**Ground Movement Assessment** 

40 Frognal Lane London NW3 6PP

## February 2021





#### CONTROL SHEET

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#### 1.0 INTRODUCTION

#### 1.1 Background

Fairhurst has been commissioned by John Paleomylites (The Client) to complete a Ground Movement Assessment (GMA) in connection with a proposed development at 40 Frognal Lane, London NW3 6PP. The location of the site is detailed on Figure 1. The purpose of this assessment is to determine what effects the proposed permanent basement construction may have upon nearby permanent structures.

#### 1.2 Proposed Development

The assessment is required to supplement the planning application ref. 2020/4553/P, in particular the Basement Impact Assessment (BIA) for the construction of a basement level swimming pool below the existing garden of the subject property.

The proposed excavation will be 23.2m long x 6.2m wide, and taken down to a level of 86.5mAOD at the deep end of the pool. The maximum excavation depth may therefore reach a maximum of 7.5m as the current ground levels within the garden range between 92mAOD and 94mAOD. A secant piled wall will be constructed prior to basement excavation, with this to be propped during the temporary excavation stage. The details of the secant piled wall are not known at this stage.

Drawings submitted as part of the planning application are included in Appendix A to show the proposed development. These include plans, elevations and cross section of the proposals relative to the existing buildings.

#### 1.3 Limitations

The conclusions and recommendations made in this report have been provided on the basis of the historical ground investigations undertaken on site, which were scoped, designed, arranged and managed by third parties. Fairhurst have proceeded in good faith with the information made available at the time of writing this report and can take no responsibility or liability for inaccuracies in such information.

In addition to this, the client provided site-specific ground investigation data and has permitted the use of other third party data where appropriate.

The effect of the proposed construction on existing (both known and unrecorded) subterranean assets (including services and tunnels) is outside the scope of this report.

It should be noted that the movements described in this report are indicative only for the purposes of providing pre-planning guidance with regards to the development. It is anticipated the actual movement observed on site will be heavily affected by the form of construction, the construction techniques employed, the level and quality of workmanship and therefore all of these considerations should be reviewed at the detailed design stage following discussions with the project structural engineer and the appointed contractor. The design of temporary works is outside the scope of this report, and is the responsibility of the structural engineer and/or the chosen contractor to adequately consider these stages and aspects of the construction especially since these may present more onerous situations that will be applicable in the final permanent design case.

As this report represents a pre-planning document (and not detailed design), Fairhurst do not take any responsibility for movement that occurs to neighbouring structures (including No. 38) before, during and after the construction works.

#### 2.0 BASELINE CONDITIONS

#### 2.1 Site Description

The site is located within the London Borough of Camden, with a National Grid Reference of 526060,185474. The site location plan is shown as Figure 1. It is bounded by Frognal Lane to the north, property No. 38 to the west and a private driveway to the east. The surrounding area is predominantly residential.

A site visit has not been undertaken as part of the preparation of this GMA. Topographical data has been extracted from a previous GMA produced by Train and Kemp (Consulting Engineers) in 2017 and it has been assumed that the site conditions and levels have largely remained the same since this time.

The property at 40 Frognal Lane is a three-storey Grade II listed building with a semi-basement and is located within the eastern part of the site. The western part of the site is used as a garden, above the proposed basement swimming pool footprint. Site levels generally vary from 94mAOD in the north-eastern part of the site to 92mAOD in the south-western part of the site. No. 38 is at 91mAOD and does not have a basement or other below ground structure as far as we understand. Due to the change in topography, there is a boundary retaining wall between the gardens of Nos. 38 and 40. The retaining wall is 2m high at the front northern corner of the pool with No.38 situated on the lower side of the wall.

Site levels and clearances between adjacent structures and the proposed excavation are summarised in Table 2-1 below.

Structure	Foundation Level (mAOD)	Approximate Height (m)	Approximate Length (m)	Approximate Width (m)	Perpendicular Distance from Excavation
No. 40	91.5	12	15	10.2	3.5m
No. 38	90.0	8	15	11.6	<ul><li>7.8m to the front northern corner of the basement;</li><li>9.8m to the centre of the basement</li></ul>
Boundary Wall	91.0	2	24	Unknown	4.3m to the front northern corner of the basement; and 11.3m to the rear southern corner of the basement

#### Table 2-1: Summary of Structures Surrounding the Site

Notes and Assumptions relating to above dimensions:

- 1. The numbers in bold are dimensions perpendicular to the excavation.
- 2. The lower ground floor of No. 40 is at a level of 92mAOD. Its foundation is therefore assumed to be at 91.5mAOD, as per the Train and Kemp GMA (2017).
- 3. The dimensions of No. 40 have been based on architect's drawings, its length excluding the front porch.
- 4. The length of No. 38 has been assumed based on the distance between two exploratory holes undertaken in the vicinity of the property. Its height has been assumed.
- 5. Due to the nature of retaining walls with a limited width, the boundary wall has been modelled as a single straight line. The section of the boundary wall located closest to the western side or part of the proposed basement excavation has been assessed.

#### 2.2 Geology

The 1:50,000 Geological Survey of Great Britain (England and Wales) map covering the site area (Sheet 256, 'North London', Solid and Drift Edition, dated 2006) indicates the site to be underlain by superficial deposits of the Bagshot Formation and Claygate Member with bedrock comprising the London Clay Formation.

#### 3.0 GROUND INVESTIGATION AND MONITORING

#### 3.1 Ground Conditions

A ground investigation consisting of two cable percussive boreholes (BH01 and BH02) progressed to a depth of 18.0m below ground level (mbgl) was undertaken by AP Geotechnics in July 2011 in the garden of No. 40. In-situ testing in the form of standard penetration tests (SPT) were undertaken in both boreholes and a permeability test carried out in BH01. Geotechnical laboratory testing undertaken comprised classification tests, undrained unconsolidated triaxial tests, pH and sulphates and one-dimensional consolidation tests.

A second ground investigation consisting of two continuous percussive window sample holes (WS01 and WS02) to a depth of 6.0mbgl was undertaken by Soils Ltd in December 2014 in the garden of No. 38. No in-situ testing or laboratory testing was undertaken as part of this ground investigation.

The ground conditions deviated slightly from published records in that the Bagshot Formation was not encountered. A summary of the ground conditions is presented in Table 3-1.

Ctroto	Top Surfac	ce of Strata	Thickness	Description	
Strata	Depth (mbgl)	Level (mAOD)	(m)	Description	
Made Ground	Ground Ground level 90.8 to 93.2 0.35 to 1.3		Soft silty CLAY containing brick fragments		
Claygate Member	0.35 to 1.3	89.9 to 92.3	4.2 to 5.65	Firm brown mottled orange brown and grey silty CLAY	
London Clay Formation	5.1 to 5.6	5.1 to 5.6     87.6 to 88.1     Base not proven horizon, beccond class     Stiff fissured horizon, beccond class		Stiff fissured brown CLAY with occasional pockets of fine sand in the weathered horizon, becoming stiff fissured dark grey CLAY at depth	

Table 3-1: Summary of Ground Conditions

#### 3.2 Groundwater

Monitoring standpipes were installed in BH01, WS01 and WS02. Subsequent groundwater monitoring of BH01 was undertaken on two occasions and monitoring of WS01 and WS02 was done on three occasions. Table 3-2 details the groundwater monitoring results obtained from this limited monitoring regime.

Table 3-2: Summary of	Groundwater	Monitoring
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Parabala	Groundwa	ater Depth	Groundwa	iter Level	Response Zone	
Borenoie	Min. (mbgl)	Max. (mbgl)	Min. (mAOD)	Max. (mAOD)	Response zone	
BH01	2.9	3.9	89.3	90.3	Made Ground/ Claygate Member/ London Clay	
WS01	1.5	2.8	88.0	89.3	Claygate Member	
WS02	0.8	2.0	88.9	90.1	Claygate Member	

#### 3.3 In-situ and Laboratory Testing

A summary of laboratory and in-situ test results from the 2011 ground investigation is presented in this section. Factual data can be found in the Train and Kemp GMA (2017).

#### Bulk Density

The bulk density of the London Clay Formation was obtained from five undrained unconsolidated triaxial tests undertaken on samples from depths of 6.5mbgl to 12.5mbgl. The results ranged from 2.01kN/m<sup>3</sup> to 2.11kN/m<sup>3</sup>.

#### Atterberg Limits and Moisture Contents

Two classification tests were undertaken on samples from the London Clay Formation in BH01 at depths of 6.5mbgl and 9.5mbgl. The moisture content results for the clay were both recorded to be 28% and the plasticity indices were 46% and 51%.

#### Strength Testing

A single SPT was undertaken within the Claygate Member at 1.45mbgl, with an uncorrected value of 6. Using an  $f_1$  value of 4.5, its undrained shear strength is determined to be  $27kN/m^2$  based on Stroud's correlation (1974).

Eight SPTs were undertaken within the London Clay Formation at depths of 8.0mbgl to 17.0mbgl, with uncorrected values of 21 to 47. Five undrained unconsolidated triaxial tests were undertaken on samples of the London Clay Formation from depths of 6.5mbgl to 12.5mbgl. The undrained shear strength of the material from laboratory testing and SPT correlations ranged from 95kN/m<sup>2</sup> to 212kN/m<sup>2</sup>.

#### 4.0 PREDICTION OF GROUND MOVEMENT AND DAMAGE ASSESSMENT

#### 4.1 Introduction

In connection with the proposed basement construction, a ground movement and damage assessment has been prepared for the site. The purpose of this assessment is to determine the effects of the proposed basement excavation upon the existing building within the subject property and the neighbouring structures adjacent to the subject property.

The sources of ground movement over the footprint of the excavated area are different from those for the movement occurring outside and the associated ground movements require assessment using different approaches.

In the area of the new basement, the soil will tend to 'heave' or lift upwards due to unloading of the ground associated with the excavation which will remove a large weight of soil from the basement footprint. However, the full extent of heave is unlikely to manifest fully during typical construction time periods. Subsequent downwards vertical movement will also be expected as a result of the re-application of vertical loading from the completion of the basement and swimming pool construction and the follow-on filling of this with water.

Around the site, ground movements during and after the works are mainly related to the basement excavation and installation of a secant piled wall, which would induce a reduction of vertical and lateral stresses in the ground along the excavation boundaries, with these tending to be at the greatest magnitude closest to the footprint of the basement excavation and closest to the existing ground surface.

The magnitude and distribution of ground movements inside and outside the excavated area are a function of changes of load in the ground and also, potentially more critically, a function of workmanship and construction techniques used.

Ground movements associated with unloading of the ground due to basement excavation have been estimated using the geotechnical software Pdisp whilst the expected movements and impact assessment of the area around the site and surrounding structures have been estimated using the software Xdisp. Xdisp relies on empirical relationships provided in CIRIA report C580 Embedded Retaining Walls – Guidance for Economic Design (superseded by C760, 2017) which is based on field measurements of movements from various basement constructions across London.

The calculations provided are specific to the proposed development and the advice herein should be reviewed should any aspect of the development proposals change.

#### 4.2 Adjacent Properties

The properties or structures pertinent to this GMA as a result of the basement excavation and retaining wall construction are summarised in Table 2-1. The specific properties and walls under consideration for properties Nos. 38 and 40 are the same as those assessed in the Train and Kemp GMA (2017), as follows:-

- West wall of No. 40 Frognal Lane (east of the proposed basement footprint);
- East wall of No. 38 Frognal Lane (west of the proposed basement footprint); and
- Boundary retaining wall between Nos. 38 and 40 (west of the proposed basement).

#### 4.3 Ground Model and Soil Parameters

The ground model determined for this assessment is based on the historical ground investigations undertaken on site and in the garden of No. 38. It should be noted that Fairhurst can take no responsibility or liability for inaccuracies in the factual data from these ground investigations.

The existing ground level has been assumed to be 93.5mAOD based on surveyed levels from the 2011 ground investigation and taken as an average of the sloping ground across the garden.

Ground movement analysis requires soil stiffness parameters to be derived. The undrained Young's Modulus ( $E_u$ ) is used for short-term analysis while the drained Young's Modulus (E') is used for long-term analysis. Soil stiffness is dependent on the strain rate applicable to a specific engineering problem and consideration has been given to recommendations in BS 8004:2015 which suggests that the strain rate generally applicable to foundation design is in the range of 0.075% to 0.200%.

	Tom of Strate		Undr	ained	Drained		
Strata	(mAOD)	(kN/m³)	E <sub>u</sub> (kN/m²)	Poisson's Ratio (v)	E' (kN/m²)	Poisson's Ratio (v')	
Made Ground	93.5	18	5,000	0.5	3,500	0.2	
Claygate Member	92.1	18	12,000	0.5	8,400	0.2	
London Clay Formation	87.8	21	36,000 to 90,000	0.5	25,200 to 63,000	0.2	

 Table 4-1: Ground Model and Soil Parameters Used in Movement Analysis

Notes and assumptions:

- 1. The unit weight of Made Ground and Claygate Member has been determined based on log descriptions and recommendations in BS 8002:2015. The unit weight of London Clay Formation has been derived from laboratory test results.
- 2.  $E_u$  of Made Ground has been determined based on typical values for this material.  $E_u$  of Claygate Member and London Clay Formation is derived from their undrained shear strength using the relationship  $E_u/c_u = 450$  (Jardine et al, 1985) and based on the appropriate strain rates.
- 3. E' has been derived using the correlation  $E_u/E' = 0.7$  based on recommendations in CIRIA report C143.
- 4. The Poisson's ratios have been selected based on recommendations for stiff clays.
- 5. The horizontal rigid boundary has been assumed to be at 72.3mAOD.

#### 4.4 Movement associated with Unloading and Loading of the Ground

Vertical ground movement associated with unloading and subsequent loading of the ground within the basement footprint has been calculated using the Boussinesq method and geotechnical software Oasys Pdisp (version 20.0). This approach assumes linear elastic behaviour of the soil. Elastic vertical strains are calculated on the basis of the calculated stress changes and then integrated to obtain vertical movements.

The following load stages have been considered in the analysis:

1. **Stage 1 (unloading, short-term conditions):** this stage looks at the unloading of the ground due to the formation of the basement excavation from existing ground level (93.5mAOD) to the formation level of 86.5mAOD at the deep end of the swimming pool. Conservative assumptions have been adopted where the excavation has been modelled as one bulk excavation whereas in reality staged excavation techniques are more likely to be employed. An unloading of 130kN/m<sup>2</sup> has been applied at the formation level, based on the overburden having been removed (i.e. thickness x unit weight of each stratum). Excavation has been considered in the short-term case only, assuming there would be no significant delays before construction of the basement.

- 2. Stage 2 (loading, short-term conditions): there is no information on the anticipated loads from the permanent structures at this stage. Therefore, a nominal uniformly distributed load of 30kN/m<sup>2</sup> has been applied across the entire basement to account for floor slabs, weight of water in the swimming pool and other ancillary facilities. This approach assumes that all and any concentrated wall line and point load will be evenly distributed across the basement slab footprint due to the relative high stiffness of this construction.
- 3. **Stage 3 (loading, long-term conditions):** similarly, a nominal 30kN/m<sup>2</sup> has been applied across the entire basement footprint. Drained geotechnical parameters are used to account for the long-term case following dissipation of pore-water pressures in the clays. Same assumptions as stage 2 above in terms of the assumed distribution of the load across the basement slab footprint.

Vertical ground movement of adjacent structures as a result of load stages 1 to 3 has been estimated to be less than 5mm.

#### 4.5 Movement associated with Basement Excavation and Secant Piled Wall Installation

Oasys Xdisp (version 19.4) has been used to estimate the movements associated with the basement excavation and secant piled wall installation and to subsequently calculate the resultant damage categories of the structures of interest under review and consideration.

Temporary works have not been considered in this ground movement assessment, and it is assumed that the design of temporary works is the responsibility of the structural engineer or chosen contractor. The movements described in this assessment are very dependent on, influenced by and affected by the quality of the workmanship and propping system and arrangement of the basement excavations.

The Xdisp analysis considers 'installation of secant bored pile wall in stiff clay' (CIRIA 580 Fig. 2.8) and 'excavation in front of a high stiffness wall in stiff clay' (CIRIA 580 Fig. 2.11) to simulate any effects from excavation and basement wall construction on neighbouring structures. Stiffened walls with an assumed toe level of 5.0m below the basement level have been utilised in the analysis, an assumption which would require an adequate propping regime and extent of propping in order to achieve this. This means that the walls have been assumed to act as supported or propped walls as opposed to un-propped cantilever walls which would typically require a much greater pile embedment depth to satisfy the ultimate stability requirements. It would not be uncommon for walls such as these to need to be designed as propped walls to satisfy the serviceability criteria design requirements in relation to controlling movements, thus this assumption is not considered unreasonable in this instance. The combined cumulative movements resulting from the wall installation and basement excavation have been used to carry out an assessment of the likely damage to adjacent structures.

In order to model the more realistic effects on movements of sub-surface structures, the ground movement curves have been applied at the levels at which the buildings are founded. This means a level of 91.5mAOD for No. 40, and a level of 90.0mAOD for No. 38 and a level of 91.0mAOD for the boundary wall. This effectively reduces the excavation depth in the Xdisp models which is considered to be more representative of the movement of structures below the existing ground surface level.

For both short- and long-term cases, displacements from the corresponding Pdisp models have been imported to capture movements associated with unloading and loading across the basement footprint, basement excavation and secant piled wall installation.

#### 4.6 Building Damage Assessment

The building damage assessment has been carried out for No. 40, No. 38 and the boundary wall with structure details as summarised in Table 2-1. The expected damage categories as defined by the Burland's scale are presented in Table 4-2.

Based on these predicted ground movements, the following damage categories are anticipated for the structures under consideration:

- A maximum of Damage Category 1 (Very Slight) for the west wall of No. 40;
- Damage Category 0 (Negligible) for the east wall of No. 38; and
- Damage Category 1 (Very Slight) for the boundary retaining wall between Nos. 38 and 40.

The west wall of No. 40 is expected to experience Damage Category 1 (Very Slight) during the excavation stage only. As noted before, staged excavation techniques and an adequate level of propping are likely to be adopted by the contractor and so the damage categories should be lower in reality. Following the construction of the basement structure, the movement and hence strain experienced by the structures will be highly dependent on the quality of workmanship and control of movement during construction. Movement behind the wall will also be significantly restricted by the concrete basement box structure which will act as stiff permanent props. Any localised effects are likely to manifest themselves over a greater extent of the property through normal load and movement redistribution that will occur in practice. Consideration could be given to using an increased level of stiffness construction both in the temporary and permanent cases in certain areas of the proposed basement if required. These specific measures and other options can be considered at the detailed design stage to help mitigate any effects from the basement excavation.

The results of the Xdisp analysis and damage category assessment are presented in Appendix B.

#### Table 4-2: Ground Movement and Damage Category Summary

		Short-term Unloading		Short-term Loading			Long-term Loading			
Structure	Wall	Max. Settlement	Max. Tensile Strain	Damage Category	Max. Settlement	Max. Tensile Strain	Damage Category	Max. Settlement	Max. Tensile Strain	Damage Category
No. 40	West	7.5	0.06	1 – Very Slight	8.1	0.03	0 – Negligible	9.5	0.03	0 – Negligible
No. 38	East	3.4	0.02	0 – Negligible	3.0	0.03	0 – Negligible	3.2	0.03	0 – Negligible
Boundary Wall	-	6.7	0.06	1 – Very Slight	6.7	0.06	1 – Very Slight	7.1	0.06	1 – Very Slight

#### 5.0 CONCLUSIONS

A Ground Movement Assessment has been carried out for the proposed basement at property No. 40 Frognal Lane, London NW3 6PP as part of the planning application basement impact assessment provided to the London Borough of Camden.

Providing that appropriate consideration is given to the detailed design of the basement in order to use all available measures and employ construction techniques specifically to limit future movement, and that good workmanship and construction sequences are used with appropriate support during excavation, it is considered that the proposed basement construction is unlikely to cause significant damage to the surrounding structures. Based on the predicted ground movements, all structures assessed in the vicinity of the basement excavation are expected to be within the CIRIA C760 Damage Category 1 (Very Slight).

Early and comprehensive movement monitoring, through a series of carefully located and designed movement monitoring points, of the neighbouring buildings is recommended during the construction stage and trigger levels at the ground level between the basement excavation and the structures under review should be set in order to protect the neighbouring properties as a precautionary measure. A specification and design for a detailed movement monitoring regime should be incorporated into the final construction scheme for the proposed development to monitor the adjacent properties and establish the extent of any future potential movement to the building at an early a stage as possible. Any temporary and permanent works should be designed to limit eventual movement with a reconsideration of the predicted ground movements following this process.

**FIGURES** 



Figure 1: Site Location Plan (Source: Streetmap.co.uk, 2021)

APPENDIX A
DEVELOPMENT PROPOSAL DRAWINGS



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Section B







#### **APPENDIX B**

XDISP GROUND MOVEMENT AND DAMAGE CATEGORY RESULTS

### 40 Frognal Lane

)asys

Short-term Basement Excavation (Unloading, Wall Toe 5mbbl) Boundary Wall

Job No.	Sheet No.	Rev.
141396		
Drg. Ref.		
Made by JC	Date 10-Feb-2021	Checked

#### Problem Type

Problem Type : Tunnelling and Embedded Wall Excavations

#### Displacement Data

Туре	Name	Direction of extrusion		Point,	/Line/Lin	e for ext	rusion		No. of intervals across extrusion/line	Extrusion depth	No. of intervals along extrusion	Calculate	Surface type for tunnels
			F	First poin	t	s	econd poi	nt					
			х	Y	Z(level)	х	Y	Z(level)					
			[m]	[m]	[m]	[m]	[m]	[m]		[m]			
Line	Boundary Wall	-	6.50000	-11.60000	91.00000	13.50000	11.60000	91.00000	24	-	-	Yes	Surface

Imported Displacements The following data points and displacements were found in the import file Pdisp Short term Unloading to be Imported.csv.

Ref.	C	oordinates		Di	placeme	nts	
	x	У	z	x	У	z	
1	[m] -7 50000	[m]	[m] 91 50000	[mm]	[mm]	[mm] -0 73810	
2	-7.50000	1.00000	91.50000	0.00000	0.00000	-0.73690	
3	-7.50000	2.00000	91.50000	0.00000	0.00000	-0.73310	
4	-7.50000	4 00000	91.50000	0.00000	0.00000	-0.72380	
6	-7.50000	5.00000	91.50000	0.00000	0.00000	-0.69420	
7	-7.50000	6.00000	91.50000	0.00000	0.00000	-0.66530	
8	-7.50000	7.00000	91.50000	0.00000	0.00000	-0.62330	
10	-7.50000	9.00000	91.50000	0.00000	0.00000	-0.48730	
11	-7.50000	10.00000	91.50000	0.00000	0.00000	-0.38960	
12	-7.50000	11.00000	91.50000	0.00000	0.00000	-0.27550	
1.3	-7.50000	13 00000	91.50000	0.00000	0.00000	-0.15450	
15	-7.50000	14.00000	91.50000	0.00000	0.00000	0.05940	
16	-7.50000	15.00000	91.50000	0.00000	0.00000	0.13690	
17	-7.50000	0.00000	91.50000	0.00000	0.00000	-0.73810	
19	-9.35450	0.00000	91.50000	0.00000	0.00000	-0.09160	
20	-10.28180	0.00000	91.50000	0.00000	0.00000	0.08700	
21	-11.20910	0.00000	91.50000	0.00000	0.00000	0.20650	
23	-13.06360	0.00000	91.50000	0.00000	0.00000	0.33150	
24	-13.99090	0.00000	91.50000	0.00000	0.00000	0.35760	
25	-14.91820	0.00000	91.50000	0.00000	0.00000	0.36860	
26	-15.84550	0.00000	91.50000	0.00000	0.00000	0.36900	
28	-17.70000	0.00000	91.50000	0.00000	0.00000	0.35090	
29	-7.50000	15.00000	91.50000	0.00000	0.00000	0.13690	
30	-8.42730	15.00000	91.50000	0.00000	0.00000	0.19460	
32	-10.28180	15.00000	91.50000	0.00000	0.00000	0.26640	
33	-11.20910	15.00000	91.50000	0.00000	0.00000	0.28490	
34	-12.13640	15.00000	91.50000	0.00000	0.00000	0.29490	
35	-13.99090	15.00000	91.50000	0.00000	0.00000	0.29820	
37	-14.91820	15.00000	91.50000	0.00000	0.00000	0.29100	
38	-15.84550	15.00000	91.50000	0.00000	0.00000	0.28290	
39	-17 70000	15.00000	91.50000	0.00000	0.00000	0.27300	
41	10.00000	-11.60000	90.00000	0.00000	0.00000	0.28140	
42	10.16670	-10.63330	90.00000	0.00000	0.00000	0.28250	
43	10.33330	-9.66670	90.00000	0.00000	0.00000	0.28530	
44	10.66670	-7.73330	90.00000	0.00000	0.00000	0.29640	
46	10.83330	-6.76670	90.00000	0.00000	0.00000	0.30390	
47	11.00000	-5.80000	90.00000	0.00000	0.00000	0.31220	
48	11.33330	-3.86670	90.00000	0.00000	0.00000	0.32070	
50	11.50000	-2.90000	90.00000	0.00000	0.00000	0.33670	
51	11.66670	-1.93330	90.00000	0.00000	0.00000	0.34350	
52	12 00000	-0.96670	90.00000	0.00000	0.00000	0.34920	
54	10.00000	-11.60000	90.00000	0.00000	0.00000	0.28140	
55	11.00000	-11.60000	90.00000	0.00000	0.00000	0.30670	
56	12.00000	-11.60000	90.00000	0.00000	0.00000	0.31790	
58	14.00000	-11.60000	90.00000	0.00000	0.00000	0.31410	
59	15.00000	-11.60000	90.00000	0.00000	0.00000	0.30460	
60	16.00000	-11.60000	90.00000	0.00000	0.00000	0.29220	
62	18.00000	-11.60000	90.00000	0.00000	0.00000	0.26350	
63	19.00000	-11.60000	90.00000	0.00000	0.00000	0.24860	
64	20.00000	-11.60000	90.00000	0.00000	0.00000	0.23370	
66	22.00000	-11.60000	90.00000	0.00000	0.00000	0.21930	
67	23.00000	-11.60000	90.00000	0.00000	0.00000	0.19230	
68	24.00000	-11.60000	90.00000	0.00000	0.00000	0.17990	
59	12 00000	-11.60000	90.00000	0.00000	0.00000	0.16820	
71	13.00000	0.00000	90.00000	0.00000	0.00000	0.36780	
72	14.00000	0.00000	90.00000	0.00000	0.00000	0.36920	
73	15.00000	0.00000	90.00000	0.00000	0.00000	0.36200	
75	17.00000	0.00000	90.00000	0.00000	0.00000	0.34940	
76	18.00000	0.00000	90.00000	0.00000	0.00000	0.31570	
77	19.00000	0.00000	90.00000	0.00000	0.00000	0.29720	
78	20.00000	0.00000	90.00000	0.00000	0.00000	0.27860	
80	22.00000	0.00000	90.00000	0.00000	0.00000	0.24280	
81	23.00000	0.00000	90.00000	0.00000	0.00000	0.22620	
82	24.00000	0.00000	90.00000	0.00000	0.00000	0.21050	
84	26.00000	0.00000	90.00000	0.00000	0.00000	0.19390	
85	27.00000	0.00000	90.00000	0.00000	0.00000	0.16950	
86	6.50000	-11.60000	91.00000	0.00000	0.00000	-0.03490	1,2,
87	6.79170	-10.63330	91.00000	0.00000	0.00000	-0.05030	1,2,
88	7 37500	-9.66670	91.00000	0.00000	0.00000	-0.03220	1,2,
90	7.66670	-7.73330	91.00000	0.00000	0.00000	-0.00540	1.2
91	7.95830	-6.76670	91.00000	0.00000	0.00000	0.02830	1,2,
92	8.25000	-5.80000	91.00000	0.00000	0.00000	0.06540	1,2,
93	8.54170	-4.83330	91.00000	0.00000	0.00000	0.10340	1,2,
94	8.83330	-3.86670	91.00000	0.00000	0.00000	0.14050	1,2,
95	9.12500	-2.90000	91 00000	0.00000	0.00000	0.1/530	1,2,
97	9.70830	-0.96670	91.00000	0.00000	0.00000	0.23530	1,2,
98	10.00000	0.00000	91.00000	0.00000	0.00000	0.25990	1,2,
99	10.29170	0.96670	91.00000	0.00000	0.00000	0.28080	1,2,
100	10.58330	1.93330	91.00000	0.00000	0.00000	0.29810	1,2,
102	11.16670	2.90000	91.00000	0.00000	0.00000	0.32290	1,2,0
102		5.00070			2.00000	5.52250	•,,

FAIRHURST
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40 Frognal Lane

Job No.	Sheet No.	Rev.
141396		
Drg. Ref.		
Made by	Date 10-Eeb-2021	Checked

Short torm	<pre>Number of the second seco</pre>	Dig. Kei.		
Boundary V	/all	Made by JC	Date 10-Feb-2021	Checked
Ref. Co	ordinates         Displacements           y         z         x         y         z           [m]         [mm]         [mm] <th></th> <th></th> <th></th>			
103 11.45830 104 11.75000 105 12.04170 106 12.33330 107 12.62500 108 12.91670 109 13.20830 110 13.50030 1 Data point coincider 6 - Data point coincider	4. 8330 91.00000 0.00000 0.00000 0.33350 1,2,6           5. 80000 91.00000 0.00000 0.00000 0.33350 1,2,6           6. 76670 91.00000 0.00000 0.00000 0.33350 1,2,6           7. 7333 91.00000 0.00000 0.00000 0.33350 1,2,6           8. 70000 91.00000 0.00000 0.03350 1,2,6           9. 66670 91.00000 0.00000 0.03350 1,2,6           10.6333 91.00000 0.00000 0.03360 1,2,6           10.6333 91.00000 0.00000 0.03256 1,2,6           11.60000 91.00000 0.00000 0.33740 1,2,6           11.60000 91.00000 0.00000 0.33740 1,2,6           11.60000 91.00000 0.00000 0.33740 1,2,6           11.60000 91.00000 0.00000 0.33740 1,2,6           11.60000 91.00000 0.00000 0.33740 1,2,6           11.60000 91.00000 0.00000 0.33740 1,2,6           11.60000 91.00000 0.00000 0.33740 1,2,6           11.60000 91.00000 0.00000 0.33740 1,2,6           11.60000 91.00000 0.00000 0.30000 0.33740 1,2,6           11.60000 91.00000 0.00000 0.00000 0.33740 1,2,6           11.60000 91.00000 0.00000 0.00000 0.33740 1,2,6           11.610000 91.00000 0.00000 0.33740 1,2,6           11.610000 91.00000 0.00000 0.00000 0.33740 1,2,6           11.610000 91.00000 0.00000 0.00000 0.33740 1,2,6           11.61000000 0.00000 0.00000 0.00000 0.33740 1,2,6           11.610000000 0.00000 0.00000 0.33740 1,2,6           11.610000000 0.00000 0.00000 0.00000 0.33740 1,2,6           11.610000000 0.00000 0.00000			
Vertical Ground M	ovement Curves (Excavations)			
Curve Name: Coordinates: Curve Fitting Method: x Order: y Order: Polynomial: z =	<pre>Installation of secant bored pile wall in stiff clay (CTRIA 580 Fig. 2.8(b)) [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][2.000,0.000,0.000] Polynomial 1 0 -2.5E-2x + 5.0E-2</pre>			
Coeff. of Determination:	1.0			
Curve Name: Coordinates:	<pre>Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(b) [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 (x)[0] (0.000,0.001,0.039][0.100,0.000,0.049][0.200,0.000,0.056][0.300,0.000,0.052] (0.400,0.000,0.067][0.500,0.000,0.072][1.000,0.000,0.072][0.700,0.000,0.073] [0.800,0.000,0.063][1.300,0.000,0.061][1.400,0.000,0.058] [1.200,0.000,0.053][1.700,0.000,0.061][1.400,0.000,0.058][1.500,0.000,0.058] [1.200,0.000,0.053][1.700,0.000,0.061][1.200,0.000,0.058] [1.200,0.000,0.023][2.100,0.000,0.051][2.200,0.000,0.058] [1.200,0.000,0.033][2.100,0.000,0.051][2.200,0.000,0.023] [2.400,0.000,0.033][2.500,0.000,0.014][2.700,0.000,0.053] [2.400,0.000,0.012][2.500,0.000,0.013][2.600,0.000,0.014][2.700,0.000,0.052] [2.800,0.000,0.012][3.300,0.000,0.008][3.600,0.000,0.013][3.500,0.000,0.002] [3.200,0.000,0.012][3.700,0.000,0.002][3.800,0.000,0.003][3.500,0.000,0.001] [1.000,0.003][1.700,0.000,0.002][3.800,0.000,0.003][3.500,0.000,0.001] [1.000,0.000] [3.200,0.000,0.002][3.700,0.000,0.002][3.800,0.000,0.001][3.900,0.000,0.001] [3.000,0.000] [3.200,0.000,0.002][3.700,0.000,0.002][3.800,0.000,0.001][3.900,0.000,0.001] [3.000,0.000] [3.200,0.000,0.000][3.700,0.000,0.002][3.800,0.000,0.001][3.900,0.000,0.001] [3.000,0.000] [3.200,0.000,0.000][3.700,0.000,0.002][3.800,0.000,0.001][3.900,0.000] [3.200,0.000,0.000][3.900,0.000][3.900,0.000][3.900,0.000][3.900,0.000] [3.200,0.000,0.000][3.900,0.000]</pre>			
Method: x Order:	4			
y Order: Polynomial: z = Coeff. of Determination:	0 -2.6455E-3x <sup>4</sup> + 2.8495E-2x <sup>3</sup> - 1.0051E-1x <sup>2</sup> + 1.0569E-1x + 3.8990E-2 9.9991E-1			
Horizontal Ground	Movement Curves (Excavations)			
Curve Fitting	Installation of secant Borded pile wall in stiff clay (CINA S80 Pig. 2.8(a)) [Distance from wall / wall depth or max. excavation depth (x), Bepth / wall depth or max. excavation depth (y), Borizontal movement / wall depth or max. 60.000,0000,0.001(),0.050,0.000,0.076[0,1000,0.000,0.072][0.150,0.000,0.067] [0.200,0.000,0.043][0.250,0.000,0.053][0.300,0.000,0.056][0.350,0.000,0.052] [0.400,0.000,0.043][0.250,0.000,0.053][0.300,0.000,0.053][0.550,0.000,0.040] [0.600,0.000,0.027][0.650,0.000,0.034][0.700,0.000,0.022][0.750,0.000,0.040] [0.600,0.000,0.027][0.650,0.000,0.241[0.900,0.000,0.22][0.750,0.000,0.020] [1.200,0.000,0.011][1.550,0.000,0.024][0.900,0.000,0.141][1.150,0.000,0.020] [1.200,0.000,0.011][1.550,0.000,0.009][1.300,0.000,0.000][1.350,0.000,0.005] [1.200,0.000,0.011][1.550,0.000,0.021][1.500,0.000,0.000][1.350,0.000,0.005] [1.400,0.000,0.011][1.450,0.000,0.021][1.500,0.000,0.000] [1.200,0.000,0.011][1.450,0.000,0.002][1.500,0.000,0.000]]			
Method: x Order: y Order: Polynomial: z = Coeff. of Determination:	3 0 -1.0610E-2x <sup>3</sup> + 4.4203E-2x <sup>2</sup> - 9.6358E-2x + 8.0901E-2 1.0000			
Curve Name:	Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig.			
Coordinates: Curve Fitting	<pre>[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] Polynomial</pre>			
Method: x Order: y Order: Polynomial: z = Coeff. of Determination:	1 0-3.75E-2x + 1.50E-1 1.00			
Polygonal Excava	ions			
Excavation Name: Surface level [n Contribution:	Pool excavation 1: 91.000 Positive			
Enabled: Corner x	y Base Stiffened Previous Side Next Side			
[m] 1 -4.0000 - 2 2.2000 - 3 2.2000 4 -4.0000	Level         a         pi $p2^{x}$ a         pi $p2^{x}$ [m]         [m]         [m]         [k]         [k]         [k]         [k]           11.600         86.500         Yes         0.0         67.000         25.000         0.0         67.000         25.000           11.600         86.500         Yes         0.0         67.000         25.000         0.0         67.000         25.000           11.600         86.500         Yes         0.0         67.000         25.000         10.67.000         25.000           11.600         86.500         Yes         0.0         67.000         25.000         10.67.000         25.000			
Side Corner x [m]	1         Corner 2         Ground Movement Curve           y         x         y         Vertical           [m]         [m]         [m]			
1 -4.0000 2 2.2000 3 2.2000	-11.600 2.2000 -11.600 Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(b) -11.600 2.2000 11.600 Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(a)) (CIRIA 580 Fig. 2.11(b) (CIRIA 580 Fig. 2.11(a)) (CIRIA 580 Fig. 2.11(a)) (CIRIA 580 Fig. 2.11(a)) (CIRIA 580 Fig. 2.11(a))			
4 -4.0000	stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(b) 11.600 -4.0000 -11.600 Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(b) (CIRIA 580 Fig. 2.11(b) (CIRIA 580 Fig. 2.11(a))			
Excavation Name: Surface level [n Contribution: Enabled:	Secant Pile Wall Installation 91.000 Positive Yes v Base Stiffened Previous Side Next Side			

Job No.	Sheet No.	Rev.
141396		
Drg. Ref.		

40 Frognal Lane

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Short-term Basement Excavation (Unloading, Wall Toe 5mbbl) Boundary Wall

Made by	
JC	

Date 10-Feb-2021 Checked

1 -4.	m] [m] 0000 -11.6	[m] 00 81.500	[ Yes	d p1 m] [%] 0.0 50.0	<b>p2* c</b> [%] [n 00 20.000 (	i pl 1] [%] 0.0 50.000	<b>p2*</b> [%] 20.000					
2 2. 3 2. 4 -4.	2000 -11.6 2000 11.6 0000 11.6	00 81.500 00 81.500 00 81.500	Yes Yes Yes	0.0 50.0 0.0 50.0 0.0 50.0	00 20.000 0 00 20.000 0 00 20.000 0	0.0 50.000 0.0 50.000 0.0 50.000	20.000 20.000 20.000					
Side	Corner 1 y	Co ×	rner 2 y		Vertical	Ground Mo	ovement Cur	7e Horizontal				
1 -4.	ij [m] .0000 -11.	600 2.20	[m] 00 -11.600	Install pile wa	ation of sec 11 in stiff	ant bored clay (CIRI	Installa IA pile wal	tion of secar l in stiff cl	at bored ay (CIRIA			
2 2.	2000 -11.	600 2.20	00 11.600	Install pile wa	ation of sec ll in stiff	ant bored clay (CIRI	Installa IA pile wal	l in stiff cl	at bored ay (CIRIA			
3 2.	2000 11.	600 -4.00	00 11.600	Install pile wa	ation of sec 11 in stiff 2 8(b))	ant bored clay (CIRI	Installa IA pile wall	Lion of secar L in stiff cl	it bored ay (CIRIA			
4 -4.	0000 11.	600 -4.00	00 -11.600	Install pile wa	ation of sec 11 in stiff	clay (CIRI	Installa IA pile wal 580 Fig.	tion of secar l in stiff cl 2.8(a))	at bored ay (CIRIA			
Damage Ca	tegorv Strai	ns										
- g	Name	0 (N	egligible) to	1 (Very	Slight) 2 o	(Slight)	3 (Mod	erate)				
Burland St	rain Limit	1 (V	ery Slight) 0.0	2 (S1	ight) 3 00.00E-6	(Moderate) 750.001	<b>4 (Se</b>	vere) .0015000				
Specific St	ructures - Ge	eometry										
Structure	Name Sub	-Structure Name	Displace Line	ment D	Start Er istance Dist Along Alc Line Li	nd Ve cance Offs ong Li ine Ve	ertical sets from ine for ertical	Vertical Displacement Limit Sensitivity	Damage Cat	tegory Strains	Poisson's E/G Ratio	
Boundary W	Wall Boun	dary Wall	Boundary	Wall	[m] [n 0.00000 24.2	Calo 1] 23300	[m] 0.0	[mm] 0.10000	Burland Sti	ain Limits	0.20000 2.6000	
	Foun	dation -										
Specific Sti Structure	Name Sub	-Structure	<i>meters</i> Height D	efault		Hogging			Sagging			
		Name	Pr	operties	2nd Moment of Area	Distance of Bending	Distance g of N.A.	2nd Moment of Area	Distance of Bending	Distance of N.A.		
					(per unit width)	Strain from N.A.	from Edge of Beam in Tension	(per unit n width)	Strain from N.A.	from Edge of Beam in Tension		
Boundary W	Iall Boun Foun	dary Wall dation	[m] 2.0000 Ye	s	[m³] 2.6667	[m] 2.0000	[m] 2.000	[m³] 0.66667	[m] 1.0000	[m] 1.0000		
Building Se	egment Com	binations										
Structure	Name Sub	-Structure Name	Vertica Offset fr	1 Segm	ent Start Le	ength Curva	ature Combin Segme	ned nt				
			Vertica Movemen	r 1 t								
No structu	ires have s	egments co	Calculati [m] mbined.	ons	[m]	[m]						
Utility Strai	n Calculatio	n Options										
Neglect be	eneficial c	ontributio	n of axial	strains	: No							
Warnings												
1 Mult exca indi exca anot	vidual excav vations ar vidual exc vations (e ther).	ations hav e calculat avation. .g. overla	e been spec ed by summi No account pping zones	ified. ng the d has been of infl	The displace isplacements taken of th uence or 'sh	ements resu s resulting he interact hielding' o	ilting from g from each tions betwee of one exca	these en vation by				
Errors												
None												
Displaceme	ent and Strai	n Results										
Туре	e/No.		Coordinates				Displacem	ents		Angle of Line		
Name	Dist.	x	У	z	x	У	z	Horizontal displacement along Line	Horizontal displacement perpendicula	to x Axis t ar		
Boundary Wall	[m] Line 1	[m] 6.50000	[m] -11.60000	[m] 91.0000	[mm] 0 -5.5967	[mm] 0.0	[mm] 3.9393	[mm] -1.6167	[mm] 5.358	[°] 31 73.210 *		
	1.0097 2.0194 3.0291	6.79167 7.08333 7.37500	-10.63333 -9.66667 -8.70000	91.0000 91.0000 91.0000	0 -9.1565 0 -8.8716 0 -8.5916	0.0	6.6836 6.5440 6.4088	-2.6450 -2.5627 -2.4818	8.766 8.493 8.225	52 73.210 * 34 73.210 * 54 73.210 *		
	4.0388 5.0485 6.0583	7.66667 7.95833 8.25000	-7.73333 -6.76667 -5.80000	91.0000 91.0000 91.0000	0 -8.3165 0 -8.0460 0 -7.7800	0.0	6.2753 6.1411 6.0039	-2.4023 -2.3242 -2.2473	7.962	20 73.210 * 30 73.210 * 33 73.210 *		
	7.0680 8.0777 9.0874	8.54167 8.83333 9.12500	-4.83333 -3.86667 -2.90000	91.0000 91.0000 91.0000	0 -7.5182 0 -7.2606 0 -7.0069	0.0	5.8622 5.7152 5.5624	-2.1717 -2.0973 -2.0240	7.19	77 73.210 * 11 73.210 * 32 73.210 *		
	10.097	9.41667	-1.93333	91.0000	0 -6.7570	0.0	5.4043	-1.9518	6.468	39 73.210 * 31 73.210 *		
	12.117 13.126 14.136	10.00000 10.29167 10.58333	0.00000 0.96667 1.93333	91.0000 91.0000 91.0000	u -6.2677 0 -6.0280 0 -5.7913	0.0	5.0731 4.9016 4.7272	-1.8105 -1.7413 -1.6729	6.000 5.771 5.544	10 73.210 * 10 73.210 * 14 73.210 *		
	15.146 16.155 17.165	10.87500 11.16667 11.45833	2.90000 3.86667 4.83333	91.0000 91.0000 91.0000	0 -5.5576 0 -5.3265 0 -5.0980	0.0 0.0 0.0	4.5509 4.3734 4.1955	-1.6054 -1.5386 -1.4726	5.320 5.099 4.880	07 73.210 * 95 73.210 * 07 73.210 *		
	18.175 19.184 20.194	11.75000 12.04167 12.33333	5.80000 6.76667 7.73333	91.0000 91.0000 91.0000	0 -4.8719 0 -4.6479 0 -4.4259	0.0 0.0 0.0	4.0180 3.8414 3.6664	-1.4073 -1.3426 -1.2785	4.664 4.449 4.23	12 73.210 * 98 73.210 * 73 73.210 *		
	21.204 22.214 23.223	12.62500 12.91667 13.20833	8.70000 9.66667 10.63333	91.0000 91.0000 91.0000	0 -4.2058 0 -3.9874 0 -3.7704	0.0 0.0 0.0	3.4935 3.3230 3.1555	-1.2149 -1.1518 -1.0891	4.020 3.81 3.609	55 73.210 * 74 73.210 * 97 73.210 *		

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	Drg. Ref.		
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le of ine x Axis			

#### 40 Frognal Lane

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Short-term Basement Excavation (Unloading, Wall Toe 5mbbl) Boundary Wall

Type/No. Coordinates Displacements Angl Li 
 Name
 Dist.
 x
 y
 z
 x
 y
 z
 Horizontal displacement
 Horizontal displacement

 24.233
 13,5000
 11,6000
 91.0000
 -2.2045
 0.0
 1.7816
 -0.63679
 2.1105

 \* Result includes imported displacement(s).
 x
 y
 x
 y
 x
 y
 z
 Horizontal displacement
 Horizontal to x 2.1105 73.210 \*

#### Specific Building Damage Results - Horizontal Displacements

Structure: Boundary Wall | Sub-structure: Boundary Wall Foundation

Dist.		Coordinates Displace					ments			
	x	v	z	x	v	Horizontal	Horizontal			
						displacement	displacement			
						along the	perpendicular			
						Line	to Line			
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]			
0.0	6.50000	-11.60000	91.00000	-5.5967	0.0	-1.6167	5.3581	d		
1.0097	6.79167	-10.63333	91.00000	-9.1565	0.0	-2.6450	8.7662	d		
2.0194	7.08333	-9.66667	91.00000	-8.8716	0.0	-2.5627	8.4934	d		
3.0291	7.37500	-8.70000	91.00000	-8.5916	0.0	-2.4818	8.2254	d		
4.0388	7.66667	-7.73333	91.00000	-8.3165	0.0	-2.4023	7.9620	d		
5.0485	7.95833	-6.76667	91.00000	-8.0460	0.0	-2.3242	7.7030	d		
6.0583	8.25000	-5.80000	91.00000	-7.7800	0.0	-2.2473	7.4483	d		
7.0680	8.54167	-4.83333	91.00000	-7.5182	0.0	-2.1717	7.1977	d		
8.0777	8.83333	-3.86667	91.00000	-7.2606	0.0	-2.0973	6.9511	d		
9.0874	9.12500	-2.90000	91.00000	-7.0069	0.0	-2.0240	6.7082	d		
10.097	9.41667	-1.93333	91.00000	-6.7570	0.0	-1.9518	6.4689	d		
11.107	9.70833	-0.96667	91.00000	-6.5106	0.0	-1.8807	6.2331	d		
12.117	10.00000	0.00000	91.00000	-6.2677	0.0	-1.8105	6.0005	d		
13.126	10.29167	0.96667	91.00000	-6.0280	0.0	-1.7413	5.7710	d		
14.136	10.58333	1.93333	91.00000	-5.7913	0.0	-1.6729	5.5444	d		
15.146	10.87500	2.90000	91.00000	-5.5576	0.0	-1.6054	5.3207	d		
16.155	11.16667	3.86667	91.00000	-5.3265	0.0	-1.5386	5.0995	d		
17.165	11.45833	4.83333	91.00000	-5.0980	0.0	-1.4726	4.8807	d		
18.175	11.75000	5.80000	91.00000	-4.8719	0.0	-1.4073	4.6642	d		
19.184	12.04167	6.76667	91.00000	-4.6479	0.0	-1.3426	4.4498	d		
20.194	12.33333	7.73333	91.00000	-4.4259	0.0	-1.2785	4.2373	d		
21.204	12.62500	8.70000	91.00000	-4.2058	0.0	-1.2149	4.0265	d		
22.214	12.91667	9.66667	91.00000	-3.9874	0.0	-1.1518	3.8174	d		
23.223	13.20833	10.63333	91.00000	-3.7704	0.0	-1.0891	3.6097	d		
24.233	13.50000	11.60000	91.00000	-2.2045	0.0	-0.63679	2.1105	d		
d - Di:	splacement	ts include	imported	displace	ements	5.				

#### Specific Building Damage Results - Vertical Displacements

Dist.	Coordinates	Di	splacement		
Structure:	Boundary Wall	Sub-structure:	Boundarv	Wall	Foundation

#### x y z z [m] [m] [m] [m] [mm] Vertical Offset 1

		-			
0.0	6.50000	-11.60000	91.00000	3.9393	d
1.0097	6.79167	-10.63333	91.00000	6.6836	d
2.0194	7.08333	-9.66667	91.00000	6.5440	d
3.0291	7.37500	-8.70000	91.00000	6.4088	d
4.0388	7.66667	-7.73333	91.00000	6.2753	d
5.0485	7.95833	-6.76667	91.00000	6.1411	d
6.0583	8.25000	-5.80000	91.00000	6.0039	d
7.0680	8.54167	-4.83333	91.00000	5.8622	d
8.0777	8.83333	-3.86667	91.00000	5.7152	d
9.0874	9.12500	-2.90000	91.00000	5.5624	d
10.097	9.41667	-1.93333	91.00000	5.4043	d
11.107	9.70833	-0.96667	91.00000	5.2409	d
12.117	10.00000	0.00000	91.00000	5.0731	d
13.126	10.29167	0.96667	91.00000	4.9016	d
14.136	10.58333	1.93333	91.00000	4.7272	d
15.146	10.87500	2.90000	91.00000	4.5509	d
16.155	11.16667	3.86667	91.00000	4.3734	d
17.165	11.45833	4.83333	91.00000	4.1955	d
18.175	11.75000	5.80000	91.00000	4.0180	d
19.184	12.04167	6.76667	91.00000	3.8414	d
20.194	12.33333	7.73333	91.00000	3.6664	d
21.204	12.62500	8.70000	91.00000	3.4935	d
22.214	12.91667	9.66667	91.00000	3.3230	d
23.223	13.20833	10.63333	91.00000	3.1555	d
24.233	13.50000	11.60000	91.00000	1.7816	d

d - Displacements include imported displacements.

#### Specific Building Damage Results - All Segments

Structure: Boundary Wall | Sub-structure: Boundary Wall Foundation

Vertical Offset from Line for Vertical Movement Calculations	Segment	Start	Length	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	Damage Category		
[m] 0.0		[m] 1 0.0	[m] 3.0266	Sagging	[%] 0.063481	[%] -0.028591	[%] 0.064525	0.0010194	-0.0027207	[m] 282.34	1 (Very Slight)		
		2 3.0266	0.73552	Hogging	0.0	0.0078715	0.0078716	-80.080E-6	133.88E-6	565630.	(Negligible)		
		3 3.7621	12.926	Sagging	683.86E-6	0.0071197	0.0077004	-78.704E-6	176.21E-6	184150.	(Negligible)		
		4 16.689	4.5237	Hogging	78.535E-6	0.0063972	0.0065001	-65.369E-6	176.21E-6	410670.	(Negligible)		
		5 21.212	3.0207	Sagging	0.026464	0.019120	0.057919	-447.78E-6	0.0013600	676.22	(Negligible) 1 (Very Slight)		
Tensile horizontal	strains are	+ve, co	mpressiv	e horizont	al strains a	ire -ve.							
Specific Building Da	specific Building Damage Results - Critical Values for All Segments within Each Sub-Structure												

Structure: Bo Vertical Offset from Line for Vertical Movement	Dundary Wal: Deflection Ratio	l   Sub-str Average Horizontal Strain	ucture: Boun Max Slope	dary Wall : Max Settlement	Foundatio Max Tensile Strain	n Max Gradient of Horizontal Displacement Curve	Max Gradient of Vertical Displacement Curve	Min Radius of Curvature (Hogging)	Min Radius of Curvature (Sagging)	Damage Category	
[m] 0.0	[%] 0.063481	[%] -0.028591	-0.0027207	[mm] 6.6834	[%] 0.064525	0.0010194	-0.0027207	[m] 410670.	[m] 282.34	1 (Very Slight)	
Specific Building Damage Results - Critical Segments within Each Structure											
Structure Nam	ne Paran	meter S	Critical ub-Structure	Critical Segment	Start	End Curvatu	re Max Slope	Max Settlement	Max Tensile Strain	Min Min Radius of Radius of Curvature Curvature (Hogging) (Sagging)	Dama

age Category

	Job No.	Sheet No.	Rev.
	141396		
mbbl)	Drg. Ref.		
moory	Made by JC	Date 10-Feb-2021	Checked

**40 Frognal Lane** Short-term Basement Excavation (Unloading, Wall Toe 5r Boundary Wall

)asys

Boundary Wall	Max Slope	Boundary Wall Foundation	1	[m] 0.	[m] 0 3.026	6 Sagging	0.0027207	[mm] 6.6834	[%] 0.064525	[m] _	[m] 282.34 1	l (Very Slight)
	Max Settlement	Boundary Wall Foundation	1	0.	0 3.026	6 Sagging	0.0027207	6.6834	0.064525	-	282.34 1	l (Very Slight)
	Max Tensile Strain	Boundary Wall Foundation	1	0.	0 3.026	6 Sagging	0.0027207	6.6834	0.064525	-	282.34	l (Very Slight)
	Min Radius of Curvature	Boundary Wall Foundation	4	16.68	9 21.21	2 Hogging	176.21E-6	4.2794	0.0065001	410670.	- (	0 (Negligible)
	(Hogging) Min Radius of Curvature (Sagging)	Boundary Wall Foundation	1	0.	0 3.026	6 Sagging	0.0027207	6.6834	0.064525	-	282.34	1 (Very Slight)

		FAIRH	URST			Job No.	Sheet No.	Rev.	
Oas	sys		141396						
40 Frognal La	ne ne	Taa Embhi	Drg. Ref.						
Boundary Wa	iading, waii Il					Made by JC	Date 10-Feb-2021	Checked	
						•			
Problem Type									
Problem Type : Tunn	elling and Embedde	d Wall Excavations							
Displacement Data									
Type Name	Direction of extrusion	Point/Line/Lin	e for extrusion	No. of intervals across evtrusion/line	Extrusion No depth into a	of Calculate Surface ervals type long for rusion tunnels			
Line Boundary Wall	<b>x</b> [m] 6.500	First point Y Z(level) [m] [m] 100 -11.60000 91.00000	Second point           X         Y         Z (level           [m]         [m]         [m]           13.50000         11.60000         91.0000	.) 10 24	[m] _	- Yes Surface			

Imported Displacements
The following data points and displacements were found in the import file Pdisp Short term Loading to be Imported.csv.

Pof	· ~	·		Di			
Rei.	x	v	z	x	v v	z	
	[m]	[m]	[m]	[mm]	[mm]	[mm]	
2	-7.50000	1.00000	91.50000	0.00000	0.00000	0.17030	
3	-7.50000	2.00000	91.50000	0.00000	0.00000	0.16920	
4	-7.50000	3.00000	91.50000	0.00000	0.00000	0.16750	
6	-7.50000	5.00000	91.50000	0.00000	0.00000	0.16020	
7	-7.50000	6.00000	91.50000	0.00000	0.00000	0.15350	
9	-7.50000	8.00000	91.50000	0.00000	0.00000	0.14380	
10	-7.50000	9.00000	91.50000	0.00000	0.00000	0.11250	
11	-7.50000	10.00000	91.50000	0.00000	0.00000	0.08990	
13	-7.50000	12.00000	91.50000	0.00000	0.00000	0.03560	
14	-7.50000	13.00000	91.50000	0.00000	0.00000	0.00910	
15	-7.50000	15.00000	91.50000	0.00000	0.00000	-0.01370	
17	-7.50000	0.00000	91.50000	0.00000	0.00000	0.17030	
18	-8.42730	0.00000	91.50000	0.00000	0.00000	0.08170	
20	-10.28180	0.00000	91.50000	0.00000	0.00000	-0.02010	
21	-11.20910	0.00000	91.50000	0.00000	0.00000	-0.04770	
22	-13.06360	0.00000	91.50000	0.00000	0.00000	-0.07650	
24	-13.99090	0.00000	91.50000	0.00000	0.00000	-0.08250	
25	-14.91820	0.00000	91.50000	0.00000	0.00000	-0.08510	
27	-16.77270	0.00000	91.50000	0.00000	0.00000	-0.08360	
28	-17.70000	0.00000	91.50000	0.00000	0.00000	-0.08100	
30	-8.42730	15.00000	91.50000	0.00000	0.00000	-0.03160	
31	-9.35450	15.00000	91.50000	0.00000	0.00000	-0.05470	
32	-10.28180	15.00000	91.50000	0.00000	0.00000	-0.06150	
34	-12.13640	15.00000	91.50000	0.00000	0.00000	-0.06810	
35	-13.06360	15.00000	91.50000	0.00000	0.00000	-0.06880	
30	-14.91820	15.00000	91.50000	0.00000	0.00000	-0.06840	
38	-15.84550	15.00000	91.50000	0.00000	0.00000	-0.06530	
39	-16.77270	15.00000	91.50000	0.00000	0.00000	-0.06300	
41	10.00000	-11.60000	90.00000	0.00000	0.00000	-0.06490	
42	10.16670	-10.63330	90.00000	0.00000	0.00000	-0.06520	
43	10.50000	-8.70000	90.00000	0.00000	0.00000	-0.06690	
45	10.66670	-7.73330	90.00000	0.00000	0.00000	-0.06840	
46	10.83330	-6.76670	90.00000	0.00000	0.00000	-0.07010	
48	11.16670	-4.83330	90.00000	0.00000	0.00000	-0.07400	
49	11.33330	-3.86670	90.00000	0.00000	0.00000	-0.07590	
51	11.66670	-1.93330	90.00000	0.00000	0.00000	-0.07930	
52	11.83330	-0.96670	90.00000	0.00000	0.00000	-0.08060	
54	10.00000	-11.60000	90.00000	0.00000	0.00000	-0.08160	
55	11.00000	-11.60000	90.00000	0.00000	0.00000	-0.07080	
56	12.00000	-11.60000	90.00000	0.00000	0.00000	-0.07340	
58	14.00000	-11.60000	90.00000	0.00000	0.00000	-0.07250	
59	15.00000	-11.60000	90.00000	0.00000	0.00000	-0.07030	
61	17.00000	-11.60000	90.00000	0.00000	0.00000	-0.06740	
62	18.00000	-11.60000	90.00000	0.00000	0.00000	-0.06080	
63	20.00000	-11.60000	90.00000	0.00000	0.00000	-0.05740	
65	21.00000	-11.60000	90.00000	0.00000	0.00000	-0.05060	
66	22.00000	-11.60000	90.00000	0.00000	0.00000	-0.04740	
68	24.00000	-11.60000	90.00000	0.00000	0.00000	-0.04150	
69	25.00000	-11.60000	90.00000	0.00000	0.00000	-0.03880	
70	13.00000	0.00000	90.00000	0.00000	0.00000	-0.08160	
72	14.00000	0.00000	90.00000	0.00000	0.00000	-0.08520	
74	16.00000	0.00000	90.00000	0.00000	0.00000	-0.08350	
75	17.00000	0.00000	90.00000	0.00000	0.00000	-0.07700	
76	18.00000	0.00000	90.00000	0.00000	0.00000	-0.07290	
78	20.00000	0.00000	90.00000	0.00000	0.00000	-0.06430	
79	21.00000	0.00000	90.00000	0.00000	0.00000	-0.06010	
80	22.00000	0.00000	90.00000	0.00000	0.00000	-0.05600	
82	24.00000	0.00000	90.00000	0.00000	0.00000	-0.04860	
83	25.00000	0.00000	90.00000	0.00000	0.00000	-0.04520	
85	27.00000	0.00000	90.00000	0.00000	0.00000	-0.03910	
86	6.50000	-11.60000	91.00000	0.00000	0.00000	0.00800	1,2,6
87	6.79170 7.08330	-10.63330	91.00000	0.00000	0.00000	0.01120	1,2,6
89	7.37500	-8.70000	91.00000	0.00000	0.00000	0.00740	1,2,6
90	7.66670	-7.73330	91.00000	0.00000	0.00000	0.00120	1,2,6
91	7.95830	-6.76670	91.00000	0.00000	0.00000	-0.00650	1,2,6
92	8.54170	-4.83330	91.00000	0.00000	0.00000	-0.02390	1,2,6
94	8.83330	-3.86670	91.00000	0.00000	0.00000	-0.03240	1,2,6
95	9.12500	-2.90000	91.00000	0.00000	0.00000	-0.04050	1,2,6
96	9.41670	-1.93330	91.00000	0.00000	0.00000	-0.04780	1,2,6
98	10.00000	0.00000	91.00000	0.00000	0.00000	-0.06000	1,2,6
99	10.29170	0.96670	91.00000	0.00000	0.00000	-0.06480	1,2,6
100	10.58330	2 90000	91.00000	0.00000	0.00000	-0.06880	1,2,6
102	11 16670	3 86670	91 00000	0 00000	0 00000	-0 07450	1,2,0

$\bigcap a$	FAIRHURST	Job No.	Sheet No.	Rev.
<b>U</b> a	<i>s ys</i>	141396		
40 Frognal L	.ane opding Wall Toe 5mbbl	Drg. Ref.		
Boundary W	all	Made by JC	Date 10-Feb-2021	Checked
Ref. Coo	ordinates Displacements y z x y z	1		
103         11.45830           104         11.75000           105         12.04170           106         12.33330           107         12.62500           108         12.91670           109         13.20830           110         13.50000           2         Data point coincident           6         Data point coincident	(a)         (a)         (a)         (a)         (a)           4.8330         91.00000         0.00000         0.00000         1.2.6           5.8000         91.00000         0.00000         -0.0750         1.2.6           6.7670         91.00000         0.00000         -0.07750         1.2.6           7.3330         91.00000         0.00000         -0.07761         1.2.6           8.70000         91.00000         0.00000         -0.07761         1.2.6           9.6670         91.00000         0.00000         -0.07761         1.2.6           11.6000         91.00000         0.00000         -0.07761         1.2.6           11.6000         91.00000         0.00000         -0.07761         1.2.6           11.6000         91.00000         0.00000         -0.07761         1.2.6           11.6000         91.00000         0.00000         -0.07510         1.2.6           11.6000         91.00000         0.00000         -0.07510         1.2.6           11.6000         91.00000         0.00000         -0.07521         1.2.6           11.6000         91.00000         0.00000         -0.07520         1.2.6           11.6000         91.00000<			
Vertical Ground Mo	vement Curves (Excavations)			
Curve Name: Coordinates:	<pre>Installation of secant bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(b)) [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 (x).(%)] [0.000,0.000,0.050][2.000,0.000] Province in the second se</pre>			
Method: x Order: y Order: Polynomial: z = Coeff. of	FulyHomtal 1 -2.5E-2x + 5.0E-2 1.0			
Determination: Curve Name:	Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(b)			
Curve Site/	<pre>control tow max. excavation depth (y). Settlement / wall depth or max. excavation depth or max. excavation depth (y). Settlement / wall depth or max. excavation depth (z) (%)] [0.000, 0.000, 0.000, 0.039][0.100, 0.000, 0.070][0.600, 0.000, 0.056][0.300, 0.000, 0.062] [0.400, 0.000, 0.037][0.500, 0.000, 0.070][0.600, 0.000, 0.072][0.700, 0.000, 0.073] [0.800, 0.000, 0.055][1.300, 0.000, 0.061][1.400, 0.000, 0.058][1.500, 0.000, 0.058] [1.200, 0.000, 0.053][1.700, 0.000, 0.651][1.400, 0.000, 0.058][1.500, 0.000, 0.638] [2.400, 0.000, 0.530][2.500, 0.000, 0.058][2.200, 0.000, 0.027][2.300, 0.000, 0.638] [2.400, 0.000, 0.420][2.500, 0.000, 0.058][3.000, 0.000, 0.027][2.300, 0.000, 0.623] [2.5200, 0.000, 0.020][2.500, 0.000, 0.08][3.000, 0.000, 0.027][2.500, 0.000, 0.021] [2.5200, 0.000, 0.020][3.500, 0.000, 0.001][3.500, 0.000, 0.021] [3.5000, 0.000, 0.020][3.100, 0.000, 0.002][3.800, 0.000, 0.001][3.500, 0.000, 0.001] [3.5000, 0.000, 0.002][3.700, 0.000, 0.002][3.800, 0.000, 0.001][3.500, 0.000, 0.001] [3.5000, 0.000][3.700, 0.000][3.700, 0.000][3.5000, 0.001][3.500, 0.001][3.500, 0.001][3.5000, 0</pre>			
Curve Fitting Method: x Order: y Order: Polynomial: z = Coeff. of Determination:	Polynomial 4 0 -2.6455E-3x <sup>4</sup> + 2.8495E-2x <sup>3</sup> - 1.0051E-1x <sup>2</sup> + 1.0569E-1x + 3.8990E-2 9.9991E-1			
Horizontal Ground	Movement Curves (Excavations)			
Curve Name: Coordinates:	<pre>Installation of secant bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(a)) [Distance from wall / wall depth or max. excavation depth (x), Depth / wall depth or max. excavation depth (y), Rorizontal movement / wall depth or max. [0.000,0.000,0.031](0.250,0.000,0.076](0.100,0.072](0.150,0.000,0.057] [0.200,0.000,0.053](0.250,0.000,0.059](0.300,0.000,0.052](0.350,0.000,0.052] [0.400,0.000,0.053](0.550,0.000,0.053](0.500,0.000,0.053](0.350,0.000,0.052] [0.400,0.000,0.057](0.550,0.000,0.053](0.500,0.000,0.052][0.750,0.000,0.022] [0.400,0.000,0.057][0.550,0.000,0.054][0.700,0.000,0.022][0.750,0.000,0.023] [1.200,0.000,0.011][1.250,0.000,0.054][1.300,0.000,0.057] [1.400,0.000,0.011][1.250,0.000,0.002][1.500,0.000]</pre>			
Curve Fitting Method: x Order: y Order: Polynomial: z = Coeff. of	Polynomial 0 -1.0610E-2x <sup>3</sup> + 4.4203E-2x <sup>2</sup> - 9.6358E-2x + 8.0901E-2 1.0000			
Curve Name:	Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig.			
Coordinates: Curve Fitting Method: x Order: y Order:	<pre>[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] Polynomial 1 0</pre>			
Polynomial: z = Coeff. of Determination:	-3.75E-2x + 1.50E-1 1.00			
Polygonal Excavati Excavation Name: Surface level [m]	Dool excavation			
Enabled:	Yes Yes			
[m] 1 -4.0000 - 2 2.2000 - 3 2.2000 - 4 -4.0000	$ \begin{array}{c c c c c c c c c c c c c c c c c c c $			
Side Corner (m) 1 -4.0000 - 3 2.2000 4 -4.0000	1         Core 2         Ground Movement Curve           y         x         y         Vertical         Borizontal           [m]         [m] <td></td> <td></td> <td></td>			
Excavation Name: Surface level [m] Contribution: Enabled:	: Secant Pile Wall Installation : 91.000 Positive Yes			

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Job No.	Sheet No.	Rev.
141396		
Drg. Ref.		

40 Frognal Lane Short-term Loading, Wall Toe 5mbbl Boundary Wall

)asvs

Made by
JC

Date 10-Feb-2021

Checked

Image: Second secon											-			
Note of the state of the														
A second sec			Lowol		d n1	n2* d	51	<b>n</b> 2 <b>#</b>						
A series is not in the property in the property is not interval	1 -4	[m] [m] .0000 -11.60	[m] 0 81.500	[ Yes	m] [%] 0.0 50.000	[%] [m 20.000 0	] [%] .0 50.000 :	[%] 20.000						
No. 1       No. 2       No. 2 <th< td=""><td>2 2 3 2 4 -4</td><td>.2000 -11.60 .2000 11.60 .0000 11.60</td><td>0 81.500 0 81.500 0 81.500</td><td>Yes Yes Yes</td><td>0.0 50.000</td><td>0 20.000 0 0 20.000 0 0 20.000 0</td><td>.0 50.000</td><td>20.000 20.000 20.000</td><td></td><td></td><td></td><td></td><td></td></th<>	2 2 3 2 4 -4	.2000 -11.60 .2000 11.60 .0000 11.60	0 81.500 0 81.500 0 81.500	Yes Yes Yes	0.0 50.000	0 20.000 0 0 20.000 0 0 20.000 0	.0 50.000	20.000 20.000 20.000						
	Side	Corner 1	Cor	rner 2			Ground Mo	vement Cur	ve					
	[r 1 -4	<b>k y</b> n] [m] .0000 -11.6	x [m] 00 2.200	<b>y</b> [m] 00 -11.600	Installa	Vertical tion of sec	ant bored	Installa	Horizontal tion of secan	t bored				
	2 2	.2000 -11.6	00 2.200	0 11.600	pile wall 580 Fig.	l in stiff 2.8(b))	clay (CIRI. ant bored	A pile wal 580 Fig. Installa	l in stiff cl 2.8(a)) tion of secan	ay (CIRIA				
<pre>prove from the form the prove from the prove</pre>					pile wall 580 Fig.	l in stiff 2.8(b))	clay (CIRI	A pile wal 580 Fig.	l in stiff cl 2.8(a))	ay (CIRIA				
<pre>1 - 1.00</pre>	3 Z	.2000 11.6	.00 -4.000	JU 11.600	pile wall 580 Fig.	l in stiff 2.8(b))	ant bored clay (CIRI.	A pile wal 580 Fig.	tion of secan l in stiff cl 2.8(a))	ay (CIRIA				
	4 -4	.0000 11.6	00 -4.000	00 -11.600	pile wall	tion of sec l in stiff 2 8(b))	ant bored clay (CIRI	Installa A pile wal 580 Fig	tion of secan l in stiff cl 2 8(a))	t bored ay (CIRIA				
					500 rig.	2.0(2))		500 LLg.	2.0(0))					
	Damage Ca	Name	1 <b>5</b> 0 (Ne	egligible)	1 (Very S	Slight) 2	(Slight)	3 (Mod	erate)					
A contract with the probability of the probabili			1 (Ve	to ery Slight)	to 2 (Slig	ght) 3	to (Moderate)	4 (Se	o vere)					
Bereffectures have decommendations of the second of the se	Surland St	train Limits		0.0	501	J.UUE-6	/50.00E	-6 U	.0015000					
$ \frac{1}{10000000000000000000000000000000000$	Specific St	ructures - Ge	ometry	Dimler			d 17a		Wantinal	Demons Con				
Line Line Wetting         Number Vetting         Number Vetting         Number Vetting         Number Vetting           Normatery Null Normatery N	structure	Name Sub-	Name	Line	ment Si Dia A	tart En stance Dist Long Alo	a ve ance Offs ng Li	rtical ets from ne for	Displacement Limit	Damage Cat	egory Strains	Ratio		
					1	Line Li	ne Ve Mo	rtical vement	Sensitivity					
Purchase been dependent with the second of the seco	Boundary N	Nall Bound	lary Wall	Boundary	Wall 0	[m] [m .00000 24.2	Calc ] 3300	[m] 0.0	[mm] 0.10000	Burland Str	ain Limits	0.20000 2.6000		
Specific curve - B-ondig purpose         Build - Build		Found	lation											
Exact is No.         But but to the problem         Description         Description         Description           Iterations No.         Second 1         Second 1         Second 1         Second 1         Second 1           Second 1         Second 1         Second 1         Second 1         Second 1         Second 1           Second 1         Second 1         Second 1         Second 1         Second 1         Second 1           Second 1         Second 1         Second 1         Second 1         Second 1         Second 1           Second 1         Second 1         Second 1         Second 1         Second 1         Second 1           Second 1         Second 1         Second 1         Second 1         Second 1         Second 1           Second 1         Second 1         Second 1         Second 1         Second 1         Second 1           Second 1         Second 1         Second 1         Second 1         Second 1         Second 1           Second 1         Second 1         Second 1         Second 1         Second 1         Second 1           Second 1         Second 1         Second 1         Second 1	Specific St	ructures - Be	nding Paraı	meters										
of Xee         Score         Yee         Ye	Structure	Name Sub-	Structure Name	Height D Pr	efault operties	and Moment	Hogging Distance	Distance	2nd Moment	Sagging	Distance			
Video         From N. of Res N. wideo         From N. of Res N.         Of Res N.           hundary Nill         Roundardon         12.0000 Ps.         12.664         12.0000         12.0000         12.0000           Building Segment Combinations         Structure No.         Offset East         Segment East Length Curviture Segment         Segment East         Segment Combinations           Structure No.         Offset East         Segment East Length Curviture Segment         Segment Curviture Segment         Segment Curviture Segment         Segment Curviture Segment           offset East         Segment Curviture Segment Curviture Segment         Segment Curviture Segment Curviture Segment         Segment Curviture Segment						of Area (per unit	of Bending Strain	of N.A. from Edge	of Area (per unit	of Bending Strain f	of N.A. rom Edge			
Boundary Wall         Boundary Wall         Code of the second sec				[m]		width)	from N.A.	of Beam i Tension	n width)	from N.A. o	f Beam in Tension			
Standard Segment Combination         Note: The Segment is that Largeh Curves Combined is segment is that Largeh Curves is segment is segment is the segment combined is the segment is the segment combined is the seg	Boundary N	Wall Bound Found	lary Wall lation	2.0000 Ye	s	2.6667	2.0000	2.000	0 0.66667	1.0000	1.0000			
The bit of the bit of the bit	Building S	egment Coml	oinations											
Image of the form of t	Structure	Name Sub-	Structure	Vertica Offset fr	l Segmen	nt Start Le	ngth Curva	ture Combi	ned					
			Traine .	Line fo Vertica	r 1			begine						
No structures have segments combined.       If it is it				Movemen Calculati	it .ons	[m] [	ml							
Special contribution of axial strains : No         Special contribution of axial strains : No </td <td>No struct</td> <td>ires have se</td> <td>gments con</td> <td>mbined.</td> <td></td> <td>[] [</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>	No struct	ires have se	gments con	mbined.		[] [								
in product baneficial contribution of axial strains : NO         XHARDE         i       Subliple excavations are calculated by summing endiplementer resulting from each access are calculated by summing ones of influence or 'shelding' of one excavation by access are calculated by summing ones of influence or 'shelding' of one excavation by access are calculated by summing ones of influence or 'shelding' of one excavation by access are calculated by summing ones of influence or 'shelding' of one excavation by access are calculated by access are calc	Utility Stra	in Calculatior	o Options											
Native secands have been particular the displacements are selected in the displacement are selected in the d	Neglect be	eneficial co	ntributior	n of axial	strains :	No								
Multiple excavations are calculated by summing the displacements resulting from these         excavations are calculated by summing the displacements resulting from excavation by         andivating (e.g. overlapping rows of influence of the interactions between         andivating (e.g. overlapping rows of influence of the interactions between         andivating (e.g. overlapping rows of influence of the interactions between         andivating (e.g. overlapping rows of influence of the interactions between         andivating (e.g. overlapping rows of influence of the interactions between         andivating (e.g. overlapping rows of influence of the interactions between         andivating (e.g. overlapping rows of influence of the interactions         between	Warnings													
None         Source state s	l Mult exca	tiple excava avations are	calculate	e been spec ed by summi	ified. The dis	ne displace splacements	ments resu resulting	lting from from each	these					
Series	exca	avations (e. ther).	g. overlap	oping zones	of influe	ence or 'sh	ielding' o	f one exca	vation by					
Support         Source           State         Source														
None           Sparker           Sparker         Sparker           Sparker         Sparker         Sparker         Sparker         Sparker           Sparker         Sparker         Sparker         Sparker         Sparker           Sparker         Sparker         Sparker         Sparker         Sparker           Sparker         Sparker         Sparker         Sparker           Sparker         Sparker         Sparker         Sparker           Sparker         Sparker         Sparker         Sparker           Sparker         Sparker         Sparker         Sparker           Sparker         Sparker         Sparker           Sparker         Sparker         Sparker           Sparker         Sparker         Sparker           Sparker         Sparker <th colsp<="" td=""><td>Errors</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></th>	<td>Errors</td> <td></td>	Errors												
<th and="" colspace="" product="" star<="" start="" td=""><td>None</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></th>	<td>None</td> <td></td>	None												
type//         toordinate         Disple//         toordinate         Disple//         toordinate         Disple//	Displacem	ent and Strair	n Results											
Name         Dist.         x         y         x         y         x         p         x         horizonal bilalesme bilal	Туре	e/No.	C	Coordinates				Displacem	ents		Angle of Line			
Ling Ling bergendeutlar           Ling Ling [m]	Name	Dist.	x	У	z	x	У	z	Horizontal displacement	Horizontal displacement	to x Axis			
Boundary Mall         Line 1         6.50000         -11.6000         91.0000         -5.5967         0.0         3.922         -1.6167         5.3581         73.210           Mall         1.0097         6.79167         -10.63333         91.0000         -9.1565         0.0         6.7455         -2.6450         8.7662         73.210         *           3.0291         7.37500         -8.70000         91.0000         -8.5916         0.0         6.6437         -2.5627         8.4934         73.210         *           3.0291         7.37500         -8.70333         91.0000         -8.5916         0.0         6.4484         -2.44818         8.2254         73.210         *           5.0485         7.9583         -6.76667         91.0000         -8.1650         0.0         6.2413         -2.4023         7.9620         73.210         *           7.0077         8.5436         -4.8236         91.0000         -7.5186         0.0         5.3433         -2.4713         7.1451         73.210         *           9.0874         9.41667         -1.9333         91.00000         -6.7570         0.0         5.3466         -2.0240         6.7062         73.210         *           10.097		[m]	[m]	[m]	[m]	[ mm ]	[mm]	[mm]	[mm]	to Line	r [°]			
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	Boundary Wall	Line 1	6.50000	-11.60000	91.00000	-5.5967	0.0	3.9822	-1.6167	5.358	1 73.210 *			
		2.0194 3.0291	7.08333	-9.66667 -8.70000	91.00000 91.00000 91.00000	-8.8716	0.0	6.6037 6.4484	-2.5627 -2.4818	8.493 8.225	4 73.210 * 4 73.210 * 4 73.210 *			
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$		4.0388 5.0485 6.0583	7.66667 7.95833 8.25000	-7.73333 -6.76667 -5.80000	91.00000 91.00000	-8.3165 -8.0460 -7.7800	0.0	6.2819 6.1063 5.9234	-2.4023 -2.3242 -2.2473	7.962 7.703 7.448	0 73.210 * 0 73.210 * 3 73.210 *			
9.0874 9.12500 -2.90000 91.00000 -7.0069 0.0 5.3466 -2.0240 6.7082 73.210 * 10.097 9.41667 -1.9333 91.00000 -6.570 0.0 5.1494 -1.9518 6.4669 73.210 * 11.107 9.70833 -0.96667 91.00000 -6.2677 0.0 4.7532 -1.8807 6.2331 73.210 * 12.117 10.0000 0.0000 91.00000 -6.2677 0.0 4.7532 -1.8105 6.0005 73.210 * 14.136 10.29167 0.96667 91.00000 -6.0280 0.0 4.5560 -1.7413 5.7710 73.210 * 14.136 10.85333 1.9333 91.00000 -5.5576 0.0 4.1668 -1.6054 5.3207 73.210 * 15.146 10.87500 2.90000 91.00000 -5.5576 0.0 3.9760 -1.5386 5.0995 73.210 * 15.156 11.45833 4.8333 91.0000 -5.0980 0.0 3.9760 -1.5386 5.0995 73.210 * 15.1651 11.45833 4.8333 91.0000 -5.0980 0.0 3.8785 -1.4726 4.8807 73.210 * 15.146 10.87500 91.00000 -4.64719 0.0 3.6046 -1.4073 4.6642 73.210 * 19.184 12.04167 6.76667 91.00000 -4.6479 0.0 3.2429 -1.3426 4.4498 73.210 * 20.194 12.03333 7.7333 91.00000 -4.258 0.0 3.0796 -1.2149 4.0265 73.210 * 21.204 12.62508 8.70000 91.00000 -4.2058 0.0 3.0796 -1.2149 4.0265 73.210 *		7.0680	8.54167 8.83333	-4.83333 -3.86667	91.00000 91.00000	-7.5182	0.0	5.7349	-2.1717 -2.0973	7.197 6.951	7 73.210 * 1 73.210 *			
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$		9.0874 10.097 11.107	9.12500 9.41667 9.70833	-2.90000 -1.93333 -0.96667	91.00000 91.00000 91.00000	-7.0069 -6.7570 -6.5106	0.0	5.3466 5.1494 4.9513	-2.0240 -1.9518 -1.8807	6.708 6.468 6.233	2 73.210 * 9 73.210 * 1 73.210 *			
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		12.117	10.00000	0.00000	91.00000 91.00000	-6.2677	0.0	4.7532	-1.8105	6.000	5 73.210 * 0 73.210 *			
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$		14.136 15.146 16.155	10.58333	2.90000 3.86667	91.00000 91.00000	-5.7913 -5.5576 -5.3265	0.0	4.1668 3.9760	-1.6054 -1.5386	5.544 5.320 5.099	7 73.210 * 5 73.210 *			
20.194         12.3333         7.7333         91.0000         -4.4259         0.0         3.2498         -1.2785         4.2373         73.210         *           21.204         12.62500         8.70000         91.00000         -4.2058         0.0         3.0796         -1.2745         4.0255         73.210         *           22.214         12.62500         8.70000         91.00000         -4.2058         0.0         2.0796         -1.2149         4.0265         73.210         *           22.214         12.91667         9.6667         91.00000         -3.9874         0.0         2.9145         -1.1518         3.8174         73.210         *           23.223         13.20833         10.63333         91.00000         -3.7704         0.0         2.7548         -1.0891         3.6097         73.210         *		17.165 18.175 19.184	11.45833 11.75000 12.04167	4.83333 5.80000 6.76667	91.00000 91.00000 91.00000	-5.0980 -4.8719 -4.6479	0.0	3.7885 3.6046	-1.4726 -1.4073 -1.3426	4.880 4.664	7 73.210 * 2 73.210 * 8 73.210 *			
22.214 12.91667 9.66667 91.00000 -3.9874 0.0 2.9145 -1.1518 3.8174 73.210 * 23.223 13.20833 10.63333 91.00000 -3.7704 0.0 2.7548 -1.0891 3.6097 73.210 *		20.194 21.204	12.33333 12.62500	7.73333	91.00000	-4.4259	0.0	3.2498	-1.2785	4.237	3 73.210 * 5 73.210 *			
		22.214 23.223	12.91667 13.20833	9.66667 10.63333	91.00000 91.00000	-3.9874 -3.7704	0.0	2.9145 2.7548	-1.1518 -1.0891	3.817 3.609	4 73.210 * 7 73.210 *			

$\frown$	FAIRHURS	т		Job No.	Sheet No.	Rev.
Oasys				141396		
40 Frognal Lane				Drg. Ref.		
Short-term Loading, Wall Toe Boundary Wall	9 SMDDI			Made by	Date	Checked
Type/No. Coordinates		Displacements	Ang	JC le of	10-Feb-2021	
Name Dist. x y	z x y	z Horizor displace	ntal Horizontal to ement displacement	x Axis		
* Result includes imported displacement(s).	91.00000 -2.2045	0.0 1.3910 -0.6	2.1103	73.210 -		
Specific Building Damage Results - Horizontal	Displacements					
Structure: Boundary Wall   Sub-structure: Dist. Coordinates x y z x	Boundary Wall Foundation Displacements y Horizontal Hori displacement displ along the perpe	zontal acement ndicular				
[m] [m] [m] [m] [m] [mm] 0.0 6.50000 -11.60000 91.00000 -5.596	Line to [mm] [mm] [ 7 0.0 -1.6167	Line mm] 5.3581 d				
1.0097 6.79167 -10.63333 91.00000 -9.156 2.0194 7.08333 -9.66667 91.00000 -8.871 3.0291 7.37500 -8.70000 91.00000 -8.591	5 0.0 -2.6450 6 0.0 -2.5627 6 0.0 -2.4818	8.7662 d 8.4934 d 8.2254 d				
4.0388 7.66667 -7.73333 91.00000 -8.316 5.0485 7.95833 -6.76667 91.00000 -8.046 6.0583 8.25000 -5.80000 91.00000 -7.780	5 0.0 -2.4023 0 0.0 -2.3242 0 0.0 -2.2473	7.9620 d 7.7030 d 7.4483 d				
7.0680 8.54167 -4.83333 91.00000 -7.518 8.0777 8.83333 -3.86667 91.00000 -7.260 9.0874 9.12500 -2.90000 91.00000 -7.006	2 0.0 -2.1717 6 0.0 -2.0973 9 0.0 -2.0240	7.1977 d 6.9511 d 6.7082 d				
10.097 9.41667 -1.93333 91.00000 -6.757 11.107 9.70833 -0.96667 91.00000 -6.510 12.117 10.00000 0.00000 91.00000 -6.267	0 0.0 -1.9518 6 0.0 -1.8807 7 0.0 -1.8105	6.4689 d 6.2331 d 6.0005 d				
13.126 10.29167 0.96667 91.00000 -6.028 14.136 10.58333 1.93333 91.00000 -5.791 15.146 10.87500 2.90000 91.00000 -5.557	0 0.0 -1.7413 3 0.0 -1.6729 6 0.0 -1.6054	5.7710 d 5.5444 d 5.3207 d				
16.155 11.16667 3.86667 91.00000 -5.326 17.165 11.45833 4.83333 91.00000 -5.098 18.175 11.75000 5.80000 91.00000 -4.871	5 0.0 -1.5386 0 0.0 -1.4726 9 0.0 -1.4073	5.0995 d 4.8807 d 4.6642 d				
19.184 12.04167 6.76667 91.00000 -4.647 20.194 12.33333 7.73333 91.00000 -4.425 21.204 12.62500 8.70000 91.00000 -4.205	9 0.0 -1.3426 9 0.0 -1.2785 8 0.0 -1.2149	4.4498 d 4.2373 d 4.0265 d				
22.214 12.91667 9.66667 91.00000 -3.987 23.223 13.20833 10.63333 91.00000 -3.770 24.233 13.50000 11.60000 91.00000 -2.204	4 0.0 -1.1518 4 0.0 -1.0891 5 0.0 -0.63679	3.8174 d 3.6097 d 2.1105 d				
d - Displacements include imported displa	cements.					
Structure: Boundary Wall   Sub-structure:	Boundary Wall Foundation					
Dist.         Coordinates         Di           x         y         z         z           [m]         [m]         [m]         [m]         [m]	splacements					
Vertical Offset 1 0.0 6.50000 -11.60000 91.00000 3.9822 1.0097 6.79167 -10.63333 91.00000 6.7455	d d					
2.0194 7.08333 -9.66667 91.00000 6.6037 3.0291 7.37500 -8.70000 91.00000 6.4484 4.0388 7.66667 -7.73333 91.00000 6.2819	d d					
5.0485 7.95833 -6.76667 91.00000 6.1063 6.0583 8.25000 -5.80000 91.00000 5.9234 7.0680 8.54167 -4.83333 91.00000 5.7349	d d					
8.0777 8.83333 -3.86667 91.00000 5.5423 9.0874 9.12500 -2.90000 91.00000 5.3466 10.097 9.41667 -1.93333 91.00000 5.1494	d d d					
11.107 9.70833 -0.96667 91.00000 4.9513 12.117 10.00000 0.00000 91.00000 4.7532 13.126 10.29167 0.96667 91.00000 4.5560	d d					
14.136 10.58333 1.93333 91.00000 4.3603 15.146 10.87500 2.90000 91.00000 4.1668 16.155 11.16667 3.86667 91.00000 3.9760	d d d					
17.165 11.45833 4.83333 91.00000 3.7885 18.175 11.75000 5.80000 91.00000 3.6046 19.184 12.04167 6.76667 91.00000 3.4249	d d d					
20.194 12.33333 7.73333 91.00000 3.2498 21.204 12.62500 8.70000 91.00000 3.0796 22.214 12.91667 9.66667 91.00000 2.9145	d d d					
23.223 13.20833 10.63333 91.00000 2.7548 24.233 13.50000 11.60000 91.00000 1.3910 d - Displacements include imported displa	d d cements.					
Specific Building Damage Results - All Segmen	ts					
Structure: Boundary Wall   Sub-structure:	Boundary Wall Foundation					
Vertical Offset Segment Start Le from Line for Vertical Movement Calculations	ngth Curvature Deflection Ratio	Average Max M Horizontal Tensile Strain Strain I	Max Gradient Max Gradie of of Vertica Horizontal Displaceme Displacement Curve Curve	nt Min Damage 1 Radius of Category nt Curvature		
[m] [m] [ 0.0 1 0.0 11	m] [%] .074 Sagging 0.024104	[%] [%] -0.0024053 0.020767	0.0010194 -0.00273	[m] 95 280.63 0 (Negligible)		
2 11.074 10 3 21.221 3.	.148 Hogging 395.39E-6 0119 Sagging 0.026349	0.0065945 0.0071768	-70.472E-6 196.18E -447.78E-6 0.00135	-6 198940. 0 (Negligible) 00 677.24 1 (Very		
Tensile horizontal strains are +ve, compr	essive horizontal strains	are -ve.		Slight)		
Specific Building Damage Results - Critical Val	ues for All Segments within E	ach Sub-Structure				
Structure: Boundary Wall   Sub-structure:	Boundary Wall Foundation					
Vertical Deflection Average Max Sl Offset from Ratio Horizontal	ope Max Max Settlement Tensile	Max Gradient Max Gradie of of Vertica	ent Min Min al Radius of Radius of	Damage Category		
Line for Strain Vertical Movement	Strain	Horizontal Displaceme Displacement Curve Curve	ent Curvature Curvature (Hogging) (Sagging)	•		
Calculations           [m]         [%]         [%]           0.0         0.026349         0.019158         -0.002	[mm] [%] 7395 6.7400 0.057758	0.0010194 -0.00273	[m] [m] 395 198940. 280.63	1 (Very Slight)		
Specific Building Damage Results - Critical Seg	ments within Each Structure					
Structure Name Parameter Critic Sub-Struc	al Critical Start E cture Segment	nd Curvature Max Slop	pe Max Max Settlement Tensile	Min Min Dama Radius of Radius of	ge Category	
	[m] [	ml	Strain	Curvature Curvature (Hogging) (Sagging)		
Boundary Wall Max Slope Boundary Foundatio	Wall 1 0.0 11 n Wall 1 0.0 11	.074 Sagging 0.002739	95 6.7400 0.02076	- 280.63 0 (Neglig	ible)	

Oasys 40 Frognal Lane								Job No. 1413	96	Sheet No.	F	ev.	
Short-term Boundary V	Loading, V Vall	Vall Toe 5m	ıbbl						Made by JC		Date 10-Feb-2021	Che	cked
Structure Name	Parameter	Critical Sub-Structure	Critical Start Segment	End Curvatur	e Max Slope	Max Settlement	Max Tensile Strain	Min Radius Curvata (Hoggin	Min of Radius of ure Curvature ng) (Sagging)	Damage Cateo	lory		
	Max Tensile Strain	Foundation Boundary Wall Foundation	3 21.221	24.233 Sagging	0.0013500	3.0767	0.057758		- 677.24	l (Very Slight)			
	Min Radius of Curvature (Hogging)	Boundary Wall Foundation	2 11.074	21.221 Hogging	196.18E-6	4.9578	0.0071768	1989	40. –	0 (Negligible)			
	Min Radius of Curvature (Sagging)	Boundary Wall Foundation	1 0.0	11.074 Sagging	0.0027395	6.7400	0.020767		- 280.63	0 (Negligible)			

### FAIRHURST Jasys 40 Frognal Lane Long-term Loading (Wall Toe 5mbbl) Boundary Wall

Job No.	Sheet No.	Rev.
141396		
Drg. Ref.		
Made by JC	Date 10-Feb-2021	Checked

#### Problem Type

Problem Type : Tunnelling and Embedded Wall Excavations

#### Displacement Data

Туре	Name	Direction of extrusion		Point/Line/Line for extrusion		No. of intervals across extrusion/line	Extrusion depth	No. of intervals along extrusion	Calculate	Surface type for tunnels			
			F	First poin	t	S	econd poi	nt					
			х	Y	Z(level)	х	Y	Z(level)					
			[m]	[m]	[m]	[m]	[m]	[m]		[m]			
Line	Boundary Wall	-	6.50000	-11.60000	91.00000	13.50000	11.60000	91.00000	24		-	Yes	Surface

Imported Displacements The following data points and displacements were found in the import file Pdisp Long term Loading to be Imported.csv.

Ref.	C	ordinates		Di	splaceme	nts	
	x	y	z	x	у	z	
1	[m]	[m]	[m]	[mm]	[mm]	[mm]	
2	-7.50000	1.00000	91.50000	0.00000	0.00000	0.85840	
3	-7.50000	2.00000	91.50000	0.00000	0.00000	0.85260	
4	-7.50000	3.00000	91.50000	0.00000	0.00000	0.84250	
6	-7.50000	5.00000	91.50000	0.00000	0.00000	0.80660	
7	-7.50000	6.00000	91.50000	0.00000	0.00000	0.77880	
8	-7.50000	7.00000	91.50000	0.00000	0.00000	0.74270	
10	-7.50000	9.00000	91.50000	0.00000	0.00000	0.64020	
11	-7.50000	10.00000	91.50000	0.00000	0.00000	0.57280	
12	-7.50000	11.00000	91.50000	0.00000	0.00000	0.49670	
14	-7.50000	13.00000	91.50000	0.00000	0.00000	0.33950	
15	-7.50000	14.00000	91.50000	0.00000	0.00000	0.26980	
16	-7.50000	15.00000	91.50000	0.00000	0.00000	0.21050	
18	-8.42730	0.00000	91.50000	0.00000	0.00000	0.64620	
19	-9.35450	0.00000	91.50000	0.00000	0.00000	0.48830	
20	-10.28180	0.00000	91.50000	0.00000	0.00000	0.37000	
21	-12.13640	0.00000	91.50000	0.00000	0.00000	0.21260	
23	-13.06360	0.00000	91.50000	0.00000	0.00000	0.16070	
24	-13.99090	0.00000	91.50000	0.00000	0.00000	0.12090	
25	-15.84550	0.00000	91.50000	0.00000	0.00000	0.06700	
27	-16.77270	0.00000	91.50000	0.00000	0.00000	0.04900	
28	-17.70000	0.00000	91.50000	0.00000	0.00000	0.03510	
30	-8.42730	15.00000	91.50000	0.00000	0.00000	0.16900	
31	-9.35450	15.00000	91.50000	0.00000	0.00000	0.13430	
32	-10.28180	15.00000	91.50000	0.00000	0.00000	0.10570	
33	-12 13640	15.00000	91.50000	0.00000	0.00000	0.08240	
35	-13.06360	15.00000	91.50000	0.00000	0.00000	0.04830	
36	-13.99090	15.00000	91.50000	0.00000	0.00000	0.03610	
38	-15.84550	15.00000	91.50000	0.00000	0.00000	0.01870	
39	-16.77270	15.00000	91.50000	0.00000	0.00000	0.01250	
40	-17.70000	15.00000	91.50000	0.00000	0.00000	0.00770	
41	10.00000	-11.60000	90.00000	0.00000	0.00000	0.12510	
43	10.33330	-9.66670	90.00000	0.00000	0.00000	0.14240	
44	10.50000	-8.70000	90.00000	0.00000	0.00000	0.14810	
45	10.66670	-7.73330	90.00000	0.00000	0.00000	0.15170	
40	11.00000	-5.80000	90.00000	0.00000	0.00000	0.15350	
48	11.16670	-4.83330	90.00000	0.00000	0.00000	0.15190	
49	11.33330	-3.86670	90.00000	0.00000	0.00000	0.14910	
51	11.66670	-1.93330	90.00000	0.00000	0.00000	0.14020	
52	11.83330	-0.96670	90.00000	0.00000	0.00000	0.13460	
53	12.00000	-11 60000	90.00000	0.00000	0.00000	0.12830	
55	11.00000	-11.60000	90.00000	0.00000	0.00000	0.09250	
56	12.00000	-11.60000	90.00000	0.00000	0.00000	0.06780	
57	14 00000	-11.60000	90.00000	0.00000	0.00000	0.04900	
59	15.00000	-11.60000	90.00000	0.00000	0.00000	0.02390	
60	16.00000	-11.60000	90.00000	0.00000	0.00000	0.01570	
61	17.00000	-11.60000	90.00000	0.00000	0.00000	0.00940	
63	19.00000	-11.60000	90.00000	0.00000	0.00000	0.00110	
64	20.00000	-11.60000	90.00000	0.00000	0.00000	-0.00150	
65	21.00000	-11.60000	90.00000	0.00000	0.00000	-0.00350	
67	23.00000	-11.60000	90.00000	0.00000	0.00000	-0.00600	
68	24.00000	-11.60000	90.00000	0.00000	0.00000	-0.00670	
69	25.00000	-11.60000	90.00000	0.00000	0.00000	-0.00710	
71	13.00000	0.00000	90.00000	0.00000	0.00000	0.09390	
72	14.00000	0.00000	90.00000	0.00000	0.00000	0.06800	
73	15.00000	0.00000	90.00000	0.00000	0.00000	0.04850	
75	17.00000	0.00000	90.00000	0.00000	0.00000	0.02270	
76	18.00000	0.00000	90.00000	0.00000	0.00000	0.01440	
77	19.00000	0.00000	90.00000	0.00000	0.00000	0.00810	
79	21.00000	0.00000	90.00000	0.00000	0.00000	0.00000	
80	22.00000	0.00000	90.00000	0.00000	0.00000	-0.00250	
81	23.00000	0.00000	90.00000	0.00000	0.00000	-0.00440	
83	25.00000	0.00000	90.00000	0.00000	0.00000	-0.00660	
84	26.00000	0.00000	90.00000	0.00000	0.00000	-0.00720	
85	27.00000	0.00000	90.00000	0.00000	0.00000	-0.00760	1.0.0
86	6.50000	-11.60000	91.00000	0.00000	0.00000	0.35240	1,2,6
88	7.08330	-9.66670	91.00000	0.00000	0.00000	0.38390	1.2.6
89	7.37500	-8.70000	91.00000	0.00000	0.00000	0.38570	1,2,6
90	7.66670	-7.73330	91.00000	0.00000	0.00000	0.38030	1,2,6
91	7.95830	-6.76670	91.00000	0.00000	0.00000	0.36940	1,2,6
92	8.25000	-5.80000	91.00000	0.00000	0.00000	0.33700	1,2,6
94	8.83330	-3.86670	91.00000	0.00000	0.00000	0.31770	1,2,6
95	9.12500	-2.90000	91.00000	0.00000	0.00000	0.29740	1,2,6
96	9.41670	-1.93330	91.00000	0.00000	0.00000	0.27670	1,2,6
97	9.70830	-0.96670	91.00000	0.00000	0.00000	0.25580	1,2,6
90	10.29170	0.96670	91.00000	0.00000	0.00000	0.23520	1,2,6
100	10.58330	1.93330	91.00000	0.00000	0.00000	0.19490	1,2,6
101	10.87500	2.90000	91.00000	0.00000	0.00000	0.17560	1,2,6
102	11.16670	3.86670	91.00000	0.00000	0.00000	0.15690	1,2,6

FAIRHURST	Job No.	Sheet No.	Rev.
Oasys	141396		
40 Frognal Lane	Drg. Ref.		
Boundary Wall	Made by JC	Date 10-Feb-2021	Checked
Ref. Coordinates Displacements x y z x y z (a) (b) (c) (c) (c) (c)	1		
(m)         (m)         (m)         (ma)         (ma)           103         11.45830         4.83330         91.00000         0.00000         0.13890         1,2,6           104         11.7500         5.8000         91.00000         0.00000         0.12170         1,2,6           105         12.04170         6.76670         91.00000         0.00000         0.12170         1,2,6           106         12.3330         7.73330         91.00000         0.00000         0.00020         1,2,6           107         12.62500         8.70000         91.00000         0.00000         0.00020         1,2,6           108         12.91670         9.66670         91.00000         0.00000         0.00100         1,2,6           108         12.91670         9.66670         91.00000         0.00000         0.05170         1,2,6           109         13.50000         11.6000         91.00000         0.00000         0.01710         1,2,6           110         13.50000         11.60000         91.00000         0.00000         0.00100         0.00000         0.01410         1,2,6           1         12.5010         11.60000         91.00000         0.00000         0.00112,6			
Vertical Ground Movement Curves (Excavations)			
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) (%)] [0.000,0.000,0.005][2.000,0.000,0.000] Curve Fitting Polynomial Method:			
x Order: 1 y Order: 0 Polynomial: z = -2.5E-2x + 5.0E-2 Coeff. of 1.0 Determination:			
Curve Name: Excavation in front of high stiffness wall in stiff clay (CRIRA 580 Fig. 2.11(b) Coordinates: [Distance from wall / wall depth or max. excavation depth (y), Settlement / wall depth or max. excavation			
Curve Fitting Method: Curve Fitting Method: x Order: y Order: 0 -26455E-3x <sup>4</sup> + 2.8495E-2x <sup>3</sup> - 1.0051E-1x <sup>2</sup> + 1.0569E-1x + 3.8990E-2 Coeff. of 9.9991E-1 0.2007,0.0007,0.033 [C -2007,0.0007,0.0007,0.0007,0.0007,0.007,0.0007			
Horizontal Ground Movement Curves (Excavations)			
Curve Name:         Installation of secant bored pile wall in stiff clay (CIRTS 500 Fig. 2.8(a))           Coordinates:         [Distance from wall / wall depth or max. excavation depth (x), Depth / wall depth or max. excavation depth (y), Borizontal movement / wall depth or max. excavation depth (z) (b)           [0.000,0.000,0.0081](0.050,0.000,0.076](0.100,0.000,0.056](0.150,0.000,0.067)         [0.000,0.000,0.0081](0.050,0.000,0.076](0.300,0.000,0.056](0.350,0.000,0.062)           [0.400,0.000,0.003][0.650,0.000,0.005](0.500,0.000,0.052](0.750,0.000,0.029)         [0.600,0.000,0.031][0.650,0.000,0.021](0.700,0.000,0.012](0.750,0.000,0.029)           [0.600,0.000,0.018][1.050,0.000,0.021][1.1000,0.000,0.014][1.150,0.000,0.021]         [1.200,0.000,0.018][1.50,0.000,0.021][1.300,0.000,0.012]           [1.000,0.000,0.018][1.050,0.000,0.000]         [1.200,0.000,0.001][1.250,0.000,0.012]         [1.200,0.000,0.001][1.250,0.000,0.012]           [1.200,0.000,0.004][1.450,0.000,0.002][1.300,0.000,0.001][1.350,0.000,0.005]         [1.200,0.000,0.004][1.450,0.000,0.002][1.500,0.000,0.000]           Curve Fitting         Polynomial         Polynomial         Polynomial           x Order:         3         0         0           y Order:         0         0         0           Polynomial:         = -1.0610E-2x <sup>3</sup> + 4.4203E-2x <sup>2</sup> - 9.6358E-2x + 8.0901E-2         1.0000			
Curve Name:         Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.1(a)           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) (%)] [0.000,0.000,0.105] [4.000,0.000]			
Curve Fitting Polynomial Method: x Order: 1 y Order: 0 Polynomial: z = -3.75E-2x + 1.50E-1 Coeff. of 1.00 Determination:			
Polygonal Excavations			
Excavation Name:         Pool excavation           Surface level [m]:         91.000           Contribution:         Positive           Enabled:         Yes			
Corner         x         y         Base         Stiffend         Previous         Side         Next Side           Image:			
1 -4.0000 -11.600       2.2000 -11.600 Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(b)       stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(b)         2 2.2000 -11.600       2.2000 11.600 Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(b)       Excavation in front of high (CIRIA 580 Fig. 2.11(a))         3 2.2000 11.600 -4.0000       11.600 Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(b)       (CIRIA 580 Fig. 2.11(a))         4 -4.0000 11.600 -4.0000 -11.600 Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(b)       stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(a))			
Excavation Name:     Secant Pile Wall Installation       Surface level [m]:     91.000       Contribution:     Positive       Enabled:     Yes       Corner x     y       Base Stiffened     Previous Side			

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Job No.	Sheet No.	Rev.
141396		
Drg. Ref.		
Made by	Date	Checked

Made by JC

Date 10-Feb-2021

**Boundary Wall** 
 Level
 d
 p1
 p2\*
 d
 p1
 p2\*

 [m]
 [m]
 [m]
 [m]
 [m]
 [m]
 [m]
 [m]
 [m]
 [s]
 [m]
 [m]

Corner 2

Long-term Loading (Wall Toe 5mbbl)

asys

40 Frognal Lane

3 2.2000	11.600 81.500	Yes	0.0 50.000 20.00	0.0 50.000 20.000
4 -4.0000	11.600 81.500	Yes	0.0 50.000 20.00	0 0.0 50.000 20.000

Ground Movement Curve Vertical Horizontal

Side	Corne	r 1	Corne	r 2	Ground Move	ement Curve
	x	У	x	У	Vertical	Horizontal
	[m]	[m]	[m]	[m]		
1	-4.0000	-11.600	2.2000	-11.600	Installation of secant bored	Installation of secant bored
					pile wall in stiff clay (CIRIA	pile wall in stiff clay (CIRIA
					580 Fig. 2.8(b))	580 Fig. 2.8(a))
2	2.2000	-11.600	2.2000	11.600	Installation of secant bored	Installation of secant bored
					pile wall in stiff clay (CIRIA	pile wall in stiff clay (CIRIA
					580 Fig. 2.8(b))	580 Fig. 2.8(a))
3	2.2000	11.600	-4.0000	11.600	Installation of secant bored	Installation of secant bored
					pile wall in stiff clay (CIRIA	pile wall in stiff clay (CIRIA
					580 Fig. 2.8(b))	580 Fig. 2.8(a))
4	-4.0000	11.600	-4.0000	-11.600	Installation of secant bored	Installation of secant bored
					pile wall in stiff clay (CIRIA	pile wall in stiff clay (CIRIA
					580 Fig. 2.8(b))	580 Fig. 2.8(a))

#### Damage Category Strains

Corner 1

Side

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

#### Specific Structures - Geometry

Structure Name	Sub-Structure Name	Displacement Line	Start Distance Along Line	End Distance Along Line	Vertical Offsets from Line for Vertical Movement Calculations	Vertical Displacement Limit Sensitivity	Damage	Category	Strains	Poisson's Ratio	E/G
Boundary Wall	Boundary Wall Foundation	Boundary Wall	[m] 0.00000	[m] 24.23300	[m] 0.0	[mm] 0.10000	Burland	Strain L	imits	0.20000	2.6000

#### Specific Structures - Bending Parameters

Structure Name	Sub-Structure Name	Height	Default Properties		Hogging		Sagging				
				2nd Moment of Area (per unit width)	Distance of Bending Strain from N.A.	Distance of N.A. from Edge of Beam in	2nd Moment of Area (per unit width)	Distance of Bending Strain from N.A.	Distance g of N.A. from Edge of Beam in		
						Tension			Tension		
		[m]		[m <sup>3</sup> ]	[m]	[m]	[m <sup>3</sup> ]	[m]	[m]		
Boundary Wall	Boundary Wall	2.0000	Yes	2.6667	2.0000	2.0000	0.66667	1.0000	1.0000		

#### **Building Segment Combinations**

Str	ucture	Name	e Si	ub-Structu	ure Vertica	al Segment	Start	Length	Curvature	Combined
				Name	Offset fr	rom				Segment
					Line fo	or				
					Vertica	al				
					Movemen	nt				
					Calculati	ions				
					[m]		[m]	[m]		
No :	structu	ires	have	segments	combined.					

#### Utility Strain Calculation Options

Neglect beneficial contribution of axial strains : No

#### Warnings

Multiple excavations have been specified. The displacements resulting from these excavations are calculated by summing the displacements resulting from each individual excavation. No account has been taken of the interactions between excavations (e.g. overlapping zones of influence or 'shielding' of one excavation by another).

#### Errors

None

#### Displacement and Strain Results

Туре	/No.	c	Coordinates				Displacen	nents		Angle of Line	
Name	Dist.	x	У	z	x	У	z	Horizontal displacement along Line	Horizontal displacement perpendicular to Line	to x Axis	
	[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[ mm ]	[ mm ]	[°]	
Boundary Wall	Line 1	6.50000	-11.60000	91.00000	-5.5967	0.0	4.3266	-1.6167	5.3581	73.210	*
	1.0097	6.79167	-10.63333	91.00000	-9.1565	0.0	7.1070	-2.6450	8.7662	73.210	*
	2.0194	7.08333	-9.66667	91.00000	-8.8716	0.0	6.9764	-2.5627	8.4934	73.210	*
	3.0291	7.37500	-8.70000	91.00000	-8.5916	0.0	6.8267	-2.4818	8.2254	73.210	*
	4.0388	7.66667	-7.73333	91.00000	-8.3165	0.0	6.6610	-2.4023	7.9620	73.210	*
	5.0485	7.95833	-6.76667	91.00000	-8.0460	0.0	6.4822	-2.3242	7.7030	73.210	*
	6.0583	8.25000	-5.80000	91.00000	-7.7800	0.0	6.2931	-2.2473	7.4483	73.210	*
	7.0680	8.54167	-4.83333	91.00000	-7.5182	0.0	6.0958	-2.1717	7.1977	73.210	*
	8.0777	8.83333	-3.86667	91.00000	-7.2606	0.0	5.8924	-2.0973	6.9511	73.210	*
	9.0874	9.12500	-2.90000	91.00000	-7.0069	0.0	5.6845	-2.0240	6.7082	73.210	*
	10.097	9.41667	-1.93333	91.00000	-6.7570	0.0	5.4739	-1.9518	6.4689	73.210	*
	11.107	9.70833	-0.96667	91.00000	-6.5106	0.0	5.2614	-1.8807	6.2331	73.210	*
	12.117	10.00000	0.00000	91.00000	-6.2677	0.0	5.0484	-1.8105	6.0005	73.210	*
	13.126	10.29167	0.96667	91.00000	-6.0280	0.0	4.8356	-1.7413	5.7710	73.210	*
	14.136	10.58333	1.93333	91.00000	-5.7913	0.0	4.6240	-1.6729	5.5444	73.210	*
	15.146	10.87500	2.90000	91.00000	-5.5576	0.0	4.4144	-1.6054	5.3207	73.210	*
	16.155	11.16667	3.86667	91.00000	-5.3265	0.0	4.2074	-1.5386	5.0995	73.210	*
	17.165	11.45833	4.83333	91.00000	-5.0980	0.0	4.0037	-1.4726	4.8807	73.210	*
	18.175	11.75000	5.80000	91.00000	-4.8719	0.0	3.8038	-1.4073	4.6642	73.210	*
	19.184	12.04167	6.76667	91.00000	-4.6479	0.0	3.6085	-1.3426	4.4498	73.210	*
	20.194	12.33333	7.73333	91.00000	-4.4259	0.0	3.4181	-1.2785	4.2373	73.210	*
	21.204	12.62500	8.70000	91.00000	-4.2058	0.0	3.2333	-1.2149	4.0265	73.210	*
	22.214	12.91667	9.66667	91.00000	-3.9874	0.0	3.0543	-1.1518	3.8174	73.210	*
	23.223	13.20833	10.63333	91.00000	-3.7704	0.0	2.8816	-1.0891	3.6097	73.210	*

FAIRHURST	Job No.	Sheet No. F	Rev.
Oasys	141396		
40 Frognal Lane	Drg. Ref.		
Boundary Wall	Made by Da JC 10	ite Cheo -Feb-2021	cked
Type/No.     Coordinates     Displacements     Angle of Line       Name     Dist.     x     y     z     x     y     z     Kordinates       24.233     13.50000     11.60000     91.00000     -2.2045     0.0     1.5056     -0.63679     2.1105     73.21       * Result includes imported displacement(s).	s 0 *		
Specific Building Damage Results - Horizontal Displacements			
Structure: Boundary Wall   Sub-structure: Boundary Wall   Foundation Dist. Coordinates Displacements x y z x y Horizontal Horizontal displacement displacement along the perpendicular [m] [m] [mm] [mm] [mm] [mm]			
$\begin{array}{cccccccccccccccccccccccccccccccccccc$			
Specific Building Damage Results - Vertical Displacements			
Structure: Boundary Wall   Sub-structure: Boundary Wall Foundation			
Dist.         Coordinates         Displacements           x         y         z			
Vertical Offset 1         0.000         6.5000         11.60000         91.00000         4.3266         4           1.0037         6.79157         11.60000         91.00000         4.3266         4           2.0031         7.73530         92.6667         91.0000         6.2974         4           2.0031         7.73530         92.6667         91.0000         6.2974         4           4.0383         7.6667         91.0000         6.2827         4           5.0485         7.95833         -6.76667         91.0000         6.2821           6.0583         6.5100         91.0000         6.2984         4           7.0680         8.54167         -4.8333         91.0000         6.2981 d           7.0780         8.333         -9.86667         91.0000         5.845 d           9.0874         9.12500         -2.9000         91.0000         5.484 d           13.126         10.29167         0.96667         91.0000         5.484 d           13.126         10.29167         0.96667         91.0000         4.634 d           13.126         10.29167         0.96667         91.0000         4.634 d           15.146         10.87500         2.90000			
Specific Building Damage Results - All Segments			
Structure: Boundary Wall   Sub-structure: Boundary Wall Foundation			
Vertical Offset from Line for Vertical Movement         Start         Length Curvature         Deflection         Average Ratio         Max         Gradient         Max Gradient           Movement         Form Jine Movement         Form Jine Movement         Form Jine Movement         Form Jine Movement         Form Jine Movement         Form Jine Movement         Displacement         Curve           [m] 0.0         [m] 0.0         [m] 0.0         [m] 0.0         [m] 0.0         [m] 0.0         [m] 0.0         [m] 0.0         [m] 0.022856         [m] 0.022856         [m] 0.019062         0.0010194         -0.0027565           2         2         11.816         9.4079         Hogging         403.555-6         0.006560         0.007169         -69.497E-6         210.92E-6           3         2         2.24         3.0094         Sagging         0.026310         0.019169         0.057704         -447.78E-6         0.0013621	Min Damage dius of Category rvature [m] 0 (Negligible) 677.59 1 (Very		
Tensile horizontal strains are +ve, compressive horizontal strains are -ve.	Slight)		
Specific Building Damage Results - Critical Values for All Segments within Each Sub-Structure			
Structure: Boundary Wall   Sub-structure: Boundary Wall Foundation			
Vertical Offset from Vertical         Deflection Ratio         Average Horizontal         Max Settlement         Max Tensile         Max Settlement         Max Tensile         Max Offset Tensile         Max Offset Settlement         Max Tensile         Max Offset Settlement         Max Tensile         Max Offset Settlement         Max Tensile         Max Offset Settlement         Max Tensile         Max Settlement         Max Tensile         Max Offset Settlement         Max Tensile         Max Settlement         Max Tensile         Max Settlement         Settlement Settlement         Settlement Settlement         Settlement         Settlement	mage Category ery Slight)		
Specific Building Damage Results - Critical Segments within Each Structure			
Structure Name Parameter Critical Critical Start End Curvature Max Slope Max Max M Sub-Structure Segment Settlement Tensile Radi Strain Curv	in Min Damage Category us of Radius of ature Curvature ging) (Sarging)		
Boundary Wall         Boundary Wall         (m)         (m) <th(m)< th="">         (m)         (m)</th(m)<>	[m] [m] 280.17 0 (Negligible)		

Oa	sys	, F	AIRHUR	ST				ŀ	<sub>Јор No.</sub> 14139	96	She	et No.	F	Rev.
40 Frognal	Lane	all Toe 5m	bbl)					Γ	Drg. Ref.					
Boundary \	Vall		661)					F	Made by JC		Date 10-Fe	b-2021	Che	cked
Structure Name	Parameter	Critical Sub-Structure	Critical Start Segment	End Curvatu	re Max Slope	Max Settlement	Max Tensile Strain	Min Radius Curvati (Hoggin	Min of Radius of ure Curvature ng) (Sagging)	Damage Categ	ory			
	Max Tensile Strain	Foundation Boundary Wall Foundation	3 21.224	24.233 Sagging	0.0013621	3.2298	0.057704		- 677.59 1	(Very Slight)				
	Min Radius of Curvature (Hogging)	Boundary Wall Foundation	2 11.816	21.224 Hogging	210.92E-6	5.1118	0.0071698	1737	90 0	(Negligible)				
	Min Radius of Curvature (Sagging)	Boundary Wall Foundation	1 0.0	11.816 Sagging	0.0027565	7.0986	0.019062		- 280.17 0	(Negligible)				

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#### 40 Frognal Lane

Short-term Basement Excavation (Unloading, Wall Toe 5mbbl) No. 38

Job No.	Sheet No.	Rev.
141396		
Drg. Ref.		
Made by	Date 10-Feb-2021	Checked

Problem Type

Problem Type : Tunnelling and Embedded Wall Excavations

#### Displacement Data

Туре		Name	Direction of extrusion		Point/1	Line/Line	for extr	usion		No. of intervals across extrusion/line	Extrusion depth	No. of intervals along extrusion	Calculate	Surface type for tunnels
				1	First point	t	See	cond poi	nt					
				х	Y	Z(level)	х	Y	Z(level)					
				[m]	[m]	[m]	[m]	[m]	[m]		[m]			
Line	No.	. 38 East	-	10.00000	-11.60000	90.00000	12.00000	0.00000	90.00000	12	-	-	Yes	Surface

Imported Displacements The following data points and displacements were found in the import file Pdisp Short term Unloading to be Imported.csv.

Ref.	C	oordinates		Di	splaceme	nts	
	x	У	z	x	У.	z	
1	-7.50000	0.00000	[m] 91.50000	[mm]	[mm] 0.00000	[mm] -0.73810	
2	-7.50000	1.00000	91.50000	0.00000	0.00000	-0.73690	
3	-7.50000	2.00000	91.50000	0.00000	0.00000	-0.73310	
-4	-7.50000	4.00000	91.50000	0.00000	0.00000	-0.71350	
6	-7.50000	5.00000	91.50000	0.00000	0.00000	-0.69420	
7	-7.50000	6.00000	91.50000	0.00000	0.00000	-0.66530	
9	-7.50000	8.00000	91.50000	0.00000	0.00000	-0.56500	
10	-7.50000	9.00000	91.50000	0.00000	0.00000	-0.48730	
11	-7.50000	10.00000	91.50000	0.00000	0.00000	-0.38960	
13	-7.50000	12.00000	91.50000	0.00000	0.00000	-0.15450	
14	-7.50000	13.00000	91.50000	0.00000	0.00000	-0.03940	
15	-7.50000	14.00000	91.50000	0.00000	0.00000	0.05940	
17	-7.50000	0.00000	91.50000	0.00000	0.00000	-0.73810	
18	-8.42730	0.00000	91.50000	0.00000	0.00000	-0.35400	
19	-9.35450	0.00000	91.50000	0.00000	0.00000	-0.09160	
21	-11.20910	0.00000	91.50000	0.00000	0.00000	0.20650	
22	-12.13640	0.00000	91.50000	0.00000	0.00000	0.28400	
23	-13.06360	0.00000	91.50000	0.00000	0.00000	0.33150	
25	-14.91820	0.00000	91.50000	0.00000	0.00000	0.36860	
26	-15.84550	0.00000	91.50000	0.00000	0.00000	0.36900	
27	-17 70000	0.00000	91.50000	0.00000	0.00000	0.36230	
29	-7.50000	15.00000	91.50000	0.00000	0.00000	0.13690	
30	-8.42730	15.00000	91.50000	0.00000	0.00000	0.19460	
31	-9.35450	15.00000	91.50000	0.00000	0.00000	0.23/10	
33	-11.20910	15.00000	91.50000	0.00000	0.00000	0.28490	
34	-12.13640	15.00000	91.50000	0.00000	0.00000	0.29490	
35	-13.99090	15.00000	91.50000	0.00000	0.00000	0.29820	
37	-14.91820	15.00000	91.50000	0.00000	0.00000	0.29100	
38	-15.84550	15.00000	91.50000	0.00000	0.00000	0.28290	
40	-17.70000	15.00000	91.50000	0.00000	0.00000	0.27300	
41	10.00000	-11.60000	90.00000	0.00000	0.00000	0.28140	1,2,6
42	10.16670	-10.63330	90.00000	0.00000	0.00000	0.28250	1,2,6
43	10.33330	-9.66670	90.00000	0.00000	0.00000	0.28530	1,2,6
44	10.66670	-7.73330	90.00000	0.00000	0.00000	0.29640	1,2,0
46	10.83330	-6.76670	90.00000	0.00000	0.00000	0.30390	1,2,6
47	11.00000	-5.80000	90.00000	0.00000	0.00000	0.31220	1,2,6
48	11.16670	-4.83330	90.00000	0.00000	0.00000	0.32070	1,2,6
49	11.53550	-2.90000	90.00000	0.00000	0.00000	0.32900	1,2,0
51	11.66670	-1.93330	90.00000	0.00000	0.00000	0.34350	1,2,6
52	11.83330	-0.96670	90.00000	0.00000	0.00000	0.34920	1,2,6
53	12.00000	0.00000	90.00000	0.00000	0.00000	0.35360	1,2,6
54	11 00000	-11.60000	90.00000	0.00000	0.00000	0.28140	1,2,6
56	12.00000	-11.60000	90.00000	0.00000	0.00000	0.31790	
57	13.00000	-11.60000	90.00000	0.00000	0.00000	0.31930	
59	15.00000	-11.60000	90.00000	0.00000	0.00000	0.30460	
60	16.00000	-11.60000	90.00000	0.00000	0.00000	0.29220	
61	17.00000	-11.60000	90.00000	0.00000	0.00000	0.27830	
63	19.00000	-11.60000	90.00000	0.00000	0.00000	0.24860	
64	20.00000	-11.60000	90.00000	0.00000	0.00000	0.23370	
65	22.00000	-11.60000	90.00000	0.00000	0.00000	0.21930	
67	23.00000	-11.60000	90.00000	0.00000	0.00000	0.19230	
68	24.00000	-11.60000	90.00000	0.00000	0.00000	0.17990	
70	12.00000	0.00000	90.00000	0.00000	0.00000	0.35360	1.2.6
71	13.00000	0.00000	90.00000	0.00000	0.00000	0.36780	, ,.
72	14.00000	0.00000	90.00000	0.00000	0.00000	0.36920	
74	16.00000	0.00000	90.00000	0.00000	0.00000	0.34940	
75	17.00000	0.00000	90.00000	0.00000	0.00000	0.33350	
76	18.00000	0.00000	90.00000	0.00000	0.00000	0.31570	
78	20.00000	0.00000	90.00000	0.00000	0.00000	0.27860	
79	21.00000	0.00000	90.00000	0.00000	0.00000	0.26030	
80	22.00000	0.00000	90.00000	0.00000	0.00000	0.24280	
82	24.00000	0.00000	90.00000	0.00000	0.00000	0.21050	
83	25.00000	0.00000	90.00000	0.00000	0.00000	0.19590	
84	26.00000	0.00000	90.00000	0.00000	0.00000	0.18220	
86	6.50000	-11.60000	91.00000	0.00000	0.00000	-0.03490	
87	6.79170	-10.63330	91.00000	0.00000	0.00000	-0.05030	
89	7.37500	-8.70000	91.00000	0.00000	0.00000	-0.03220	
90	7.66670	-7.73330	91.00000	0.00000	0.00000	-0.00540	
91	7.95830	-6.76670	91.00000	0.00000	0.00000	0.02830	
92	8.54170	-4.83330	91.00000	0.00000	0.00000	0.10340	
94	8.83330	-3.86670	91.00000	0.00000	0.00000	0.14050	
95 96	9.12500	-2.90000	91.00000	0.00000	0.00000	0.17530	
97	9.70830	-0.96670	91.00000	0.00000	0.00000	0.23530	
98	10.00000	0.00000	91.00000	0.00000	0.00000	0.25990	
100	10.291/0	1.93330	91.00000	0.00000	0.00000	0.28080	
101	10.87500	2.90000	91.00000	0.00000	0.00000	0.31210	
102	11.16670	3.86670	91.00000	0.00000	0.00000	0.32290	

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40 Frognal Lane

Job No.	Sheet No.	Rev.
141396		
Drg. Ref.		
Made by	Date	Checked

	Description (Links ding, Mall Tes Crehel)			
No. 38	Basement Excavation (Unloading, Wall Toe 5mbbl)	Made by JC	Date 10-Feb-2021	Checke
Ref. Co	ordinates         Displacements           y         z         x         y           [m]         [mm]         [mm]         [mm]			
104 11.75000 105 12.04170 106 12.3330 107 12.62500 108 12.91670 109 13.20830 110 13.50000 1 - Data point coincider 6 - Data point coincider	(m)         (m)         (m)         (m)           5.8000         9.00000         0.00000         0.23590           5.76570         91.00000         0.00000         0.23340           7.7330         91.00000         0.00000         0.23590           7.7333         91.00000         0.00000         0.23530           9.66670         91.00000         0.00000         0.23530           9.10000         0.00000         0.23530           10.63330         91.00000         0.00000         0.23550           11.60000         91.00000         0.00000         0.23550           11.60000         91.00000         0.00000         0.235260           11.60000         91.00000         0.00000         0.23740           with displacement data. Its displacement has been added to those calculated by Xdisp.         1.10000           with horizontal movement calculation point for a specific building. Its displacement has been added before performing building damage calculations.           twith vertical movement calculation point for a specific building.         Its displacement has been added before performing building damage calculations.			
Vertical Ground M	ovement Curves (Excavations)			
Curve Name: Coordinates: Curve Fitting	<pre>Installation of secant bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(b)) [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][2.000,0.000,0.000] Polynomial</pre>			
Method: x Order: y Order: Polynomial: z = Coeff. of Determination:	1 0 2.5E-2x + 5.0E-2 1.0			
Curve Name: Coordinates:	<pre>Excavation in front of high stiffness wall in stiff clay (CTRIA 580 Fig. 2.11(b) [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 (x) (00, 0.000, 0.067)[0.100, 0.000, 0.049][0.200, 0.000, 0.056][0.300, 0.000, 0.073] [0.400, 0.000, 0.067][0.500, 0.000, 0.071][0.200, 0.000, 0.072][0.700, 0.000, 0.073] [0.800, 0.000, 0.067][0.500, 0.000, 0.071][1.000, 0.000, 0.073][1.200, 0.000, 0.054] [1.200, 0.000, 0.053][1.300, 0.000, 0.061][1.400, 0.000, 0.058][1.500, 0.000, 0.054] [1.600, 0.000, 0.033][1.100, 0.000, 0.030][2.200, 0.000, 0.272][2.300, 0.000, 0.023] [2.400, 0.000, 0.012][2.500, 0.000, 0.012][2.600, 0.000, 0.141][2.700, 0.000, 0.053] [3.200, 0.000, 0.014][3.300, 0.000, 0.008][3.400, 0.000, 0.031][3.500, 0.000, 0.003] [3.600, 0.000, 0.004][3.300, 0.000, 0.021][3.400, 0.000, 0.031][3.500, 0.000, 0.001] [3.600, 0.000, 0.000, 0.012][2.500, 0.000, 0.021][3.400, 0.000, 0.003][3.500, 0.000, 0.001]</pre>			
Curve Fitting Method: x Order: y Order: Polynomial: z = Coeff. of Determination:	[4.000,0.000,0.000] Polynomial 4 0 -2.6455E-3x <sup>4</sup> + 2.8495E-2x <sup>3</sup> - 1.0051E-1x <sup>2</sup> + 1.0569E-1x + 3.8990E-2 9.9991E-1			
Horizontal Ground	Movement Curves (Evrentions)			
Curve Name: Coordinates:	<pre>Installation of secant bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(a)) [Distance from wall / wall depth or max. excavation depth (x), Depth / wall depth or max. excavation depth (y), Borizontal movement / wall depth or max. excavation depth (z) (%)] [0.000,.0000,.0081](0.050,0.000,0.076][0.100,0.000,0.072][0.150,0.000,0.067] [0.200,0.000,0.083](0.250,0.000,0.059][0.300,0.000,0.056][0.350,0.000,0.052] [0.400,0.000,0.037][0.450,0.000,0.045][0.700,0.000,0.023][0.550,0.000,0.052] [0.600,0.000,0.037][0.650,0.000,0.034][0.700,0.000,0.022][0.550,0.000,0.029] [0.600,0.000,0.027][0.850,0.000,0.024][0.900,0.000,0.022][0.550,0.000,0.020] [1.000,0.000,0.018][1.050,0.000,0.018][1.100,0.000,0.014][1.150,0.000,0.012] [1.200,0.000,0.011][1.250,0.000,0.003][1.350,0.000,0.012]</pre>			
Curve Fitting Method: x Order: y Order: Polynomial: z =	1. 6407.0.5007.0.5009.0.5009.0.5007.0			
Coeff. of Determination:	1.0000			
Curve Name: Coordinates:	Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(a)) [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] Polymonia			
Method: x Order: y Order: Polynomial: z = Coeff. of Determination:	1 0.75E-2x + 1.50E-1 1.00			
Polygonal Excava	ions			
Excavation Name: Surface level [m Contribution: Enabled:	Pool excavation 90.000 Positive Yes			
Corner x [m] 1 -4.0000 - 2 2.2000 - 3 2.2000 4 -4.0000	y         Base Stiffened         Previous Side         Next Side           Level         d         pl         p2*         d         pl         p2*           [m]         [m]         [m]         [m]         [m]         [4]         [4]           [1.600         86.500         Yas         0.0         67.000         25.000         0.0         67.000         25.000           [1.600         86.500         Yas         0.0         67.000         25.000         0.0         67.000         25.000           [1.600         86.500         Yas         0.0         67.000         25.000         10.67.000         25.000			
Side         Corner           x         [m]           1         -4.0000           2         2.2000           3         2.2000           4         -4.0000	$ \begin{array}{c c c c c c } 1 & Corner 2 & Cornant Curve \\ \hline y & x & y & Vertical & Roizontal \\ \hline y & z & y & Vertical & Roizontal \\ \hline y & z & y & Vertical & Roizontal \\ \hline y & z & y & Vertical & Roizontal \\ \hline y & z & z & y & Vertical & Roizontal \\ \hline y & z & z & z & z & z & z & z & z & z &$			
Excavation Name: Surface level [m Contribution: Enabled:	]: 90.000 Positive Yes			
Corner x	y Base Stiffened Previous Side Next Side Level d pl p2* d pl p2* [m] (m] (m] (%) (%) (m) (%)			

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Job No.	Sheet No.	Rev.
141396		
Drg. Ref.		
Made by JC	Date 10-Feb-2021	Checked

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JUSYS	141396
0 Frognal Lane	Drg. Ref.
hort-term Basement Excavation (Unloading, Wall Toe 5mbbl)	Made by
orner x y Base Stiffened Previous Side Next Side	
Level         d         pl         p2*         d         pl         p2*           [m]         [m]         [m]         [m]         [m]         [%]	
2         2.2000         -11.600         61.500         Yes         0.0         50.000         20.000         0.0         50.000         20.000           3         2.2000         11.600         81.500         Yes         0.0         50.000         20.000         0.0         50.000         20.000           4         -4.0000         11.600         81.500         Yes         0.0         50.000         20.000         20.000	
ide Corner 1 Corner 2 Ground Movement Curve x y y Vertical Horizontal [m] [m] [m] [m]	
1 -4.0000 -11.000 2.2000 -11.000 installation of secant bored installation of secant bored pile wall in stiff clay (CIRIA pile wall in stiff clay (CIRIA 580 Fig. 2.8(b)) 580 Fig. 2.8(c)) 2 2.2000 -11.600 2.2000 11.600 Installation of secant bored Installation of secant bored	
pile wall in stiff clay (CIRIA pile wall in stiff clay (CIRIA 580 Fig. 2.8(b)) 580 Fig. 2.8(a)) 3 2.2000 11.600 -4.0000 11.600 Installation of secant bored pile wall in stiff clay (CIRIA pile wall in stiff clay (CIRIA pile wall in stiff clay (CIRIA	
580 Fig. 2.8(b))         580 Fig. 2.8(a))           4 -4.0000         -4.0000         -11.600           580 Fig. 2.8(b))         580 Fig. 2.8(a))	
lamage Category Strains	
Name 0 (Negligible) 1 (Very Slight) 2 (Slight) 3 (Moderate) to to to to 1 (Very Slight) 2 (Slight) 3 (Moderate) 4 (Severe)	
urland Strain Limits 0.0 500.00E-6 750.00E-6 0.0015000	
pecne Structures - Geometry tructure Name Sub-Structure Displacement Start End Vertical Vertical Damage Category St Name Line Distance Distance Offsets from Displacement Along Along Line for Limit Line Vertical Sensitivity	rains Poisson's E/G Ratio
Movement           Calculations         [m]         [m]	ts 0.20000 2.600
pecific Structures - Bending Parameters	
tructure Name Sub-Structure Height Default Hogging Sagging	
Name Flopertees 2nd Moment Distance Distance 2nd Moment Distance Distance of Area of Bending of N.A. of Area of Bending of N.A. (per unit Strain from Edge (per unit Strain from Edge width) from N.A. of Beam in width) from N.A. of Beam i Tenzion	n
[m] [m <sup>3</sup> ] [m] [m <sup>3</sup> ] [m] [m <sup>3</sup> ] [m] [m] o. 38 East Wall 8.0000 Yes 170.67 8.0000 8.0000 42.667 4.0000 4.000	0
uilding Segment Combinations	
tructure Name Sub-Structure Vertical Segment Start Length Curvature Combined Name Offset from Segment Line for Vertical Movement	
Calculations [m] [m] [m] o structures have segments combined.	
Itility Strain Calculation Options	
eglect beneficial contribution of axial strains : No	
<pre>Warnings Multiple excavations have been specified. The displacements resulting from these excavations are calculated by summing the displacements resulting from each individual excavation. No account has been taken of the interactions between excavations (e.g. overlapping zones of influence or 'shielding' of one excavation by another).</pre>	
one	
visplacement and Strain Results	
Type/No. Coordinates Displacements Angle Line Name Dist. x v z x v z Horizontal Horizontal	>f xis
displacement along Line perpendicular to Line	
[m] [m] [m] [m] [mm] [mm] [mm] [mm] [mm	218 *
0.98093 10.16667 -10.6333 90.0000 -4.0206 0.0 3.3762 -0.68313 3.9622 80. 1.9619 10.3333 -9.66667 90.0000 -3.8895 0.0 3.2820 -0.66085 3.8329 80. 2.9428 10.50000 -8.70000 90.0000 -3.7593 0.0 3.1918 -0.63872 3.7046 80.	218 * 218 * 218 *
3.9237 10.66667 -7.73333 90.0000 -3.6299 0.0 3.1052 -0.61674 3.5771 80. 4.9046 10.83333 -6.76667 90.0000 -3.5013 0.0 3.0219 -0.59490 3.4504 80. 5.8856 11.00000 -5.80000 90.00000 -3.3735 0.0 2.9416 -0.57319 3.3245 80.	218 * 218 * 218 *
6.8665         11.1667         -4.8333         90.0000         -3.2465         0.0         2.8637         -0.55160         3.1993         80.           7.8474         11.33333         -3.86667         90.0000         -3.1201         0.0         2.7879         -0.53013         3.0748         80.           8.2284         11.50000         -2.9000         90.00000         -2.12944         0.0         2.7138         -0.50877         2.9509         80.	218 * 218 * 218 *
9,8093         11.66667         -1.9333         90.0000         -2.8693         0.0         2.6111         -0.49752         2.8276         80.0           10.790         11.8333         -0.96667         90.0000         -2.748         0.0         2.5696         -0.4655         2.7049         80.0           11.771         12.00000         0.00000         -2.6208         0.0         2.8527         -0.44529         2.5827         80.           Result includes imported displacement(s).	218 * 218 * 218 *
necific Ruildinn Damage Results - Horizontal Displacements	

	x	у	z	×	У	Horizontal displacement along the	Horizontal displacement perpendicular	
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]	d
0.0	10.00000	-11.60000	90.00000	-2.4716	0.0	-0.41994	2.4357	

Structure: No. 38 | Sub-structure: East Wall

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#### 40 Frognal Lane

Short-term Basement Excavation (Unloading, Wall Toe 5mbbl) No. 38

Job No.	Sheet No.	Rev.
141396		
Drg. Ref.		
Made by JC	Date 10-Feb-2021	Checked

Dist.	Coordinates		Displace	ements							
x	У 2	х у	Horizon displace	ntal Hor ement disc	izontal						
0.00000.10.100		0000 4 0000 0	along	the perp	endicular						
1.9619 10.333	33 -9.66667 90.0	0000 -3.8895 0	.0 -0.0	66085	3.8329 d						
3.9237 10.666	57 -7.73333 90.0	0000 -3.6299 0	.0 -0.0	53872 51674	3.5771 d						
4.9046 10.833 5.8856 11.0000	-5.80000 90.0	0000 -3.3735 0	.0 -0.	59490 57319	3.3245 d						
6.8665 11.166 7.8474 11.333	57 -4.83333 90.0 33 -3.86667 90.0	0000 -3.2465 0 0000 -3.1201 0	.0 -0.5	55160 53013	3.1993 d 3.0748 d						
8.8284 11.5000 9.8093 11.6660	00 -2.90000 90.0 57 -1.93333 90.0	0000 -2.9944 0 0000 -2.8693 0	.0 -0.	50877 48752	2.9509 d 2.8276 d						
10.790 11.833	33 -0.96667 90.0 00 0.00000 90.0	0000 -2.7448 0 0000 -2.6208 0	.0 -0.4	16636 14529	2.7049 d 2.5827 d						
d - Displacemen	nts include impor	ted displacement	ts.								
Specific Building	g Damage Results -	Vertical Displacer	ments								
	,	· · · · ·									
Structure: No.	38   Sub-structu	re: East Wall									
Dist.	Coordinates	Displa	cements								
[m] [m]	[m] [n	[mm]									
Vertical Offset	t 1 00 -11 60000 90 0	0000 2 3108 4									
0.98093 10.166	57 -10.63333 90.0	0000 3.3762 d									
2.9428 10.500	-8.70000 90.0	0000 3.1918 d									
4.9046 10.833	33 -6.76667 90.0	0000 3.1052 d 0000 3.0219 d									
6.8665 11.166	57 -4.83333 90.0	0000 2.9416 d 0000 2.8637 d									
7.8474 11.333 8.8284 11.5000	33 -3.86667 90.0 00 -2.90000 90.0	0000 2.7879 d 0000 2.7138 d									
9.8093 11.666	67 -1.93333 90.0 33 -0.96667 90.0	0000 2.6411 d 0000 2.5696 d									
11.771 12.0000 d - Displacement	00 0.00000 90.0 hts include impor	0000 2.8527 d ted displacement	ts.								
Specific Building	g Damage Results -	All Segments									
Structure: No.	38   Sub-structu	re: East Wall									
Vertical Offset	t Segment	Start Length (	Curvature I	Deflection	Average	Max Ma	x Gradient	Max Gradien	t Min	Damage	
from Line for Vertical				Ratio	Horizontal Strain	Tensile Strain H	of Horizontal	of Vertical Displacemer	. Radius of it Curvature	E Category	
Movement						Di	Splacement	Curve			
[m]	1	[m] [m]	Connina	[%]	[%]	[%]	260 207 6	0 001096	[m]	,	0
0.0	1	2 0306 8 9404 1	Ussaisa	0.020170	0.0001011	0.0022712	200.501 0	200 625	< 0170 C	(Negligible	2)
Tennile benine	2	2.5500 8.8404	nogging	0.0030203	0.0021911	0.0050515	-22.3386-0	-200.026-	0 21/2.2	(Negligible	2)
Tensile notizo	ital Stialis ale	ive, compleasive	e norr20110	ii Stiains	are ve.						
Specific Building											
	I I I I I I I I I I I I I I I I I I I	Critical Values for	r All Soamo	nte within F	Each Sub-Stru	cturo					
Specific Building	g Damage Results -	Critical Values for	r All Segmei	nts within E	Each Sub-Stru	cture					
Structure: No.	38   Sub-structu	Critical Values for	r All Segmei	nts within E	Each Sub-Stru	cture					
Structure: No.	38   Sub-structu	Critical Values for re: East Wall Max Slope	r All Segmei	Max	Each Sub-Stru	Cture Max Gradier	nt Min	Min	Damage Ca	tegory	
Structure: No. Vertical De Offset from Line for	38   Sub-structu aflection Averag Ratio Horizon Strai	Critical Values for re: East Wall me Max Slope tal	Max Settlement	Max Tensile Strain	Each Sub-Stru Max Gradient of Horizontal	Max Gradier of Vertical Displacemen	nt Min L Radius of ht Curvature	Min Radius of Curvature	Damage Ca	tegory	
Structure: No. Vertical De Offset from Line for Vertical Movement	38   Sub-structu aflection Averag Ratio Horizon Strai	Critical Values for re: East Wall re Max Slope tal	Max Max Settlement	Max Tensile Strain	Each Sub-Stru Max Gradient of Horizontal Displacement Curve	Max Gradier of Vertical Displacemen Curve	ht Min L Radius of ht Curvature (Hogging)	Min Radius of Curvature (Sagging)	Damage Ca	tegory	
Structure: No. Vertical De Offset from Line for Vertical Movement Calculations [m]	38   Sub-structu aflection Averag Ratio Horizor Strai	Critical Values for re: East Wall re Max Slope tal	Max Settlement	Max Tensile Strain	Each Sub-Strue of Horizontal Displacement Curve	Max Gradier of Vertical Displacemer Curve	nt Min L Radius of nt Curvature (Hogging) [m]	Min Radius of Curvature (Sagging) [m]	Damage Ca	tegory	
Structure: No. Vertical De Offset from Line for Vertical Movement Calculations [m] 0.0	38   Sub-structu         aflection Averag         Ratio Horizor         Strai         [%]       [%]         0.026178 -0.0074	Critical Values for re: East Wall tal sin 747 -0.0010864	Max Max Settlement [mm] 3.3737	Max Tensile Strain (%) 0.022712	Each Sub-Strue of Horizontal Displacement Curve 268.38E-6	Max Gradier of Vertical Displacemer Curve	nt Min Radius of ht Curvature (Hogging) [m] 54 2172.2	Min Radius of Curvature (Sagging) [m] 663.18	Damage Ca 0 (Negligik	ategory	
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Specific Building Structure: No. Vertical Duroffset from Vertical Movement Calculations [m] 0.0 Specific Building Structure Name No. 38	38   Sub-structu flection Averag Ratio Horizor Strai (%) (%) 0.026178 -0.0074 Damage Results - Parameter Max Slope Max Stlement Max Tensile Strain Min Radius of Curvature (Bogging) Min Radius of Curvature (Sagging)	Critical Values for re: East Wall e Max Slope tal 747 -0.0010864 Critical Segments Critical Sub-Structure East Wall East Wall East Wall East Wall	Max Settlement [mm] 3.3737 swithin Eac. Critical Segment 1 1 1 2 2 1	Max           Tensile           Strain           0.022712           h Structure           Start           E           [m]           0.02           0.02           2.002           0.02           0.02           0.02           0.02           0.02           0.02           0.02           0.02           0.02           0.02           0.02           0.02	Each Sub-Stru Max Gradient of Horisontal Displacement Curve 268.38E-6	Cture Max Gradier of Vertical Displacemer -0.001086 0.0010866 0.0010866 0.0010866	ht Min L Radius of the Curvature (Rogging) 54 [mm] 54 2172.2 54 Max Settlement 1 3.3737 3 .3737 5 3.1929 5 3.1929	Min Radius of Curvature (Sagging) [m] 663.18 Max Strain [%] 0.022712 0.022712 0.022712 0.022712	Damage Ca 0 (Negligit Min Radius of I [m] - - 2172.2	Min tadius of Durvature (Sagging) [m] 663.18 0 ( 663.18 0 ( 663.18 0 (	Damage Category (Negligible) (Negligible) (Negligible) (Negligible) (Negligible)
Specific Building Structure: No. Vertical Duron Vertical Movement Calculations [m] 0.0 Specific Building Structure Name No. 38	<pre>38   Sub-structu sflection Averag Ratio Borizon Strai [%] [%] 0.026178 -0.0074 Damage Results - Parameter Max Slope Max Stlement Max Tensile Strain Min Radius of Curvature (Hogging) Min Radius of Curvature (Sagging)</pre>	Critical Values for re: East Wall e Max Slope tal 747 -0.0010864 Critical Segments Critical Sub-Structure East Wall East Wall East Wall East Wall East Wall	Max Settlement [mm] 3.3737 swithin Eac. Critical Segment 1 1 1 2 2 1	Max Tensile Strain (%) 0.022712 h Structure Start E (%) 0.0 2. 0.0 2. 0.0 2. 2.9306 11 0.0 2.	Each Sub-Stru Max Gradient of Horizontal Displacement Curve 268.38E-6 and Curvatu m] 9306 Sagging 9306 Sagging 9306 Sagging 9306 Sagging	<pre>Max Gradier of Vertical Displacement -0.001086 re Max Slope 0.0010864 0.0010864 0.0010864 0.0010864</pre>	t Min L Radius of t Curvature (Rogging) 54 [m] 54 2172.2 55 55 55 55 10 3.3737 3.3737 3.3737 3.3737 3.3737	Min Radius of Curvature (Sagging) [m] 663.18 Max Strain 0.022712 0.022712 0.022712 0.022712	Damage Cd 0 (Negligik Min Radius of I [m] - 2172.2	Min Sadius of Urvature (Sagging) 663.18 0 0 663.18 0 0 663.18 0 0 663.18 0 0	Damage Category (Negligible) (Negligible) (Negligible) (Negligible)
Specific Building Structure: No. Vertical Diffset from Vertical Movement Calculations [m] 0.0 Specific Building Structure Name No. 38	<pre>38   Sub-structu sflection Averag Ratio Horizor Strai [%] (%] 0.026178 -0.0074 Damage Results - Parameter Max Slope Max Slope Max Settlement Max Tensile Strain Min Radius of Curvature (Hogging) Min Radius of Curvature (Sagging)</pre>	Critical Values for re: East Wall e Max Slope tal 747 -0.0010864 Critical Segments Critical Segments Sub-Structure East Wall East Wall East Wall East Wall	All Segment Max Settlement 3.3737 3 within Eac. Critical Segment 1 1 1 2 2 1	Max           Tensile           Strain           0.022712           h Structure           Start           [m]           [m]           0.0 2.           0.0 2.           2.9306 11           0.0 2.	Each Sub-Stru Max Gradient of Horizontal Displacement Curve 268.38E-6 and Curvatu m] 9306 Sagging 9306 Sagging 9306 Sagging 9306 Sagging	<pre>cture Max Gradier of Vertical Displacement -0.001086 re Max Slope 0.0010864 0.0010864 0.0010864 0.0010864</pre>	t Min L Radius of t Curvature (Rogging) 54 [m] 54 2172.2 5 Max 5 Settlement [mm] 3.3737 3.3737 3.3737 3.3737 3.3737	Min Radius of Curvature (Sagging) [m] 663.18 <b>Max</b> <b>Tensie</b> Strain 0.022712 0.022712 0.022712	Damage Ca 0 (Negligik Min Radius of I [m] - 2172.2 -	Min Min Sadius of Jurvature (Sagging) [m] 663.18 0 ( 663.18 0 ( 663.18 0 ( 663.18 0 (	Damage Category (Negligible) (Negligible) (Negligible) (Negligible) (Negligible)
Specific Building Structure: No. Vertical Diffset from Vertical Movement Calculations [m] 0.0 Specific Building Structure Name No. 38	<pre>38   Sub-structu sflection Averag Ratio Horizor Strai [%] (%] 0.026178 -0.0074 y Damage Results - Parameter Max Slope Max Settlement Max Tensile Strain Min Radius of Curvature (Hogqing) Min Radius of Curvature (Sagging)</pre>	Critical Values for re: East Wall e Max Slope tal 747 -0.0010864 Critical Segments Critical Sub-Structure East Wall East Wall East Wall East Wall East Wall	x All Segment Max Settlement 3.3737 s within Eac. Critical Segment 1 1 2 2 1	Max Tensile Strain (%) 0.022712 h Structure Start E [m] (0.0 2. 0.0 2. 0.0 2. 2.9306 11 0.0 2.	Each Sub-Stru Max Gradient of Horizontal Displacement Curve 268.38E-6 2 and Curvatu m] 9306 Sagging 9306 Sagging 9306 Sagging 9306 Sagging	<pre>cture Max Gradier of Vertical Displacement -0.001086 re Max Slope 0.0010864 0.0010864 0.0010864 0.0010864</pre>	t Min Radius of Comparison (Rogging) 4 2172.2 6 Max Settlement (mm) 1 3.3737 3.3737 3.3737 3.3737 1 3.3737	Min Radius of Curvature (Sagging) (m) 663.18 <b>Max</b> <b>Tensic</b> <b>Strain</b> 0.022712 0.022712 0.022712	Damage Ca 0 (Negligih Min Radius of I (Hogging) [m] - - 2172.2 -	Min Min fadius of Uurvature (Sagging) [m] 663.18 0 ( 663.18 0 ( 663.18 0 ( 663.18 0 (	Damage Category (Negligible) (Negligible) (Negligible) (Negligible) (Negligible)
Specific Editions Structure: No. Vertical Du Offset from Vertical Movement Calculations [m] 0.0 Specific Building Structure Name No. 38	<pre>38   Sub-structu eflection Averag Ratio Horizor Strai [%] (%] 0.026178 -0.0074 g Damage Results - Parameter Max Slope Max Settlement Max Tensile Strain Min Radius of Curvature (Hogging) Min Radius of Curvature (Sagging)</pre>	Critical Values for re: East Wall e Max Slope tal n 747 -0.0010864 Critical Segments Critical Segments Sub-Structure East Wall East Wall East Wall East Wall East Wall	x All Segment Max Settlement 3.3737 swithin Eac. Critical Segment 1 1 2 2 1	Max Tensile Strain (%) 0.022712 h Structure Start E (m) (0.0 2. 0.0 2. 0.0 2. 2.9306 11 0.0 2.	Each Sub-Stru Max Gradient of Horizontal Displacement Curve 268.38E-6 2 and Curvatu m] 9306 Sagging 9306 Sagging 9306 Sagging 9306 Sagging	<pre>Max Gradier of Vertical Displacement -0.001086 re Max Slope 0.0010864 0.0010864 0.0010864 0.0010864</pre>	t Min Radius of Carature (Hogging) 4 2172.2 Max Settlement [mm] 3.3737 3.3737 3.3737 3.3737 3.3737	Min Radius of Curvature (Sagging) (m) 663.18 <b>Max</b> <b>Tensic</b> <b>Strain</b> (%) 0.022712 0.022712 0.022712	Damage Ca 0 (Negligih Min f Radius f (Hogging) (m) - - - 2172.2	Min Min fadius of Jurvature (Sagging) [m] 663.18 0 ( 663.18 0 ( 663.18 0 (	Damage Category (Negligible) (Negligible) (Negligible) (Negligible) (Negligible)
Specific Editions Structure: No. Vertical Du Offset from Vertical Movement Calculations [m] 0.0 Specific Building Structure Name No. 38	38   Sub-structu sflection Averag Ratio Horizor Strai [%] [%] 0.026178 -0.0074 y Damage Results - Parameter Max Slope Max Settlement Max Stellement Max Tensile Strain Min Radius of Curvature (Boging) Min Radius of Curvature (Sagging)	Critical Values for re: East Wall e Max Slope tal n 747 -0.0010864 Critical Segments Critical Sub-Structure East Wall East Wall East Wall East Wall East Wall	x All Segment Max Settlement (mm) 3.3737 s within Eac. Critical Segment 1 1 1 2 2 1	Max Tensile Strain (%) 0.022712 h Structure Start E (m) ( 0.0 2. 0.0 2. 0.0 2. 2.9306 11 0.0 2.	Each Sub-Stru Max Gradient of Horizontal Displacement Curve 268.38E-6 2 and Curvatu m] 9306 Sagging 9306 Sagging 9306 Sagging 9306 Sagging	<pre>Max Gradier of Vertical Displace -0.001086 re Max Slope 0.0010864 0.0010864 0.0010864 0.0010864</pre>	t Min Radius of Construction (Rogging) 4 [m] 54 [m] 54 [m] 53,3737 14,3737 14,3757 14,37577 14,37577 14,37577 14,375777 14,375777 14,375777 14,3757777 14,375	Min Radius of Curvature (Sagging) 663.18 Max Strain (%) 0.022712 0.022712 0.022712 0.022712	Damage Ca Min fi Radius of I (Hogging) (m) _ 2172.2 -	Min Min tadius of Jurvature (Sagging) [m] 663.18 0 ( 663.18 0 ( 663.18 0 (	Damage Category (Negligible) (Negligible) (Negligible) (Negligible) (Negligible)
Specific Building Structure: No. Vertical Dr Offset from Vertical Movement Calculations [m] 0.0 Specific Building Structure Name No. 38	<pre>38   Sub-structu sflection Averag Ratio Horizon Strai 0.026178 -0.0074 Damage Results - Parameter Max Slope Max Sope Max Setlement Max Tensile Strain Min Radius of Curvature (Sagging)</pre>	Critical Values for re: East Wall tal n 747 -0.0010864 Critical Segments Critical Segments Sub-Structure East Wall East Wall East Wall East Wall East Wall	x All Segment Max Settlement 3.3737 s within Eac. Critical Segment 1 1 1 2 1	Max Tensile Strain (%) 0.022712 h Structure Start E (m) ( 0.0 2. 0.0 2. 0.0 2. 2.9306 11 0.0 2.	Each Sub-Stru Max Gradient of Horizontal Displacement Curve 268.38E-6 2 and Curvatu m] 9306 Sagging 9306 Sagging 9306 Sagging 9306 Sagging 9306 Sagging	<pre>Max Gradier of Vertical Displace -0.001086 re Max Slope 0.0010864 0.0010864 0.0010864 0.0010864</pre>	t Min Radius of Construction (Rogging) 4 [m] 5 Max Settlement (mm] 3.3737 3.3737 3.3737 3.3737 3.3737 3.3737 3.3737	Min Radius of Curvature (Sagging) [m] 663.18 <b>Max</b> <b>Tensin</b> Strain (%) 0.022712 0.022712 0.022712 0.022712	Damage Ca Min F Radius of G (Hogging) [m] 2172.2 	Min Min tadius of Jurvature (Sagging) [m] 663.18 0 ( 663.18 0 ( 663.18 0 (	Damage Category (Negligible) (Negligible) (Negligible) (Negligible)
Specific Building Structure: No. Vertical Du Offset from Vertical Movement Calculations [m] 0.0 Specific Building Structure Name No. 38	38   Sub-structu flection Averag Ratio Horizon Strai 0.026178 -0.0074 Jamage Results - Parameter Max Slope Max Stlement Max Teslie Strain Min Radius of Curvature (Sagging)	Critical Values for re: East Wall e Max Slope tal 747 -0.0010864 Critical Segments Critical Sub-Structure East Wall East Wall East Wall East Wall East Wall	x All Segment Max Settlement 3.3737 5 within Eac. Critical Segment 1 1 2 1	Max Tensile Strain (%) 0.022712 h Structure Start E (m) ( 0.0 2. 0.0 2. 0.0 2. 0.0 2. 2.9306 11 0.0 2.	Each Sub-Stru Max Gradient of Horizontal Displacement Curve 268.38E-6 Ind Curvatu m) 9306 Sagging 9306 Sagging 9306 Sagging 9306 Sagging	<pre>Max Gradier of Vertical Displace Curve -0.001086 0.0010864 0.0010864 0.0010864 0.0010864</pre>	t Min Radius of Correture (Rogging) 4 [m] 5 Max Settlement [mm] 3.3737 3.3737 3.3737 3.3737 3.3737 3.3737	Min Radius of Curvature (Sagging) [m] 663.18 <b>Max</b> <b>Tensin</b> Strain [%] 0.022712 0.022712 0.022712 0.022712	Damage Ca Min F Radius of G (Hogging) (m)	Min Min tadius of Jurvature (Sagging) [m] 663.18 0 ( 663.18 0 ) 663.18 0 ( 663.18 0 )	Damage Category (Negligible) (Negligible) (Negligible) (Negligible)
Specific Building Structure: No. Vertical Du Offset from Vertical Movement Calculations [m] 0.0 Specific Building Structure Name No. 38	38   Sub-structu flection Averag Ratio Horizon Strai 0.026178 -0.0074 Jamage Results - Parameter Max Slope Max Stlement Max Xetlement Max Tensile Strain Min Radius of Curvature (Sagging)	Critical Values for re: East Wall e Max Slope tal 747 -0.0010864 Critical Segments Critical Sub-Structure East Wall East Wall East Wall East Wall	r All Segmen Max Settlement 3.3737 5 within Eac. Critical Segment 1 1 2 1	Max Tensile Strain (%) 0.022712 h Structure Start E (m) (( 0.0 2. 0.0 2. 0.0 2. 2.9306 11 0.0 2.	Each Sub-Stru Max Gradient of Horizontal Displacement Curve 268.38E-6 Ind Curvatu m] 9306 Sagging 9306 Sagging 9306 Sagging 9306 Sagging 9306 Sagging	Cture Max Gradier of Vertical Displace Curve -0.001086 0.0010864 0.0010864 0.0010864 0.0010864	t Min Radius of Curvature (Hogging) 4 [m] 5 Max Settlement [mm] 3.3737 3.3737 3.3737 3.3737 3.3737 3.3737	Min Radius of Curvature (Sagging) [m] 663.18 <b>Max</b> <b>Tensin</b> Strain [%] 0.022712 0.022712 0.022712 0.022712	Damage Ca Min F Radius of G (Hogging) (m) - - 2172.2	Min Min tadius of Jurvature (Sagging) [m] 663.18 0 ( 663.18 0 ) 663.18 0 (	Damage Category (Negligible) (Negligible) (Negligible) (Negligible)
Specific Building Structure: No. Vertical Du Offset from Vertical Movement Calculations [m] 0.0 Specific Building Structure Name No. 38	38   Sub-structu flection Averag Ratio Horizor Strai 0.026178 -0.0074 Jamage Results - Parameter Max Slope Max Sope Max Setlement Max Tensile Strain Min Radius of Curvature (Sagging)	Critical Values for re: East Wall e Max Slope tal 747 -0.0010864 Critical Segments Critical Segments Sub-Structure East Wall East Wall East Wall East Wall East Wall	r All Segmen Max Settlement 3.3737 5 within Eac. Critical Segment 1 1 2 1	Max Tensile Strain (%) 0.022712 h Structure Start E (m) ( 0.0 2. 0.0 2. 0.0 2. 2.9306 11 0.0 2.	Each Sub-Stru Max Gradient of Horizontal Displacement Curve 268.38E-6 and Curvatu ") 9306 Sagging 9306 Sagging 9306 Sagging 9306 Sagging 9306 Sagging	cture Max Gradier of Vertical Displacent Curve -0.001086 0.0010864 0.0010864 0.0010864 0.0010864	t Min Radius of Curvature (Hogging) 4 [m] 5 Max Settlement [mm] 3.3737 3.3737 3.3737 3.3737 3.3737 3.3737	Min Radius of Curvature (Sagging) [m] 663.18 <b>Max</b> <b>Tensile</b> Strain [%] 0.022712 0.022712 0.022712 0.022712	Damage Ca Min F Radius of G (Hogging) (m)	Min Min tadius of Jurvature (Sagging) [m] 663.18 0 663.18 0 663.18 0 663.18 0	Damage Category (Negligible) (Negligible) (Negligible) (Negligible)

40 Frognal Lane Short-term Loading (Wall Toe 5mbbl)

No. 38

#### Job No. Sheet No. Rev. 141396 Drg. Ref. Made by JC Date 10-Feb-2021 Checked

Problem Type

Problem Type : Tunnelling and Embedded Wall Excavations

#### Displacement Data

Туре		Name	Direction of extrusion		Point/Line/Line for extrusion				No. of intervals across extrusion/line	Extrusion depth	No. of intervals along extrusion	Calculate	Surface type for tunnels	
				1	First poin	t	See	cond poi	nt					
				х	Y	Z(level)	х	Y	Z(level)					
				[m]	[m]	[m]	[m]	[m]	[m]		[m]			
Line	No.	38 East	-	10.00000	-11.60000	90.00000	12.00000	0.00000	90.00000	12	-	-	Yes	Surface

Imported Displacements
The following data points and displacements were found in the import file Pdisp Short term Loading to be Imported.csv.

Pof	Coordinates			Di	Displacements			
Ner .	x	y	z	x	у	z		
	[m]	[m]	[m]	[mm]	[mm]	[mm]		
1	-7.50000	0.00000	91.50000	0.00000	0.00000	0.17030		
3	-7.50000	2.00000	91.50000	0.00000	0.00000	0.16920		
4	-7.50000	3.00000	91.50000	0.00000	0.00000	0.16750		
5	-7.50000	4.00000	91.50000	0.00000	0.00000	0.16470		
6	-7.50000	5.00000	91.50000	0.00000	0.00000	0.16020		
8	-7.50000	7.00000	91.50000	0.00000	0.00000	0.14380		
9	-7.50000	8.00000	91.50000	0.00000	0.00000	0.13040		
10	-7.50000	9.00000	91.50000	0.00000	0.00000	0.11250		
12	-7.50000	11.00000	91.50000	0.00000	0.00000	0.08990		
13	-7.50000	12.00000	91.50000	0.00000	0.00000	0.03560		
14	-7.50000	13.00000	91.50000	0.00000	0.00000	0.00910		
15	-7.50000	15.00000	91.50000	0.00000	0.00000	-0.01370		
17	-7.50000	0.00000	91.50000	0.00000	0.00000	0.17030		
18	-8.42730	0.00000	91.50000	0.00000	0.00000	0.08170		
19	-9.35450	0.00000	91.50000	0.00000	0.00000	0.02110		
20	-11.20910	0.00000	91.50000	0.00000	0.00000	-0.02010		
22	-12.13640	0.00000	91.50000	0.00000	0.00000	-0.06550		
23	-13.06360	0.00000	91.50000	0.00000	0.00000	-0.07650		
24	-13.99090	0.00000	91.50000	0.00000	0.00000	-0.08250		
26	-15.84550	0.00000	91.50000	0.00000	0.00000	-0.08520		
27	-16.77270	0.00000	91.50000	0.00000	0.00000	-0.08360		
28	-17.70000	0.00000	91.50000	0.00000	0.00000	-0.08100		
30	-8.42730	15.00000	91.50000	0.00000	0.00000	-0.03160		
31	-9.35450	15.00000	91.50000	0.00000	0.00000	-0.05470		
32	-10.28180	15.00000	91.50000	0.00000	0.00000	-0.06150		
33	-12.13640	15.00000	91.50000	0.00000	0.00000	-0.06810		
35	-13.06360	15.00000	91.50000	0.00000	0.00000	-0.06880		
36	-13.99090	15.00000	91.50000	0.00000	0.00000	-0.06840		
37	-14.91820	15.00000	91.50000	0.00000	0.00000	-0.06720		
39	-16.77270	15.00000	91.50000	0.00000	0.00000	-0.06300		
40	-17.70000	15.00000	91.50000	0.00000	0.00000	-0.06040		
41	10.00000	-11.60000	90.00000	0.00000	0.00000	-0.06490	1,2,0	
42	10.16670	-10.63330	90.00000	0.00000	0.00000	-0.06520	1,2,0	
43	10.33330	-9.66670	90.00000	0.00000	0.00000	-0.06580	1,2,0	
45	10.66670	-7.73330	90.00000	0.00000	0.00000	-0.06840	1.2.0	
46	10.83330	-6.76670	90.00000	0.00000	0.00000	-0.07010	1,2,0	
47	11.00000	-5.80000	90.00000	0.00000	0.00000	-0.07210	1,2,6	
48	11.16670	-4.83330	90.00000	0.00000	0.00000	-0.07400	1,2,0	
49	11.33330	-3.86670	90.00000	0.00000	0.00000	-0.07590	1,2,0	
50	11.50000	-2.90000	90.00000	0.00000	0.00000	-0.07930	1,2,0	
52	11.83330	-0.96670	90.00000	0.00000	0.00000	-0.08060	1.2.0	
53	12.00000	0.00000	90.00000	0.00000	0.00000	-0.08160	1,2,0	
54	10.00000	-11.60000	90.00000	0.00000	0.00000	-0.06490	1,2,6	
55	11.00000	-11.60000	90.00000	0.00000	0.00000	-0.07080		
57	13.00000	-11.60000	90.00000	0.00000	0.00000	-0.07370		
58	14.00000	-11.60000	90.00000	0.00000	0.00000	-0.07250		
59	15.00000	-11.60000	90.00000	0.00000	0.00000	-0.07030		
61	17.00000	-11.60000	90.00000	0.00000	0.00000	-0.06420		
62	18.00000	-11.60000	90.00000	0.00000	0.00000	-0.06080		
63	19.00000	-11.60000	90.00000	0.00000	0.00000	-0.05740		
64	20.00000	-11.60000	90.00000	0.00000	0.00000	-0.05390		
66	22.00000	-11.60000	90.00000	0.00000	0.00000	-0.04740		
67	23.00000	-11.60000	90.00000	0.00000	0.00000	-0.04440		
68	24.00000	-11.60000	90.00000	0.00000	0.00000	-0.04150		
70	12 00000	0 00000	90.00000	0.00000	0.00000	-0.03380	120	
71	13.00000	0.00000	90.00000	0.00000	0.00000	-0.08490	-,-,-	
72	14.00000	0.00000	90.00000	0.00000	0.00000	-0.08520		
74	16.00000	0.00000	90.00000	0.00000	0.00000	-0.08350		
75	17.00000	0.00000	90.00000	0.00000	0.00000	-0.07700		
76	18.00000	0.00000	90.00000	0.00000	0.00000	-0.07290		
77	19.00000	0.00000	90.00000	0.00000	0.00000	-0.06860		
79	21.00000	0.00000	90.00000	0.00000	0.00000	-0.06430		
80	22.00000	0.00000	90.00000	0.00000	0.00000	-0.05600		
81	23.00000	0.00000	90.00000	0.00000	0.00000	-0.05220		
82	24.00000	0.00000	90.00000	0.00000	0.00000	-0.04860		
84	26.00000	0.00000	90.00000	0.00000	0.00000	-0.04200		
85	27.00000	0.00000	90.00000	0.00000	0.00000	-0.03910		
86	6.50000	-11.60000	91.00000	0.00000	0.00000	0.00800		
87	6./91/0 7.08330	-10.63330	91.00000	0.00000	0.00000	0.01120		
89	7.37500	-8.70000	91.00000	0.00000	0.00000	0.00740		
90	7.66670	-7.73330	91.00000	0.00000	0.00000	0.00120		
91	7.95830	-6.76670	91.00000	0.00000	0.00000	-0.00650		
92	8.54170	-4.83330	91.00000	0.00000	0.00000	-0.02390		
94	8.83330	-3.86670	91.00000	0.00000	0.00000	-0.03240		
95	9.12500	-2.90000	91.00000	0.00000	0.00000	-0.04050		
96	9.41670	-1.93330	91.00000	0.00000	0.00000	-0.05430		
98	10.00000	0.00000	91.00000	0.00000	0.00000	-0.06000		
99	10.29170	0.96670	91.00000	0.00000	0.00000	-0.06480		
100	10.58330	2 90000	91.00000	0.00000	0.00000	-0.06880		
102	11.16670	2.90000	91.00000	0.00000	0.00000	-0.07450		
103	11.45830	4.83330	91.00000	0.00000	0.00000	-0.07630		

FAIRHURST	Job No.	Sheet No.	Rev.
Oasys	141396		
40 Frognal Lane	Drg. Ref.		
No. 38	Made by JC	Date 10-Feb-2021	Checked
Ref. Coordinates Displacements x y z x y z [m] [m] [mm] [mm] [mm]			
Image: Constraint of the state of	ntions. ors.		
Vertical Ground Movement Curves (Excavations)			
<pre>Curve Name: Installation of secant bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(b)) 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) (%) [0.000,0.000,0.050][2.000,0.000,0.000] Curve Fitting Polynomial</pre>			
Method: x Order: 1 y Order: 0 Polynomial: z = -2.5E-2x + 5.0E-2 Coeff. of 1.0 Determination:			
Curve Name:         Excavation in front of high stiffness wall in stiff clay (CRIM, 580 Fig. 2.11(b)           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 (y), 0.000, 0			
[4.000,0.000,0.000]         Curve Fitting         Polynomial         Method:         x Order:         4         y Order:         0         Polynomial:         z         -2.6455E-3x <sup>4</sup> + 2.8495E-2x <sup>3</sup> - 1.0051E-1x <sup>2</sup> + 1.0569E-1x + 3.8990E-2         Coeff. of         9.9991E-1			
Determination:			
Horizontal Ground Movement Curves (Excavations) Curve Name: Installation of secant bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(a))			
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) (%) [0.000,0.000,0.001] [0.050,0.000,0.075] [0.100,0.000,0.072] [0.150,0.000,0.067] [0.200,0.000,0.0049] [0.450,0.000,0.055] [0.300,0.000,0.043] [0.550,0.000,0.052] [0.400,0.000,0.027] [0.650,0.000,0.034] [0.750,0.000,0.043] [0.550,0.000,0.022] [1.000,0.000,0.019] [1.450,0.000,0.034] [0.700,0.000,0.022] [0.550,0.000,0.029] [1.000,0.000,0.019] [1.450,0.000,0.016] [1.100,0.000,0.021] [1.50,0.000,0.021] [1.400,0.000,0.011] [1.250,0.000,0.021] [1.300,0.000,0.021] [1.50,0.000,0.012] [1.400,0.000,0.014] [1.450,0.000,0.021] [1.500,0.000,0.007] [1.550,0.000,0.005] Curve Fitting Method: x Order: 3 y Order: 0 Polynomial: z = -1.0610E-2x <sup>3</sup> + 4.4203E-2x <sup>2</sup> - 9.6358E-2x + 8.0901E-2 Coeff. of 1.0000			
Curve Name:         Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(a))           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) (%)			
Curve Fitting Fitting Formatic Fitting F			
Polygonal Excavations			
Excavation         Pool excavation           Surface level [m]:         90.000           Contribution:         Positive           Enabled:         Yes			
Corner x y Base Stiffened Previous Side Next Side Level d pl p2* d pl p2*			
[m]         [m]         [m]         [k]         [m]         [k]         [k]           1 -4.0000 -11.600 86.500         Yes         0.0 67.000 25.000         0.0 67.000 25.000         0.2 5.000           2 .2000 -11.600 86.500         Yes         0.0 67.000 25.000         0.0 67.000 25.000         0.3 67.000 25.000           3 2.2000 11.600 86.500         Yes         0.0 67.000 25.000         0.0 67.000 25.000         0.0 67.000 25.000           4 -4.0000 11.600 86.500         Yes         0.0 67.000 25.000         0.0 67.000 25.000         0.0 67.000 25.000			
Side         Corner 1         Corner 2         Ground Movement Curve           x         y         x         y         Vertical         Horizontal           [m]         [m] <td< td=""><td></td><td></td><td></td></td<>			
1       -4.0000       -11.600       2.2000       -11.600       Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(b)         2       2.2000       -11.600       2.2000       11.600       Form and			
CIRIA 580 Fig. 2.11(b) (CIRIA 580 Fig. 2.11(a)) 4 -4.0000 11.600 -4.0000 -11.600 Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(b) (CIRIA 580 Fig. 2.11(a))			
Excavation Name:         Secant Pile Wall Installation           Surface level [m]:         90,000           Contribution:         Positive           Enabled:         Yes			

 y
 Base Stiffened
 Previous Side
 Next Side

 Level
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Corner x

[m]

		Job No.	Sheet No.	Rev.	
Oasys		141396			
40 Frognal Lane		Drg. Ref.			
Short-term Loading (Wall Toe 5mbbl) No. 38		Made by JC	Date 10-Feb-2021	Checked	
Corner x         y         Base Stiffened Previous Side           Level         d         p1         p2*           [m]         [m]         [m]         [%]         [%]	Next Side           d         pl         p2*           [m]         [%]         [%]				
1         -4.000         -11.600         81.500         Yes         0.0         50.000         20.000           2         2.2000         -11.600         81.500         Yes         0.0         50.000         20.000           3         2.2000         11.600         81.500         Yes         0.0         50.000         20.000	0.0 50.000 20.000 0.0 50.000 20.000 0.0 50.000 20.000				
4 -4.0000 11.600 81.500 Yes 0.0 50.000 20.000 Side Corner 1 Corner 2	0.0 50.000 20.000 Ground Movement Curve				
x         y         x         y         Vertic           [m]         [m]         [m]         [m]         [m]         1         -4.0000         -11.600         Installation of :	al Horizontal ecant bored Installation of secant bored				
pile wall in stif 580 Fig. 2.8(b)) 2 2 2000 -11 600 2 2000 11 600 Instilution of	f clay (CIRIA pile wall in stiff clay (CIRIA 580 Fig. 2.8(a))				
pile wall in stif 580 Fig. 2.8(b)) 2 2 2000 11 600 4 0000 11 601 Extended	f clay (CIRIA pile wall in stiff clay (CIRIA 580 Fig. 2.8(a))				
3 2.2000 11.000 -4.0000 11.000 Installation of s pile wall in stif 580 Fig. 2.8(b))	f clay (CIRIA pile wall in stiff clay (CIRIA 580 Fig. 2.8(a))				
4 -4.0000 11.600 -4.0000 -11.600 Installation of s pile wall in stif 580 Fig. 2.8(b))	ecant bored Installation of secant bored f clay (CIRIA pile wall in stiff clay (CIRIA 580 Fig. 2.8(a))				
Damage Category Strains					
Name 0 (Negligible) 1 (Very Slight) to to to	2 (Slight) 3 (Moderate) to to				
1 (Very Slight)         2 (Slight)           Burland Strain Limits         0.0         500.00E-6	3 (Moderate) 4 (Severe) 750.00E-6 0.0015000				
Specific Structures - Geometry					
Along 2 Line Mo. 38 East Wall No. 38 East 0.00000 13	long         Line for         Limit           Line         Vertical         Sensitivity           Movement         Calculations           [m]         [m]           .77100         0.0         0.10000 Burland Strain Ling	nits 0.20000 2.6000			
Specific Structures - Bending Parameters					
Structure Name Sub-Structure Height Default Name Properties	Hogging Sagging				
2nd Momer of Area (per uni)	t Distance Distance 2nd Moment Distance Distan of Bending of N.A. of Area of Bending of N.A Strain from Edge (per unit Strain from Ed	ce ge			
width)	from N.A. of Beam in width) from N.A. of Beam Tension Tensio	in n			
lo. 38 East Wall 8.0000 Yes 170.6	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	000			
Building Segment Combinations					
Structure Name Sub-Structure Vertical Segment Start Name Offset from Line for Vertical Movement Calculations	Length Curvature Combined Segment				
Structure Name Sub-Structure Vertical Segment Start Name Offset from Line for Vertical Movement Calculations [m] [m]	Length Curvature Combined Segment [m]				
tructure Name Sub-Structure Vertical Segment Start Name Offset from Line for Vertical Movement Calculations [m] [m] Jtility Strain Calculation Options	Length Curvature Combined Segment [m]				
Structure Name Sub-Structure Vertical Segment Start Name Offset from Line for Vertical Movement Calculations [m] [m] No structures have segments combined.	Length Curvature Combined Segment [m]				
Structure Name Sub-Structure Vertical Segment Start Name Offset from Line for Vertical Movement Calculations [m] [m] No structures have segments combined. Willity Strain Calculation Options Neglect beneficial contribution of axial strains : No Warnings 1 Multiple excavations have been specified. The displacemen- individual excavation. No account has been taken of excavations (e.g. overlapping zones of influence or ' another).	<pre>[m] [m] cements resulting from these ts resulting from each the interactions between shielding' of one excavation by</pre>				
Structure Name Sub-Structure Vertical Segment Start Name Offset from Line for Vertical Movement Calculations [m] [m] No structures have segments combined. Vtility Strain Calculation Options leglect beneficial contribution of axial strains : No Narnings Multiple excavations have been specified. The displacement excavations are calculated by summing the displacement excavations are calculated by summing the displacement is account in excavation. No account has been taken of excavations (e.g. overlapping zones of influence or ' another).	<pre>[m] [m] cements resulting from these ts resulting from these ts resulting from each the interactions between shielding' of one excavation by</pre>				
Structure Name Sub-Structure Vertical Segment Start Name Offset from Line for Vertical Movement Calculations [m] No structures have segments combined. [m] N	<pre>[m] [m] cements resulting from these ts resulting from each the interactions between shielding' of one excavation by</pre>				
tructure Name Sub-Structure Vertical Segment Start Name Offset from Line for Vertical Movement Calculations [m] [m] To structures have segments combined.  Millity Strain Calculation Options leglect beneficial contribution of axial strains : No Varnings Multiple excavations have been specified. The displacement individual excavation. No account has been taken of excavations (e.g. overlapping zones of influence or ' another).  Errors Home	<pre>[m] [m] cements resulting from these ts resulting from these the interactions between shielding' of one excavation by</pre>				
Structure Name Sub-Structure Vertical Segment Start Name Offset from Line for Vertical Movement Calculations [m] [m] No structures have segments combined. Willight Strain Calculation Options Reglect beneficial contribution of axial strains : No Warnings Multiple excavations have been specified. The displacement individual excavation. No account has been taken of excavations are calculated by summing the displacement individual excavation. No account has been taken of excavations (e.g. overlapping zones of influence or ' another). Errors None Displacement and Strain Results Tore (No. Conditional)	<pre>[m] [m] cements resulting from these ta resulting from these the interactions between shielding' of one excavation by</pre>				
<pre>Structure Name Sub-Structure Vertical Segment Start Name Offset from Line for Vertical Movement Calculations [m] [m] No structures have segments combined. ////////////////////////////////////</pre>	Langth Curvature Combined         Segment         [m]         (m)         cements resulting from these         ts resulting from these         ts resulting from each         the interactions between         shielding' of one excevation by         Displacements       Angl.         Ji       y       z         Horizontal Horizontal to x       Horizontal to x	a of ne Axis			
Structure Name Sub-Structure Vertical Segment Start Name Offset from Line for Vertical Movement Calculations [m] [m] No structures have segments combined. Hillity Strain Calculation Options Reglect beneficial contribution of axial strains : No Marnings Multiple excavations have been specified. The displacement individual excavation. No account has been taken of excavations are calculated by summing the displacement individual excavation. No account has been taken of excavations (e.g. overlapping zones of influence or ' another). Errors Name Dist. x y z x	Eangth Curvature Combined Segment [m] [m] [m] [m] [m] [m] [m] [m] [m] [m]	e of ne Axis			
Structure Name     Sub-Structure Name     Vertical forset from Vertical Movement Calculations     Segment Start       No structures have segments combined.     [m]     [m]       No structures have segments combined.     [m]     [m]       Warnings     Image: Calculation Options     [m]     [m]       1     Multiple excavations have been specified. The displacement individual excavation. No account has been taken of excavations (e.g. overlapping zones of influence or ' another).       Errors       None       Displacement and Strain Results       Type/No.     Coordinates       Name     Dist.     x     y     x       [m]     [m]     [m]     [m]     [m]       No. 38     Line 1     10.00000 -11.60000     90.00000 -2.471	Langth Curvature Combined Segment         [m]         [m]         Displacements       Angl.         the interactions between shielding' of one excevation by         y       z         displacement       fis         uisplacement       displacement along Line perpendicular         to Line       to Line         [mm]       [mm]         6       0.0	a of ne Axis 0.218 ★			
Structure Name     Sub-Structure Name     Vertical Segment Start       Name     Offset from Usertical Movement Calculations       [m]     [m]       No structures have segments combined.       Utility Strain Calculation Options       Neglect beneficial contribution of axial strains : No       Warnings       1     Multiple excavations have been specified. The displacement individual excavation. No account has been taken of excavations (e.g. overlapping zones of influence or ' another).       Errors       None       Displacement and Strain Results       Type/No.       Coordinates       Name     Dist.     x     y     z     x       No. 38     Line 1     10.00000     -11.6000     00.00000     -2.471       East     0.98093     10.16667     -10.63333     90.00000     -3.855       2.9428     10.03000     -3.7000     90.00000     -3.855	Eargth Curvature Combined Segment [m] [m] Displacements Angl. y z Horizontal Korizontal to X along Line perpendicular content along Line perpendicular (mm) (mm) (mm) (mm) (mm) ( 6 0.0 1.6182 -0.66085 3.8329 8 5 0.0 2.8348 -0.66392 3.7046 8	a of ne Axis "] 0.218 * 0.218 * 0.218 * 0.218 *			

	1.9019	10.00000	-9.0000/	90.00000	-2.0095	0.0	2.3303	-0.00000	2.0325	00.210 "
	2.9428	10.50000	-8.70000	90.00000	-3.7593	0.0	2.8348	-0.63872	3.7046	80.218 *
	3.9237	10.66667	-7.73333	90.00000	-3.6299	0.0	2.7404	-0.61674	3.5771	80.218 *
	4.9046	10.83333	-6.76667	90.00000	-3.5013	0.0	2.6479	-0.59490	3.4504	80.218 *
	5.8856	11.00000	-5.80000	90.00000	-3.3735	0.0	2.5573	-0.57319	3.3245	80.218 *
	6.8665	11.16667	-4.83333	90.00000	-3.2465	0.0	2.4690	-0.55160	3.1993	80.218 *
	7.8474	11.33333	-3.86667	90.00000	-3.1201	0.0	2.3830	-0.53013	3.0748	80.218 *
	8.8284	11.50000	-2.90000	90.00000	-2.9944	0.0	2.2994	-0.50877	2.9509	80.218 *
	9.8093	11.66667	-1.93333	90.00000	-2.8693	0.0	2.2183	-0.48752	2.8276	80.218 *
	10.790	11.83333	-0.96667	90.00000	-2.7448	0.0	2.1398	-0.46636	2.7049	80.218 *
	11.771	12.00000	0.00000	90.00000	-2.6208	0.0	1.9823	-0.44529	2.5827	80.218 *
* Result includes	imported disp	placement(s).								
Specific Build	Specific Building Damage Results - Horizontal Displacements									
	5									

Structu	re: No. 3	8   Sub-st	ructure: 1	East Wall	L			
Dist.		Coordinate	s			Displacement	3	
	x	У	z	x	У	Horizontal displacement along the	Horizontal displacement perpendicular	
[m] 0.0	[m] 10.00000	[m] -11.60000	[m] 90.00000	[mm] -2.4716	[mm] 0.0	[mm] -0.41994	[mm] 2.4357	d

No	38

FAIRHURST	Job No. Sheet No. Rev
JUSYS	141396
) Frognal Lane	Drg. Ref.
hort-term Loading (Wall Toe 5mbbl) o. 38	Made by Date Checke
Dist. Coordinates Displacements x y z x y Horizontal Horizontal displacement displacement	
along the perpendicular .98093 10.16667 -10.63333 90.00000 -4.0206 0.0 -0.68313 3.9622 d 1.9619 10.33333 -9.66667 90.00000 -3.8895 0.0 -0.66085 3.8329 d	
2.9428 10.50000 -8.70000 90.00000 -3.7593 0.0 -0.63872 3.7046 d 3.9237 10.66667 -7.73333 90.00000 -3.6299 0.0 -0.61674 3.5771 d 4.9046 10.83333 -6.76667 90.00000 -3.5013 0.0 -0.559490 3.4504 d	
5.8856 11.00000 -5.80000 90.00000 -3.3735 0.0 -0.57319 3.3245 d 6.8665 11.16667 -4.8333 90.00000 -3.2465 0.0 -0.55160 3.1993 d 7.8474 11.33333 -3.86667 90.00000 -3.1201 0.0 -0.53013 3.0748 d	
8.8284 11.50000 -2.90000 90.00000 -2.9944 0.0 -0.50877 2.9509 d 9.8093 11.66667 -1.93333 90.00000 -2.8693 0.0 -0.48752 2.8276 d 10.790 11.83333 -0.96667 90.00000 -2.7448 0.0 -0.46636 2.7049 d	
1.771 12.00000 0.00000 90.00000 -2.6208 0.0 -0.44529 2.5827 d - Displacements include imported displacements.	
pecific Building Damage Results - Vertical Displacements	
tructure: No. 38   Sub-structure: East Wall	
List.         Coordinates         Displacements           x         y         z         z           [m]         [m]         [m]         [m]	
ertical Offset 1 0.0 10.00000 -11.60000 90.00000 1.6182 d 9893 10.16667 -10.6333 90.00000 3.0285 d	
1.9619 10.33333 -9.66667 90.00000 2.9309 d 2.9428 10.50000 -8.70000 90.00000 2.9348 d 9237 10.6667 -7.7333 90.00000 2.7404 d	
3.925 10:0000 1.7533 -6.7667 90.00000 2.6479 d 5.8856 11.00000 -5.80000 90.00000 2.5573 d	
7.8474 11.33333 -3.86667 90.00000 2.3830 d 8.8284 11.50000 -2.9000 90.00000 2.2994 d 9.09311 6667 -1 9333 90.00000 2.2183 d	
10.790 11.83333 -0.96667 90.00000 2.1398 d 11.771 12.00000 0.00000 90.0000 1.9823 d - Displacements include imported displacements.	
pecific Building Damage Results - All Segments	
tructure: No. 38   Sub-structure: East Wall	
ertical Offset Segment Start Length Curvature Deflection Average Max Max Gradie: from Line for Ratio Horizontal Tensile of	ıt Max Gradient Min Damage of Vertical Radius of Category
Vertical Strain Strain Horizonta Movement Displaceme Alculations Curve	. Displacement Curvature it Curve
[m] [m] [m] [%] [%] [%] 0.0 1 0.0 2.9384 Sagging 0.034129 -0.0074489 0.030310 268.38E	-6 -0.0014381 510.24 0 (Negligible)
2 2.9384 6.0110 Hogging 171.46E-6 0.0022072 0.0023028 -22.558E 3 8.9494 2.8216 Sagging 0.0017809 0.0021566 0.0030931 -21.667E	-6 97.946E-6 383570. 0 (Negligible) -6 160.54E-6 9680.5 0
ensile horizontal strains are +ve, compressive horizontal strains are -ve.	(Negligible)
pecific Building Damage Results - Critical Values for All Segments within Each Sub-Structure	
tructure: No. 38   Sub-structure: East Wall	
Vertical Deflection Average Max Slope Max Max Max Gradient Max Gradient Min ffset from Ratio Horizontal Settlement Tensile of of Vertical Radius Line for Strain Strain Horizontal Displacement Curvat	Min Damage Category of Radius of re Curvature
Vertical Displacement Curve (Hoggi: Movement Curve alculations	(\$agging)
[m]         [%]         [%]         [m]         [%]         [m]           0.0         0.034129         -0.0074489         -0.0014381         3.0266         0.030310         268.38E-6         -0.0014381         3835	[m] /0. 510.24 0 (Negligible)
pecific Building Damage Results - Critical Segments within Each Structure	
tructure Name Parameter Critical Critical Start End Curvature Max Slope Max Sub-Structure Segment Settlem	Max Min Min Damage Category Int Tensile Radius of Radius of Strain Curvature Curvature
[m] [m] [m] 5. 38 Max Slope East Wall 1 0.0 2.9384 Sagging <b>0.0014381</b> 3.0	(Hogging) (Sagging) [%] [m] [m] 266 0.030310 - 510.24 0 (Negligible)
Max Settlement         East Wall         1         0.0         2.9384         Sagging         0.0014381         3.0           Max Tensile         East Wall         1         0.0         2.9384         Sagging         0.0014381         3.0           Strain         1         0.0         2.9384         Sagging         0.0014381         3.0	66         0.030310         -         510.24 0 (Negligible)           66         0.030310         -         510.24 0 (Negligible)
Min Radius of East Wall 2 2.9384 8.9494 Hogging 97.946E-6 2.8 Curvature (Hooging)	153 0.0023028 <b>383570.</b> - 0 (Negligible)
Win Radius of East Wall 1 0.0 2.9384 Sagging 0.0014381 3.0 Curvature (Sagging)	:66 0.030310 - <b>510.24</b> 0 (Negligible)

### FAIRHURST )asys 40 Frognal Lane Long-term Loading, Wall Toe 5mbbl No. 38

Job No.	Sheet No.	Rev.
141396		
Drg. Ref.		
Made by JC	Date 10-Feb-2021	Checked

Problem Type

Problem Type : Tunnelling and Embedded Wall Excavations

#### Displacement Data

Туре	Name	Direction of extrusion		Point/	Line/Line	for extr	usion		No. of intervals across extrusion/line	Extrusion depth	No. of intervals along extrusion	Calculate	Surface type for tunnels
			1	First poin	t	Se	cond poi	nt					
			х	Y	Z(level)	х	Y	Z(level)					
			[m]	[m]	[m]	[m]	[m]	[m]		[m]			
Line	No. 38 East	-	10.00000	-11.60000	90.00000	12.00000	0.00000	90.00000	12	-	-	Yes	Surface

Imported Displacements
The following data points and displacements were found in the import file Pdisp Long term Loading to be Imported.csv.

Ref.	Ce	ordinates		Di	splacemen	nts	
Rei.	x	У	z	×	У	z .	
1	[m] -7.50000	[m] 0.00000	[m] 91.50000	[mm] 0.00000	[mm] 0.00000	[mm] 0.86030	
2	-7.50000	1.00000	91.50000	0.00000	0.00000	0.85840	
3	-7.50000	2.00000	91.50000	0.00000	0.00000	0.85260	
5	-7.50000	4.00000	91.50000	0.00000	0.00000	0.82750	
6	-7.50000	5.00000	91.50000	0.00000	0.00000	0.80660	
8	-7.50000	7.00000	91.50000	0.00000	0.00000	0.74270	
9	-7.50000	8.00000	91.50000	0.00000	0.00000	0.69680	
10	-7.50000	10.00000	91.50000	0.00000	0.00000	0.57280	
12	-7.50000	11.00000	91.50000	0.00000	0.00000	0.49670	
14	-7.50000	13.00000	91.50000	0.00000	0.00000	0.33950	
15	-7.50000	14.00000	91.50000	0.00000	0.00000	0.26980	
10	-7.50000	0.00000	91.50000	0.00000	0.00000	0.21050	
18	-8.42730	0.00000	91.50000	0.00000	0.00000	0.64620	
20	-9.35450	0.00000	91.50000	0.00000	0.00000	0.48830	
21	-11.20910	0.00000	91.50000	0.00000	0.00000	0.28060	
22	-12.13640	0.00000	91.50000	0.00000	0.00000	0.21260	
24	-13.99090	0.00000	91.50000	0.00000	0.00000	0.12090	
25	-14.91820	0.00000	91.50000	0.00000	0.00000	0.09040	
27	-16.77270	0.00000	91.50000	0.00000	0.00000	0.04900	
28	-17.70000	0.00000	91.50000	0.00000	0.00000	0.03510	
30	-8.42730	15.00000	91.50000	0.00000	0.00000	0.16900	
31	-9.35450	15.00000	91.50000	0.00000	0.00000	0.13430	
33	-11.20910	15.00000	91.50000	0.00000	0.00000	0.08240	
34	-12.13640	15.00000	91.50000	0.00000	0.00000	0.06350	
36	-13.99090	15.00000	91.50000	0.00000	0.00000	0.03610	
37	-14.91820	15.00000	91.50000	0.00000	0.00000	0.02640	
39	-16.77270	15.00000	91.50000	0.00000	0.00000	0.01250	
40	-17.70000	15.00000	91.50000	0.00000	0.00000	0.00770	1.2.6
41	10.00000	-10.63330	90.00000	0.00000	0.00000	0.12510	1,2,6
43	10.33330	-9.66670	90.00000	0.00000	0.00000	0.14240	1,2,6
44	10.50000	-8.70000	90.00000	0.00000	0.00000	0.14810	1,2,6
45	10.83330	-6.76670	90.00000	0.00000	0.00000	0.15170	1,2,6
47	11.00000	-5.80000	90.00000	0.00000	0.00000	0.15350	1,2,6
48	11.16670	-4.83330	90.00000	0.00000	0.00000	0.15190	1,2,6
49	11.53330	-2.90000	90.00000	0.00000	0.00000	0.14910	1,2,6
51	11.66670	-1.93330	90.00000	0.00000	0.00000	0.14020	1,2,6
52	11.83330	-0.96670	90.00000	0.00000	0.00000	0.13460	1,2,6
53	10.00000	-11.60000	90.00000	0.00000	0.00000	0.12830	1,2,6
55	11.00000	-11.60000	90.00000	0.00000	0.00000	0.09250	
57	13.00000	-11.60000	90.00000	0.00000	0.00000	0.06780	
58	14.00000	-11.60000	90.00000	0.00000	0.00000	0.03480	
60	16.00000	-11.60000	90.00000	0.00000	0.00000	0.02390	
61	17.00000	-11.60000	90.00000	0.00000	0.00000	0.00940	
62	19.00000	-11.60000	90.00000	0.00000	0.00000	0.00470	
64	20.00000	-11.60000	90.00000	0.00000	0.00000	-0.00150	
65 66	21.00000	-11.60000	90.00000	0.00000	0.00000	-0.00350	
67	23.00000	-11.60000	90.00000	0.00000	0.00000	-0.00600	
68	24.00000	-11.60000	90.00000	0.00000	0.00000	-0.00670	
70	12.00000	0.00000	90.00000	0.00000	0.00000	0.12830	1,2,6
71	13.00000	0.00000	90.00000	0.00000	0.00000	0.09390	
73	15.00000	0.00000	90.00000	0.00000	0.00000	0.04850	
74	16.00000	0.00000	90.00000	0.00000	0.00000	0.03380	
76	18.00000	0.00000	90.00000	0.00000	0.00000	0.01440	
77	19.00000	0.00000	90.00000	0.00000	0.00000	0.00810	
79	21.00000	0.00000	90.00000	0.00000	0.00000	0.00000	
80	22.00000	0.00000	90.00000	0.00000	0.00000	-0.00250	
81	24.00000	0.00000	90.00000	0.00000	0.00000	-0.00440	
83	25.00000	0.00000	90.00000	0.00000	0.00000	-0.00660	
84	27.00000	0.00000	90.00000	0.00000	0.00000	-0.00720	
86	6.50000	-11.60000	91.00000	0.00000	0.00000	0.35240	
87	6./9170 7.08330	-10.63330	91.00000	0.00000	0.00000	0.3/310	
89	7.37500	-8.70000	91.00000	0.00000	0.00000	0.38570	
90 91	7.95830	- 7.73330	91.00000	0.00000	0.00000	0.38030	
92	8.25000	-5.80000	91.00000	0.00000	0.00000	0.35460	
93 94	8.54170 8.83330	-4.83330	91.00000	0.00000	0.00000	0.33700	
95	9.12500	-2.90000	91.00000	0.00000	0.00000	0.29740	
96 97	9.41670	-1.93330	91.00000	0.00000	0.00000	0.27670	
98	10.00000	0.00000	91.00000	0.00000	0.00000	0.23520	
99 100	10.29170	0.96670	91.00000	0.00000	0.00000	0.21480	
101	10.87500	2.90000	91.00000	0.00000	0.00000	0.17560	
102	11.16670	3.86670 4.83330	91.00000	0.00000	0.00000	U.15690 0.13890	

asys	FAIRHURST
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Job No.	Sheet No.	Rev.
141396		
Drg. Ref.		

Date 10-Feb-2021

Checked

Made by JC

**40 Frognal Lane** Long-term Loading, Wall Toe 5mbbl No. 38

Rei.	<b>x</b>	ordinates y	<b>z</b> [m]	Di x	splaceme: y	nts z		
104 105 106 107 108 109 110 1 - Data j	11.75000 12.04170 12.33330 12.62500 12.91670 13.20830 13.50000 point coincident	5.80000 6.76670 7.73330 8.70000 9.66670 10.63330 11.60000 with displace	91.00000 91.00000 91.00000 91.00000 91.00000 91.00000 91.00000 91.00000	0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 displaceme	0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 ent has been	0.12170 0.10550 0.09020 0.07610 0.06320 0.05170 0.04140 added to those	calculated by X	disp.
2 - Data j 6 - Data j	point coincident point coincident	with horizont with vertical	al movement movement cal	calculation culation po	point for a s int for a spe	pecific building cific building.	g. Its displacem Its displacement	ent has been added before performing building damage calculation thas been added before performing building damage calculations
Vertica	l Ground Me	ovement Cu	urves (Exca	avations)				
Coordi	Name: nates:	Installat [Distance depth or	e from wal	cant bo	<b>red pile</b> l depth depth (y	wall in s or max. ex ), Settlem	<b>tiff clay (</b> cavation de ent / wall	CIRIA 580 Fig. 2.8(b)) pth (x), Depth / wall depth or max. excavation
Curve Method x Orde y Orde Polyno Coeff.	Fitting :: r: mial: z = of	1 0 -2.5E-2x	+ 5.0E-2	][2.000	,0.000,0	.000]		
Determ Curve	ination:	Excavatio	on in from	t of hi	gh stiff	ness wall :	in stiff cl	ay (CIRIA 580 Fig. 2.11(b)
Coordi	nates:	[Distance depth or depth (2) [0.000,0] [0.800,0] [1.200,0] [1.600,0] [2.000,0] [2.800,0] [3.200,0] [3.200,0] [3.600,0]	<pre>a from wal max. exca (%) 000,0.039 000,0.065 000,0.055 000,0.055 000,0.034 000,0.024 000,0.010 000,0.010 000,0.010</pre>	1 / wal vation [0.100 [0.500 [0.900 [1.300 [1.700 [2.100 [2.500 [2.900 [3.300] [3.700	1 depth (y depth (y ,0.000,0 ,0.000,0 ,0.000,0 ,0.000,0 ,0.000,0 ,0.000,0 ,0.000,0 ,0.000,0 ,0.000,0	or max. ex ), Settlem .049][0.20 .070][0.60 .061][1.40 .046][1.40 .046][1.80 .030][2.20 .017][2.60 .008][3.00 .004][3.40 .002][3.80	cavation de ent / wall 0,0.000,0.0 0,0.000,0.0 0,0.000,0.0 0,0.000,0.0 0,0.000,0.0 0,0.000,0.0 0,0.000,0.0 0,0.000,0.0	pth (x), Depth / wall depth or max. excavation 56] [0.300,0.000,0.062] 72] [0.700,0.000,0.073] 70] [1.100,0.000,0.068] 58] [1.500,0.000,0.054] 42] [1.200,0.000,0.038] 27] [2.300,0.000,0.023] 14] [2.700,0.000,0.023] 13] [3.500,0.000,0.005] 03] [3.500,0.000,0.005] 03] [3.500,0.000,0.001]
Curve Method	Fitting 1:	[4.000,0. Polynomia	1 1					
x Orde y Orde Polyno	r: r: mial: z =	4 0 -2.6455E-	-3x <sup>4</sup> + 2.8	495E-2x	<sup>3</sup> - 1.00	51E-1x <sup>2</sup> +	1.0569E-1x	+ 3.8990E-2
Coeff. Determ	of ination:	9.9991E-1						
Horizoi	ntal Ground	Movement	t Curves (E	xcavatio	ns)			
Curve Method	Fitting r:	[Distance depth or excavatic [0.000,0. [0.200,0. [0.400,0] [0.800,0. [1.000,0. [1.200,0. [1.400,0] Polynomia	a from Wall max. exca on depth ( 000,0.081 000,0.045 000,0.045 000,0.045 000,0.027 000,0.011 000,0.014	<pre>vation vation z) (%)] ][0.050 ][0.250 ][0.450 ][0.650 ][0.650 ][0.850 ][1.050 ][1.250 ][1.450</pre>	depth (y ,0.000,0 ,0.000,0 ,0.000,0 ,0.000,0 ,0.000,0 ,0.000,0 ,0.000,0	or max. ex. ), Horizon .076][0.10 .059][0.30 .045][0.50 .034][0.70 .024][0.90 .016][1.10 .009][1.30 .002][1.50	Cavarion de tal movemen 0,0.000,0.0 0,0.000,0.0 0,0.000,0.0 0,0.000,0.0 0,0.000,0.0 0,0.000,0.0 0,0.000,0.0	prn (x), Deprh / Wall t / wall depth or max. 72] [0.150,0.000,0.067] 56] [0.350,0.000,0.052] 32] [0.750,0.000,0.040] 32] [0.750,0.000,0.029] 22] [0.950,0.000,0.020] 14] [1.150,0.000,0.012] 00]
y Orde Polyno Coeff.	mial: z = of	0 -1.0610E- 1.0000	-2x <sup>3</sup> + 4.4	203E-2x	<sup>2</sup> - 9.63	58E-2x + 8	.0901E-2	
Curve	Name:	Excavatio	on in from	t of hi	gh stiff	ness wall	in stiff cl	ay (CIRIA 580 Fig.
Curve Method x Orde y Orde Polyno Coeff. Determ	<pre>nates: Fitting t: r: mial: z = of tination:</pre>	2.11(a)) [Distance depth or excavatic [0.000,0. Polynomia 1 0 -3.75E-2x 1.00	e from wal max. exca on depth ( 000,0.150 al c + 1.50E-	1 / wal vation z)(%)] ][4.000	l depth (y depth (y	or max. ex. ), Horizon .000]	cavation de tal movemen	pth (x), Depth / wall t / wall depth or max.
Polygo	onal Excavat	ions						
<b>Excava</b> Surfac Contri Enable	tion Name: the level [m bution: td:	]:		Pool e 90.000 Positi Yes	<b>xcavatio</b> ve	n		
Corner 1 2 3 4	[m] -4.0000 - 2.2000 - 2.2000 -4.0000	y Ba Lev [m] [n 11.600 86. 11.600 86. 11.600 86.	ase Stiff rel 500 Ye 500 Ye 500 Ye 500 Ye	<b>ened</b> [m s s s s o o	Previous p1 ] [%] .0 67.000 .0 67.000 .0 67.000 .0 67.000	Side p2* [%] [1 0 25.000 0 25.000 0 25.000 0 25.000	Next Sid d pl m] [%] 0.0 67.000 0.0 67.000 0.0 67.000 0.0 67.000	ie p2* [%] 25.000 25.000 25.000 25.000 25.000
Side	Corner x [m]	1 y [m]	Corner x [m]	2 9 [m]		Vertica	Ground Mc	vement Curve Horizontal
1	-4.0000	-11.600	2.2000 -	11.600	Excavati stiffnes (CIRIA 5 Excavati stiffnes	on in from s wall in 80 Fig. 2. on in from s wall in	t of high stiff clay 11(b) t of high stiff clay	Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(a)) Excavation in front of high stiffness wall in stiff clay
3	2.2000	11.600 -	4.0000	11.600	(CIRIA 5 Excavati stiffnes	80 Fig. 2. on in from s wall in	11(b) t of high stiff clay	(CIRIA 580 Fig. 2.11(a)) Excavation in front of high stiffness wall in stiff clay
4	-4.0000	11.600 -	-4.0000 -	11.600	(CIRIA 5 Excavati stiffnes (CIRIA 5	80 Fig. 2. on in from s wall in 80 Fig. 2.	11(b) t of high stiff clay 11(b)	(CIRIA 580 Fig. 2.11(a)) Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(a))
<b>Excava</b> Surfac Contri	tion Name: me level [m bution:	]:		Secant 90.000 Positi	<b>Pile Wa</b>	ll Install	ation	
	d:			Yes				

FAIRHURST	Job No.	Sheet No.	Rev.
JUSYS	141396		
Frognal Lane	Drg. Ref.		
ng-term Loading, Wall Toe 5mbbl 38	Made by	Date	Checked
er x v Base Stiffened Previous Side Next Side	JC	10-Feb-2021	
Level         d         p1         p2*         d         p1         p2*           [m]         [m]         [m]         [m]         [%]         [%]         [%]         [%]			
1         -4.0000         -11.600         81.500         Yes         0.0         50.000         20.000         0.0         50.000         20.000           2         2.2000         -11.600         81.500         Yes         0.0         50.000         20.000         0.0         50.000         20.000           3         2.2000         11.600         81.500         Yes         0.0         50.000         20.000         20.000           4         -4.0000         11.600         81.500         Yes         0.0         50.000         20.000         20.000			
e Corner 1 Corner 2 Ground Movement Curve x y x y Vertical Horizontal [m] [m] [m] [m]			
1 -4.0000 -11.600 2.2000 -11.600 Installation of secant bored Installation of secant bored pile wall in stiff clay (CIRIA pile wall in stiff clay (CIRIA 580 Fig. 2.8(b)) 580 Fig. 2.8(a)			
2 2.2000 -11.600 2.2000 11.600 Installation of secant bored Installation of secant bored pile wall in stiff clay (CIRIA pile wall in stiff clay (CIRIA 580 Fig. 2.8(b)) 580 Fig. 2.8(a))			
3 2.2000 11.000 -4.0000 11.600 installation or secant bored pile wall in stiff clay (CIRIA pile wall in stiff clay (CIRIA 580 Fig. 2.8(b)) 590 Fig. 2.8(a) 1600 Installation of secant bored			
-4.0000 11.000 -4.0000 -11.000 installation of secant bored pile wall in stiff clay (CIRIA pile wall in stiff clay (CIRIA 580 Fig. 2.8(b)) 580 Fig. 2.8(a))			
mage Category Strains			
Name 0 (Negligible) 1 (Very Slight) 2 (Slight) 3 (Moderate) to to to to 1 (Very Slight) 2 (Slight) 3 (Moderate) 4 (Severe)			
land Strain Limits 0.0 500.00E-6 750.00E-6 0.0015000			
<i>necific Structures - Geometry</i> ructure Name Sub-Structure Displacement Start End Vertical Vertical Damage Categor	y Strains Poisson's E/G		
Name Line Distance Offsets from Displacement Along Along Line for Limit Line Line Vertical Sensitivity	Ratio		
Movement           Calculations           [m]         [m]			
. 38 East Wall No. 38 East 0.00000 11.77100 0.0 0.10000 Burland Strain 3	Limits 0.20000 2.6000		
necific Structures - Bending Parameters ructure Name Sub-Structure Height Default Hogging Sagging			
Name Properties 2nd Moment Distance Distance 2nd Moment Distance Dist of Area of Bending of N & of Area of Bending of N	ance		
(per unit Strain from Edge (per unit Strain from ) width) from N.A. of Beamin width) from N.A. of Be	Edge am in		
Tension         Tension         Tension           [m]         <	.0000		
ilding Segment Combinations ructure Name Sub-Structure Vertical Segment Start Length Curvature Combined Name Offset from Segment			
Vertical Novement			
[m] [m] [m] structures have segments combined.			
ility Strain Calculation Options			
glect beneficial contribution of axial strains : No			
arnings			
wultiple excavations have been specified. The displacements resulting from these excavations are calculated by summing the displacements resulting from each individual excavation. No account has been taken of the interactions between excavations (e.g. overlapping zones of influence or 'shielding' of one excavation by another).			
7075			
ine			
splacement and Strain Results			
Type/No. Coordinates Displacements An	gle of Line		
Name Dist. x y z x y z Horizontal Horizontal to displacement displacement along Line perpendicular	x Axis		
to Line [m] [m] [m] [mm] [mm] [mm] [mm] [mm] No. 38 Line 1 10.00000 -11.60000 90.00000 -2.4716 0.0 1.9982 -0.41994 2.4357	[°] 80.218 *		
East 0.98093 10.16667 -10.63333 90.00000 -4.0206 0.0 3.2284 -0.68313 3.9622 1.9619 10.33333 -9.66667 90.00000 -3.8895 0.0 3.1391 -0.66085 3.8329	80.218 * 80.218 *		
2.9428 10.50000 -8.70000 90.00000 -3.7593 0.0 3.0498 -0.63872 3.7046 3.9237 10.6667 -7.7333 90.00000 -3.6299 0.0 2.9605 -0.61674 3.5771 4.9046 10.83333 -6.76667 90.00000 -3.5013 0.0 2.8715 -0.59490 3.4504	80.218 * 80.218 * 80.218 *		
5.8856 11.00000 -5.80000 90.00000 -3.3735 0.0 2.7829 -0.57319 3.2245 6.8665 11.16667 -4.8333 90.00000 -3.2465 0.0 2.6949 -0.55160 3.1993 7.8474 11.33333 -3.86667 90.00000 -3.1201 0.0 2.6080 -0.53013 3.0748	80.218 * 80.218 * 80.218 *		
8.8284 11.50000 -2.90000 90.00000 -2.9944 0.0 2.5222 -0.50877 2.9509 9.8093 11.6667 -1.9333 90.00000 -2.8693 0.0 2.4378 -0.48752 2.8276 10.790 11.83333 -0.96667 90.00000 -2.7448 0.0 2.3550 -0.46636 2.7049	80.218 * 80.218 * 80.218 *		
11.771 12.00000 0.00000 90.00000 -2.6208 0.0 2.4021 -0.44529 2.5827 esult includes imported displacement(s).	80.218 *		
ecific Building Damage Results - Horizontal Displacements			
ructure: No. 38   Sub-structure: East Wall			
ist. Coordinates Displacements x y z x y Horizontal Horizontal displacement displacement			
along the perpendicular Line to Line			
mj [m] [m] [m] [mm] [mm] [mm] [mm] 0.0 10.00000 -11.60000 90.00000 -2.4716 0.0 -0.41994 2.4357 d			

Job No.	Sheet No.
141396	

Damage Category

#### 40 Frognal Lane

Long-term Loading, Wall Toe 5mbbl No. 38

asys

141396		
Drg. Ref.		
Made by JC	Date 10-Feb-2021	Checked

Rev.

Т

Dist.	a At												
	Coordinates			Disp	placemen	ts							
*	У	z	x	у Ноз	rizontal	Hori	zontal						
				aisp	placemen	t dispi	acement						
0 98093 10 166	67 -10 63333 9	0 00000	-4 0206	0.0	-0 6831	3 berbe	3 9622 4						
1.9619 10.333	33 -9.666667 9	0.00000	-3.8895	0.0	-0.6608	5	3.8329 d						
2.9428 10.500	00 -8.70000 9	0.00000	-3.7593	0.0	-0.6387	2	3.7046 d						
3.9237 10.666	67 -7.73333 9	0.00000	-3.6299	0.0	-0.6167	4	3.5771 d						
4.9046 10.833	33 -6./666/ 9	0.00000	-3.5013	0.0	-0.5949	0 0	3.4504 d						
6.8665 11.166	67 -4.83333 9	0.00000	-3.2465	0.0	-0.5516	0	3.1993 d						
7.8474 11.333	33 -3.86667 9	0.00000	-3.1201	0.0	-0.5301	3	3.0748 d						
8.8284 11.500	00 -2.90000 9	0.00000	-2.9944	0.0	-0.5087	7	2.9509 d						
9.8093 11.666	67 -1.93333 9	0.00000	-2.8693	0.0	-0.4875	2	2.8276 d						
10.790 11.833	33 -0.96667 9	0.00000	-2.7448	0.0	-0.4663	6	2.7049 d						
d = Displaceme	nts include im	norted d	-2.0200 Hisplaceme	o.o	-0.4452	5	2.302/ u						
Specific Building	g Damage Resul	ts - Vertic	al Displac	cements									
Structure: No	38   Sub-stru	cture. E	ast Wall										
Structure. No.	50   500 3010	ccure. r	ast warr										
Dist.	Coordinates		Disp	lacements	5								
x	У	z	z										
[m] [m]	[m]	[m]	[mm]										
Wanting] Offer	<b>-</b> 1												
	00 -11 60000 9	0 00000	1 9982 4										
0.98093 10.166	67 -10.63333 9	0.00000	3.2284 d										
1.9619 10.333	33 -9.66667 9	0.00000	3.1391 d										
2.9428 10.500	00 -8.70000 9	0.00000	3.0498 d										
3.9237 10.666	67 -7.73333 9	0.00000	2.9605 d										
4.9046 10.833	33 -6./666/ 9	0.00000	2.8/15 d										
6.8665 11.166	67 -4.83333 9	0.00000	2.6949 d										
7.8474 11.333	33 -3.86667 9	0.00000	2.6080 d										
8.8284 11.500	00 -2.90000 9	0.00000	2.5222 d										
9.8093 11.666	67 -1.93333 9	0.00000	2.4378 d										
11 771 12 000	33 -0.96667 9	0.00000	2.3000 d										
d - Displaceme	nts include im	ported d	lisplaceme	ents.									
Specific Building	g Damage Resul	ts - All Se	egments										
Structure: No.	38   Sub-stru	cture: E	ast Wall										
Vertical Offse	t Segment	Star	t Length	h Curvatu	ure Defl	ection	Average	Max M	lax Gradient	Max Gradier	it Min	Damage	
from Line for					Ra	tio	Horizontal	Tensile	of	of Vertical	. Radius of	f Category	
Vertical							Strain	Strain	Horizontal	Displacemer	t Curvature	9	
Movement								D	isplacement	Curve			
Coloulations									<b>C</b> 1				
Calculations		[m]	[m]		r	& 1	[8]	[8]	Curve		[m]		
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Calculations [m] 0.0 Tensile horizo Specific Building Structure: No. Vertical D Offset from Vertical C Unit for Vertical D Structure: No. Specific Building Structure Name No. 38	ntal strains a g Damage Resul 38   Sub-stru eflection Ave Ratio Hori st (%) ( 0.029895 -0.0 g Damage Resul Parameter Max Slope Max Stileme Max Stileme Max Stileme Max Stilene Max Radius o Curvature (Regging) Min Radius o Curvature (Sagging)	(m)	[m] 1.0 2.9424 226 8.8284 compress: al Values : ast Wall is Slope 0.0012544 al Segmen :ritical :wall : Wall : Wall : Wall : Wall : Wall	6 Saggind 4 Hoggind ive horiz for All Se Settler 4 3.: ats within Critice Segme	g 0.0 g 0.0 g 0.0 gments v meent Tement St 22283 0.0 Each St ical Sta ant 1 1 2 2.9 1	<pre>%) 029995 029995 0013487 0013487 within Ea within Ea max M %) 26261 ucture rt En 0 02.9 0.0 2.9 426 11. 0.0 2.9</pre>	[%] -0.0074350 0.0021910 are -ve. cch Sub-Stru ax Gradient of Horizontal isplacement Curve 268.38E-6 d Curvetu 266 Sagging 426 Sagging 426 Sagging 426 Sagging 426 Sagging	[%] 0.025261 0.0032529 cture Max Gradie Of Vertica Displaceme Curve -0.001254 0.001254 0.001254 91.060E- 0.001254	Curve 268.38E-6 -22.558E-6 ant Min 1 Radius of ant Curvature (Hogging) 44 5940.3 (m) 44 5940.3 (m) 43.2283 4 3.2283 4 3.2283	-0.001254 91.060E- Min Radius of Ourvature (Sagging) [m] 583.21 [m] 0.022621 0.0226261 0.026261 0.0032529	(m) 4 583.21 6 5940.3 Damage C 0 (Negligit Min Radius of F Curvature ( (Bogging) (m) - 5940.3 -	<pre>1 (Negligible 3 (Negligible ategory cle) Min Radius of Curvature (Sagging) [m] 583.21 0 ( 583.</pre>	Damage Catego ) ) Negligible) Negligible) Negligible) Negligible) Negligible)
Calculations [m] 0.0 Tensile horizo Specific Building Structure: No. Vertical Movement Calculations [m] 0.0 Specific Building Structure Name	ntal strains a g Damage Resul 38   Sub-stru eflection Ave Ratio Hori 50 0.029895 -0.0 g Damage Resul Parameter Max Slope Max Stepsile Strain Strain Min Radius o Curvature (Sagging)	(m) 1 C 2 2.94 re +ve, ts - Critic ccture: E sontal %) 074350 - Sub ts - Critic C Sub ts - Critic C Sub f East f East	[m] 1.0 2.942( 26 8.828) compress: al Values: ast Wall ax Slope 0.001254/ al Segment critical -Structur Wall Wall Wall Wall Wall	6 Saggin 4 Hoggin ive hori: for All Se Max Settler 4 3.: nts within Crit: re Segme	g 0. y 0.0 gments v ment Tenent St j 22283 0.0 Eech St ical Sta 1 1 2 2.9 1	<pre>%] 029995 0013487 ittrains ittrains ittrains mailed mailed mailed %] 022261 %] 022261 %] 022261 0.0 2.9 0.0 2.9 0.0 2.9</pre>	<pre>[%] -0.0074350 0.0021910 are -ve. ch Sub-Stru ds Gradient of Borizontal isplacement 268.38E-6 d Curve d Curvatu 1 266 Sagging 426 Sagging 426 Sagging 426 Sagging 426 Sagging</pre>	[%] 0.025261 0.0032529 Cture Max Gradie of Vertice Diplaceme Curve -0.001254 0.001254 91.060E- 0.001254	Curve 268.38E-6 -22.558E-6 nt Min 1 Radius of Il Radius of (Hogging) 44 5940.3 45940.3 4 3.2283 4 3.2283 4 3.2283 4 3.2283	-0.001254 91.0602- 1.0602- 1.0602- 1.0602- 1.0022 1.0022 1.0022251 1.0022251 1.0022251 1.0022251 1.0022251 1.0022251 1.0022251 1.0022251 1.00022529	(m) 4 583.2: 6 5940.3 0 (Negligil Min Radius of (Kogging) (m) (M) - 5940.3	(Negligible (Negligible (Negligible ategory ble) Min Radius of Curvature (Sagging) [m] 583.21 0 ( 583.21 0 ( 583.21 0 (	0 ) 0 ) Damage Category Negligible) Negligible) Negligible) Negligible)
Calculations [m] 0.0 Tensile horizo Specific Building Structure: No. Vertical D offset from 0.0 Specific Building Structure Name No. 38	ntal strains a g Damage Resul 38   Sub-stru eflection Ave Ratio Hori st (%) ( 0.029895 -0.0 g Damage Resul Parameter Max Slope Max Stolem Max Settlem Max Restilem Min Radius o Curvature (Sagging)	(m)	[m] 1.0 2.9424 126 8.8284 compress: al Values : ast Wall iax Slope 0.0012544 al Segmen critical -structur : Wall : Wall : Wall : Wall : Wall	6 Saggind 4 Hoggind ive horiz for All Se Max Settler 4 [mm] 4 3.: 1ts within Crit: re Segme	g 0.0 g 0.0 gments v meent Ten st <i>Each Sta</i> 1 1 2 2.9 1	<pre>%] 029895 0013487 vithin Ea vithin Ea vit</pre>	<pre>[%] 0.0074350 0.0021910 are -ve. ch Sub-Stru ax Gradient of Borizontal isplacement Curve 268.38E-6 d Curvatu ) 226 Sagging 226 Sagging 226 Sagging 226 Sagging 226 Sagging</pre>	[%] 0.025261 0.0032529 cture Max Gradie of Vertica Displaceme Curve -0.001254 0.001254 0.001254	Curve 268.38E-6 -22.558E-6 ant Min 11 Radius of ant Curvature (Hogging) 44 5940.3 be Max Settlement 4 3.2283 4 3.2283 4 3.2283	-0.001254 91.060E- Min Radius of Ourvature (Sagging) [m] 583.21 [m] 583.21 [m] 0.026261 [0.0022529] 0.0026261	(m) 4 583.21 6 5940.3 Damage Cd 0 (Negligih Min Radius of I (Nogging) (Blogging) (Blogging) - 5940.3 -	<pre>1 (Negligible 3 (Negligible ategory cle) Min Radius of Curvature (Sagging) [m] 583.21 0 ( 583.</pre>	Damage Catego Negligible) Negligible) Negligible) Negligible) Negligible)

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#### 40 Frognal Lane

Short-term Basement Excavation (Unloading, Wall Toe 5mbbl) No. 40

Job No.	Sheet No.	Rev.
141396		
Drg. Ref.		
Made by JC	Date 10-Feb-2021	Checked

Problem Type

Problem Type : Tunnelling and Embedded Wall Excavations

#### Displacement Data

Туре	Name	Direction of extrusion		Point	/Line/Line	e for ext	rusion		No. of intervals across extrusion/line	Extrusion depth	No. of intervals along extrusion	Calculate	Surface type for tunnels	
			F:	irst poi	nt	S	econd poir	nt						
			х	Y	Z(level)	х	Y	Z(level)						
			[m]	[m]	[m]	[m]	[m]	[m]		[m]				
Line	No. 40 West	-	-7.50000	0.00000	91.50000	-7.50000	15.00000	91.50000	15	-	-	Yes	Surface	

Imported	Displace	ements

The following data points and displacements were found in the import file Pdisp Short term Unloading to be Imported.csv.

Ref.	C	oordinates		Di	splaceme	nts	
	x	У	z	x	У.	z	
1	[m] -7 50000	[m]	[m] 91 50000	[mm]	[mm]	[mm]	126
2	-7.50000	1.00000	91.50000	0.00000	0.00000	-0.73690	1.2.6
3	-7.50000	2.00000	91.50000	0.00000	0.00000	-0.73310	1,2,6
4	-7.50000	3.00000	91.50000	0.00000	0.00000	-0.72580	1,2,6
5	-7.50000	4.00000	91.50000	0.00000	0.00000	-0.71350	1,2,6
6	-7.50000	5.00000	91.50000	0.00000	0.00000	-0.69420	1,2,6
8	-7.50000	7.00000	91.50000	0.00000	0.00000	-0.62330	1,2,6
9	-7.50000	8.00000	91.50000	0.00000	0.00000	-0.56500	1,2,6
10	-7.50000	9.00000	91.50000	0.00000	0.00000	-0.48730	1,2,6
11	-7.50000	10.00000	91.50000	0.00000	0.00000	-0.38960	1,2,6
12	-7.50000	11.00000	91.50000	0.00000	0.00000	-0.27550	1,2,6
14	-7.50000	13.00000	91.50000	0.00000	0.00000	-0.03940	1.2.6
15	-7.50000	14.00000	91.50000	0.00000	0.00000	0.05940	1,2,6
16	-7.50000	15.00000	91.50000	0.00000	0.00000	0.13690	1,2,6
17	-7.50000	0.00000	91.50000	0.00000	0.00000	-0.73810	1,2,6
19	-9.35450	0.00000	91.50000	0.00000	0.00000	-0.09160	
20	-10.28180	0.00000	91.50000	0.00000	0.00000	0.08700	
21	-11.20910	0.00000	91.50000	0.00000	0.00000	0.20650	
23	-13.06360	0.00000	91.50000	0.00000	0.00000	0.33150	
24	-13.99090	0.00000	91.50000	0.00000	0.00000	0.35760	
25	-14.91820	0.00000	91.50000	0.00000	0.00000	0.36860	
20	-16.77270	0.00000	91.50000	0.00000	0.00000	0.36230	
28	-17.70000	0.00000	91.50000	0.00000	0.00000	0.35090	
29	-7.50000	15.00000	91.50000	0.00000	0.00000	0.13690	1,2,6
30	-8.42730	15.00000	91.50000	0.00000	0.00000	0.19460	
32	-10.28180	15.00000	91.50000	0.00000	0.00000	0.26640	
33	-11.20910	15.00000	91.50000	0.00000	0.00000	0.28490	
34	-12.13640	15.00000	91.50000	0.00000	0.00000	0.29490	
36	-13.99090	15.00000	91.50000	0.00000	0.00000	0.29650	
37	-14.91820	15.00000	91.50000	0.00000	0.00000	0.29100	
38	-15.84550	15.00000	91.50000	0.00000	0.00000	0.28290	
40	-17.70000	15.00000	91.50000	0.00000	0.00000	0.26190	
41	10.00000	-11.60000	90.00000	0.00000	0.00000	0.28140	
42	10.16670	-10.63330	90.00000	0.00000	0.00000	0.28250	
44	10.50000	-8.70000	90.00000	0.00000	0.00000	0.29010	
45	10.66670	-7.73330	90.00000	0.00000	0.00000	0.29640	
46	10.83330	-6.76670	90.00000	0.00000	0.00000	0.30390	
48	11.16670	-4.83330	90.00000	0.00000	0.00000	0.32070	
49	11.33330	-3.86670	90.00000	0.00000	0.00000	0.32900	
50	11.50000	-2.90000	90.00000	0.00000	0.00000	0.33670	
52	11.83330	-0.96670	90.00000	0.00000	0.00000	0.34920	
53	12.00000	0.00000	90.00000	0.00000	0.00000	0.35360	
54	10.00000	-11.60000	90.00000	0.00000	0.00000	0.28140	
56	12.00000	-11.60000	90.00000	0.00000	0.00000	0.31790	
57	13.00000	-11.60000	90.00000	0.00000	0.00000	0.31930	
58	14.00000	-11.60000	90.00000	0.00000	0.00000	0.31410	
60	16.00000	-11.60000	90.00000	0.00000	0.00000	0.29220	
61	17.00000	-11.60000	90.00000	0.00000	0.00000	0.27830	
62	19.00000	-11.60000	90.00000	0.00000	0.00000	0.26350	
64	20.00000	-11.60000	90.00000	0.00000	0.00000	0.23370	
65	21.00000	-11.60000	90.00000	0.00000	0.00000	0.21930	
66	22.00000	-11.60000	90.00000	0.00000	0.00000	0.20550	
68	24.00000	-11.60000	90.00000	0.00000	0.00000	0.17990	
69	25.00000	-11.60000	90.00000	0.00000	0.00000	0.16820	
70	13 00000	0.00000	90.00000	0.00000	0.00000	0.35360	
72	14.00000	0.00000	90.00000	0.00000	0.00000	0.36920	
73	15.00000	0.00000	90.00000	0.00000	0.00000	0.36200	
74	16.00000	0.00000	90.00000	0.00000	0.00000	0.34940	
76	18.00000	0.00000	90.00000	0.00000	0.00000	0.31570	
77	19.00000	0.00000	90.00000	0.00000	0.00000	0.29720	
78	20.00000	0.00000	90.00000	0.00000	0.00000	0.27860	
80	22.00000	0.00000	90.00000	0.00000	0.00000	0.24280	
81	23.00000	0.00000	90.00000	0.00000	0.00000	0.22620	
82	24.00000	0.00000	90.00000	0.00000	0.00000	0.21050	
84	26.00000	0.00000	90.00000	0.00000	0.00000	0.19390	
85	27.00000	0.00000	90.00000	0.00000	0.00000	0.16950	
86	6.50000	-11.60000	91.00000	0.00000	0.00000	-0.03490	
88	7.08330	-9.66670	91.00000	0.00000	0.00000	-0.04850	
89	7.37500	-8.70000	91.00000	0.00000	0.00000	-0.03220	
90	7.66670	-7.73330	91.00000	0.00000	0.00000	-0.00540	
91	/.95830 8.25000	-5.80000	91.00000	0.00000	0.00000	0.02830	
93	8.54170	-4.83330	91.00000	0.00000	0.00000	0.10340	
94	8.83330	-3.86670	91.00000	0.00000	0.00000	0.14050	
95	9.12500	-2.90000	91.00000	0.00000	0.00000	0.20710	
97	9.70830	-0.96670	91.00000	0.00000	0.00000	0.23530	
98	10.00000	0.00000	91.00000	0.00000	0.00000	0.25990	
100	10.291/0	1.93330	91.00000	0.00000	0.00000	0.29810	
101	10.87500	2.90000	91.00000	0.00000	0.00000	0.31210	
102	11.16670	3.86670	91.00000	0.00000	0.00000	0.32290	

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40 Frognal Lane

Job No.	Sheet No.	Rev.
141396		
Drg. Ref.		
Made by	Date	Checked

Short-term Basement Excavation (Unloading, Wall Toe 5mbbl) No. 40 JC. 10-Feb-2021 Ref. Coordinates Displacements **x** [m] **x y** [mm] [mm] **Y** [m] [m] [mm] 103 11.45830 4.83330 91.00000 0.00000 0.00000 0.33070 104 11.75000 5.80000 91.00000 0.00000 0.00000 0.33590 104 11.75000 5.80000 91.00000 0.00000 0.00000 0.33540 105 12.04170 6.76670 91.00000 0.00000 0.00000 0.33840 106 12.33330 7.73330 91.00000 0.00000 0.00000 0.33850 107 12.62500 8.7000 91.00000 0.00000 0.00000 0.33530 108 12.91670 9.66670 91.00000 0.00000 0.00000 0.33530 109 13.20330 10.63330 91.00000 0.00000 0.00000 0.33740 10 13.50000 11.60000 91.00000 0.00000 0.00000 0.33740 1 - Data point coincident with displacement data. Its displacement has been added to those calculated by Xdisp. 1 Data point coincident with outpacement data. Its uspacement has been adued to insee calculated by Autsy.
2 Data point coincident with horizontal movement calculation point for a specific building. Its displacement has been added before performing building damage calculations. Vertical Ground Movement Curves (Excavations) Installation of secant bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(b))
[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][2.000,0.000]
Folynomial Curve Name: Coordinates: Curve Fitting Method: x Order: y Order: J Grader: 0 Polynomial: z = -2.5E-2x + 5.0E-2 Coeff. of 1.0 Determination: Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(b) [Distance from vall / 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,.0000,0.033][0.100,0.000,0.049][0.200,0.000,0.056][0.300,0.000,0.062] [0.400,0.000,0.073][0.900,0.000,0.772][1.000,0.000,0.073][1.000,0.000,0.073] [1.200,0.000,0.055][1.300,0.000,0.072][1.100,0.000,0.058][1.500,0.000,0.054] [1.600,0.000,0.055][1.700,0.000,0.466][1.800,0.000,0.022][2.300,0.000,0.038] [2.400,0.000,0.034][2.100,0.000,0.031][2.200,0.000,0.072][1.300,0.000,0.023] [2.400,0.000,0.026][3.500,0.000,0.031][2.200,0.000,0.070][3.500,0.000,0.022] [3.200,0.000,0.028][3.700,0.000,0.032][3.800,0.000,0.001][3.800,0.000,0.002] [3.600,0.000,0.028][3.700,0.000,0.002][3.800,0.000,0.001][3.800,0.000,0.001] Forynomial Curve Name Coordinates: Curve Fitting Method: x Order: y Order:  $^{-2.6455E-3x^4}$  + 2.8495E-2x^3 - 1.0051E-1x^2 + 1.0569E-1x + 3.8990E-2 9.9991E-1 Polynomial: z = Coeff. of Determination: Horizontal Ground Movement Curves (Excavations) Curve Name: Installation of secant bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(a)) [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 ((8)] [0.000,0.000,0.001][0.050,0.000,0.076][0.100,0.000,0.072][0.150,0.000,0.067]] Coordinates [1.200,0.000,0.011][1.250,0.000,0.009][1.300,0.000,0.007][1.350,0.000,0.005] [1.400,0.000,0.004][1.450,0.000,0.002][1.500,0.000,0.000] Polynomia Curve Fitting Method: x Order: y Order: Polynomial: z = -1.0610E-2x<sup>3</sup> + 4.4203E-2x<sup>2</sup> - 9.6358E-2x + 8.0901E-2 Coeff. of 1.0000 Determination: Curve Name: Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(a)) 2.11(a) [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] Polynomial Coordinates: 
 Curve Fitting
 Folynomial

 Method:
 Polynomial

 y Order:
 1

 Polynomial:
 z = -3.75E-2x + 1.50E-1

 Coeff.
 of
 Determination: Polygonal Excavations Excavation Name: Pool excavation 91.500 Positive Yes Surface level Contribution: Enabled: 
 Corner
 x
 y
 Base base
 Stiffend Stiffend
 Previous Side previous Side
 Next Side

 [m]
 [m]
 [m]
 [m]
 [m]
 [m]
 [k]
 [m]
 [k]
 [k Ground Movement Curve Horizontal Side Corner 1 Corner 2 Vertical 
 x
 y
 x
 y
 Vertical

 [m]
 [m]
 [m]
 [m]
 1
 1
 -4.0000
 -11.600
 2.2000
 -11.600
 Excavation in front of high
 Excavation in front of high 

 1
 -4.0000
 -11.600
 2.2000
 -11.600
 Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(a))

 2
 2.2000
 -11.600
 2.2000
 11.600
 Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(a))

 3
 2.2000
 11.600
 -4.0000
 11.600
 Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(a))

 3
 2.2000
 11.600
 -4.0000
 11.600
 Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(a))

 4
 -4.0000
 11.600
 -4.0000
 -11.600
 Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(a))

 4
 -4.0000
 11.600
 -4.0000
 -11.600
 Excavation in front of high stiffness wall in stiff clay stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(a))

 Secant Pile Wall Installation Excavation Name Surface level [m]: Contribution: Enabled: 91.500 Positive Yes Corner x y Base Stiffened Previous Side Next Side Level d p1 p2\* d p1 p2\*

Job No.	Sheet No.	Rev.
141396		
Drg. Ref.		

Short-term Basement Excavation (Unloading, Wall Toe 5mbbl) No. 40

)asys

40 Frognal Lane

Made	b
JC	

v

Date 10-Feb-2021

Checked

1 -4	m] [m] 0000 -11.60 2000 -11.60	[m] 00 81.500	Yes Yes	m] [%] 0.0 50.000	[%] [r 0 20.000 ( 0 20.000 (	n] [%] 0.0 50.000	[%] 20.000 20.000					
3 2 4 -4	2000 11.60 0000 11.60	00 81.500 00 81.500	Yes Yes	0.0 50.000	0 20.000 0	0.0 50.000	20.000 20.000					
Side 3	Corner 1 y	Cor x	mer 2 y		Vertical	Ground Mo L	vement Curv	Morizontal				
1 -4.	0000 -11.6	600 2.200	0 -11.600	) Installat pile wall	tion of sec l in stiff	cant bored clay (CIRI	Installat A pile wall	ion of secan in stiff cl	t bored ay (CIRIA			
2 2.	2000 -11.6	600 2.200	10 11.600	) Installat pile wall	2.8(D)) tion of sec l in stiff	cant bored clay (CIRI	Installat A pile wall	2.8(a)) tion of secan in stiff cl	t bored ay (CIRIA			
32.	2000 11.0	600 -4.000	11.600	) Installat pile wall	2.8(D)) tion of sec l in stiff	cant bored clay (CIRI	Installat A pile wall	ion of secan in stiff cl	t bored ay (CIRIA			
4 -4.	0000 11.6	600 -4.000	0 -11.600	580 Fig. Installat pile wall	2.8(b)) tion of sec 1 in stiff	cant bored clay (CIRI	580 Fig. Installat A pile wall	2.8(a)) ion of secan in stiff cl	t bored ay (CIRIA			
				580 Fig.	2.8(b))		580 Fig.	2.8(a))				
Damage Ca	tegory Strain	0 (Ne	gligible)	1 (Very S	Slight) 2	2 (Slight)	3 (Mode	erate)				
Dunland Ca	unin Timita	1 (Ve	to ery Slight)	to 2 (Slig	ght) 3	to (Moderate)	4 (Set	vere)				
		5	0.0	501	0.002-0	/30.00E	-0 0.	.0013000				
Structure	Name Sub-	Structure	Displace	ement St	tart Er	nd Ve	rtical	Vertical	Damage Ca	tegory Strains	Poisson's E/G	
		Name	Line	e Dia Al	stance Dist long Alo Line Li	tance Offs ong Li ine Ve Mo	ets from ne for rtical vement	Displacement Limit Sensitivity			Ratio	
No. 40	West	Wall	No. 40 We	est 0	[m] [r .00000 15.0	<b>Calc</b> n] )0000	ulations [m] 0.0	[mm] 0.10000	Burland St:	rain Limits	0.20000 2.6000	
Specific St	ructures - Be	nding Paran	neters									
Structure	Name Sub-	-Structure Name	Height D Pr	efault operties		Hogging			Sagging			
				2	2nd Moment of Area (per unit width)	Distance of Bending Strain from N.A.	Distance of N.A. from Edge of Beam in	2nd Moment of Area (per unit width)	Distance of Bending Strain from N.A.	Distance of N.A. from Edge of Beam in		
No. 40	West	Wall	[m] 12.000 Ye	25	[m³] 576.00	[m] 12.000	[m] 12.000	[m³] 144.00	[m] 6.0000	[m] 6.0000		
Building Se	egment Com	binations										
Structure	Name Sub-	-Structure Name	Vertica Offset fr Line fo Vertica Movemen	al Segmen com or al at	nt Start Le	angth Curva	ture Combir Segmer	ned nt				
No structu	res have se	egments com	Calculati [m] bined.	ons	[m]	[m]						
Utility Strai	n Calculatio	n Options										
Neglect be	neficial co	ontribution	of axial	strains :	No							
Warnings												
1 Mult exca indi exca anot	iple excava vations are vidual exca vations (e. her).	ations have e calculate avation. N .g. overlap	e been spec ed by summi No account oping zones	ng the di has been to of influe	he displace splacements taken of th ence or 'sh	ements resu s resulting he interact hielding' o	lting from from each ions betwee f one excav	these en vation by				
Errors												
None												
Displaceme	ent and Strai	n Results										
Туре	/No.	c	cordinates	3			Displaceme	ents		Angle of Line		
Name	Dist.	x	У	z	x	У	z	Horizontal displacement along Line	Horizontal displacement perpendicula to Line	to x Axis t ar		
No. 40	[m] Line 1	[m] -7.50000	[m] 0.00000	[m] 91.50000	[mm] 11.401	[mm] 0.0	[mm] 6.2921	[mm] 0.0	[mm] -11.4	[°] 01 90.000 *		
nest	1.0000	-7.50000	1.00000	91.50000 91.50000	11.401 11.401	0.0	7.0314 7.0352 7.0425	0.0	-11.4	01 90.000 * 01 90.000 *		
	4.0000	-7.50000	4.00000	91.50000	11.401 11.401 11.401	0.0	7.0548	0.0	-11.4	01 90.000 * 01 90.000 *		
	7.0000	-7.50000	7.00000	91.50000 91.50000 91.50000	11.401 11.401 11.401	0.0	7.1450	0.0	-11.4	01 90.000 * 01 90.000 *		
	9.0000	-7.50000	9.00000	91.50000	11.401	0.0	7.2810	0.0	-11.4	)1 90.000 *		
	11.000	-7.50000	11.00000	91.50000	11.401	0.0	7.4928	0.0	-11.4	)1 90.000 *		
	11.000 12.000 13.000 14.000	-7.50000 -7.50000 -7.50000 -7.50000	11.00000 12.00000 13.00000 14.00000	91.50000 91.50000 91.50000 91.50000	11.401 6.1369 4.6230 3.3347	0.0 -0.37443 -1.2245 -1.8523	7.4928 4.1972 3.9348 3.6804	0.0 -0.37443 -1.2245 -1.8523	-11.4 -6.13 -4.62 -3.33	90.000 * 99.000 * 80 90.000 * 47 90.000 *		

#### Specific Building Damage Results - Horizontal Displacements

Structure	: No. 40	)   Sub-	structure:	West	Wall	
Dist.	Cod	ordinate	5			Displacements
	x	У	z	x	У	Horizontal Horizontal displacement displacement



#### 40 Frognal Lane

Short-term Basement Excavation (Unloading, Wall Toe 5mbbl)

No. 40

Job No.	Sheet No.	Rev.
141396		
Drg. Ref.		
Made by JC	Date 10-Feb-2021	Checked

						along the	perpendicular	
						Line	to Line	
[m]	[m]	[m]	[m]	[mm]	[mm]	[ mm ]	[mm]	
0.0	-7.50000	0.00000	91.50000	11.401	0.0	0.0	-11.401	d
1.0000	-7.50000	1.00000	91.50000	11.401	0.0	0.0	-11.401	d
2.0000	-7.50000	2.00000	91.50000	11.401	0.0	0.0	-11.401	d
3.0000	-7.50000	3.00000	91.50000	11.401	0.0	0.0	-11.401	d
4.0000	-7.50000	4.00000	91.50000	11.401	0.0	0.0	-11.401	d
5.0000	-7.50000	5.00000	91.50000	11.401	0.0	0.0	-11.401	d
6.0000	-7.50000	6.00000	91.50000	11.401	0.0	0.0	-11.401	d
7.0000	-7.50000	7.00000	91.50000	11.401	0.0	0.0	-11.401	d
8.0000	-7.50000	8.00000	91.50000	11.401	0.0	0.0	-11.401	d
9.0000	-7.50000	9.00000	91.50000	11.401	0.0	0.0	-11.401	d
10.000	-7.50000	10.00000	91.50000	11.401	0.0	0.0	-11.401	d
11.000	-7.50000	11.00000	91.50000	11.401	0.0	0.0	-11.401	d
12.000	-7.50000	12.00000	91.50000	6.1369	-0.37443	-0.37443	-6.1369	d
13.000	-7.50000	13.00000	91.50000	4.6230	-1.2245	-1.2245	-4.6230	d
14.000	-7.50000	14.00000	91.50000	3.3347	-1.8523	-1.8523	-3.3347	d
15.000	-7.50000	15.00000	91.50000	2.3489	-2.2390	-2.2390	-2.3489	d
d - Di:	splacement	ts include	e imported	displa	acements.			

#### Specific Building Damage Results - Vertical Displacements

#### Structure: No. 40 | Sub-structure: West Wall

Dist.	Co	ordinates	Displacement			
	x	У	z	z		
[m]	[m]	[m]	[m]	[mm]		
Vertica	al Offset	1				
0.0	-7.50000	0.00000	91.50000	6.2921	d	
1.0000	-7.50000	1.00000	91.50000	7.0314	d	
2.0000	-7.50000	2.00000	91.50000	7.0352	d	
3.0000	-7.50000	3.00000	91.50000	7.0425	d	
4.0000	-7.50000	4.00000	91.50000	7.0548	d	
5.0000	-7.50000	5.00000	91.50000	7.0741	d	
6.0000	-7.50000	6.00000	91.50000	7.1030	d	
7.0000	-7.50000	7.00000	91.50000	7.1450	d	
8.0000	-7.50000	8.00000	91.50000	7.2033	d	
9.0000	-7.50000	9.00000	91.50000	7.2810	d	
10.000	-7.50000	10.00000	91.50000	7.3787	d	
11.000	-7.50000	11.00000	91.50000	7.4928	d	
12.000	-7.50000	12.00000	91.50000	4.1972	d	

13.000 -7.50000 13.00000 91.50000 3.9348 d 14.000 -7.50000 14.00000 91.50000 3.6804 d 15.000 -7.50000 15.00000 91.50000 3.5664 d d - Displacements include imported displacements.

#### Specific Building Damage Results - All Segments

Structure: No. 40 | Sub-structure: West Wall

Vertical Offset from Line for Vertical Movement	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max Tensile Strain	Max Gradient of Horizontal Displacement	Max Gradient of Vertical Displacement Curve	Min Radius of Curvature	Damage Category
[m]		[m]	[m]		[%]	[%]	[%]	Curve		[m]	
0.0		1 0.0	2.9724	Sagging	0.016231	0.0	0.015979	0.0	-739.30E-6	1086.7	(Negligible)
	:	2 2.9724	6.0496	Hogging	988.09E-6	0.0	972.28E-6	0.0	-97.700E-6	52789.	0
	:	3 9.0221	2.5634	Sagging	0.059642	-0.0085516	0.055754	374.57E-6	0.0032968	1062.2	(Negligible) 1 (Very Slight)
		4 11.585	3.4145	Hogging	0.032868	-0.059151	0.024597	850.77E-6	0.0032968	1252.8	0
Terrile berirertel					al atraina						(Negligible)

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

#### Specific Building Damage Results - Critical Values for All Segments within Each Sub-Structure

Structure: No. 40 | Sub-structure: West Wall

Vertical Offset from Line for Vertical Movement	Deflection Ratio	Average Horizontal Strain	Max Slope	Max Settlement	Max Tensile Strain	Max Gradient of Horizontal Displacement Curve	Max Gradient of Vertical Displacement Curve	Min Radius of Curvature (Hogging)	Min Radius of Curvature (Sagging)	Damage Category
Calculations										
[m]	[%]	[%]		[mm]	[%]			[m]	[m]	
0.0	0.059642	-0.059151	0.0032968	7.4916	0.055754	850.77E-6	0.0032968	1252.8	1062.2 1	(Very Slight)

#### Specific Building Damage Results - Critical Segments within Each Structure

Structure Name	Parameter	Critical Sub-Structure	Critical Segment	. Start	End	Curvature	Max Slope	Max Settlement	Max Tensile Strain	Min Radius of Curvature	Min Radius of Curvature	Damage C	ategory
										(Hogging)	(Sagging)		
				[m]	[m]			[mm]	[%]	[m]	[m]		
No. 40	Max Slope	West Wall	3	9.0221	11.585	Sagging	0.0032968	7.4916	0.055754	-	1062.2 1	(Very Sligh	t)
	Max Settlement	West Wall	3	9.0221	11.585	Sagging	0.0032968	7.4916	0.055754	-	1062.2 1	(Very Sligh	t)
	Max Tensile Strain	West Wall	3	9.0221	11.585	Sagging	0.0032968	7.4916	0.055754	-	1062.2 1	(Very Sligh	t)
	Min Radius of	West Wall	4	11.585	15.000	Hogging	0.0032968	5.5633	0.024597	1252.8	- 0	(Negligible	)
	Curvature (Hogging) Min Radius of Curvature (Sagging)	West Wall	3	9.0221	11.585	Sagging	0.0032968	7.4916	0.055754	-	<b>1062.2</b> 1	(Very Sligh	t)

	Sheet No.	Rev
	Date 10-Feb-2021	Checke
A De 10 Heat		
Non-the control between the data b		
1         1		
1         1         2         2         0		
Image: Point of the second s		
1       1		
10       7.50000       1.40000       0.10000       0.0000		
1         1.1.2.480         0.0000 <td></td> <td></td>		
41         1.9000         0.0000         1.5000         0.0000         0.0000         0.0000           1         1.9000         0.0000         1.5000         0.0000         0.0000         0.0000           1         1.9000         0.0000         1.5000         0.0000         0.0000         0.0000           1         1.9000         1.5000         0.0000         0.0000         0.0000         0.0000           1         1.9000         1.5000         0.0000         0.0000         0.0000         0.0000           1         1.9000         1.5000         0.0000         0.0000         0.0000         0.0000           1         1.9000         1.9000         0.0000         0.0000         0.0000         0.0000           1         1.9000         1.9000         0.0000         0.0000         0.0000         0.0000           1         1.9000         1.9000         0.0000         0.0000         0.0000         0.0000           1         1.9000         1.9000         0.0000         0.0000         0.0000         0.0000           1         1.9000         1.9000         0.0000         0.0000         0.0000         0.0000           1         1		
21         1.5         1.5         0.0000         1.5         0.0000        <		
3         11.20510         12.0000         12.0000         0.0000         0.0000           4         12.0000         12.0000         12.0000         0.0000         0.0000           4         12.0000         12.0000         12.0000         12.0000         12.0000           4         12.0000         12.0000         12.0000         12.0000         12.0000           4         12.0000         12.0000         12.0000         12.0000         12.0000           4         12.0000         12.0000         12.0000         12.0000         12.0000           4         12.0000         12.0000         12.0000         12.0000         12.0000           4         12.0000         12.0000         12.0000         12.0000         12.0000           4         12.0000         12.0000         12.0000         12.0000         12.0000         12.0000           4         12.0000         12.0000         12.0000         12.0000         12.0000         12.0000         12.0000           5         12.0000         12.0000         12.0000         12.0000         12.0000         12.0000         12.0000           5         12.0000         12.0000         12.00000         12.00000		
31         1.3.9000         1.3.0000         1.3.0000         1.4.0000         1.3.0000         1		
3         1.6.77270         15.0000         91.0000         0.0000         -0.0640           4         10.0000         -10.0000         0.0000         -0.0640           4         10.1000         -10.0000         0.0000         -0.0640           4         10.3330         90.0000         0.0000         -0.0640           4         10.3330         90.0000         0.0000         -0.0640           4         10.3330         90.0000         0.0000         -0.0640           4         10.3330         90.0000         0.0000         -0.0640           4         10.3330         90.0000         0.0000         -0.0640           4         10.0000         -5.6600         90.0000         -0.0000         -0.0720           5         11.66070         -5.8700         90.0000         -0.0000         -0.0720           5         11.66070         -1.8700         0.0000         -0.0000         -0.0720           5         11.66070         -1.8700         0.0000         -0.0000         -0.0730           5         11.66070         -1.8700         0.0000         -0.0000         -0.0730           5         10.00000         -1.60000         0.00000 <td></td> <td></td>		
41         10.4670         -10.6330         00.0000         0.0000         -0.06420           41         10.3000         -7.7000         0.0000         0.0000         -0.06420           41         10.4670         -7.7333         0.0000         0.0000         -0.0640           41         10.4530         -7.6763         0.0000         0.0000         -0.0040           41         11.3507         -8.6770         0.0000         0.0000         -0.0040           41         11.35370         -1.53330         0.0000         0.0000         -0.00750           51         11.6600         -1.5330         0.0000         0.0000         -0.00750           51         11.6600         -1.5330         0.0000         0.0000         -0.00750           51         11.6600         0.0000         0.0000         -0.00750           51         11.6000         0.10000         0.0000         -0.00750           51         11.6000         0.0000         0.0000         -0.00750           51         11.6000         0.0000         0.0000         -0.00750           51         11.6000         0.0000         0.0000         -0.00750           51         11.6000		
43         10.46470         -7.333         90.0000         0.0000         -0.06440           41         10.3300         -7.3601         0.0000         -0.0004           41         11.3670         -4.8333         90.0000         0.0000         -0.07310           41         11.3530         -2.6000         0.0000         0.0000         -0.0750           51         11.8530         -2.6000         0.0000         0.0000         -0.0750           51         11.6000         -2.6000         0.0000         0.0000         -0.0750           51         11.6000         -1.6000         0.0000         0.0000         -0.00740           51         11.6000         0.0000         0.0000         -0.00740         -0.0740           51         11.6000         0.0000         0.0000         -0.00730         -0.0731           51         11.6000         0.0000         0.0000         -0.00730         -0.0731           51         11.6000         0.0000         0.0000         -0.00730         -0.0731           51         11.6000         0.0000         0.0000         -0.00730         -0.0731           51         11.6000         0.0000         0.0000		
48         11.8800         -4.8800         90.0000         0.0000         0.0000           11.8800         -2.8000         90.0000         0.0000         0.0000         0.0000           11.86670         -2.8000         90.0000         0.0000         0.0000         0.0000           11.86670         -1.8330         90.0000         0.0000         0.0000         0.0000           11.86670         -1.6000         90.0000         0.0000         0.0000         0.0000           11.0000         -1.6000         90.0000         0.0000         0.0000         0.0000           11.0000         -1.6000         90.0000         0.0000         0.0000         0.0000           11.0000         -1.6000         90.0000         0.0000         0.0000         0.0000           11.0000         -1.6000         90.0000         0.0000         0.0000         0.0000           11.0000         -1.6000         90.0000         0.0000         0.0000         0.0000           11.0000         -1.6000         90.0000         0.0000         0.0000         0.0000           11.0000         -1.6000         90.0000         0.0000         0.0000         0.0000           11.0000         -1.6000		
11       1.4.6670       -1.3330       90.0000       0.0000       -0.0000         11       1.4.8000       -1.6000       0.0000       0.0000       -0.0660         11       0.0000       -1.1.6000       90.0000       0.0000       -0.0660         11       0.0000       -1.1.6000       90.0000       0.0000       -0.0780         11       0.0000       -1.1.6000       90.0000       0.0000       -0.0770         11       0.0000       -1.1.6000       90.0000       0.0000       -0.0770         11       1.0000       -1.1.6000       90.0000       -0.0000       -0.0770         11       1.0000       -1.1.6000       90.0000       -0.0000       -0.0770         12       1.8.0000       -1.1.6000       90.0000       -0.0000       -0.0620         13       1.0000       -1.1.6000       90.0000       -0.0000       -0.0620         14       1.0000       -1.1.6000       90.0000       -0.0000       -0.0620         14       1.0000       -1.1.6000       90.0000       -0.0000       -0.0000         14       1.0000       -1.1.6000       90.0000       -0.0000       -0.0000         14       1.00000		
54         10.0000         -11.6000         90.0000         0.0000         -0.0789           57         11.0000         -11.6000         90.0000         0.0000         -0.0780           57         12.0000         -11.6000         90.0000         0.0000         -0.0739           59         15.0000         -11.6000         90.0000         0.0000         -0.0739           61         16.0000         -11.6000         90.0000         0.0000         -0.07430           61         17.0000         -11.6000         90.0000         0.0000         -0.06420           61         10.0000         -11.6000         90.0000         0.0000         -0.06420           62         12.0000         -11.6000         90.0000         0.0000         -0.06420           63         12.0000         -11.6000         90.0000         0.0000         -0.0440           64         12.0000         -11.6000         90.0000         -0.0440           62         22.0000         -11.6000         90.0000         -0.0440           63         25.0000         -11.6000         90.0000         -0.0440           64         26.0000         -11.6000         90.0000         -0.0440		
7         3.         00000         -11.6000         90.0000         -0.0000         -0.07370           50         14.0000         -11.6000         90.0000         -0.0000         -0.07230           51         14.0000         -11.6000         90.0000         -0.0000         -0.0010           51         15.0000         -11.6000         90.0000         -0.0000         -0.0010           62         18.0000         -11.6000         90.0000         -0.0000         -0.0010           63         19.0000         -11.6000         90.0000         -0.0000         -0.0011           64         20.0000         -11.6000         90.0000         -0.0000         -0.0011           65         21.0000         -11.6000         90.0000         -0.0000         -0.0011           67         22.0000         -11.6000         90.0000         -0.0000         -0.0011           70         12.0000         0.0000         90.0000         -0.0000         -0.0011           71         13.0000         0.0000         90.0000         -0.0000         -0.0011           71         13.0000         0.0000         90.0000         -0.0000         -0.0011           71         14.0000 <td></td> <td></td>		
0       16. 00000       -11. 60000       90. 00000       0. 00000       -0. 06420         62       18. 00000       -11. 60000       90. 00000       0. 00000       -0. 06420         64       20. 00000       -11. 60000       90. 00000       0. 00000       -0. 06420         64       20. 00000       -11. 60000       90. 00000       0. 00000       -0. 05330         64       20. 00000       -11. 60000       90. 00000       0. 00000       -0. 05330         67       23. 00000       -11. 60000       90. 00000       0. 00000       -0. 04440         68       24. 00000       -11. 60000       90. 00000       -0. 00000       -0. 04440         71       13. 00000       0. 00000       0. 00000       -0. 00000       -0. 04440         71       14. 00000       90. 00000       -0.00000       -0.0000       -0.0000         71       14. 00000       90. 00000       -0.00000       -0.00000       -0.00000         71       14. 00000       90. 00000       -0.00000       -0.00000       -0.00000         71       14. 00000       0.00000       -0.00000       -0.00000       -0.00000         71       14. 0.0000       90.00000       -0.00000       <		
63       19.0000       -11.6000       90.0000       0.0000       -0.5740         64       20.0000       -11.6000       90.0000       0.0000       -0.5540         65       21.0000       -11.6000       90.0000       0.0000       -0.5540         67       23.0000       -11.6000       90.0000       0.0000       -0.4440         67       23.0000       -11.6000       90.0000       0.0000       -0.4440         68       24.0000       -11.6000       90.0000       0.0000       -0.4440         69       25.0000       -11.6000       90.0000       0.0000       -0.4440         71       14.0000       0.00000       90.0000       -0.0000       -0.8460         71       14.0000       0.00000       0.00000       -0.0000       -0.8520         73       15.0000       0.00000       0.00000       -0.0000       -0.0000         74       16.0000       0.00000       0.00000       -0.0000       -0.0000         75       70.0000       0.00000       0.00000       -0.0000       -0.0000         74       16.0000       0.00000       0.00000       -0.0000       -0.0000         74       16.0000 <t< td=""><td></td><td></td></t<>		
66         22.0000         -11.6000         90.0000         0.0000         -0.4440           67         23.0000         -11.6000         90.0000         0.0000         -0.4450           68         24.0000         -11.6000         90.0000         0.0000         -0.0450           71         13.0000         -0.0000         90.0000         0.0000         -0.0840           71         13.0000         0.00000         0.0000         -0.08450           73         15.0000         0.00000         0.0000         -0.0000           74         16.0000         0.00000         0.0000         -0.0000           75         17.0000         0.00000         0.00000         -0.0000         -0.0000           76         18.0000         0.00000         0.00000         -0.0000         -0.0000           71         10.0000         0.00000         0.00000         -0.0000         -0.0000           70         10.0000         0.00000         0.00000         -0.0000         -0.0000           82         0.0000         0.00000         0.00000         -0.0000         -0.0000           82         0.0000         0.00000         0.00000         -0.06430		
69         25.0000         -1.6000         90.0000         0.0000         -0.03860           71         13.0000         0.00000         90.0000         0.00000         -0.08460           71         13.0000         0.00000         0.00000         -0.0000         -0.08460           73         15.0000         0.00000         0.00000         -0.0000         -0.0000           74         15.0000         0.00000         0.00000         -0.0000         -0.0000           74         15.0000         0.00000         0.00000         -0.0000         -0.0000           75         15.0000         0.00000         0.00000         -0.0000         -0.0000           76         15.0000         0.00000         0.00000         -0.0000         -0.0000           78         20.0000         0.00000         0.00000         -0.0000         -0.0000           80         22.0000         0.00000         0.00000         -0.0000         -0.0000           81         20.0000         0.00000         0.00000         -0.0000         -0.0000           81         20.0000         0.00000         0.00000         -0.0000         -0.0000           82         20.0000         0.00000<		
12       14.0000       0.00000		
75       17.0000       0.0000       90.0000       0.00000       0.0000       0.0000		
18         24.10000         10.0000         10		
12         24.0000         0.0		
85       27.0000       0.0010       0.0000       0.0000       0.0010       0.0000       0.0010       0.0000       0.0010       0.0000       0.0010		
88         7.08330         -3.66670         91.00000         0.00000         0.0120           90         7.36500         -8.70000         91.00000         0.00000         0.00740           90         7.66670         -7.73330         91.00000         0.00000         0.00740           91         7.95530         -6.76670         91.00000         0.00000         0.00740           92         7.3530         -6.76670         91.00000         0.00000         0.00000           92         8.55100         -5.80000         91.00000         0.00000         -0.01550           93         8.54170         -4.83330         91.00000         0.00000         -0.02390           94         8.83330         -3.66670         91.00000         0.00000         -0.02390           94         9.41670         -1.93330         91.00000         0.00000         -0.04550           95         9.12500         -2.90000         91.00000         0.00000         -0.04550           94         8.03330         -1.93333         91.00000         0.00000         -0.04550           94         91.02170         -0.96670         91.00000         0.00000         -0.64600           99         10.29		
91       7.95830       -6.76670       91.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00000       0.00100       0.00000       0.00000       0.00100       0.00000       0.00000       0.00100       0.00000		
94         8.83330         -3.86670         11.00000         0.00000         -0.03340           95         9.12500         -2.90000         91.00000         0.00000         -0.04350           95         9.41670         -1.93330         91.00000         0.00000         -0.04450           97         9.70830         -0.96670         91.00000         0.00000         -0.044780           97         9.70830         -0.96670         91.00000         0.00000         -0.064780           98         10.00000         0.00000         0.00000         -0.06400         -0.06400           98         10.0000         0.00000         0.00000         -0.06400         -0.0000           99         10.29170         0.96670         91.00000         0.00000         -0.06480           101         10.87500         2.90000         91.00000         0.00000         -0.07450           101         11.670         3.66670         91.00000         0.00000         -0.07450		
97 9,70830 -0.56670 91.00000 0.00000 0.0000 -0.05430 98 10.0000 0.00000 91.00000 0.00000 -0.06000 99 10.29170 0.96670 91.00000 0.00000 0.0000 -0.06480 101 10.87500 2.90000 91.00000 0.00000 -0.06880 101 10.87500 2.90000 91.00000 0.00000 -0.07200 102 11.16670 3.86670 91.00000 0.00000 -0.07450		
100 10.58330 1.93330 91.00000 0.00000 0.00000 -0.06880 101 10.87500 2.90000 91.00000 0.00000 0.07200 102 11.16670 3.86670 91.00000 0.00000 -0.07450		

Gasars FAIRHURST	Job No.	Sheet No.	Rev.
Oasys	141396		
40 Frognal Lane Short term Loading, Wall Too 5mbbl	Drg. Ref.		
No. 40	Made by	Date 10-Eeb-2021	Checked
Ref. Coordinates Displacements		10-F6D-2021	
(m) (m) (m) (mm) (mm) (mm)			
104         11.75000         5.80000         91.00000         0.00000         -0.07750           105         12.04170         6.76670         91.00000         0.00000         -0.07750           106         12.3300         7.3330         91.30000         0.00000         -0.07810           107         12.62500         8.70000         91.00000         0.00000         -0.07810           108         12.91670         9.66670         91.00000         0.00000         -0.07810           108         12.91670         9.66670         91.00000         0.00000         -0.07660           109         13.20830         10.63330         91.00000         0.00000         -0.07660           100         13.50000         11.60000         91.00000         0.00000         -0.077510           10         13.50000         11.60000         91.00000         0.00000         -0.077820           1- Data point coincident with displacement data. Its displacement has been added to those calculated by Xdisp.         2         -Data point coincident with displacement calculation point for a specific building. Its displacement has been added before performing building damage calculate           6 - Data point coincident with vertical movement calculation point for a specific building. Its displacement has been added before performing building damage calculat	ations. Jus.		
Vertical Ground Movement Curves (Excavations)			
Curve Name: Installation of secant bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(b)) 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 (x), 000,0.000] [0,000,0.000] [0,000,0.000]			
Curve sitting Polynomial Method: x Order: 1 y Order: 0 Polynomial: z = -2.5E-2x + 5.0E-2 Coeff. of 1.0 Determination:			
Curve Name:         Excevation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(b)           Coordinates:         [Distance from wall / wall depth or max. excavation depth (x), Depth / wall depth or max. excavation depth (z) (8)]           (dot (z) (8)]         [0.000, 0.000, 0.039]         [0.100, 0.000, 0.000, 0.049]         [0.200, 0.000, 0.000, 0.062]           [0.400, 0.000, 0.033]         [0.100, 0.000, 0.070]         [0.400, 0.000, 0.051]         [0.400, 0.000, 0.051]         [0.400, 0.000, 0.051]           [1.600, 0.000, 0.053]         [1.700, 0.000, 0.070]         [0.400, 0.000, 0.053]         [1.400, 0.000, 0.071]         [1.400, 0.000, 0.073]           [1.600, 0.000, 0.053]         [1.700, 0.000, 0.044]         [1.200, 0.000, 0.033]         [1.200, 0.000, 0.023]           [2.400, 0.000, 0.020]         [2.200, 0.000, 0.021]         [2.200, 0.000, 0.021]         [2.300, 0.000, 0.023]           [2.400, 0.000, 0.020]         [2.500, 0.000, 0.017]         [2.600, 0.000, 0.021]         [2.700, 0.000, 0.023]			
[3.200,0.000;0.004][3.300,0.000]0.004][3.400,0.000][3.500,0.000][3.500,0.000] [3.600,0.000,0.002][3.700,0.000,0.002][3.800,0.000,0.001][3.900,0.000,0.001] [4.000,0.000,0.000] Curve Fitting Polynomial Method: x Order: 4 v Order: 4			
Polynomial: z = -2.6455E-3x <sup>4</sup> + 2.8495E-2x <sup>3</sup> - 1.0051E-1x <sup>2</sup> + 1.0569E-1x + 3.8990E-2 Coeff. of 9.9991E-1 Determination:			
Horizontal Ground Movement Curves (Excavations)			
Curve Name:         Installation of secant bored pile wall in stift clay (CTRI 580 Fig. 2.8(a))           Coordinates:         [Distance from wall / wall depth or max. excavation depth (x), bepth / wall depth or max. excavation depth (y), Borizontal movement / wall depth or max. excavation depth (z) (%)           [0.000,0.000,0.001][0.050,0.000,0.076][0.100,0.000,0.072][0.150,0.000,0.067]         [0.000,0.000,0.061][0.050,0.000,0.056][0.300,0.000,0.055][0.350,0.000,0.062]           [0.400,0.000,0.001][0.450,0.000,0.045][0.300,0.000,0.053][0.750,0.000,0.040]         [0.600,0.001][0.450,0.000,0.045][0.700,0.000,0.052][0.750,0.000,0.040]           [0.400,0.000,0.012][0.450,0.000,0.045][0.300,0.000,0.052][0.750,0.000,0.040]         [0.600,0.001][0.450,0.000,0.045][0.700,0.000,0.052][0.750,0.000,0.040]           [0.400,0.000,0.012][0.450,0.000,0.045][0.1300,0.000,0.052]         [0.400,0.000,0.012][0.750,0.000,0.025]           [0.400,0.000,0.012][0.450,0.000,0.045][0.1300,0.000,0.002][0.750,0.000,0.040]         [1.50,0.000,0.025]           [0.400,0.000,0.014][1.450,0.000,0.002][1.300,0.000,0.007][1.350,0.000,0.012]         [1.400,0.000,0.004][1.450,0.000,0.002][1.300,0.000,0.001]           [1.400,0.000,0.041][1.450,0.000,0.02][1.500,0.000,0.000]         [1.400,0.000,0.041][1.450,0.000,0.02][1.500,0.000,0.000]           Curve Fitting         Polynomial         3           wethod:         3         9           0         Polynomial         4.4003E-2x <sup>2</sup> - 9.6358E-2x + 8.0901E-2			
Determination:			
Curve Name:         Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(a))           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) (%)           Course Fikher         [0.000,0.000,0.150][4.000,0.000]			
Method: x Order: 1 y Order: 0 Polynomial: z = -3.75E-2x + 1.50E-1 Coeff. of 1.00 Determination:			
Polygonal Excavations			
Excavation Name:     Pool excavation       Surface level [m]:     91.500       Contribution:     Positive       Enabled:     Yes			
Corner         x         y         Base Stiffend         Previous Side         Next Side           Level         d         pl         p2*         d         pl         p2*           [m]			
x y x y Vertical Horizontal [m] [m] [m] [m] [m] 1 - 40000 -11 600 2 2000 -11 600 Evenuation in front of high Evenuation in front of high			
1       4.0000       11.000       11.000       Interfaces and in stiff clay stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(b) (CIRIA 580 Fig. 2.11(a))         2       2.2000       -11.600       2.2000       11.600       Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(a))         (CIRIA 580 Fig. 2.11(b)       (CIRIA 580 Fig. 2.11(a))       (CIRIA 580 Fig. 2.11(a))			
3       2.2000       11.600       -4.0000       11.600 Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(b)       stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(a))         4       -4.0000       11.600       -4.0000       -11.600 Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(b)         (CIRIA 580 Fig. 2.11(b)       (CIRIA 580 Fig. 2.11(b)       (CIRIA 580 Fig. 2.11(a))			
Excavation Name:     Secant Pile Wall Installation       Surface level [m]:     91,500       Contribution:     Positive       Enabled:     Yes       Corner x     y Base Stiffend Previous Side Next Side       Level     depole p2* depole p2*			

Job No.	Sheet No.	Rev.
141396		
Drg. Ref.		
Made by JC	Date 10-Feb-2021	Checked

40 Frognal Lane Short-term Loading, Wall Toe 5mbbl No. 40

)asys

[m]	[m] [m]	[m]	[%]	[%] [m	] [%]	[%]					
2 2.2000 3 2.2000	-11.600 81.500 -11.600 81.500 11.600 81.500	Yes 0. Yes 0. Yes 0.	0 50.000 2	20.000 0 20.000 0 20.000 0	.0 50.000	20.000					
4 -4.0000 Side Corne	r1 Cor	res 0.	.0 50.000 2	20.000 0	Ground M	lovement Curv	7e				
x [m] 1 -4.0000	<b>y x</b> [m] [m] -11.600 2.200	<b>y</b> [m] 0 -11.600 I	Installatio	Vertical	ant bored	l Installat	Horizontal	it bored			
2 2 2000	-11 600 2 200	0 11 600 T	pile wall : 580 Fig. 2	in stiff .8(b))	clay (CIR	IA pile wal: 580 Fig.	L in stiff cl 2.8(a))	ay (CIRIA			
2 2.2000	11.600 4.000	0 11 600 1	pile wall : 580 Fig. 2	in stiff .8(b))	clay (CIR	IA pile wall 580 Fig.	l in stiff cl 2.8(a))	ay (CIRIA			
3 2.2000	11.600 -4.000	0 11.600 I	pile wall : 580 Fig. 2	in stiff .8(b))	clay (CIR	IA pile wall 580 Fig.	l in stiff cl 2.8(a))	ay (CIRIA			
4 -4.0000	11.600 -4.000	0 -11.600 I	Installatio pile wall : 580 Fig. 2	on of sec in stiff .8(b))	ant bored clay (CIR	I Installat IA pile wal: 580 Fig.	tion of secar l in stiff cl 2.8(a))	at bored ay (CIRIA			
Damage Category	/ Strains										
Name	0 (Ne	gligible) 1	1 (Very Sli	ight) 2	(Slight)	3 (Mode	erate)				
Burland Strain	1 (Ve Limits	ery Slight) 0.0	2 (Slight 500.0	t) 3 00E-6	(Moderate 750.00	e) 4 (Ser IE-6 0.	<b>vere)</b> .0015000				
Specific Structure	es - Geometry										
Structure Name	Sub-Structure	Displaceme	ent Star	rt En	d v	Vertical	Vertical	Damage Cat	tegory Strains	Poisson's E/G	
	Name	Line	Dista Alor Lir	ance Dist ng Alo ne Li	ance Off ng L ne V M	sets from ine for Vertical Novement	Limit Sensitivity	:		Ratio	
No. 40	West Wall	No. 40 West	[m]	] [m	Cal	[m] 0.0	[mm]	Burland Str	ain Limits	0.20000 2.6000	
Creatific Cómotom											
Structure Name	Sub-Structure	Height Def	fault		Hogging			Sagging			
	Name	Prop	perties 2nd	d Moment	Distance	Distance	2nd Moment of Area	Distance of Bending	Distance of N.A.		
			(pe	er unit width)	Strain from N.A.	from Edge of Beam in	(per unit h width)	Strain f from N.A.	from Edge of Beam in		
No. 40	West Wall	[m] 12.000 Yes		[m³] 576.00	[m] 12.00	[m] 12.000	[m <sup>3</sup> ] 144.00	[m] 6.0000	[m] 6.0000		
Building Segmen	t Combinations										
Structure Name	Sub-Structure Name	Vertical Offset from	Segment	Start Le	ngth Curv	ature Combin	ned				
						Segmen	10				
		Line for Vertical Movement				Segmen					
No structures h	ave segments com	Line for Vertical Movement Calculation [m] bined.	ns	[m] [:	m]	Segme					
No structures h	ave segments com	Line for Vertical Movement Calculation [m] bined.	ns	[m] [:	m]	Segue					
No structures h <b>Utility Strain Calc</b> Neglect benefic	ave segments com ulation Options ial contribution	Line for Vertical Movement Calculation [m] bined.	ns trains : No	[m] [:	m]	Segue					
No structures h <b>Utility Strain Calc</b> Neglect benefic <b>Warnings</b>	ave segments com ulation Options ial contribution	Line for Vertical Movement Calculation [m] bined.	ns trains : No	[m] [: o	m ]	Segue					
No structures h Utility Strain Calc Neglect benefic Warnings 1 Multiple	ave segments com ulation Options ial contribution	Line for Vertical Movement Calculation [m] bbined.	ns trains : No fied. The	[m] [: o	m]	ulting from	these				
No structures h Utility Strain Calc Neglect benefic Warnings 1 Multiple excavatio individua excavatio	ave segments com <b>ulation Options</b> ial contribution excavations have ns are calculate 1 excavation. N ns (e.g. overlap	Line for Vertical Movement Calculation [m] bined. of axial st been specifi d by summing o account ha ping zones c	ns trains : No fied. The g the displ as been tal	[m] [: o displace: lacements ken of th ce or 'sh	ments res resultin e interac ielding'	ulting from g from each tions betwee of one exca	these an ration by				
No structures h Utility Strain Calc Neglect benefic Warnings 1 Multiple excavatio another).	ave segments com ulation Options ial contribution excavations have ns are calculate l excavation. N ns (e.g. overlap	Line for Vertical Movement Calculatior [m] bined. of axial st been specif d by summing o account ha ping zones o	ns trains : No fied. The g the disp is been tal of influence	[m] [: o lacements ken of th ce or 'sh	ments res resultin e interac ielding'	ulting from g from each tions betwee of one excen	these en ration by				
No structures h Utility Strain Calc Neglect benefic Warnings 1 Multiple another). Errors	ave segments com ulation Options ial contribution excavations have ns are calculate 1 excavation. N ns (e.g. overlap	Line for Vertical Movement [m] bined. of axial st been specified d by summing o account hap ping zones c	hs fied. The y the disp is been tal of influence	[m] [; o displacements ken of th ce or 'sh	m] ments res resultin e interac ielding'	ulting from g from each tions betwee of one excav	these en ration by				
No structures h Utility Strain Calo Neglect benefic Warnings 1 Multiple excavatio another). Errors None	ave segments com <b>ulation Options</b> ial contribution excavations have ns are calculate l excavation. N ns (e.g. overlap	Line for Vertical Movement Calculatior [m] bined. of axial st been specifi d by summing o account hap ping zones c	ns fied. The g the disp js been tai	[m] [: o displace lacements ken of th ce or 'sh	m] ments res resultin e interac ielding'	ulting from g from each tions betwee of one excav	these en ration by				
No structures h Utility Strain Calc Neglect benefic Warnings 1 Multiple excavatio indivatio another). Errors None Displacement and	ave segments com ulation Options ial contribution excavations have ns are calculate l excavation. N ns (e.g. overlap d Strain Results	Line for Vertical Movement Calculatior [m] bined. of axial st been specif d by summing o account ha ping zones c	ns fied. The g the disp s been taip of influence	[m] [: o displace: lacements keen of th ce or 'sh	m] ments res resultin e interac ielding'	ulting from g from each tions betwee of one excar	these en ration by				
No structures h Utility Strain Calc Neglect benefic Warnings 1 Multiple excavatio another). Errors None Displacement and Type/No.	ave segments com ulation Options ial contribution excavations have ns are calculate l excavation. N ns (e.g. overlap d Strain Results	Line for Vertical Movement Calculatior [m] bined. of axial st been specified d by summing o account ha ping zones c	ns fied. The ; the disp is been tais of influence	[m] [: o lacements keen of th ce or 'sh	m] ments resultin e interac ielding'	ulting from g from each tions between of one excav	these en ration by		Angle of Line		
No structures h Utility Strain Calo Neglect benefic Umanings 1 Multiple excavatio another). Errors None Displacement and Type/No.	ave segments com ulation Options ial contribution excavations have ns are calculate l excavation. N ns (e.g. overlap d Strain Results c st. x	Line for Vertical Movement Calculatior [m] bined. • of axial st • been specified to by summing to account happing zones of ping zones of coordinates	ns fied. The j the display in first so been tain f influence z	[m] [; o displace lacements ken of th ce or 'sh	m] ments res resultin e interac ielding'	ulting from g from each tions between of one excent Displacement g	these an ration by Horizontal isplacement	Horisontal	Angle of Line to x Axis		
No structures h Utility Strain Calc Neglect benefic Warnings 1 Multiple excavatio another). Errors None Displacement and Type/No. Name Di	ave segments com ulation Options ial contribution excavations have ms are calculate l excavation. N ns (e.g. overlap) d Strain Results c st. x m] [m]	Line for Vertical Movement Calculatior [m] of axial st been specif d by summing o account ha ping zones c	fied. The fied. The fiss been tail finfluence finfluence finfluence	[m] [: o displace: lacements ken of th ce or 'sh x [mm]	m] ments resultin e interac ielding' <b>y</b> [mm]	Displaceme [mm]	these en vation by Horizontal Hisplacement along Line [mm]	Horizontal displacement perpendicula to Line [mm]	Angle of Line to x Axis tr		
No structures h Utility Strain Calc Neglect benefic Warnings 1 Multiple accavatio another). Errors None Displacement and Type/No. Name Di No. 40 Line West	ave segments com ulation Options ial contribution excavations have ms are calculate l excavation. N ns (e.g. overlap d Strain Results c st. x m] [m] 1 -7.50000 .0000 -7.50000	Line for Vertical Movement [m] bined. of axial st been specified by summing to account haping zones of account haping zones of coordinates y [m] 0.00000 5	fied. The fied. The fied disp is been tai finfluence [m] pl.50000 pl.50000	[m] [: o displace: lacements ken of th ce or 'sh m [mm] 11.401 11.401	m] ments resultin e interac ielding' y [mm] 0.0	Displaceme mm bisplaceme z (mm) 8.1089 7.9384	these en ration by Horizontal displacement along Line [mm] 0.0 0.0	Horizontal displacement perpendicula to Line [mm] -11.4( -11.4)	Angle of Line to x Axis xr )1 90.000 *		
No structures h Utility Strain Calc Neglect benefic Warnings 1 Multiple excavatio another). Errors None Displacement and Type/No. Name Di No. 40 Line West 1 2 3 4	ave segments com ulation Options ial contribution excavations have ns are calculate l excavation. N ns (e.g. overlap d Strain Results c st. x m] [m] 1 -7.50000 .0000 -7.50000 .0000 -7.50000	Line for Vertical Movement Calculatior [m] o of axial st been specified by summing o account ha ping zones of coordinates y [m] 0.00000 5 1.00000 5 2.00000 5 3.00000 5	m fied. The fied. The fied. The field. The field of the f	[m] [; o displaces ken of th ce or 'sh 11.401 11.401 11.401 11.401 11.401	m] ments resultin e interace ielding' [mm] 0.0 0.0 0.0 0.0	Displaceme g from each of one excav Displaceme g [mm] 8.1089 7.9384 7.9330	these en vation by Horizontal displacement along Line [mm] 0.0 0.0 0.0 0.0	Borizontal displacement perpendicule fumi -11.44 -11.44 -11.44 -11.44 -11.44	Angle of Line to x Axis 1 90.000 = 11 90.000 = 11 90.000 = 11 90.000 =		
No structures h Utility Strain Calc Neglect benefic Warnings 1 Multiple excavatio another). Errors None Displacement and Type/No. Name Di No. 40 Line West 1 2 3 3 6 7 7 7	ave segments com ulation Options ial contribution excavations have ns are calculate l excavation. N ns (e.g. overlap d Strain Results c st. x m] [m] 1 -7.50000 .0000 -7.50000 .0000 -7.50000 .0000 -7.50000 .0000 -7.50000 .0000 -7.50000 .0000 -7.50000	Line for Vertical Movement (m) bined. of axial st been specified by summing o account hap ping zones of coordinates y (m) 0.00000 5 3.00000 5 5.00000 5 5.000000 5 5.00000 5 5.00000 5 5.00000 5 5.00000 5 5.00000 5 5.00000 5 5.00000 5 5.00000 5 5.0000000000	rains : No fied. The y the disp is been taip is been taip influence z [m] 01.50000 01.50000 01.50000 01.50000 01.50000 01.50000 01.50000 01.50000	<pre>[m] [: o displace: lacements keen of th ce or 'sh [mm] 11.401 11.401 11.401 11.401 11.401 11.401 11.401</pre>	m] ments res resultin ielding' [mm] 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.	Displaceme z (mm) 8,1089 7,9358 7,9218 7,9212	these en vation by Horizontal iisplacement [mm] 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.	Horizontal displacement perpendicula [mm] -11.4()))))))))))))))))))))))))))))))))))	Angle of Line to x Axis t I I I I I I I I I I I I I I I I I I		
No structures h Utility Strain Calc Neglect benefic Warnings 1 Multiple 1 excavatio another). Errors None Displacement and Type/No. Name Di No. 40 Line West 1 2 3 4 5 6 7 7 9 9 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	ave segments com ulation Options ial contribution excavations have ms are calculate 1 excavation. N ns (e.g. overlap d Strain Results c st. x m] [m] 1 -7.50000 .0000 -7.50000	Line for Vertical Movement [m] of axial st been specified base spe	rains : NG fied. The j the disp is been tai of influence [m] bl.500000 bl.500000 bl.500000 bl.500000 bl.500000 bl.500000 bl.500000 bl.500000 bl.50000000 bl.500000 bl.500000 bl.5000000 bl.50000000000 bl.5000000000000000000000000000000000000	[m] [: displace: lacements ken of the ce or 'sh 11.401 1	<pre>m ] ments res resultin e interact ielding'  [mm] 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.</pre>	Displaceme (mm) 8.1089 7.9384 7.9375 7.9375 7.9384 7.9375 7.9375 7.9384 7.9375 7.9475 7.94	these ents Horizontal displacement along Line [mm] 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Horizontal displacement perpendicula to Line [mm] -11.44 -	Angle of Line to x Axis xr 1 90.000 * 190.000 * 190.000 * 190.000 * 190.000 * 190.000 * 190.000 * 190.000 * 190.000 * 190.000 *		
No structures h Utility Strain Calc Neglect benefic Warnings 1 Multiple excavatio another). Errors None Displacement and Type/No. Name Di No. 40 Line West 1 2 3 4 5 6 7 7 8 9 9 1 1 1 1	ave segments com ulation Options ial contribution excavations have ns are calculate l excavation. N ns (e.g. overlap d Strain Results m] [m] 1 -7.50000 .0000 -7.50000	Line for Vertical Movement [m] bined. of axial st been specified by summing to account haping zones of account haping zones of secondinates y [m] 0.00000 5 1.00000 5 5.00000 5 5.00000 5 5.00000 5 5.00000 5 1.00000 5 1.00000 5 5.00000 5 5.000000 5 5.00000 5 5.00000 5 5.000000 5 5.00000 5 5.0000000000	rains : NG fied. The fiel. The field	[m] [: displace: lacements keen of the keen of the lacements keen of 'sh 11.401 11.401 11.401 11.401 11.401 11.401 11.401 11.401 11.401 11.401 11.401 11.401 11.401 11.401 11.401	m] ments res resultin ielding' (mm) 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.	Displaceme g from each of one excav Displaceme z (mm) 8,1089 7,9355 7,9355 7,9355 7,9355 7,9359 7,93	these en ration by Horizontal isplacement along Line [mm] 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Horizontal displacement perpendicula to Line [mm] -11.40 -	Angle of Line to XAXIS X 1 90.000 * 1 90.000 *		
No structures h Utility Strain Calc Neglect benefic Warnings 1 Multiple excavatio another). Errors None Displacement and Type/No. Name Di No. 40 Line West 1 2 3 4 5 7 7 8 9 9 9 1 1 1 1 1 1 1 1 1 1 1 1 1	ave segments com ulation Options ial contribution excavations have ns are calculate l excavation. N ns (e.g. overlap d Strain Results (Strain Results (St. x m) [m] 1 -7.50000 .0000 -7.50000	Line for Vertical Movement Calculatior [m] bined. been specifid by summing o account haping zones c been specifid by summing o account haping zones c coordinates y [m] 0.00000 5 3.00000 5 3.00000 5 5.00000 5 5.00000 5 3.00000 5 3.000000 5 3.00000 5 5.00000 5 5.00000 5 5.00000 5 5.000000 5 5.00000 5 5.00000 5 5.00000 5 5.00000 5 5.00000 5 5.00000 5 5.0000000000	rains : No fied. The fied. The fied. The field of the fie	[m] [: displace: lacements ken of the ce or 'sh 11.401 1	m] ments res resultin ielding' [mm] 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.	Displaceme z (mm) 8,1089 7,9358 7,79358 7,79357 7,79358 7,79358 7,79577 7,795777 7,79577777777777777777	these en vation by Horizontal displacement [mm] 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.	Horizontal displacement perpendicula [mm] -11.40 -11.44 -1	Angle of Line to x Axis to x 1 90.000 * 1 90.000 *		
No structures h Utility Strain Calc Neglect benefic Warnings 1 Multiple excavatio another). Errors None Displacement and Type/No. Name Di No. 40 Line West 1 1 No. 40 Line West 1 1 * Result includes important	ave segments com ulation Options ial contribution excavations have ms are calculate l excavation. N ns (e.g. overlap) d Strain Results m] [m] 1 -7.50000 0000 -7.50000 0.000 -7.50000 0.00	Line for Vertical Movement [m] bined. of axial st been specified bases specifi	rains : NG fied. The y the disp is been tai f influence m m m m m m m m m m m m m m m m m m m	[m] [: displace: lacements ken of th ce or 'sh 11.401 11.4	<pre>m ] ments res resultin e interact ielding'  [mm] 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.</pre>	Displacement (mm) 8.1089 7.9384 7.9375 7.9388 7.9318 7.9328 7.9318 7.9328 7.8329 7.8389 7.8329 7.	these en ration by Horizontal displacement along Line [mm] 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.	Horizontal displacement perpendicul to Line [mm] -11.40 -11.40 -11.44 -11.45 -1	Angle of Line to X Axis 1 90.000 * 1 90.000 *		
No structures h Neglect benefic Multiple scattering 1 Multiple excavatio another). Errors None Displacement and Type/No. Name Di No. 40 Line West 1 1 1 1 1 1 1 1 1 1 1 1 1	ave segments com ulation Options ial contribution excavations have ns are calculate l excavation. N ns (e.g. overlap d Strain Results m] [m] 1 -7.50000 .0000 -7.50000 .000 -7.50000 .0000 -7.50000 .000 -7.50000 .000 -7.50000 .000 -7.50000 .000 -7.50000	Line for Vertical Movement [m] bined. of axial st been specific d by summing to account haping zones of account haping zones of account haping zones of to account haping zones of the summing to account haping to account to account haping to account to account haping to account haping to account to account to account haping to account to account to account to account to account to account to the second to account to account to account to account to account to the second to account to account to account to account to account to the second to account to the second to account to acco	rains : NG fied. The y the disp: sbeen tail of influence [m] 91.500000 91.50000 91.500000 91.50000 91.50000000000000000000000000	[m] [: displace: lacements ken of thh ce or 'sh 11.401 11.	m] ments res resultin e interac ielding' (mm] 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.	Displaceme g from each of one excav plassifications betwee of one excav z (mm] 8.1089 7,9336 7,9337 7,9336 7,9336 7,9337 7,9357 7,9357	these en ration by Horizontal isplacement along Line [mm] 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Horizontal displacement perpendicula to Line [mm] -11.4()))))))))))))))))))))))))))))))))))	Angle of Line to Xaxis I I I I I I I I I I I I I I I I I I I		

Coordinates x y

Dist.

Job No
141

Job No.	Sheet No.	Rev.
141396		
Drg. Ref.		
Made by JC	Date 10-Feb-2021	Checked

**40 Frognal Lane** Short-term Loading, Wall Toe 5mbbl

No. 40

)asys

[m] [m] 0.0 -7.50000 1.0000 -7.50000 2.0000 -7.50000 3.0000 -7.50000	[m] [m] 0.00000 91.5( 1.00000 91.5( 2.00000 91.5( 3.00000 91.5( 4.00000 91.5(	[mm] [mm 0000 11.401 0000 11.401 0000 11.401 0000 11.401	along Li 0.0 0.0 0.0 0.0 0.0	g the pe ine nm] 0.0 0.0 0.0 0.0 0.0	rpendicular to Line [mm] -11.401 c -11.401 c -11.401 c -11.401 c						
5.000 -7.5000 6.0000 -7.5000 7.0000 -7.5000 9.0000 -7.5000 10.000 -7.5000 11.000 -7.5000 12.000 -7.5000 13.000 -7.5000 14.000 -7.50000 d - Displacement	0 5.0000 91.50 6.0000 91.50 7.0000 91.50 9.0000 91.50 11.0000 91.50 11.0000 91.50 12.0000 91.50 13.0000 91.50 14.0000 91.50 14.0000 91.50 15.0000 91.50 15.0000 15.0000 15.000 15.0000 15.0000 15.0000 15.000 15.0000 15.0000 15.000 15.00000 15.000000 15.00000 15.00000 15.00000 15.00000 15.000000 15.000000 15.000000 15.000000 15.00000000000 15.000000000000000000000000000000000000	0000 11.401 0000 11.401 0000 11.401 0000 11.401 0000 11.401 0000 11.401 0000 11.401 0000 6.1369 -0.37 0000 4.6230 -1.2 0000 3.3347 -1.8 0000 2.3489 -2.2 prted displacemen	0.0 0.0 0.0 0.0 0.0 0.0 0.0 443 -( 245 - 523 - 390 - ts.	0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.37443 -1.2245 -1.8523 -2.2390	-11.401 c -11.401 c -11.401 c -11.401 c -11.401 c -11.401 c -11.401 c -4.6230 c -3.3347 c -2.3489 c						
Specific Building	Damage Results	- Vertical Displace	ments								
Structure: No.	40   Sub-struct	ure: West Wall									
Dist. C	Coordinates v z	Displace	ments								
[m] [m]	[m] [m]	[mm]									
$\begin{array}{cccc} 0.0 & -7, 50000\\ 1.0000 & -7, 50000\\ 2.0000 & -7, 50000\\ 4.0000 & -7, 50000\\ 6.0000 & -7, 50000\\ 6.0000 & -7, 50000\\ 9.0000 & -7, 50000\\ 10.000 & -7, 50000\\ 11.000 & -7, 50000\\ 12.000 & -7, 50000\\ 13.000 & -7, 5000\\ 13.000 & -7,$	0.00000 91.5; 1.00000 91.5; 0.00000 91.5; 0.00000 91.5; 0.00000 91.5; 0.00000 91.5; 0.00000 91.5; 0.00000 91.5; 10.00000 91.5; 11.00000 91.5; 13.00000 91.5; 13.00000 91.5; 14.00000 91.5; 15.00000 91.5; 15.0000 91.5; 15.0000 91.5; 15.0000 91.5; 15.00000 91.5; 15.000000000000000000000000000000000000	0000 8.1089 d 0000 7.3384 d 0000 7.3375 d 0000 7.3375 d 0000 7.3330 d 0000 7.9285 d 0000 7.9218 d 0000 7.9218 d 0000 7.8987 d 0000 7.8582 d 0000 7.8319 d 0000 4.3873 d 0000 4.3873 d 0000 3.6073 d 0000 3.6273 d	ts.								
Creation Duilding	Domono Dooute	All Commonto									
Specific Building	Damage Results	- All Segments									
Structure: No.	40   Sub-struct	ure: West Wall		. Deflecti		Mara M	an Cardiant	New Credit	at Min	Dama	
from Line for Vertical Movement Calculations	begmente	[m] [m]	Curveture	Ratio	Horizontal Strain	I Tensile Strain D	of Horizontal Displacement Curve	of Vertica Displaceme Curve	al Radius of ent Curvature	Category	
0.0		1 0.0 2.9726	Hogging	0.00374	28 0.0	0.0037282	0.0	170.50	5-6 4712.5	(Negligible	0
		3 11 585 2 7974	Hogging	0.0216	99 -0.063670	a 0.018589	3/4.5/E=6 850 77E=6	0.00344	159 1055.1 159 1291 5	(Negligible	e)
		4 14.382 0.61754	None	0.0001	.0 -0.038666	6 0.0077332	386.81E-6	378.05	5-6 108890.	(Negligible	0
Tensile horizor	tal strains are	+ve, compressiv	e horizont	tal strain	s are -ve.					(Negligible	:)
Specific Building	Damage Results	- Critical Values fo	r All Segme	ents within	Each Sub-Stru	icture					
Structure: No.	40   Sub-struct	ure: West Wall									
Vertical De Offset from Line for Vertical Movement Calculations	flection Avera Ratio Horizo Stra	nge Max Slope ontal S nin	Max ettlement	Max Tensile Strain	Max Gradient of Horizontal Displacement Curve	Max Gradient of Vertical Displacement Curve	Min Radius of Curvature (Hogging)	Min Radius of Curvature (Sagging)	Damage Cate	gory	
[m] 0.0	[%] 0.038499 -0.06	3670 0.0034459	[mm] 8.1089	[%] 0.028674	850.77E-6	0.0034459	[m] 1291.5	[m] 1055.1 (	) (Negligible)		
Specific Building	Damage Results	- Critical Segments	s within Ead	ch Structur	e						
Structure Name	Parameter	Critical Sub-Structure	Critical Segment	l Start	End Curvatu	ıre Max Slope	e Max Settlement	Max Tensile Strain	Min Radius of Rad Curvature Curvature Curvatur	Min dius of rvature	Damage Category
No. 40	Max Slope	West Wall	2	[m] 2 2.9726 1	[m] 1.585 Sagging	g 0.0034459	[mm] 7.9358	[%] 0.018589	[m] _	[m] 1055.1 0 (N	egligible)
	Max Settlement Max Tensile	West Wall West Wall	1	1 0.0 2 3 11.585 1	.9726 Hogging 4.382 Hogging	g 170.50E-6 g 0.0034459	8.1089 5.8167	0.0037282	4712.5 1291.5	4) 0 -	legligible) legligible)
	Strain Min Radius of	West Wall	3	3 11.585 1	4.382 Hogging	g 0.0034459	5.8167	0.028674	1291.5	- 0 (1	legligible)
	(Hogging) Min Radius of Curvature (Sagging)	West Wall	2	2 2.9726 1	1.585 Sagging	g 0.0034459	7.9358	0.018589	-	1055.1 0 (1	legligible)

	-		FAI	RHURST				L	Job No.		Sheet No.	F	Rev.
	as	sys							141	396			
0 Frog	gnal La	ne ading Wall T	o 5mbb	ı				F	Drg. R	ef.			4
lo. 40		auniy, wan ro		1					Made b <u>y</u> JC	4	Date 10-Feb-2021	Che	cke
Problem Ty	уре												
Problem Ty	ype : Tunr	elling and Embedded	Wall Excavat	cions									
Displaceme	ent Data												
Гуре	Name	Direction of extrusion	Point/Li	ine/Line for extrusion	1	No. of intervals across	Extrusion depth	No. of interval: along	Calculate	Surface type for			
Line No.	40 West	<b>x</b> [m] -7.500	First point Y Z [m] 0 0.00000 91	Second           (level)         X         Y           [m]         [m]         [m]           1.50000         -7.50000         15.00	point <b>Z(level)</b> [m] 0000 91.50000	extrusion/line	[m] _	extrusion	Yes	Surface			

.

9 -7.3000 9.0000 91.5000 0.0000 0.0000 0.0000 0.6420 1.20 10 -7.5000 9.0000 91.5000 0.0000 0.0000 0.6420 1.26 11 -7.5000 10.0000 91.5000 0.0000 0.0000 0.45728 1.26 12 -7.5000 11.0000 91.5000 0.0000 0.0000 0.49670 1.26 

0.00000 91.50000 0.00000 0.00000 0.86030 0.00000 91.50000 0.00000 0.00000 0.64620

1,2,6

13 -7.50000 14 -7.50000

17 -7.50000 18 -8.42730

FAIRHURST	Job No.	Sheet No.	Rev.
Oasys	141396		
40 Frognal Lane	Drg. Ref.		
No. 40	Made by JC	Date 10-Feb-2021	Checked
Ref. Coordinates Displacements <b>x y z x y z</b> [m] [m] [mm] [mm] [mm]	•		
Lery         Lery <thlery< th="">         Lery         Lery         <thl< td=""><td>ge calculations. calculations.</td><td></td><td></td></thl<></thlery<>	ge calculations. calculations.		
Vertical Ground Movement Curves (Excavations)			
Curve Name: Installation of secant bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(b)) 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][2.000,0.000]			
Curve Fitting Folynomial Method: x Order: 1 y Order: 0 Polynomial: z = -2.5E-2x + 5.0E-2 Coeff. of 1.0			
Determination: Curve Name: Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(b)			
<pre>Coordinates: [Ustance 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) (%] [0.000,0.000,0.039][0.100,0.000,0.049][0.200,0.000,0.056][0.300,0.000,0.062] [0.400,0.0000,0.073][0.900,0.000,0.170][1.600,0.000,0.070][1.100,0.000,0.068] [1.200,0.0000,0.055][1.300,0.000,0.070][1.400,0.000,0.070][1.100,0.000,0.068] [1.200,0.0000,0.055][1.300,0.000,0.061][1.400,0.000,0.042][1.900,0.000,0.038] [2.000,0.0000,0.050][1.700,0.000,0.051][1.200,0.000,0.042][1.900,0.000,0.038] [2.000,0.0000,0.020][2.500,0.000,0.12][2.200,0.000,0.012][2.300,0.000,0.023] [2.400,0.0000,0.020][2.500,0.000,0.000][3.400,0.000,0.031][3.100,0.000,0.005] [3.200,0.0000,0.002][3.700,0.000,0.002][3.800,0.000,0.001][3.900,0.000,0.001] [4.000,0.0000,0.000] Folynomial</pre>			
x Order: 4 y Order: 0 Polynomial: z = -2.6455E-3x <sup>4</sup> + 2.8495E-2x <sup>3</sup> - 1.0051E-1x <sup>2</sup> + 1.0569E-1x + 3.8990E-2 Coeff. of 9.9991E-1			
Determination:			
Correv Name: Coordinates: Coordinates: Coordinates: Coordinates: Coordinates: Coordinates: Coordinates: Distance from wall / wall depth or max. excavation depth (x). Pepth / wall depth or max. excavation depth (y). Horizontal movement / wall depth or max. excavation depth (z) (%)] (0.000,0.000,0.004) [0.050,0.000,0.076] [0.100,0.000,0.072] [0.150,0.000,0.067] [0.200,0.000,0.049] [0.450,0.000,0.059] [0.350,0.000,0.040] [0.600,0.000,0.027] [0.550,0.000,0.059] [0.350,0.000,0.040] [0.600,0.000,0.027] [0.550,0.000,0.034] [0.750,0.000,0.020] [1.000,0.000,0.027] [0.550,0.000,0.034] [0.750,0.000,0.020] [1.000,0.000,0.018] [1.150,0.000,0.031] [1.250,0.000,0.020] [1.000,0.000,0.018] [1.150,0.000,0.002] [1.300,0.000,0.020] [1.350,0.000,0.001] [1.400,0.0000,0.004] [1.450,0.000,0.002] [1.500,0.000,0.000] Curve Fitting Method: x Order: 0 Polynomial: z = -1.0610E-2x <sup>3</sup> + 4.4203E-2x <sup>2</sup> - 9.6358E-2x + 8.0901E-2 Coeff. of 1.0000			
Curve Name:         Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(a))           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] Method: x Order: 1 y Order: 0 Polynomial: z = -3.75E-2x + 1.50E-1 Coeff. of 1.00 Determination:			
Polygonal Excavations			
Excavation Name:         Pool excavation           Surface level [m]:         91.500           Contribution:         Positive           Enabled:         Yes			
K         Y         Base Level         Stiffened d         Previous plas         Side plas         Next Side           [m]         [m]         [m]         [k]         [k]         [k]         [k]         [k]           1         -4.0000         -11.600         86.500         Yes         0.0         67.000         25.000         0.0         67.000         25.000           2         2.2000         11.600         86.500         Yes         0.0         67.000         25.000         0.0         67.000         25.000           3         2.2000         11.600         86.500         Yes         0.0         67.000         25.000         0.0         67.000         25.000           4         -4.0000         11.600         86.500         Yes         0.0         67.000         25.000         0.0         67.000         25.000			
Side         Corner 1         Corner 2         Ground Movement Curve           x         y         x         y         Vertical         Horizontal           [m]         [m]         [m]         [m]         [m]         [m]			
1       -4.0000       -11.600       2.2000       -11.600       Excavation in front of high stiffness wall in stiff clay stiffness wall wall sti			
4 -4.0000 11.600 -4.0000 -11.600 Excavation in front of high stiffness wall in stiff clay (CIRIA 580 Fig. 2.11(b) (CIRIA 580 Fig. 2.11(a))			
Excavation Name:         Secant Pile Wall Installation           Surface level [m]:         91.500           Contribution:         Positive           Enabled:         Yes			

Corner x

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Drg. Ref.				
Made by JC	Date 10-Feb-2021	Checked		

**40 Frognal Lane** Long-term Loading, Wall Toe 5mbbl No. 40

ISYS

	[m] L -4.0000	[m] -11.600 8	[m] 81.500	[n Yes (	1] [%] [%] 1.0 50.000 20.000	[m] [%] 0 0.0 50.000	[%] 20.000					
	2 2.2000 3 2.2000 4 -4.0000	11.600 8 11.600 8	81.500 81.500 81.500	Yes ( Yes (	1.0 50.000 20.000 1.0 50.000 20.000	0.0 50.000 0 0.0 50.000 0 0.0 50.000	20.000					
Side	Corne	er 1 	Corne	r 2	Vort	Ground M	lovement Curv	Ve Horigontal				
1	[m] -4.0000	[m] -11.600	[m] 2.2000	[m] -11.600	Installation of pile wall in st: 580 Fig. 2.8(b)	secant bored iff clay (CIR )	l Installat TA pile wall 580 Fig.	ion of secant in stiff clay 2.8(a))	bored / (CIRIA			
2	2.2000	-11.600	2.2000	11.600	Installation of pile wall in st 580 Fig. 2.8(b)	secant bored iff clay (CIR )	l Installat NA pile wall 580 Fig.	ion of secant in stiff clay 2.8(a))	bored / (CIRIA			
3	2.2000	11.600	-4.0000	11.600	Installation of pile wall in st 580 Fig. 2.8(b)	secant bored iff clay (CIR )	I Installat IA pile wall 580 Fig.	ion of secant in stiff clay 2.8(a))	bored / (CIRIA			
4	-4.0000	11.600	-4.0000	-11.600	Installation of pile wall in st 580 Fig. 2.8(b)	secant bored iff clay (CIR )	l Installat MA pile wall 580 Fig.	ion of secant in stiff clay 2.8(a))	bored V (CIRIA			
Damag	ge Categor	y Strains										
	Name		0 (Negl t	igible) o	1 (Very Slight) to	2 (Slight) to	3 (Mode to	erate)				
Burla	nd Strain	Limits	1 (Very	Slight) 0.0	2 (Slight) 500.00E-6	3 (Moderate 750.00	e) <b>4 (Sev</b> IE-6 0.	<b>vere)</b> .0015000				
Specif	ic Structur	res - Geom	etry									
Struct	ture Name	Sub-Sti Nar	ructure ne	Displacen Line	ent Start Distance I Along Line	End V Distance Off Along L Line V	Vertical Sets from Jine for Vertical	Vertical Displacement Limit Sensitivity	Damage Cate	gory Strains	Poisson's Ratio	E/G

# Acting Line Line Line Line Line Line Line Line Movement Movement Calculations [m] <t

#### Specific Structures - Bending Parameters

Structure Name	Sub-Structure Name	Height	Default Properties	Hogging			Sagging			
				2nd Moment of Area (per unit	Distance of Bending Strain	Distance of N.A. from Edge	2nd Moment of Area (per unit	Distance of Bending Strain	Distance of N.A. from Edge	
				width)	from N.A.	of Beam in	width)	from N.A.	of Beam in	
						Tension			Tension	
No. 40	West Wall	[m] 12.000	Yes	[m³] 576.00	[m] 12.000	[m] 12.000	[m³] 144.00	[m] 6.0000	[m] 6.0000	

#### Building Segment Combinations

Structure Name	Sub-Structure	Vertical	Segment	Start	Length	Curvature	Combined
	Name	Offset from					Segment
		Line for					
		Vertical					
		Movement					
		Calculations					
		[m]		[m]	[m]		

[m] [m] [n] [n]

#### Utility Strain Calculation Options

Neglect beneficial contribution of axial strains : No

#### Warnings

1 Multiple excavations have been specified. The displacements resulting from these excavations are calculated by summing the displacements resulting from each individual excavation. No account has been taken of the interactions between excavations (e.g. overlapping zones of influence or 'shielding' of one excavation by another).

#### Errors

None

#### Displacement and Strain Results

Туре	e/No.	c	cordinates		Displacements						
Name	Dist.	x	У	z	x	У	z	Horizontal displacement along Line	Horizontal displacement perpendicular to Line	to x Axis	
	[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]	[mm]	[°]	
No. 40 West	Line 1	-7.50000	0.00000	91.50000	11.401	0.0	9.4889	0.0	-11.401	90.000	*
	1.0000	-7.50000	1.00000	91.50000	11.401	0.0	8.6267	0.0	-11.401	90.000	*
	2.0000	-7.50000	2.00000	91.50000	11.401	0.0	8.6209	0.0	-11.401	90.000	*
	3.0000	-7.50000	3.00000	91.50000	11.401	0.0	8.6108	0.0	-11.401	90.000	*
	4.0000	-7.50000	4.00000	91.50000	11.401	0.0	8.5958	0.0	-11.401	90.000	*
	5.0000	-7.50000	5.00000	91.50000	11.401	0.0	8.5749	0.0	-11.401	90.000	*
	6.0000	-7.50000	6.00000	91.50000	11.401	0.0	8.5471	0.0	-11.401	90.000	*
	7.0000	-7.50000	7.00000	91.50000	11.401	0.0	8.5110	0.0	-11.401	90.000	*
	8.0000	-7.50000	8.00000	91.50000	11.401	0.0	8.4651	0.0	-11.401	90.000	*
	9.0000	-7.50000	9.00000	91.50000	11.401	0.0	8.4085	0.0	-11.401	90.000	*
	10.000	-7.50000	10.00000	91.50000	11.401	0.0	8.3411	0.0	-11.401	90.000	*
	11.000	-7.50000	11.00000	91.50000	11.401	0.0	8.2650	0.0	-11.401	90.000	*
	12.000	-7.50000	12.00000	91.50000	6.1369	-0.37443	4.7686	-0.37443	-6.1369	90.000	*
	13.000	-7.50000	13.00000	91.50000	4.6230	-1.2245	4.3137	-1.2245	-4.6230	90.000	*
	14.000	-7.50000	14.00000	91.50000	3.3347	-1.8523	3.8908	-1.8523	-3.3347	90.000	*
	15.000	-7.50000	15.00000	91.50000	2.3489	-2.2390	3.7136	-2.2390	-2.3489	90.000	*
* Result inclue	les imported disp	placement(s).									

#### Specific Building Damage Results - Horizontal Displacements

Structure	: No. 40	Sub-	structure:	West	Wall		
Dist.	Coo x	rdinate: Y	z	x	У	Displacements Horizontal displacement	Horizontal displacement

Job No.	She
141396	

Damage Category

#### 40 Frognal Lane

s D

Long-term Loading, Wall Toe 5mbbl No. 40

asys

Job No.	Sheet No.	Rev.			
141396					
Drg. Ref.					
Made by JC	Date 10-Feb-2021	Checked			

[m] [m] 0.0 -7.50000 1.000 -7.50000 2.0000 -7.50000 5.0000 -7.50000 5.0000 -7.50000 7.0000 -7.50000 9.0000 -7.50000 9.0000 -7.50000 10.000 -7.50000 12.000 -7.50000 13.000 -7.50000 14.000 -7.50000 15.000 -7.50000 5.000 -7.50000 15.000 -7.50000 15.0000 -7.50000 15.0000 -7.50000 15.000000 15.00000 15.0000 15.0000000000 15.000	[m] 0.00000 9 2.00000 9 2.00000 9 4.00000 9 6.00000 9 6.00000 9 8.00000 9 9.00000 9 10.00000 9 11.00000 9 12.00000 9 13.00000 9 14.00000 9 15.00000 9 15.00000 9 15.00000 9	[m] 11.50000 1	[mm] 11.401	alon [mm] [ 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.	g the perminance permi	rpendicular to Line [mm] -11.401 d -11.401 d -1.401 d -1.4					
Specific Dununing	Damage Ne	suns - ver	ucai Dispie	acements							
Structure: No.	40   Sub-st	ructure:	West Wal	1							
Dist. C	oordinates Y	z	Displ. z	acements							
[m] [m] Vertical Offset 0.0 -7.50000 1.0000 -7.50000 3.0000 -7.50000 5.0000 -7.50000 6.0000 -7.50000 6.0000 -7.50000 0.0000 -7.50000 10.000 -7.50000 11.000 -7.50000 12.000 -7.50000 13.000 -7.50000 d - Displacemen Specific Building Structure: No.	[m] 1 0.0000 9 1.0000 9 4.0000 9 4.0000 9 4.0000 9 4.0000 9 4.0000 9 4.0000 9 4.0000 9 1.0000 9 5.0000	[m] 91.500000 91.50000 91.50000 91.50000 91.50000 91.50000 91.50000	[mm] 9.4889 d 8.6267 d 8.6209 d 8.6209 d 8.5598 d 8.5598 d 8.5598 d 8.5471 d 8.5471 d 8.5471 d 8.5471 d 8.4651 d 8.4651 d 8.4651 d 8.4651 d 8.4651 d 8.4651 d 8.4651 d 8.3411 d 8.3411 d 8.34137 d 3.7136 d displacer <b>Segments</b> West Wal art Leng	ments. 1 th Curvature	Deflectio	n Average	Max 1	Max Gradient	Max Gradient	Min	Damage
Vertical Offset from Line for Vertical Movement Calculations	Segmen	nt St	art Leng	th Curvature	Deflectio Ratio	n Average Horizontal Strain	Max I Tensile Strain	Max Gradient of Horizontal Displacement Curve	Max Gradient of Vertical Displacement Curve	Min Radius of Curvature	Damage Category
[m] 0.0		1	m] [m] 0.0 2.97	68 Hogging	[%] 0.01891	0 0.0	[%] 0.018836	0.0	862.20E-6	[m] 933.21	(Negligible)
		22.	9768 8.60	84 Sagging	0.02182	6 -0.0025454	0.018734	374.57E-6	0.0034977	1052.7	(Negligible)
		3 11	.585 3.41	48 Hogging	0.03349	8 -0.059150	0.025024	850.77E-6	0.0034977	1192.4	(Negligible)
Tensile horizon Specific Building Structure: No.	Damage Res	s are +ve sults - Crit	, compres. tical Values West Wal	sive horizon s for All Segm	tal strain ents within	s are -ve. Each Sub-Strue	cture				
Vertical De Offset from 1 Line for Vertical Movement Calculations	flection A Ratio Ho	Average prizontal Strain	Max Slop	e Max Settlement	Max I Tensile Strain	Max Gradient of Horizontal Displacement Curve	Max Gradio of Vertic Displacem Curve	ent Min al Radius of ent Curvature (Hogging)	Min f Radius of e Curvature ) (Sagging)	Damage Cat	cegory
0.0	0.033498 -	-0.059150	0.003497	7 9.4889	0.025024	850.77E-6	0.0034	977 933.21	1 1052.7 0	(Negligib)	Le)
Specific Building	Damage Res	sults - Crit	tical Segm	ents within Ea	ch Structur	e					
Structure Name	Paramet	er S	Critical ub-Struct	Critica ure Segment	[m]	End Curvatu	re Max Sl	ope Max Settlemer	Max nt Tensile R Strain C ( [%]	Min adius of Ra aurvature Ca Hogging) (S [m]	Min adius of urvature Sagging) [m]
No. 40	Max Slope	We	st Wall		2 2.9768 1	1.585 Sagging	0.0034	977 8.611	10 0.018734	-	1052.7 0 (Ne

							Scrain	curvacure	curvacure		
								(Hogging)	(Sagging)		
			[m]	[m]		[mm]	[%]	[m]	[m]		
No. 40	Max Slope	West Wall	2 2.9768 1	1.585 Sagging	0.0034977	8.6110 0	.018734	-	1052.7 0	(Negligible)	
	Max Settlement	West Wall	1 0.0 2	.9768 Hogging	862.20E-6	9.4889 0	.018836	933.21	- 0	(Negligible)	
	Max Tensile Strain	West Wall	3 11.585 1	5.000 Hogging	0.0034977	6.2188 <b>0</b>	.025024	1192.4	- 0	(Negligible)	
	Min Radius of	West Wall	1 0.0 2	2.9768 Hogging	862.20E-6	9.4889 0	.018836	933.21	- 0	(Negligible)	
	Curvature (Hogging) Min Radius of Curvature (Sagging)	West Wall	2 2.9768 1	1.585 Sagging	0.0034977	8.6110 0	.018734	-	<b>1052.7</b> 0	(Negligible)	

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