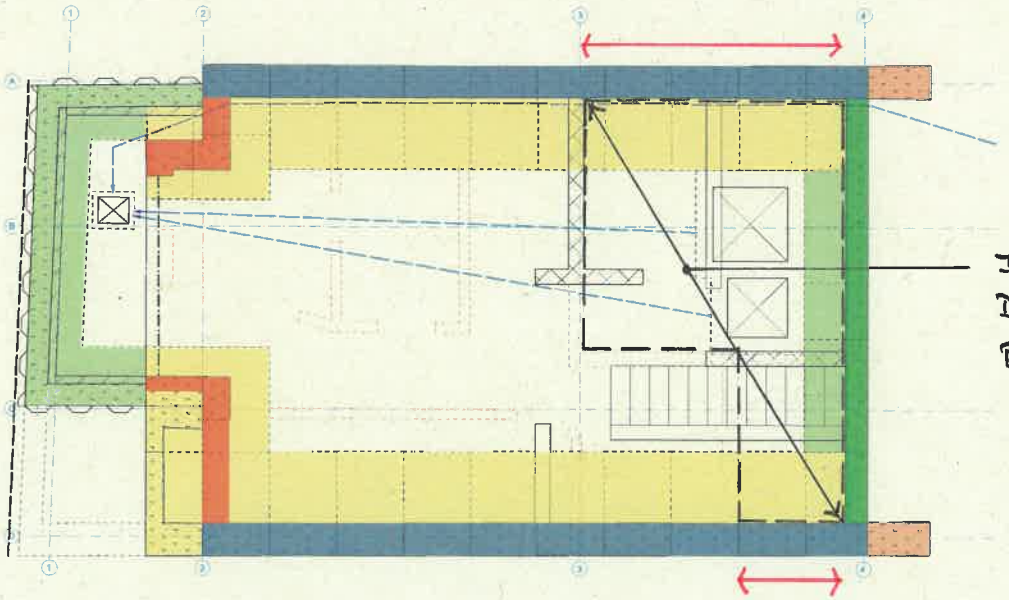
Do not scale from this drawing. Setting out to Architect's details.

KEY:

1. GFL party walls
2. GFL rear wall
3. BFL underpin (incl. spine wall weight)
4. BFL retaining wall
5. BFL front wall



Ex: DL: 140kn/m LL = 18kn/m



Ex DL = 140kn/m LL 18 kn/m

	EXISTING (U.N.O)		PROPOSED	
WALL TYPE	DL	LL	DL	LL
1.	70 kn/m	5 kn/m	70 kn/m	5 kn/m
2.	40 kn/m	11 kn/m	40 kn/m	11 kn/m
3.	165 kn/m	28 kn/m	155 kn/m	28 kn/m
4.	~~51 kn/m~~ 64 kn/m	19 kn/m	~~67.5 kn/m~~ 79.9 kn/m	19 kn/m
5.	100 kn/m	13 kn/m	110 kn/m	13 kn/m

ALL LOADS PROVIDED ARE UNFACTORED

PRELIMINARY

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Engineering & Technical Design
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London SE17 3QA
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rev.	description	date
-	-	-.-.-

project: Glenmore Road
title: Foundation Loads
scale: 1:50 @ A1
drawn: WW
appr.: SR
drg. no.: 19029.SK02
rev.: P1

Oasys

10 Glenmore Road, London NW3 4DB

Vertical and Horizontal Movements from Underpinning

Plan of proposed basement and nearby sensitive structures

Job No.	Sheet No.	Rev.
J20026		

Drg. Ref.

Made by	Date	Checked
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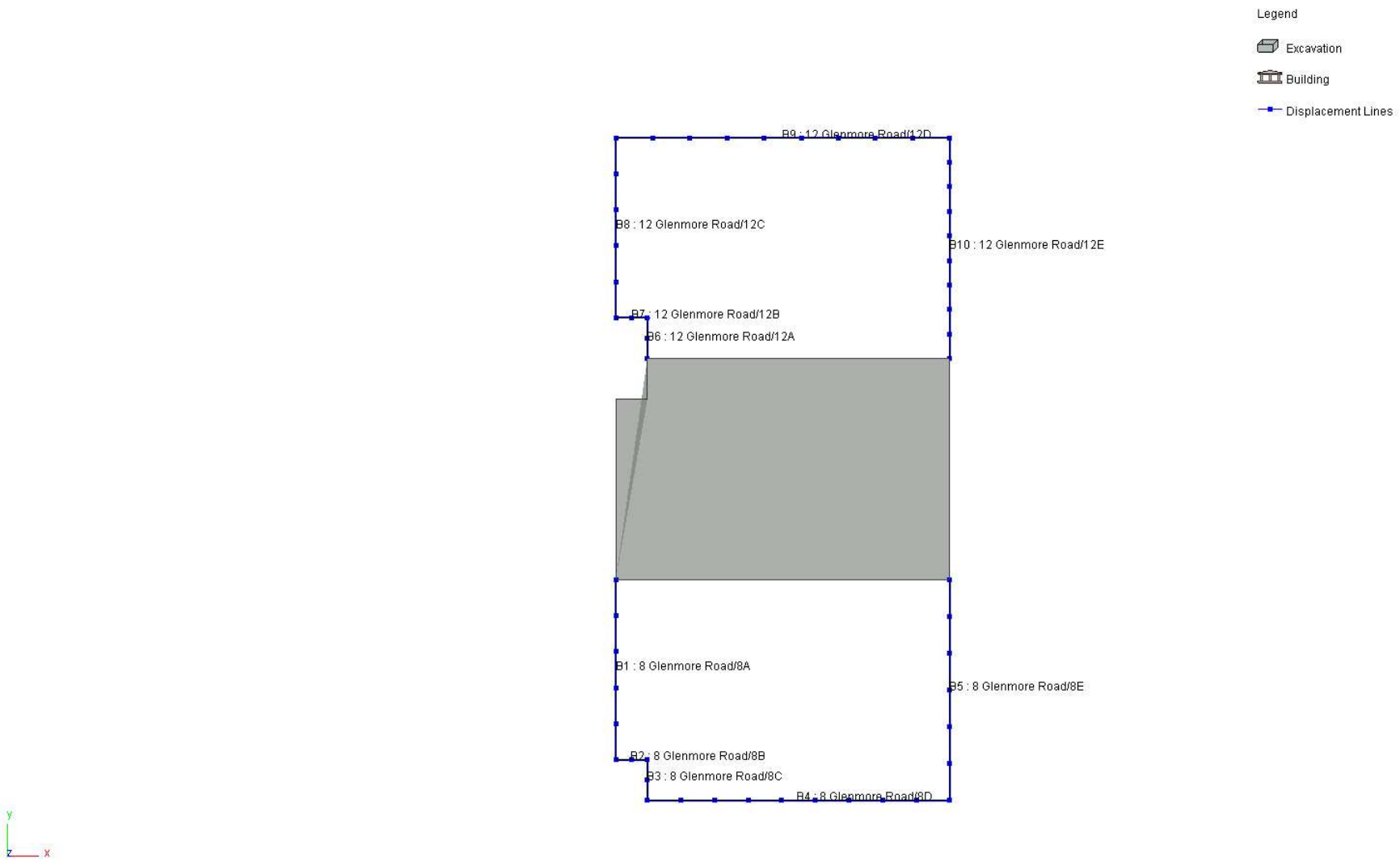

Titles

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Initials: ML
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Date Saved:
Date Checked:
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History

Date	Time	By	Notes
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14-Feb-2020	14:47	Matt Legg	
16-Feb-2020	21:03	Matt Legg	
16-Feb-2020	22:03	Matt Legg	
17-Feb-2020	13:46	Matthew Penfold	Open

Analysis Options

General
Global Poisson's ratio: 0.20
Maximum allowable ratio between values of E: 1.5
Horizontal rigid boundary level: 25.40 [m OD]
Displacements at load centroids: Yes
GSA piled raft data : No

Elastic
Elastic : Yes
Analysis: Boussinesq
Stiffness for horizontal displacement calculations: Weighted average
Using legacy heave correction factor: No

Consolidation
Consolidation : No

Soil ProfilesShort-term

Layer ref.	Name	Level at top [mOD]	Number of intermediate displacement levels	Youngs Modulus : Top [kN/m²]	Youngs Modulus : Btm. [kN/m²]	Poissons ratio	Non-linear curve
1	Made Ground	65.400	2	15000.	15000.	0.50000	None
2	L.Clay	63.800	2	33750.	37500.	0.50000	None
3	L.Clay	62.900	2	37500.	45000.	0.50000	None
4	L.Clay	61.400	2	45000.	54000.	0.50000	None
5	L.Clay	59.400	3	54000.	67500.	0.50000	None
6	L.Clay	56.400	6	67500.	103500.	0.50000	None
7	L.Clay	50.400	10	103500.	142500.	0.50000	None
8	L.Clay	40.400	15	142500.	201000.	0.50000	None

Soil ProfilesTotal

Layer ref.	Name	Level at top [mOD]	Number of intermediate displacement levels	Youngs Modulus : Top [kN/m²]	Youngs Modulus : Btm. [kN/m²]	Poissons ratio	Non-linear curve
1	Made Ground	65.400	2	11200.	11200.	0.20000	None
2	L.Clay	63.800	2	25200.	28000.	0.20000	None
3	L.Clay	62.900	2	28000.	33600.	0.20000	None
4	L.Clay	61.400	2	33600.	40320.	0.20000	None
5	L.Clay	59.400	3	40320.	50400.	0.20000	None
6	L.Clay	56.400	6	50400.	77280.	0.20000	None
7	L.Clay	50.400	10	77280.	106400.	0.20000	None
8	L.Clay	40.400	15	106400.	150080.	0.20000	None

Soil Zones

Zone	Name	X min [m]	X max [m]	Y min [m]	Y max [m]	Profile
1	Soil Zone 1	5.0000	25.000	0.0	28.000	Total

Polygonal Load Data

Load ref.	Name	Position : Level [m]	Position : Polygon : Coords. [m]	Position : Polygon : Rect. tolerance [%]	No. of Rectangles	Value : Normal (local z) [kN/m²]
1	Excavation 1	62.70000	(10,10) (10,15.3) (10.9,15.3) (10.9,16.5) (15.8,16.5) (15.8,12.7) (17.8,12.7) (17.8,10) (10,10)	10.000	3	-30.000
2	Excavation 2	62.70000	(15.8,16.5) (19.8,16.5) (19.8,10) (17.8,10) (17.8,12.7) (15.8,12.7) (15.8,16.5)	10.000	2	-46.000
3	No. 8 party wall	62.70000	(10,10) (10,11.4) (19.8,11.4) (19.8,10) (10,10)	10.000	1	57.000
4	No. 12 party wall	62.70000	(10.9,15.1) (10.9,16.5) (19.8,16.5) (19.8,15.1) (10.9,15.1)	10.000	1	57.000
5	Rear elevation	62.70000	(19,11.4) (19,15.1) (19.8,15.1) (19.8,11.4) (19,11.4)	10.000	1	116.00
6	Front elevation	62.70000	(10,11.4) (10,15.1) (11.4,15.1) (11.4,11.4) (10,11.4)	10.000	1	88.000

Polygonal Loads' Rectangles

No.	Centre : Centre x [m]	Centre : Centre y [m]	Angle of local x from global X [Degrees]	Width x [m]	Depth y [m]
Load 1 : Excavation 1					
(Edge 2 optimal)					
1	13.91500	11.35000	90.000	2.7000	7.8300
2	12.91500	14.00000	90.000	2.6000	5.8300
3	13.38000	15.90000	90.000	1.2000	4.9000
Load 2 : Excavation 2					

No.	Centre : Centre : Angle of local x from global X		Width x	Depth y
	x	y		
(Edge 2 optimal)				
1	16.83000	14.60000	0.0	2.0000	3.8000
2	18.83000	13.25000	0.0	2.0000	6.5000
Load 3 : No. 8 party wall					
(Edge 2 optimal)					
1	14.91500	10.70000	90.000	1.4000	9.8300
Load 4 : No. 12 party wall					
(Edge 2 optimal)					
1	15.38000	15.80000	90.000	1.4000	8.9000
Load 5 : Rear elevation					
(Edge 2 optimal)					
1	19.43000	13.25000	90.000	3.7000	0.80000
Load 6 : Front elevation					
(Edge 2 optimal)					
1	10.70000	13.25000	90.000	3.7000	1.4000

Displacement Lines

Name	X1 [m]	Y1 [m]	Z1 [m]	X2 [m]	Y2 [m]	Z2 [m]	Intervals [No.]	Calculate	Detailed Results
8A	10.00000	10.00000	63.71000	10.00000	4.70000	63.71000	5	Yes	Yes
8B	10.00000	4.70000	63.71000	10.93000	4.70000	63.71000	2	Yes	Yes
8C	10.93000	4.70000	63.71000	10.93000	3.50000	63.71000	2	Yes	Yes
8D	10.93000	3.50000	63.71000	19.83000	3.50000	63.71000	9	Yes	Yes
8E	19.83000	3.50000	63.71000	19.83000	10.00000	63.71000	6	Yes	Yes
12A	10.93000	16.50000	63.09000	10.93000	17.70000	63.09000	2	Yes	Yes
12B	10.93000	17.70000	63.09000	10.00000	17.70000	63.09000	2	Yes	Yes
12C	10.00000	17.70000	63.09000	10.00000	23.00000	63.09000	5	Yes	Yes
12D	10.00000	23.00000	63.09000	19.83000	23.00000	63.09000	9	Yes	Yes
12E	19.83000	23.00000	63.09000	19.83000	16.50000	63.09000	9	Yes	Yes

Displacement Grids

Name	Extrusion: Direction	X1 [m]	Y1 [m]	Z1 [m]	X2 [m]	Y2 [m]	Z2 [m]	Intervals Along Line [No.]	Extrusion: Distance [m]	Extrusion: Intervals Along [No.]	Calculate	Detailed Results
Displacement Grid 1	Global X	5.00000	0.00000	62.70000	-	28.00000	62.70000	10	20.00000	10	Yes	Yes

Oasys

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10 Glenmore Road, London NW3 4DB

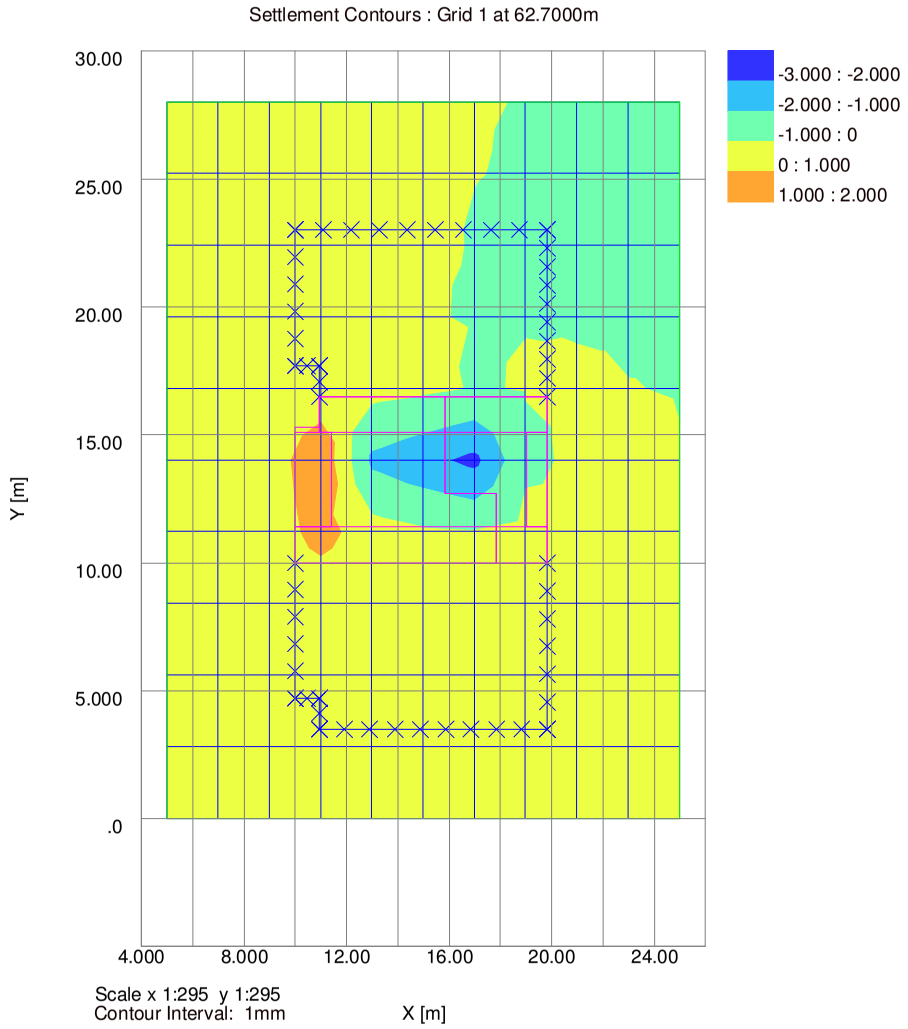
Vertical Movements from Basement Excavation

Undrained Short-term Condition

Job No.	Sheet No.	Rev.
J20026		

Drg. Ref.

Made by	Date	Checked
ML		



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Vertical Movements from Basement Excavation

Drained Total Condition

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J20026		

Drg. Ref.

Made by	Date	Checked
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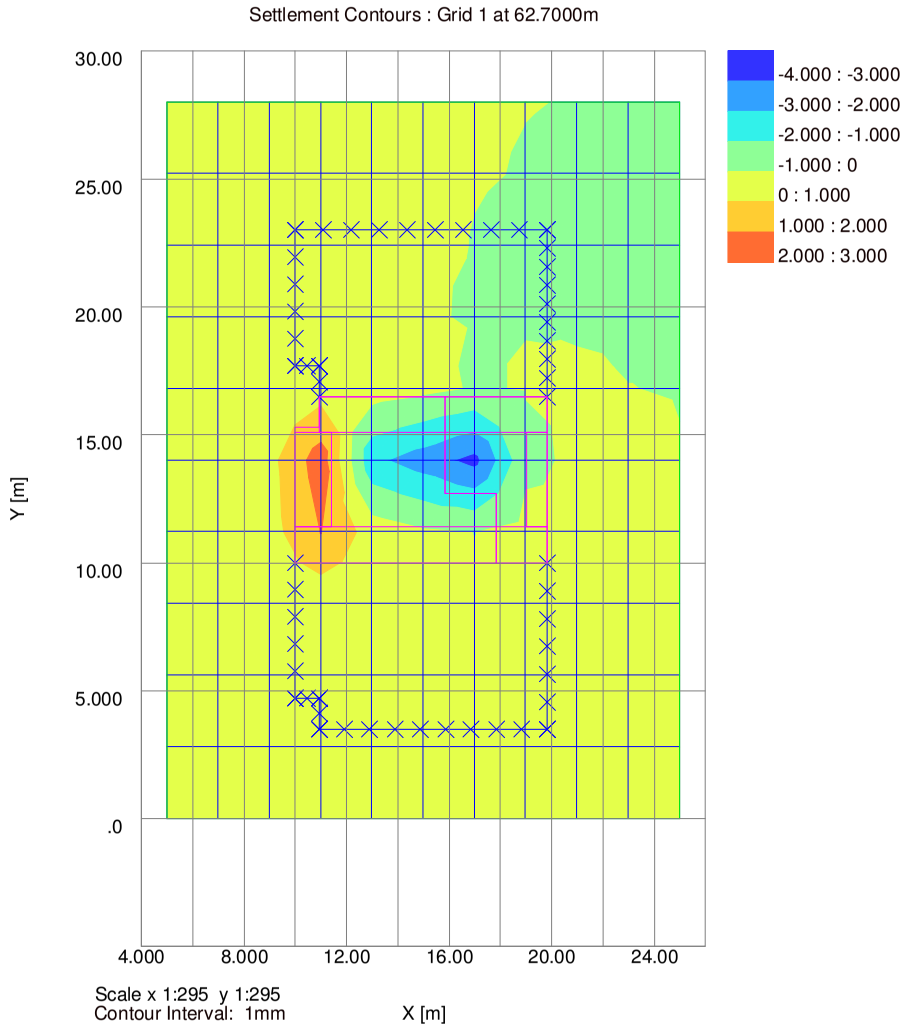


Titles

Job No.: J20026
Job Title: 10 Glenmore Road, London NW3 4DB
Sub-title: Vertical and Horizontal Movements from Underpinning
Calculation Heading: Combined P-Disp and X-Disp Models
Initials: ML
Checker:
Date Saved:
Date Checked:
Notes:
File Name: J20026 Building Damage.xdd
File Path: G:\CURRENT\20-\J20026 - 10 Glenmore Road\APPENDIX

History

Date	Time	By	Notes
14-Feb-2020	14:51	Matt Legg	New
14-Feb-2020	15:16	Matt Legg	
16-Feb-2020	21:11	Matt Legg	
17-Feb-2020	13:45	Matthew Penfold	Open

Displacement Lines

Ref.	Name	x1 [m]	y1 [m]	z1 [m]	x2 [m]	y2 [m]	z2 [m]	Intervals [No.]	Surface type for tunnels	Interpolate imported displacements	Calculate
1	8A	10.00000	10.00000	63.71000	10.00000	4.70000	63.71000	5	Surface	No	Yes
2	8B	10.00000	4.70000	63.71000	10.93000	4.70000	63.71000	2	Surface	No	Yes
3	8C	10.93000	4.70000	63.71000	10.93000	3.50000	63.71000	2	Surface	No	Yes
4	8D	10.93000	3.50000	63.71000	19.83000	3.50000	63.71000	9	Surface	No	Yes
5	8E	19.83000	3.50000	63.71000	19.83000	10.00000	63.71000	6	Surface	No	Yes
6	12A	10.93000	16.50000	63.09000	10.93000	17.70000	63.09000	2	Surface	No	Yes
7	12B	10.93000	17.70000	63.09000	10.00000	17.70000	63.09000	2	Surface	No	Yes
8	12C	10.00000	17.70000	63.09000	10.00000	23.00000	63.09000	5	Surface	No	Yes
9	12D	10.00000	23.00000	63.09000	19.83000	23.00000	63.09000	9	Surface	No	Yes
10	12E	19.83000	23.00000	63.09000	19.83000	16.50000	63.09000	9	Surface	No	Yes
11	8A	10.00000	10.00000	63.71000	10.00000	4.70000	63.71000	5	Surface	No	Yes
12	8B	10.00000	4.70000	63.71000	10.93000	4.70000	63.71000	2	Surface	No	Yes
13	8C	10.93000	4.70000	63.71000	10.93000	3.50000	63.71000	2	Surface	No	Yes
14	8D	10.93000	3.50000	63.71000	19.83000	3.50000	63.71000	9	Surface	No	Yes
15	8E	19.83000	3.50000	63.71000	19.83000	10.00000	63.71000	6	Surface	No	Yes
16	12A	10.93000	16.50000	63.09000	10.93000	17.70000	63.09000	2	Surface	No	Yes
17	12B	10.93000	17.70000	63.09000	10.00000	17.70000	63.09000	2	Surface	No	Yes
18	12C	10.00000	17.70000	63.09000	10.00000	23.00000	63.09000	5	Surface	No	Yes
19	12D	10.00000	23.00000	63.09000	19.83000	23.00000	63.09000	9	Surface	No	Yes
20	12E	19.83000	23.00000	63.09000	19.83000	16.50000	63.09000	9	Surface	No	Yes

Displacement Grids

Ref.	Name	Extrusion: Direction	Base line start: X [m]	Base line start: Y [m]	Base line start: Z(level) [m]	Base line end: X [m]	Base line end: Y [m]	Base line end: Z(level) [m]	Base line: Intervals [No.]	Extrusion: Distance [m]	Extrusion: Intervals [No.]	Surface type for tunnels	Calculate
1	Displacement Grid 1	Global X	5.00000	0.00000	62.70000	-	28.00000	62.70000	20	20.00000	20	Surface	Yes
2	Displacement Grid 2	Global X	5.00000	0.00000	63.71000	-	28.00000	63.71000	20	20.00000	20	Surface	Yes
3	Displacement Grid 1	Global X	5.00000	0.00000	62.70000	-	28.00000	62.70000	10	20.00000	10	Surface	Yes

Imported Displacements

Set: Ref.	Set: Name	Result: Ref.	Coordinates: x [m]	Coordinates: y [m]	Coordinates: z [m]	Displacements: x [mm]	Displacements: y [mm]	Displacements: z [mm]
1	ID Set #	1	10.00000	8.94000	63.71000	0.00000	0.00000	0.36127
		2	10.00000	7.88000	63.71000	0.00000	0.00000	0.20694
		3	10.00000	6.82000	63.71000	0.00000	0.00000	0.13156
		4	10.00000	5.76000	63.71000	0.00000	0.00000	0.08933
		5	10.00000	4.70000	63.71000	0.00000	0.00000	0.06361
		6	10.00000	4.70000	63.71000	0.00000	0.00000	0.06361
		7	10.46500	4.70000	63.71000	0.00000	0.00000	0.06368
		8	10.93000	4.70000	63.71000	0.00000	0.00000	0.06312
		9	10.93000	4.70000	63.71000	0.00000	0.00000	0.06312
		10	10.93000	4.10000	63.71000	0.00000	0.00000	0.05272
		11	10.93000	3.50000	63.71000	0.00000	0.00000	0.04453
		12	10.93000	3.50000	63.71000	0.00000	0.00000	0.04453
		13	11.91889	3.50000	63.71000	0.00000	0.00000	0.04227
		14	12.90778	3.50000	63.71000	0.00000	0.00000	0.03866
		15	13.89667	3.50000	63.71000	0.00000	0.00000	0.03412
		16	14.88556	3.50000	63.71000	0.00000	0.00000	0.02914
		17	15.87444	3.50000	63.71000	0.00000	0.00000	0.02420
		18	16.86333	3.50000	63.71000	0.00000	0.00000	0.01966
		19	17.85222	3.50000	63.71000	0.00000	0.00000	0.01572
		20	18.84111	3.50000	63.71000	0.00000	0.00000	0.01244
		21	19.83000	3.50000	63.71000	0.00000	0.00000	0.00978
		22	19.83000	3.50000	63.71000	0.00000	0.00000	0.00978
		23	19.83000	4.58333	63.71000	0.00000	0.00000	0.01127
		24	19.83000	5.66667	63.71000	0.00000	0.00000	0.01356
		25	19.83000	6.75000	63.71000	0.00000	0.00000	0.01788
		26	19.83000	7.83333	63.71000	0.00000	0.00000	0.02793
		27	19.83000	8.91667	63.71000	0.00000	0.00000	0.05706
		28	19.83000	10.00000	63.71000	0.00000	0.00000	0.22181
		29	10.93000	16.50000	63.09000	0.00000	0.00000	0.75837
		30	10.93000	17.10000	63.09000	0.00000	0.00000	0.38739
		31	10.93000	17.70000	63.09000	0.00000	0.00000	0.25360
		32	10.93000	17.70000	63.09000	0.00000	0.00000	0.25360
		33	10.46500	17.70000	63.09000	0.00000	0.00000	0.23834
		34	10.00000	17.70000	63.09000	0.00000	0.00000	0.21978
		35	10.00000	17.70000	63.09000	0.00000	0.00000	0.21978
		36	10.00000	18.76000	63.09000	0.00000	0.00000	0.13283
		37	10.00000	19.82000	63.09000	0.00000	0.00000	0.08509
		38	10.00000	20.88000	63.09000	0.00000	0.00000	0.05726
		39	10.00000	21.94000	63.09000	0.00000	0.00000	0.04016
		40	10.00000	23.00000	63.09000	0.00000	0.00000	0.02916
		41	10.00000	23.00000	63.09000	0.00000	0.00000	0.02916
		42	11.09222	23.00000	63.09000	0.00000	0.00000	0.02674
		43	12.18444	23.00000	63.09000	0.00000	0.00000	0.02277
		44	13.27667	23.00000	63.09000	0.00000	0.00000	0.01756
		45	14.36889	23.00000	63.09000	0.00000	0.00000	0.01176
		46	15.46111	23.00000	63.09000	0.00000	0.00000	0.00612
		47	16.55333	23.00000	63.09000	0.00000	0.00000	0.00136
		48	17.64556	23.00000	63.09000	0.00000	0.00000	-0.00210

Set: Ref.	Set: Name	Result: Ref.	Coordinates: x [m]	Coordinates: y [m]	Coordinates: z [m]	Displacements: x [mm]	Displacements: y [mm]	Displacements: z [mm]
		49	18.73778	23.00000	63.09000	0.00000	0.00000	-0.00419
		50	19.83000	23.00000	63.09000	0.00000	0.00000	-0.00514
		51	19.83000	23.00000	63.09000	0.00000	0.00000	-0.00514
		52	19.83000	22.27778	63.09000	0.00000	0.00000	-0.00687
		53	19.83000	21.55556	63.09000	0.00000	0.00000	-0.00902
		54	19.83000	20.83333	63.09000	0.00000	0.00000	-0.01158
		55	19.83000	20.11111	63.09000	0.00000	0.00000	-0.01440
		56	19.83000	19.38889	63.09000	0.00000	0.00000	-0.01700
		57	19.83000	18.66667	63.09000	0.00000	0.00000	-0.01786
		58	19.83000	17.94444	63.09000	0.00000	0.00000	-0.01271
		59	19.83000	17.22222	63.09000	0.00000	0.00000	0.01185
		60	19.83000	16.50000	63.09000	0.00000	0.00000	0.14559
		61	5.00000	0.00000	62.70000	0.00000	0.00000	0.01742
		62	7.00000	0.00000	62.70000	0.00000	0.00000	0.01929
		63	9.00000	0.00000	62.70000	0.00000	0.00000	0.02013
		64	11.00000	0.00000	62.70000	0.00000	0.00000	0.01947
		65	13.00000	0.00000	62.70000	0.00000	0.00000	0.01731
		66	15.00000	0.00000	62.70000	0.00000	0.00000	0.01415
		67	17.00000	0.00000	62.70000	0.00000	0.00000	0.01075
		68	19.00000	0.00000	62.70000	0.00000	0.00000	0.00771
		69	21.00000	0.00000	62.70000	0.00000	0.00000	0.00532
		70	23.00000	0.00000	62.70000	0.00000	0.00000	0.00358
		71	25.00000	0.00000	62.70000	0.00000	0.00000	0.00236
		72	5.00000	2.80000	62.70000	0.00000	0.00000	0.02867
		73	7.00000	2.80000	62.70000	0.00000	0.00000	0.03395
		74	9.00000	2.80000	62.70000	0.00000	0.00000	0.03735
		75	11.00000	2.80000	62.70000	0.00000	0.00000	0.03691
		76	13.00000	2.80000	62.70000	0.00000	0.00000	0.03202
		77	15.00000	2.80000	62.70000	0.00000	0.00000	0.02445
		78	17.00000	2.80000	62.70000	0.00000	0.00000	0.01686
		79	19.00000	2.80000	62.70000	0.00000	0.00000	0.01091
		80	21.00000	2.80000	62.70000	0.00000	0.00000	0.00683
		81	23.00000	2.80000	62.70000	0.00000	0.00000	0.00418
		82	25.00000	2.80000	62.70000	0.00000	0.00000	0.00249
		83	5.00000	5.60000	62.70000	0.00000	0.00000	0.04852
		84	7.00000	5.60000	62.70000	0.00000	0.00000	0.06485
		85	9.00000	5.60000	62.70000	0.00000	0.00000	0.08030
		86	11.00000	5.60000	62.70000	0.00000	0.00000	0.08455
		87	13.00000	5.60000	62.70000	0.00000	0.00000	0.07103
		88	15.00000	5.60000	62.70000	0.00000	0.00000	0.04845
		89	17.00000	5.60000	62.70000	0.00000	0.00000	0.02898
		90	19.00000	5.60000	62.70000	0.00000	0.00000	0.01673
		91	21.00000	5.60000	62.70000	0.00000	0.00000	0.00968
		92	23.00000	5.60000	62.70000	0.00000	0.00000	0.00532
		93	25.00000	5.60000	62.70000	0.00000	0.00000	0.00269
		94	5.00000	8.40000	62.70000	0.00000	0.00000	0.08010
		95	7.00000	8.40000	62.70000	0.00000	0.00000	0.13120
		96	9.00000	8.40000	62.70000	0.00000	0.00000	0.21811
		97	11.00000	8.40000	62.70000	0.00000	0.00000	0.28954
		98	13.00000	8.40000	62.70000	0.00000	0.00000	0.22954
		99	15.00000	8.40000	62.70000	0.00000	0.00000	0.13789
		100	17.00000	8.40000	62.70000	0.00000	0.00000	0.07905
		101	19.00000	8.40000	62.70000	0.00000	0.00000	0.04721
		102	21.00000	8.40000	62.70000	0.00000	0.00000	0.02575
		103	23.00000	8.40000	62.70000	0.00000	0.00000	0.01045
		104	25.00000	8.40000	62.70000	0.00000	0.00000	0.00371
		105	5.00000	11.20000	62.70000	0.00000	0.00000	0.11245
		106	7.00000	11.20000	62.70000	0.00000	0.00000	0.22699
		107	9.00000	11.20000	62.70000	0.00000	0.00000	0.61563
		108	11.00000	11.20000	62.70000	0.00000	0.00000	2.02687
		109	13.00000	11.20000	62.70000	0.00000	0.00000	0.55097
		110	15.00000	11.20000	62.70000	0.00000	0.00000	0.12594
		111	17.00000	11.20000	62.70000	0.00000	0.00000	-0.00710
		112	19.00000	11.20000	62.70000	0.00000	0.00000	0.31124
		113	21.00000	11.20000	62.70000	0.00000	0.00000	0.12604
		114	23.00000	11.20000	62.70000	0.00000	0.00000	0.02388
		115	25.00000	11.20000	62.70000	0.00000	0.00000	0.00523
		116	5.00000	14.00000	62.70000	0.00000	0.00000	0.11468
		117	7.00000	14.00000	62.70000	0.00000	0.00000	0.23684
		118	9.00000	14.00000	62.70000	0.00000	0.00000	0.68666
		119	11.00000	14.00000	62.70000	0.00000	0.00000	2.51578
		120	13.00000	14.00000	62.70000	0.00000	0.00000	-1.76826
		121	15.00000	14.00000	62.70000	0.00000	0.00000	-2.49931
		122	17.00000	14.00000	62.70000	0.00000	0.00000	-3.31615
		123	19.00000	14.00000	62.70000	0.00000	0.00000	-0.21650
		124	21.00000	14.00000	62.70000	0.00000	0.00000	0.16114
		125	23.00000	14.00000	62.70000	0.00000	0.00000	0.02246
		126	25.00000	14.00000	62.70000	0.00000	0.00000	0.00298
		127	5.00000	16.80000	62.70000	0.00000	0.00000	0.08332
		128	7.00000	16.80000	62.70000	0.00000	0.00000	0.14213
		129	9.00000	16.80000	62.70000	0.00000	0.00000	0.25743
		130	11.00000	16.80000	62.70000	0.00000	0.00000	0.51162
		131	13.00000	16.80000	62.70000	0.00000	0.00000	0.48057
		132	15.00000	16.80000	62.70000	0.00000	0.00000	0.22346
		133	17.00000	16.80000	62.70000	0.00000	0.00000	-0.07096
		134	19.00000	16.80000	62.70000	0.00000	0.00000	0.04012
		135	21.00000	16.80000	62.70000	0.00000	0.00000	0.01694
		136	23.00000	16.80000	62.70000	0.00000	0.00000	0.00065
		137	25.00000	16.80000	62.70000	0.00000	0.00000	-0.00258
		138	5.00000	19.60000	62.70000	0.00000	0.00000	0.04960
		139	7.00000	19.60000	62.70000	0.00000	0.00000	0.06791
		140	9.00000	19.60000	62.70000	0.00000	0.00000	0.08689
		141	11.00000	19.60000	62.70000	0.00000	0.00000	0.09260
		142	13.00000	19.60000	62.70000	0.00000	0.00000	0.06621
		143	15.00000	19.60000	62.70000	0.00000	0.00000	0.01826
		144	17.00000	19.60000	62.70000	0.00000	0.00000	-0.01625
		145	19.00000	19.60000	62.70000	0.00000	0.00000	-0.01957
		146	21.00000	19.60000	62.70000	0.00000	0.00000	-0.01194
		147	23.00000	19.60000	62.70000	0.00000	0.00000	-0.00730
		148	25.00000	19.60000	62.70000	0.00000	0.00000	-0.00493
		149	5.00000	22.40000	62.70000	0.00000	0.00000	0.02803
		150	7.00000	22.40000	62.70000	0.00000	0.00000	0.03302
		151	9.00000	22.40000	62.70000	0.00000	0.00000	0.03547
		152	11.00000	22.40000	62.70000	0.00000	0.00000	0.03242
		153	13.00000	22.40000	62.70000	0.00000	0.00000	0.02260
		154	15.00000	22.40000	62.70000	0.00000	0.00000	0.00933
		155	17.00000	22.40000	62.70000	0.00000	0.00000	-0.00133
		156	19.00000	22.40000	62.70000	0.00000	0.00000	-0.00606
		157	21.00000	22.40000	62.70000	0.00000	0.00000	-0.00640
		158	23.00000	22.40000	62.70000	0.00000	0.00000	-0.00521
		159	25.00000	22.40000	62.70000	0.00000	0.00000	-0.00394
		160	5.00000	25.20000	62.70000	0.00000	0.00000	0.01613
		161	7.00000	25.20000	62.70000	0.00000	0.00000	0.01739
		162	9.00000	25.20000	62.70000	0.00000	0.00000	0.01721
		163	11.00000	25.20000	62.70000	0.00000	0.00000	0.01503
		164	13.00000	25.20000	62.70000	0.00000	0.00000	0.01095
		165	15.00000	25.20000	62.70000	0.00000	0.00000	0.00600
		166	17.00000	25.20000	62.70000	0.00000	0.00000	0.00166
		167	19.00000	25.20000	62.70000	0.00000	0.00000	-0.00113
		168	21.00000	25.20000	62.70000	0.00000	0.00000	-0.00236
		169	23.00000	25.20000	62.70000	0.00000	0.00000	-0.00258
		170	25.00000	25.20000	62.70000	0.00000	0.00000	-0.00233
		171	5.00000	28.00000	62.70000	0.00000	0.00000	0.00965
		172	7.00000	28.00000	62.70000	0.00000	0.00000	0.00990
		173	9.00000	28.00000	62.70000	0.00000	0.00000	0.00945
		174	11.00000	28.00000	62.70000	0.00000	0.00000	0.00820
		175	13.00000	28.00000	62.70000	0.00000	0.00000	0.00628
		176	15.00000	28.00000	62.70000	0.00000	0.00000	0.00406
		177	17.00000	28.00000	62.70000	0.00000	0.00000	0.00200
		178	19.00000	28.00000	62.70000	0.00000	0.00000	0.00043

Set: Ref.	Set: Name	Result: Ref.	Coordinates: x [m]	Coordinates: y [m]	Coordinates: z [m]	Displacements: x [mm]	Displacements: y [mm]	Displacements: z [mm]
		179	21.00000	28.00000	62.70000	0.00000	0.00000	-0.00055
		180	23.00000	28.00000	62.70000	0.00000	0.00000	-0.00102
		181	25.00000	28.00000	62.70000	0.00000	0.00000	-0.00116

Polygonal Excavations

Ref.	**1**
Excavation Name:	**Excavation 1**
Surface level [m]:	63.710
Contribution:	Positive

Corner	x [m]	y [m]	Base Level [m]	Arc Enabled	Stiffened	Prev. Side: d [m]	Prev. Side: p1 [%]	Prev. Side: p2* [%]	Next Side: d [m]	Next Side: p1 [%]	Next Side: p2* [%]
1	10.000	10.000	62.700	Yes	Yes	0.0	67.000	25.000	0.0	67.000	25.000
2	10.000	15.300	62.700	Yes	Yes	0.0	67.000	25.000	0.0	67.000	25.000
3	10.930	15.300	62.700	Yes	No	-	-	-	-	-	-
4	10.930	16.500	63.320	Yes	Yes	0.0	67.000	25.000	0.0	67.000	25.000
5	19.830	16.500	63.320	Yes	Yes	0.0	67.000	25.000	0.0	67.000	25.000
6	19.830	10.000	62.700	Yes	Yes	0.0	67.000	25.000	0.0	67.000	25.000
7	10.000	10.000	62.700	Yes	Yes	0.0	67.000	25.000	0.0	67.000	25.000

Side	x1 [m]	y1 [m]	x2 [m]	y2 [m]	G.M. Curve: Vertical	G.M. Curve: Horizontal
1	10.000	10.000	10.000	15.300	No vertical ground movement	Underpinning
2	10.000	15.300	10.930	15.300	No vertical ground movement	Half underpinning for re-entrant corner
3	10.930	15.300	10.930	16.500	No vertical ground movement	Half underpinning for re-entrant corner
4	10.930	16.500	19.830	16.500	No vertical ground movement	Underpinning
5	19.830	16.500	19.830	10.000	No vertical ground movement	Underpinning
6	19.830	10.000	10.000	10.000	No vertical ground movement	Underpinning
7	10.000	10.000	10.000	10.000	No vertical ground movement	No horizontal ground movement

Circular Excavations

Vertical Ground Movement Curves

Curve Name:	**No vertical ground movement**
Coordinates:	[Distance from wall / wall depth or max. excavation depth (x), Depth / wall depth or max. excavation depth (y), Settlement / wall depth or max. excavation depth (z)(%)] [0.000,0.000,0.000][1.000,0.000,0.000][0.000,1.000,0.000][1.000,1.000,0.000]
Curve Fitting Method:	Polynomial
x Order:	1
y Order:	0
Polynomial: z =	0.0x + 0.0
Coeff. of Determination:	

Horizontal Ground Movement Curves

Curve Name:	**No horizontal ground movement**
Coordinates:	[Distance from wall / wall depth or max. excavation depth (x), Depth / wall depth or max. excavation depth (y), Horizontal movement / wall depth or max. excavation depth (z)(%)] [0.000,0.000,0.000][1.000,0.000,0.000][0.000,1.000,0.000][1.000,1.000,0.000]
Curve Fitting Method:	Polynomial
x Order:	0
y Order:	0
Polynomial: z =	0.0
Coeff. of Determination:	

Curve Name:	**Underpinning**
Coordinates:	[Distance from wall / wall depth or max. excavation depth (x), Depth / wall depth or max. excavation depth (y), Horizontal movement / wall depth or max. excavation depth (z)(%)] [0.000,0.000,0.150][4.000,0.000,0.000]
Curve Fitting Method:	Polynomial
x Order:	1
y Order:	0
Polynomial: z =	-3.75E-2x + 1.50E-1
Coeff. of Determination:	1.00

Curve Name:	**Half underpinning for re-entrant corner**
Coordinates:	[Distance from wall / wall depth or max. excavation depth (x), Depth / wall depth or max. excavation depth (y), Horizontal movement / wall depth or max. excavation depth (z)(%)] [0.000,0.000,0.075][4.000,0.000,0.000]
Curve Fitting Method:	Polynomial
x Order:	1
y Order:	0
Polynomial: z =	-1.88E-2x + 7.50E-2
Coeff. of Determination:	1.00

Damage Category Strains

Ref.	Name	0 (Negligible) to 1 (Very Slight)	1 (Very Slight) to 2 (Slight)	2 (Slight) to 3 (Moderate)	3 (Moderate) to 4 (Severe)
1	Burland Strain Limits	0.0	500.00E-6	750.00E-6	0.0015000

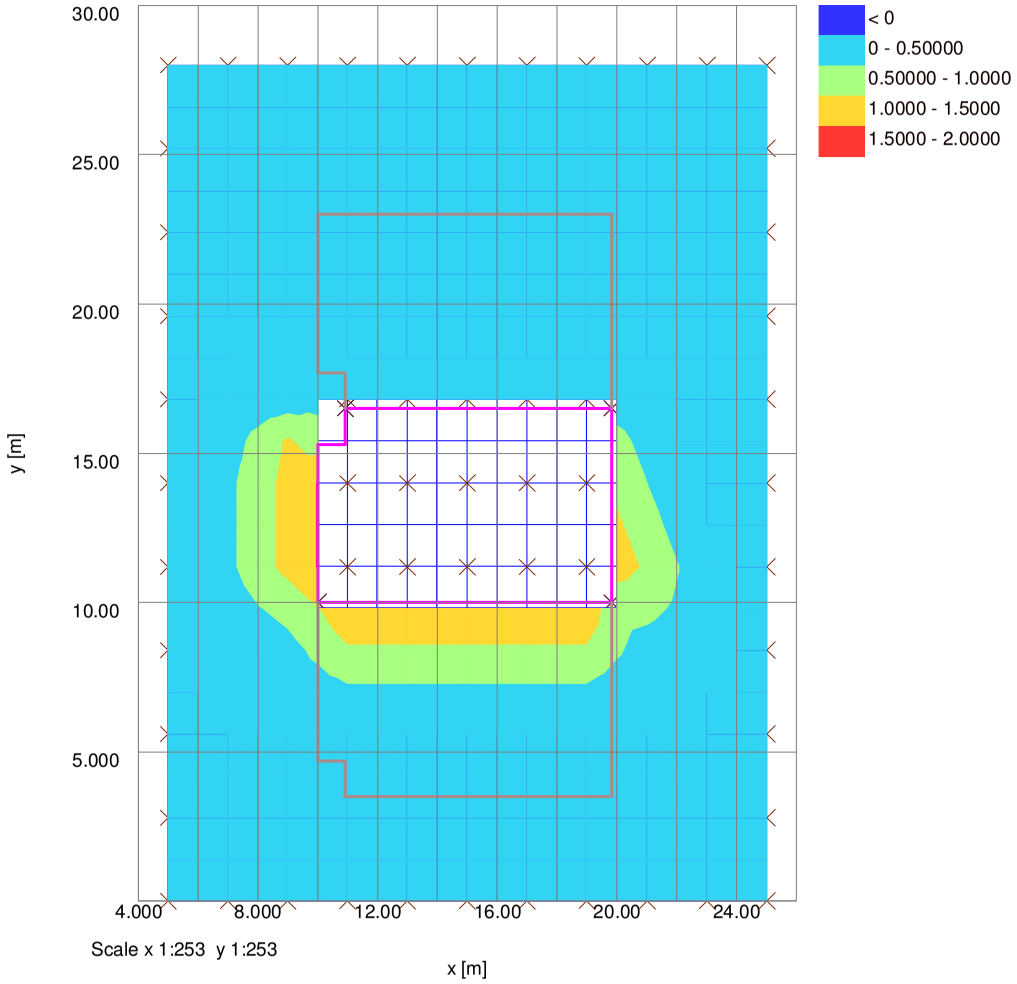
Specific Buildings - Geometry

Ref.	Building Name	Sub-Building Name	Displacement Line	Distance Along Line: Start [m]	Distance Along Line: End [m]	Vertical Offsets from Line for Vertical Movement Calculations [m]	Vertical Displacement Limit Sensitivity [mm]	Damage Category Strains	Poisson's Ratio	E/G
1	8 Glenmore Road	8A	8A	0.00000	5.30000	0.0	0.10000	Burland Strain Limits	0.20000	2.6000
2	8 Glenmore Road	8B	8B	0.00000	0.90000	0.0	0.10000	Burland Strain Limits	0.20000	2.6000
3	8 Glenmore Road	8C	8C	0.00000	1.20000	0.0	0.10000	Burland Strain Limits	0.20000	2.6000
4	8 Glenmore Road	8D	8D	0.00000	8.80000	0.0	0.10000	Burland Strain Limits	0.20000	2.6000
5	8 Glenmore Road	8E	8E	0.00000	6.50000	0.0	0.10000	Burland Strain Limits	0.20000	2.6000
6	12 Glenmore Road	12A	12A	0.00000	1.10000	0.0	0.10000	Burland Strain Limits	0.20000	2.6000
7	12 Glenmore Road	12B	12B	0.00000	0.90000	0.0	0.10000	Burland Strain Limits	0.20000	2.6000
8	12 Glenmore Road	12C	12C	0.00000	5.30000	0.0	0.10000	Burland Strain Limits	0.20000	2.6000
9	12 Glenmore Road	12D	12D	0.00000	9.80000	0.0	0.10000	Burland Strain Limits	0.20000	2.6000
10	12 Glenmore Road	12E	12E	0.00000	6.50000	0.0	0.10000	Burland Strain Limits	0.20000	2.6000

Specific Buildings - Bending Parameters

Ref.	Building Name	Sub-Building Name	Height [m]	Default	Hogging: 2nd Mom. of Area (per unit width) [m³]	Hogging: Dist. of Bending Strain from N.A. [m]	Hogging: Dist. of N.A. from Edge of Beam in Tension [m]	Sagging: 2nd Mom. of Area (per unit width) [m³]	Sagging: Dist. of Bending Strain from N.A. [m]	Sagging: Dist. of N.A. from Edge of Beam in Tension [m]
1	8 Glenmore Road	8A	9.0000	Yes	243.00	9.0000	9.0000	60.750	4.5000	4.5000
2	8 Glenmore Road	8B	9.0000	Yes	243.00	9.0000	9.0000	60.750	4.5000	4.5000
3	8 Glenmore Road	8C	9.0000	Yes	243.00	9.0000	9.0000	60.750	4.5000	4.5000
4	8 Glenmore Road	8D	9.0000	Yes	243.00	9.0000	9.0000	60.750	4.5000	4.5000
5	8 Glenmore Road	8E	9.0000	Yes	243.00	9.0000	9.0000	60.750	4.5000	4.5000
6	12 Glenmore Road	12A	9.0000	Yes	243.00	9.0000	9.0000	60.750	4.5000	4.5000
7	12 Glenmore Road	12B	9.0000	Yes	243.00	9.0000	9.0000	60.750	4.5000	4.5000
8	12 Glenmore Road	12C	9.0000	Yes	243.00	9.0000	9.0000	60.750	4.5000	4.5000
9	12 Glenmore Road	12D	9.0000	Yes	243.00	9.0000	9.0000	60.750	4.5000	4.5000
10	12 Glenmore Road	12E	9.0000	Yes	243.00	9.0000	9.0000	60.750	4.5000	4.5000

Horizontal Displacement Contours: Grid 2 (level 63.710m) Interval 0.5mm



Scale x 1:253 y 1:253

Specific Building Damage Results - Detail

Stage: Ref.	Stage: Name	Specific Building: Ref.	Specific Building: Name	Sub-building Name	Vertical Offset from Line for Vertical Movement Calculations [m]	Segment	Start [m]	Length [m]	Curvature	Deflection Ratio [%]	Average Horizontal Strain [%]	Max Tensile Strain [%]	Max Gradient of Horizontal Displacement Curve	Max Gradient of Vertical Displacement Curve	Min Radius of Curvature [m]	Damage Category
0	Base Model	1	8 Glenmore Road	8A	0.0	1	0.0	5.3000	Hogging	0.0071018	0.0095759	0.012846	-251.19E-6	496.60E-6	2522.7	0 (Negligible)
		2	8 Glenmore Road	8B	0.0	1	0.0	0.90000	Hogging	0.0067527	0.0	0.0067483	0.0	136.65E-6	1659.3	0 (Negligible)
		3	8 Glenmore Road	8C	0.0	1	0.0	0.0	None	0.0	0.0	35.763E-9	0.0	122.54E-6	3276.7	0 (Negligible)
		4	8 Glenmore Road	8D	0.0	All vertical displacements are less than the limit sensitivity.										
		5	8 Glenmore Road	8E	0.0	1	6.5000	0.0	None	0.0	0.0	35.763E-9	217.28E-6	-152.11E-6	7120.9	0 (Negligible)
		6	12 Glenmore Road	12A	0.0	1	0.0	1.1000	Hogging	0.020281	0.0	0.020262	0.0	618.31E-6	672.36	0 (Negligible)
		7	12 Glenmore Road	12B	0.0	1	0.0	0.90000	Hogging	0.025171	0.0	0.025155	0.0	578.20E-6	445.14	0 (Negligible)
		8	12 Glenmore Road	12C	0.0	1	0.0	1.0600	Sagging	0.0	0.0	35.763E-9	0.0	289.37E-6	3525.0	0 (Negligible)
		9	12 Glenmore Road	12D	0.0	All vertical displacements are less than the limit sensitivity.										
		10	12 Glenmore Road	12E	0.0	1	6.5000	0.0	None	0.0	0.0	35.763E-9	0.0	-185.17E-6	3963.4	0 (Negligible)

Tensile horizontal strains are +ve, compressive horizontal strains are -ve.

Geotechnical & Environmental Associates
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