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Our Ref: DV/BC/J12147

12 November 2015

ABSTRUCT
London House
77 High Street
Sevenoaks
Kent - TN13 1LD

For the attention of Mr A Boult

Dear Sir,

Re: 465-467 Finchley Road, NW3 6HS (J12147)

A GROUND MOVEMENT ANALYSIS.

1 Impact of the Proposed Basement in terms of Ground Movement

Following an audit carried out by Campbell Reith of the original Basement Impact Assessment for the above site it was requested that a Ground Movement Analysis (GMA) should be carried out. The required information from the GMA was to establish the vertical and horizontal movements in relation to their impact on the neighbouring property (No 469 Finchley Road) and adjacent highways (Finchley Road and West End Lane).

1.1 Modelling of movements due to vertical stress changes

Allowing for thickness of the slab, etc, the formation level of the proposed basement will be about 3.7m below existing site levels. It is proposed to construct the basement by using conventional underpinning methods and hit and miss techniques.

The vertical movements associated with the proposed construction are normally modelled as producing a short-term response followed by a longer term (drained) response. The excavation and construction of the proposed basement will result in changes in vertical soil loading, thus giving rise to short and long term displacements occurring within the underlying soils. The construction of the proposed basement will comprise a method of underpinning using hit and miss techniques. Assuming that there is no delay in excavation and construction of the basement etc, the longer term drained displacements will be governed by the net stress changes caused by the combination of the basement excavation and the net difference at formation level between the existing and new basement/foundation loadings.

The predicted ground response was modelled using the OASYS program PDISP. This program assumes a linear elastic behaviour of the soil and a flexible structure. In reality, the finite stiffness of the structure(s) will tend to redistribute or smooth out the movements, when compared to those predicted by PDISP. The settlement calculations therefore represent free field movements unaffected by the stiffness of the structure(s) and are likely to be conservative (i.e. the distortions of the structure would be less than those obtained from the predicted movements).

For PDISP modelling purposes London Clay was assumed to extend from 1.0m below existing ground surface to depth. The rigid base for the analysis was taken as 40m BGL. The soil parameters used are presented in section 20 of the original report (Refer to Stage 3 of STL report J12147 dated March 2015). Site ground level was taken as an arbitrary value of 0.0m OD, the rigid base for the analysis was taken as -40m OD.

1.2 Vertical Movements from Excavation and Existing/Proposed Construction Loadings

In terms of the proposed construction pressures associated with the underpinning and proposed foundation loadings these were taken as acting at a formation level of -3.7mOD. In addition to unload pressures associated with the excavation of soils to form the basement, the Structural Engineer also provided existing and proposed loadings for estimating net changes in vertical loadings due to foundation loadings (refer Figures 1 and 2).

A short-term (undrained) analysis was undertaken to determine the movements likely to arise as a result of the combination of the unloading due to excavation of the basement and the net difference between the existing foundations loadings (acting at their existing levels) and proposed construction loadings. This indicated a maximum undrained heave of about 10mm occurring within the central area of the basement (see Figure U1 included in Appendix A). For the purpose of illustrating the likely displacements occurring beneath the neighbouring property, No. 469 Finchley Road and the adjacent highways, displacement lines (see Figure U1) were extended from the basement excavation across No. 469 Finchley Road (Figure LU1) and also from the mid-point of the basement walls nearest to the highways Finchley Road (Figure LU2) and West End Lane (Figure LU3).

In the case of the neighbouring property (No 469) an undrained heave movement of approximately 7mm is indicated at the party wall reducing to 0.7mm at the furthest side (Figure LU1).

In the case of the Finchley Road (Figure LU2) from the basement wall, the predicted undrained heave movement is approximately 4.0mm reducing to zero approximately 20metres from the wall.

In the case of the West End Lane (Figure LU3) from the basement wall, the predicted undrained heave movement is approximately 5.5mm reducing to zero approximately 16metres from the wall.

The movements of the ground following construction were also analysed for the total long-term (drained) case. The analysis was again undertaken for the combination of the unloading due to excavation of the basement and the net difference between the existing and proposed construction loadings. The PDISP assessment indicates a maximum long-term drained heave of about 14mm occurring within the central area of the basement area (Figure V1).

Referring to displacement line plot (Figure LV1) a heave movement of 11.5mm is indicated at the party wall to No 469 reducing to about 1.4mm on the furthest side of the property.

In the case of the Finchley Road (Figure LV2), the predicted long-term drained heave movement at the basement wall is approximately 6.6mm reducing to ≤1mm approximately 8metres from the wall.

In the case of the West End Lane (Figure LV3) from the basement wall, the predicted long-term drained heave movement is 9.4mm reducing to ≤1mm approximately 8metres from the wall.

It should be noted that in practice, the vertical movements that develop from vertical changes in loading of the soil do not occur in isolation from other ground movements associated with basement excavation and construction (as discussed below).

1.3 Movements due to basement excavation and underpin construction

In addition to the changes in vertical stress caused by excavation and the construction loadings the installation of the new walls and then the removal of soil from in front of the walls will also generate both horizontal and vertical movement in the ground.

Ground movements resulting from underpinning is not well documented, and there is no specific method of assessing their magnitude. However when underpinning is carried out in a well controlled manner, movements are typically small.

To provide some basis of estimating likely movements and damage resulting from excavating the basement in front of the underpinning, and in the absence of underpinning-specific guidance, the underpinned sections of the new basement have been treated as piles. It has been assumed that the movements resulting from excavation in front of the underpins also incorporate the movements resulting from the construction of the underpins, since, unlike for the piles, the construction process requires an excavation prior to the pins being formed.

Assessment of the ground movements resulting from excavation to form the basement has been undertaken with reference to CIRIA guide C580 "Embedded retaining walls – guidance for economic design". This provides guidance on the horizontal and vertical movements of the soil adjacent to an embedded retaining wall as a result of pile installation and of excavation in front of the wall based on numerous case histories, for the cases of a high stiffness (propped) retaining wall and a low stiffness (cantilevered) retaining wall.

In this case a high stiffness wall has been assumed for the underpinned wall sections.

Estimates of movements using CIRIA guide C580, are based on empirical data. Since such data is likely collected during and soon after construction, it is assumed to include any short term heave element. However, long-term ground movements from changes in vertical stress would likely not have occurred when the measurements of ground movement were made.

The methodology within C580 indicates that the excavation to create the basement will, for a high support stiffness wall, produce horizontal movements of 0.15% of the excavation depth at the wall, with movements extending to four times the depth of the excavation, while peak vertical movements will be 0.07% of the excavation depth, with such movements becoming zero at 3.5 times the depth of the excavation. Horizontal movements will decrease in a generally linear fashion with distance from the wall, whereas vertical movements peak at about half the excavation depth from the wall, with movements at the wall being about 0.04% of the excavation depth.

Referring to the displacement line plot (Figure EL1), the horizontal movement of the party wall to No 469 in towards the basement excavation is predicted to be about 5.5mm with horizontal movements reducing to approximately 3.5mm on the furthest side of No 469. The predicted vertical settlement of the party wall to No 469 is about 1.5mm with vertical movements reducing to approximately 2.0mm on the furthest side of the property.

In the case of the adjacent highways Finchley Road and West End Lane (Figures EL2 and EL3), horizontal movements at the boundaries of the site are predicted to be about 5.5mm at the basement walls reducing to zero 15m from the site boundary. The predicted vertical movements are about 1.5mm at the basement walls reducing to near zero 13m from the site boundary.

The movements derived from the CIRIA guidance are based on the empirical data within C580. As such, it is assumed that they include any short term element of ground movement due to vertical stress changes. However, it is unlikely that the C580 data includes the long-term movements resulting from vertical stress changes. Total ground movements resulting from the proposed development are therefore taken as the sum of the predicted ground movements using C580, plus the difference in estimated PDISP movements between short and long-term conditions.

1.4 Summary of Ground Movements

As noted previously, it is unlikely that the C580 data includes the long-term movements resulting from vertical stress changes. Therefore total vertical ground movements resulting from the proposed development are taken as the sum of the predicted ground movements using C580, plus the difference in movement between short and long-term, as predicted from the PDISP analysis.

In summary the short term analysis for the wall installation/basement construction indicate that the party wall to No. 469 Finchley Road will experience about 1.5mm of settlement and 5.5mm of horizontal movement with about 2.0mm vertical movement and 3.5mm horizontal movement on the furthest side of the property (Figure EL1).

For the long-term drained condition, predicted movements of the party wall to No. 469 Finchley Road indicate about 3mm of heave movement and 5.5mm horizontal movement. Heave movements continue to reduce to zero approximately 1m from the wall. On the furthest side of the property about 1.2mm settlement movement is predicted and 3.5mm horizontal movement (Figure CL1).

The combination of horizontal and vertical strains for the short-term (see Fig A) and long-term conditions (see Fig B) suggests for No. 469 Finchley Road damage categories of 0 (short term) and 2 (long term) which fall into the ranges of negligible and slight categories as classified by Burland et al.

The above categories of damage assume good quality working practice during basement construction and that a "robust" level propping is employed. As noted previously the PDISP calculations represent free field movements unaffected by the stiffness of the structure(s) and are likely to be conservative (i.e. the distortions of the structure would be less than those obtained from the predicted movements). Accordingly the estimated long term damage category 2 is likely to be an overestimate of the actual damage to No 469 Finchley Road.

In the case of the nearby highways Finchley Road and West End Lane, plots of short term horizontal and vertical movements associated with the basement construction are given in Figures EL2 and for the long-term drained condition Figures CL2 and CL3.

In summary in the short term (Figure EL2), horizontal movements at the boundaries of the site are predicted to be about 5.5mm at the basement walls reducing to zero 15m from the site boundary. The predicted vertical settlement movements are about 1.5mm at the basement walls reducing to near zero 13m from the site boundary.

In the case of the Finchley Road highway and for the long term condition (Figure CL2), a vertical heave movement of about 1.2mm is predicted at the basement wall reducing to zero some 0.8m from the wall with settlements reaching a maximum of 1.7mm some 3.5m from the wall and then reducing to zero about 10m from the wall. Horizontal movements are predicted to be about 5.5mm at the basement walls reducing to zero 15m from the site boundary.

In the case of the West End Lane highway and for the long term condition (Figure CL3), a vertical heave movement of 2.2mm is predicted at the basement wall reducing to about zero some 1.25m from the wall with settlements reaching a maximum of 1.4mm some 4.0m from the wall and then reducing to zero about 10m from the wall. Horizontal movements are predicted to be about 5.5mm at the basement walls reducing to zero 15m from the site boundary.

The Highway Department should be consulted in relation to the predicted movements regarding their views on these movements.

Finally a formal monitoring system should be employed during construction in order to observe and monitor ground movements, especially in critical areas such as boundaries and with the neighbouring property. Monitoring data should be checked against predefined trigger limits to give early indications if any deviating ground movements are occurring.

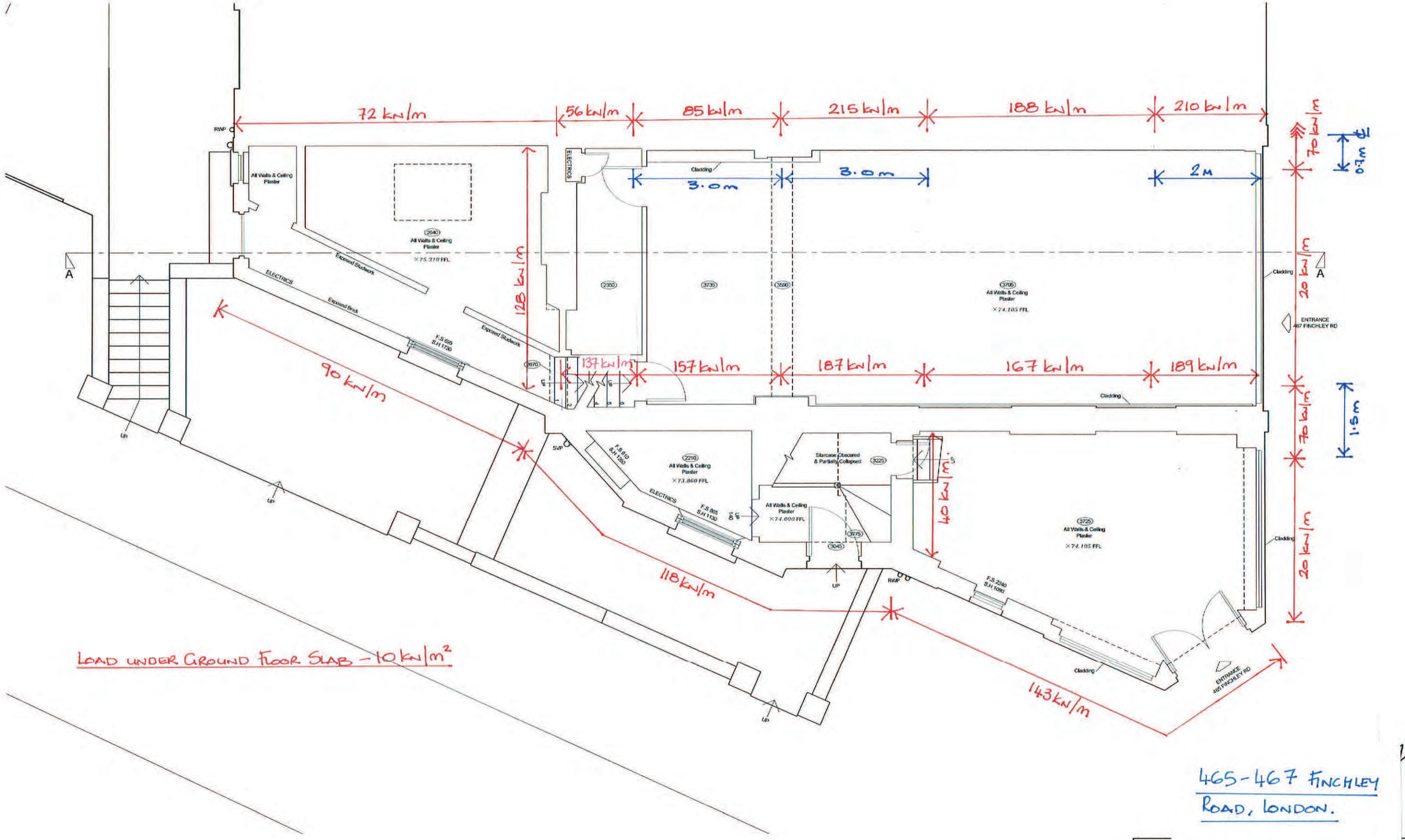
D. Vooght

D Vooght MSc
(Countersigned)

JN Race MSc CGeol
(Signed)

APPENDIX A

Figures and Plots



SCALE 1:50 @ A2

0 1 2 3 4 5M

EXISTING GROUND FLOOR PLAN

FIGURE 1

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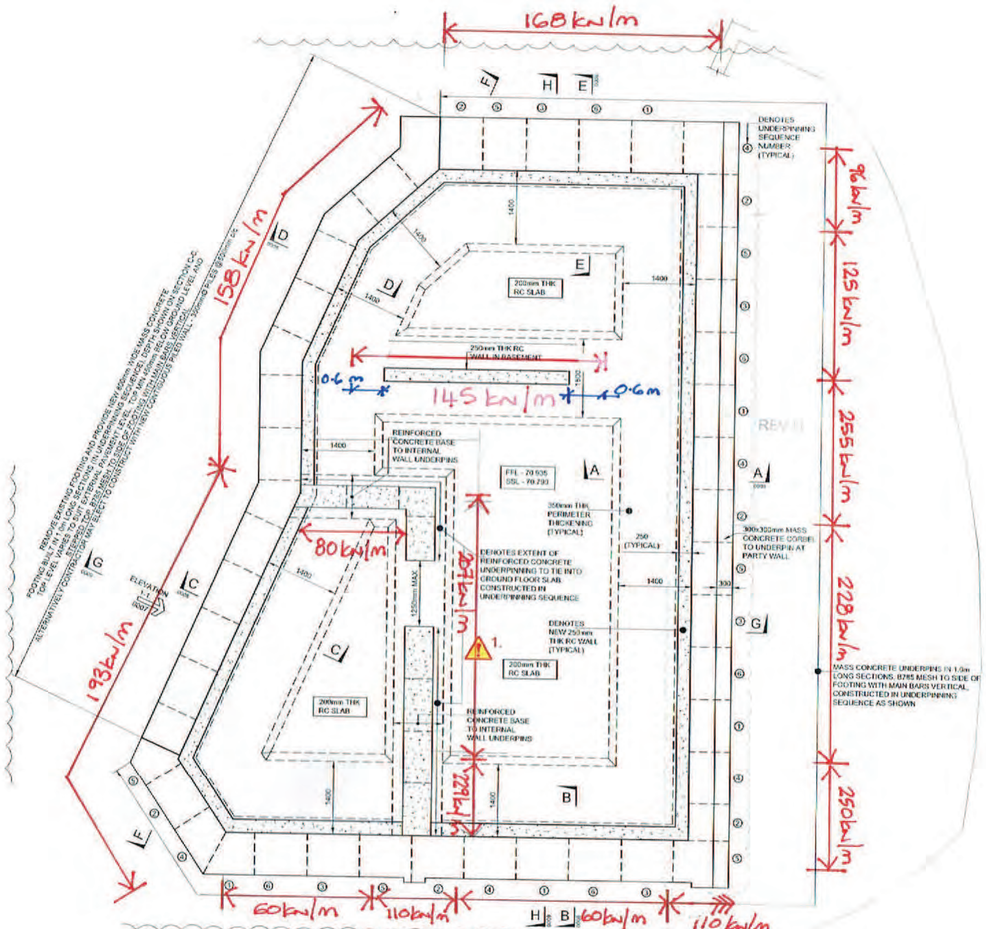
consulting engineers
LONDON + SEVENOAKS

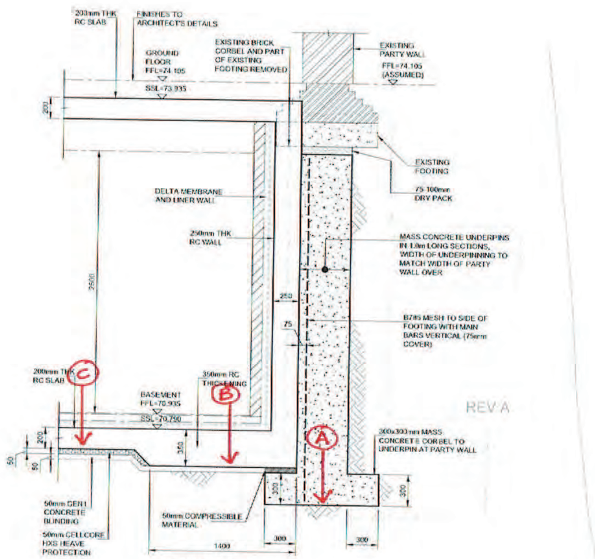
PROJECT NO: AB 1115

TITLE: EXISTING BUILDING WALL LOADS

Prepared	Date	Sketch No:		Rev
HTJ	5.11.15		SK15	



BASEMENT FOUNDATIONS PLAN



SECTION A-A
SCALE 1:25

LOADS: Ⓐ - AS DETAILED ON PLAN
Ⓑ - 45 kN/m² ACROSS BASE OF RETAINING WALL (63kN/m)
Ⓒ - 10 kN/m²

465-467 FINCHLEY ROAD,
LONDON.

FIGURE 2

abstruct
consulting engineers
LONDON + SEVENOAKS

PROJECT NO: AB 1115
TITLE: PROPOSED BUILDING WALL LOADS

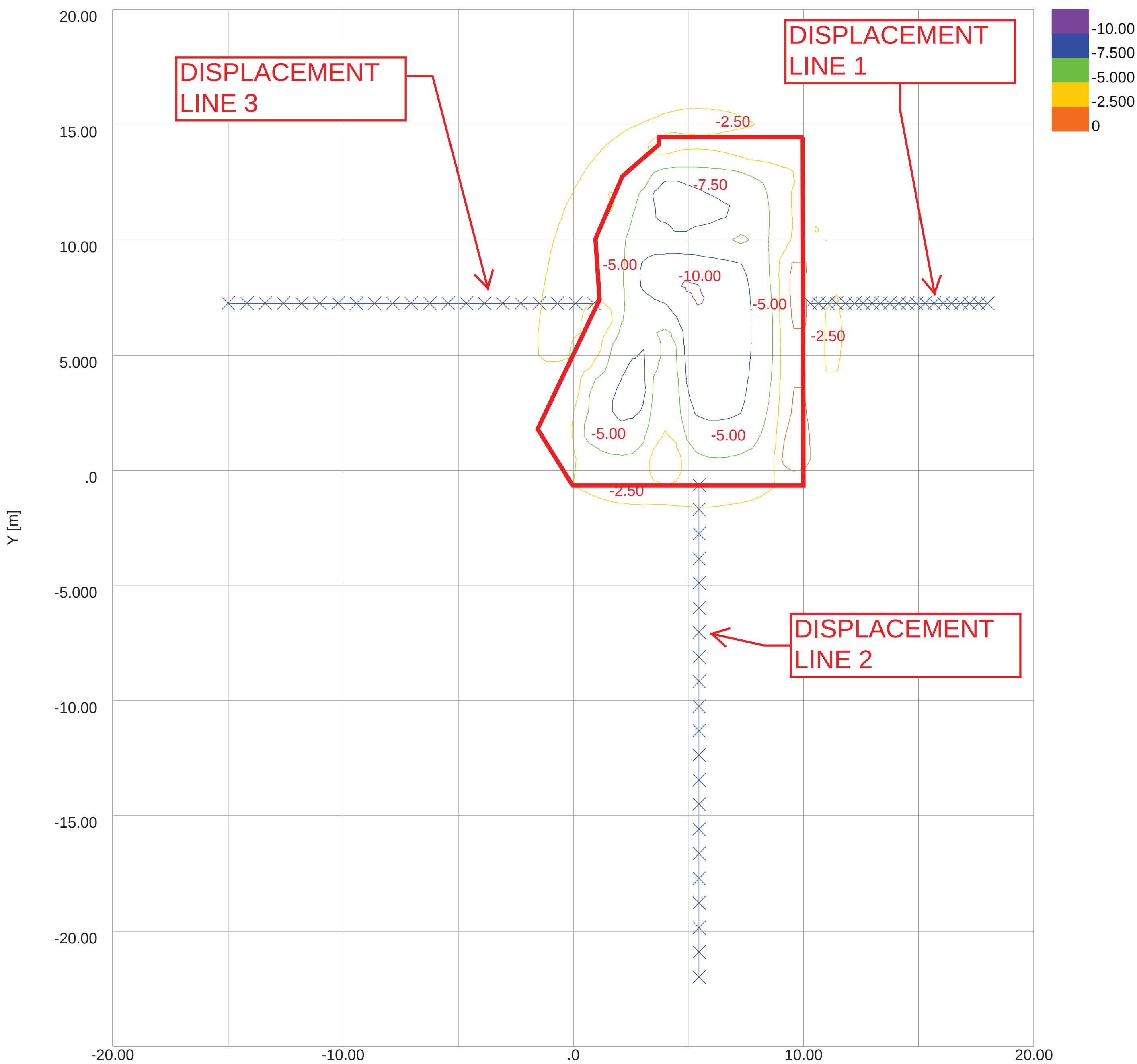
Prepared	Date	Sketch No:	Rev
HTJ	5.11.15	SK16	

465-467 Finchley Road

Combined Loading (Undrained)

Figure U1

Settlement Contours : Grid 1 at -3.7000m



Scale x 1:264 y 1:264
Contour Interval:2.5mm

X [m]

Oasys

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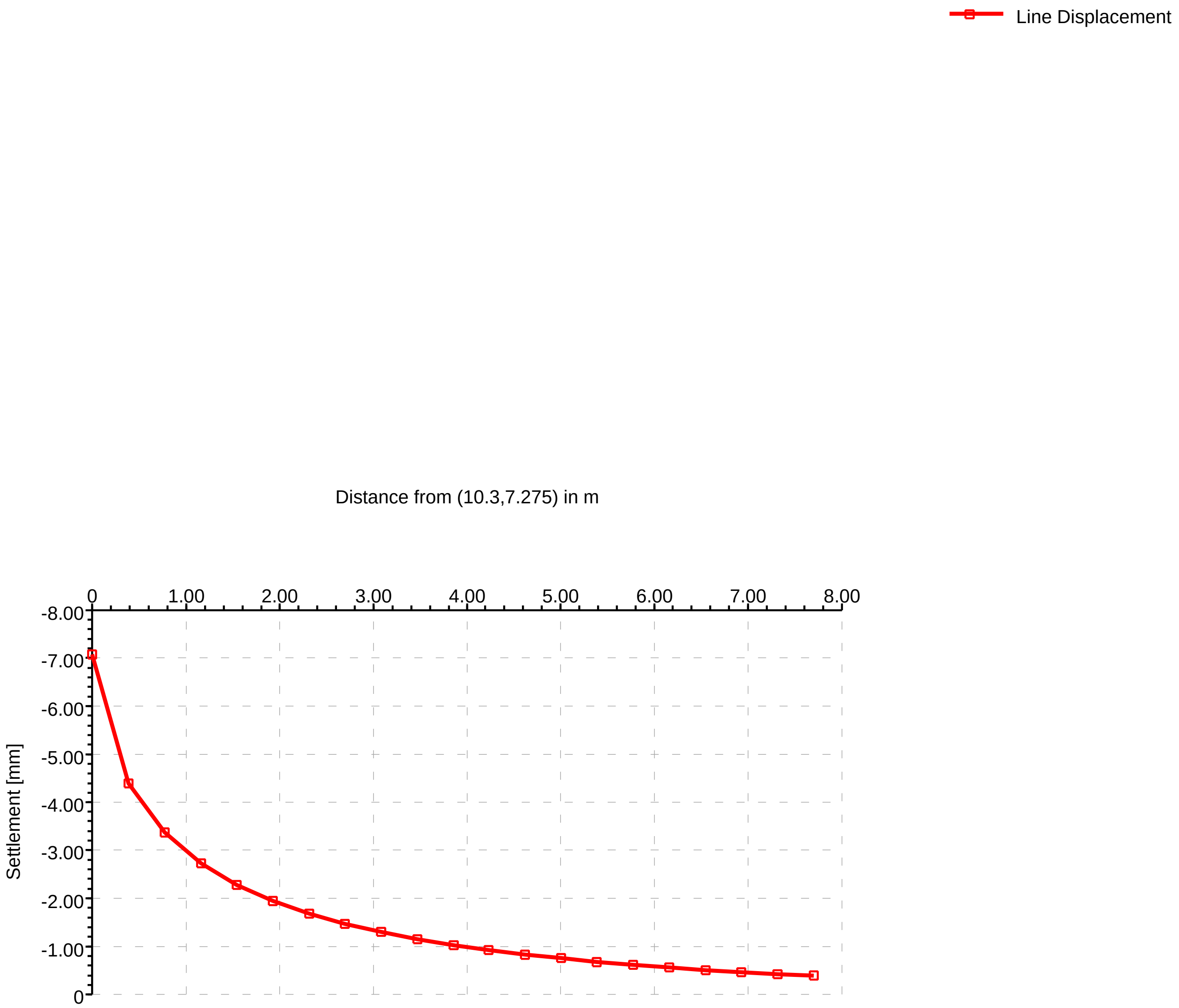
Job No.	Sheet No.	Rev.
J12147		
Drg. Ref.		
Made by	Date	Checked

465-467 Finchley Road
Combined Loading (Undrained)
Figure LU1

Displacement for Line 1



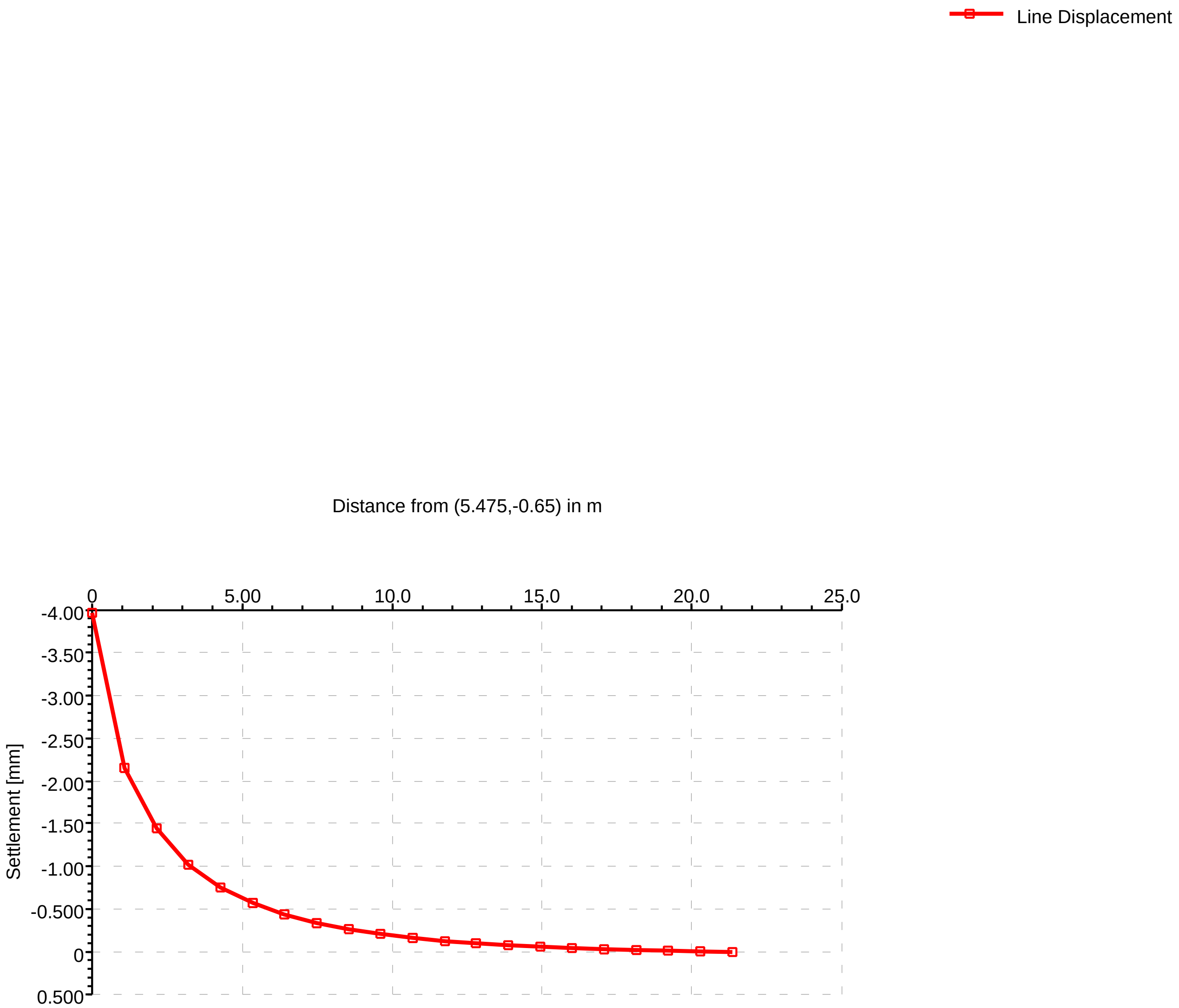
Oasys

SOUTHERN TESTING LABORATORIES

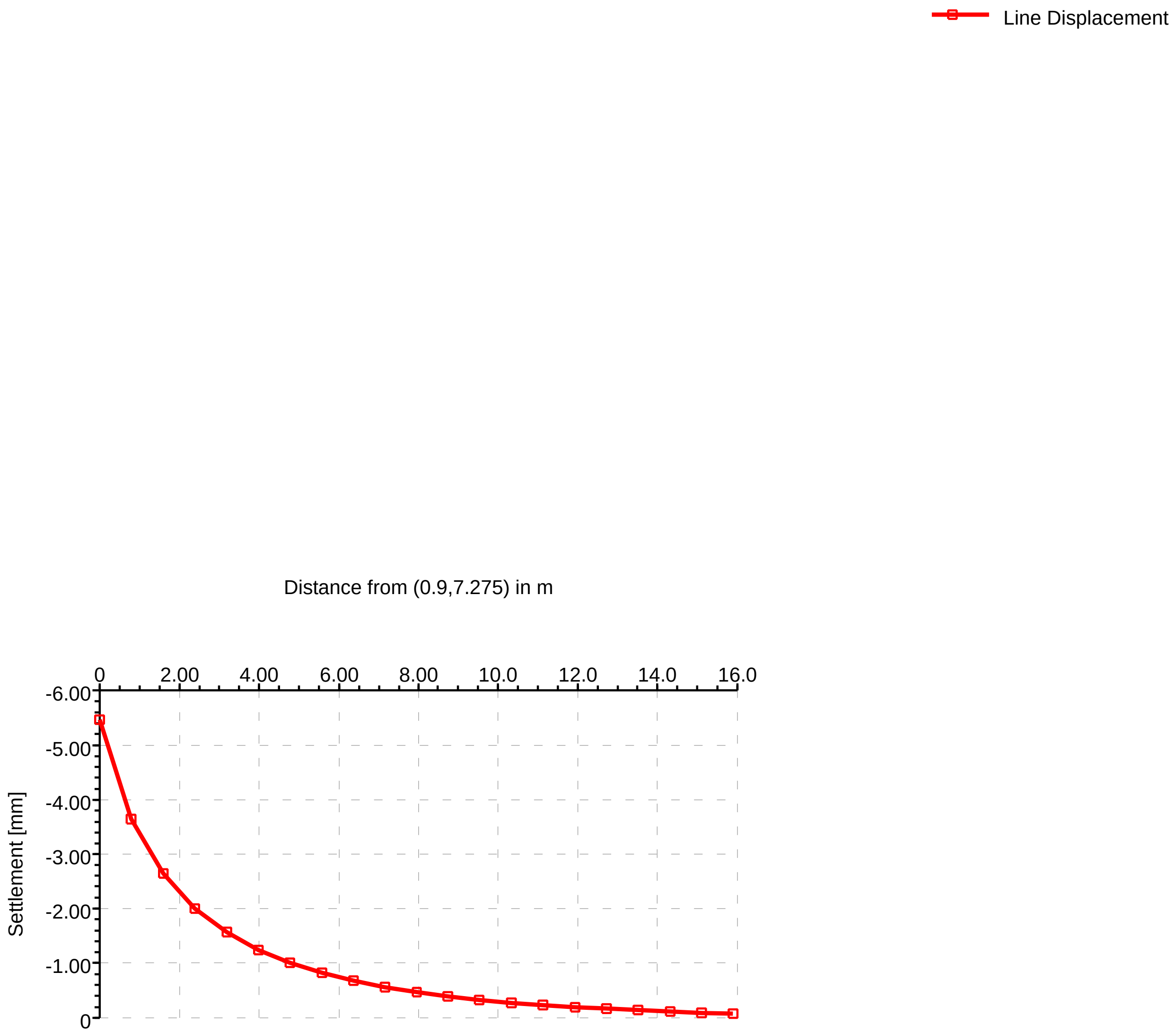
465-467 Finchley Road
Combined Loading (Undrained)
Figure LU2

Job No.	Sheet No.	Rev.
J12147		
Drg. Ref.		
Made by	Date	Checked

Displacement for Line 2



Displacement for Line 3



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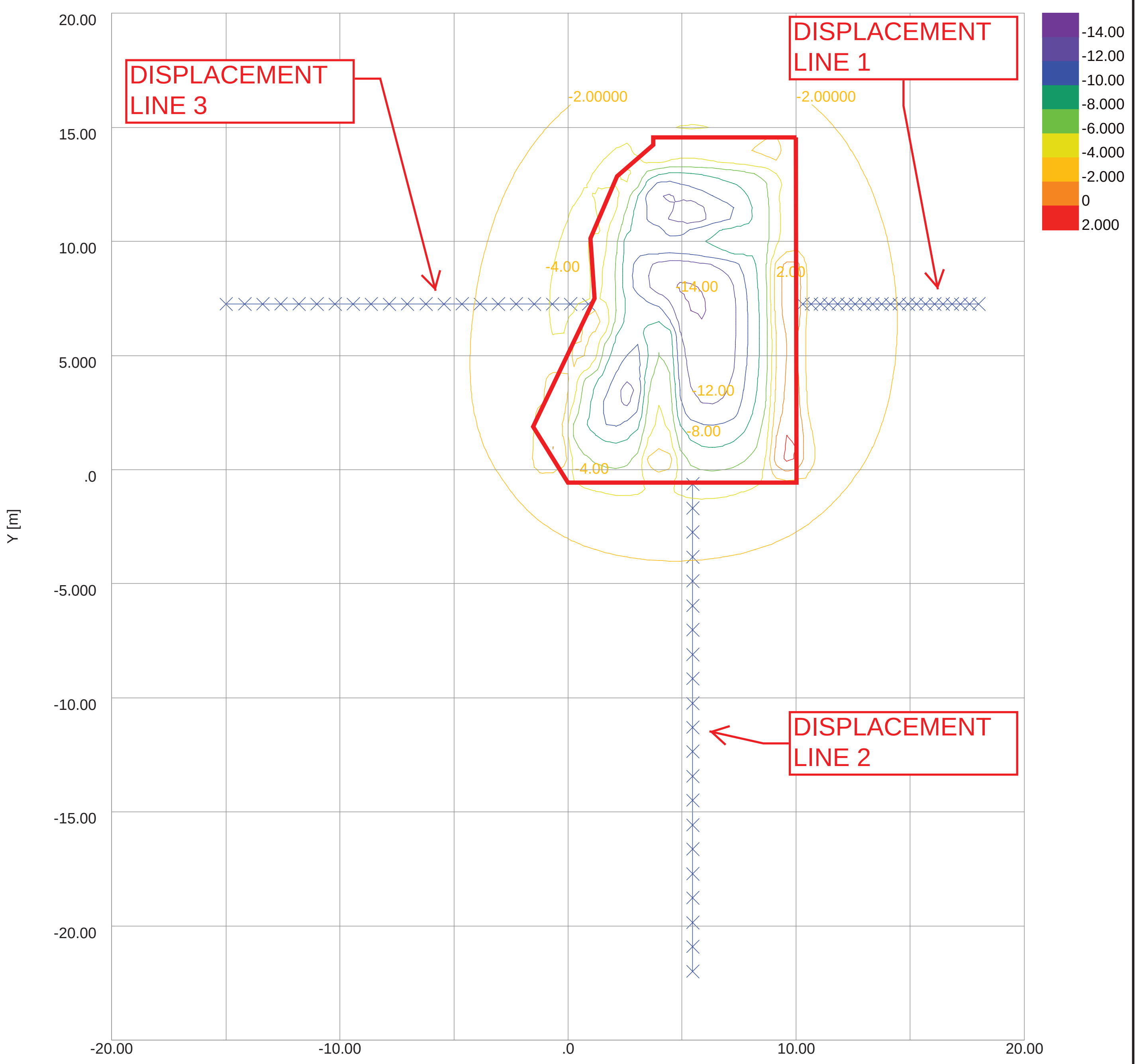
SOUTHERN TESTING LABORATORIES

465-467 Finchley Road
Combined Loading -Drained
Figure V1

Job No.	Sheet No.	Rev.
j12147		
Drg. Ref.		
Made by	Date	Checked

Settlement Contours : Grid 1 at -3.7000m



Scale x 1:264 y 1:264
Contour Interval: 2mm

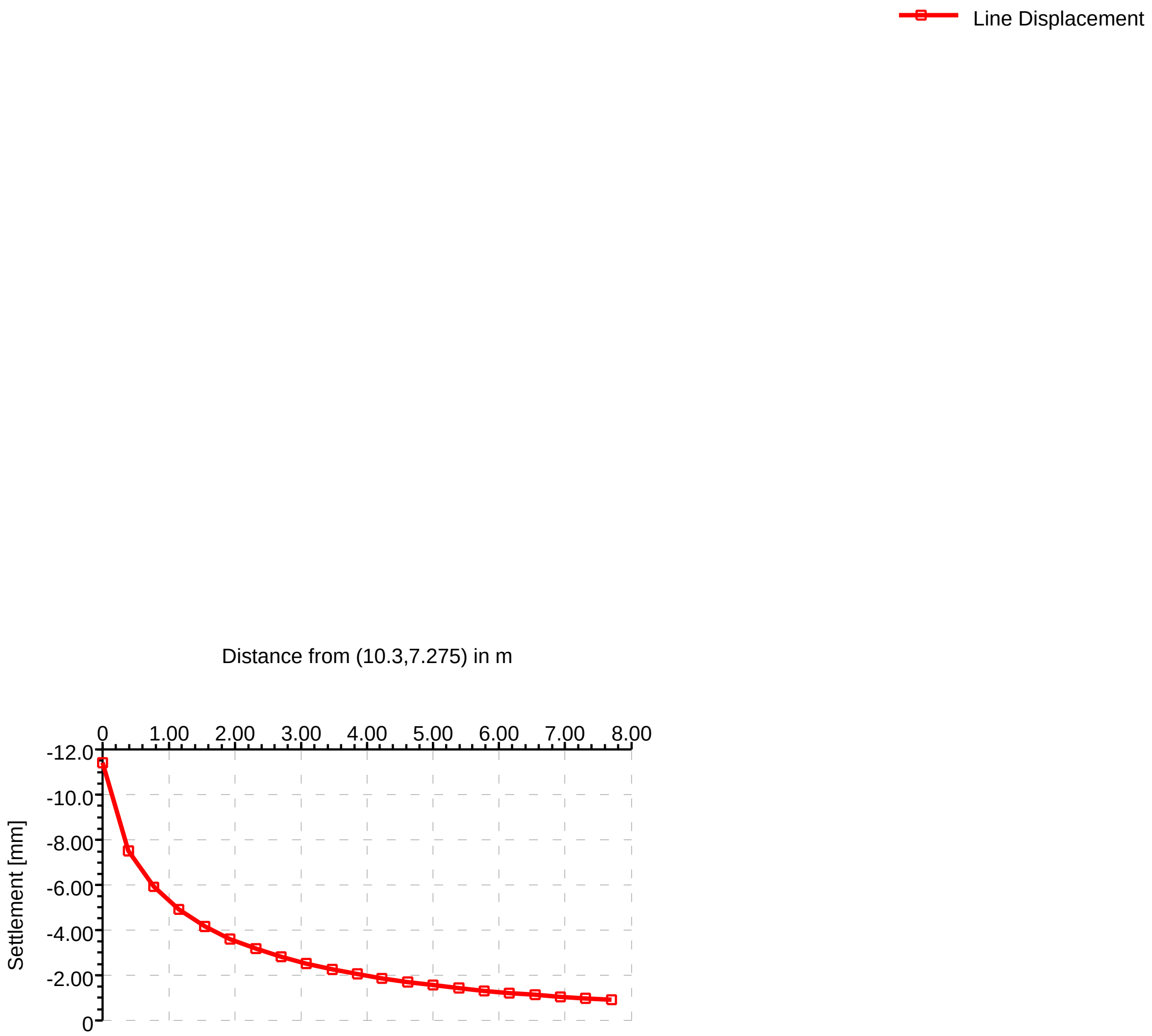
Oasys

SOUTHERN TESTING LABORATORIES

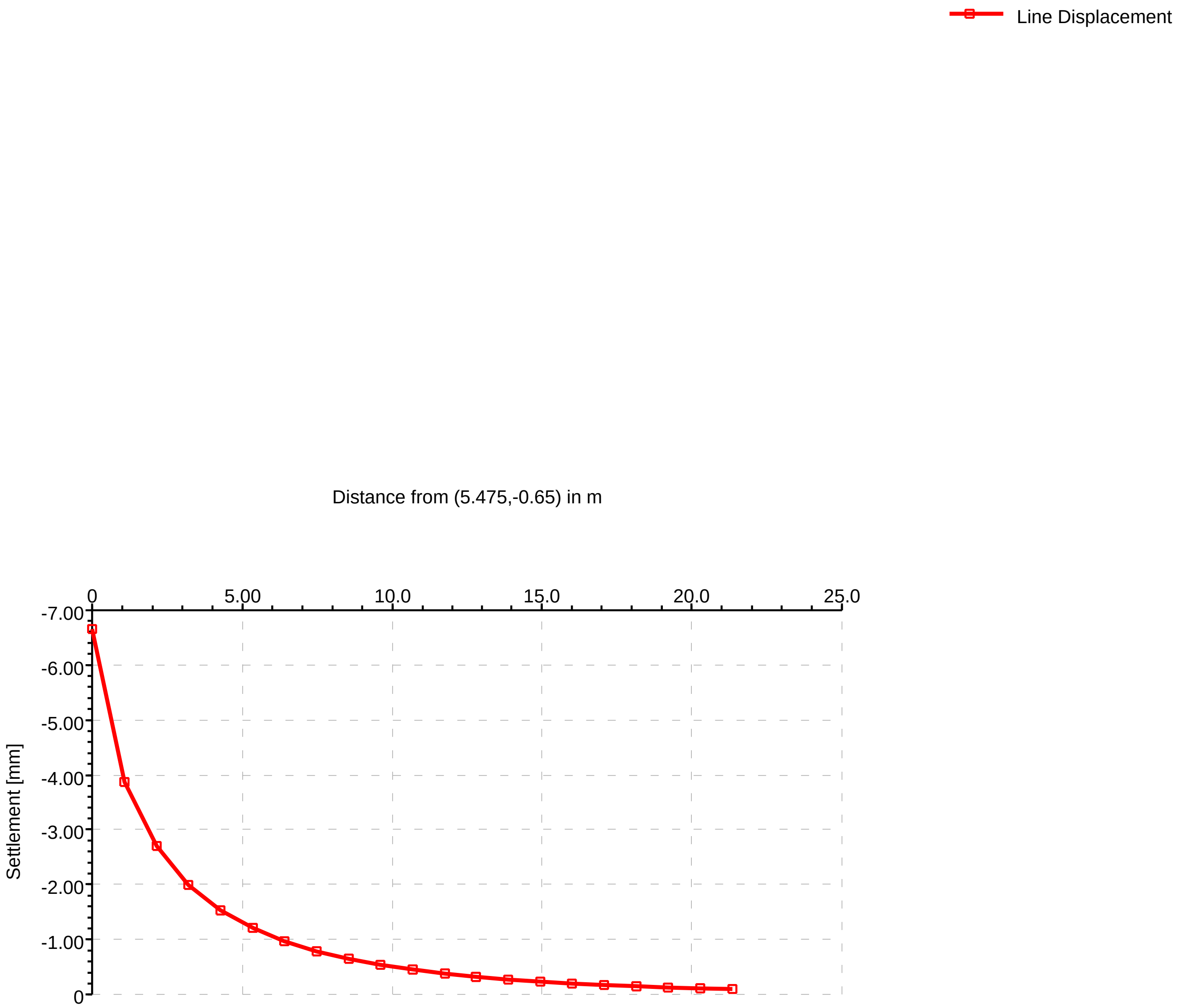
465-467 Finchley Road
Combined Loading -Drained
Figure LV1

Job No.	Sheet No.	Rev.
j12147		
Drg. Ref.		
Made by	Date	Checked

Displacement for Line 1



Displacement for Line 2



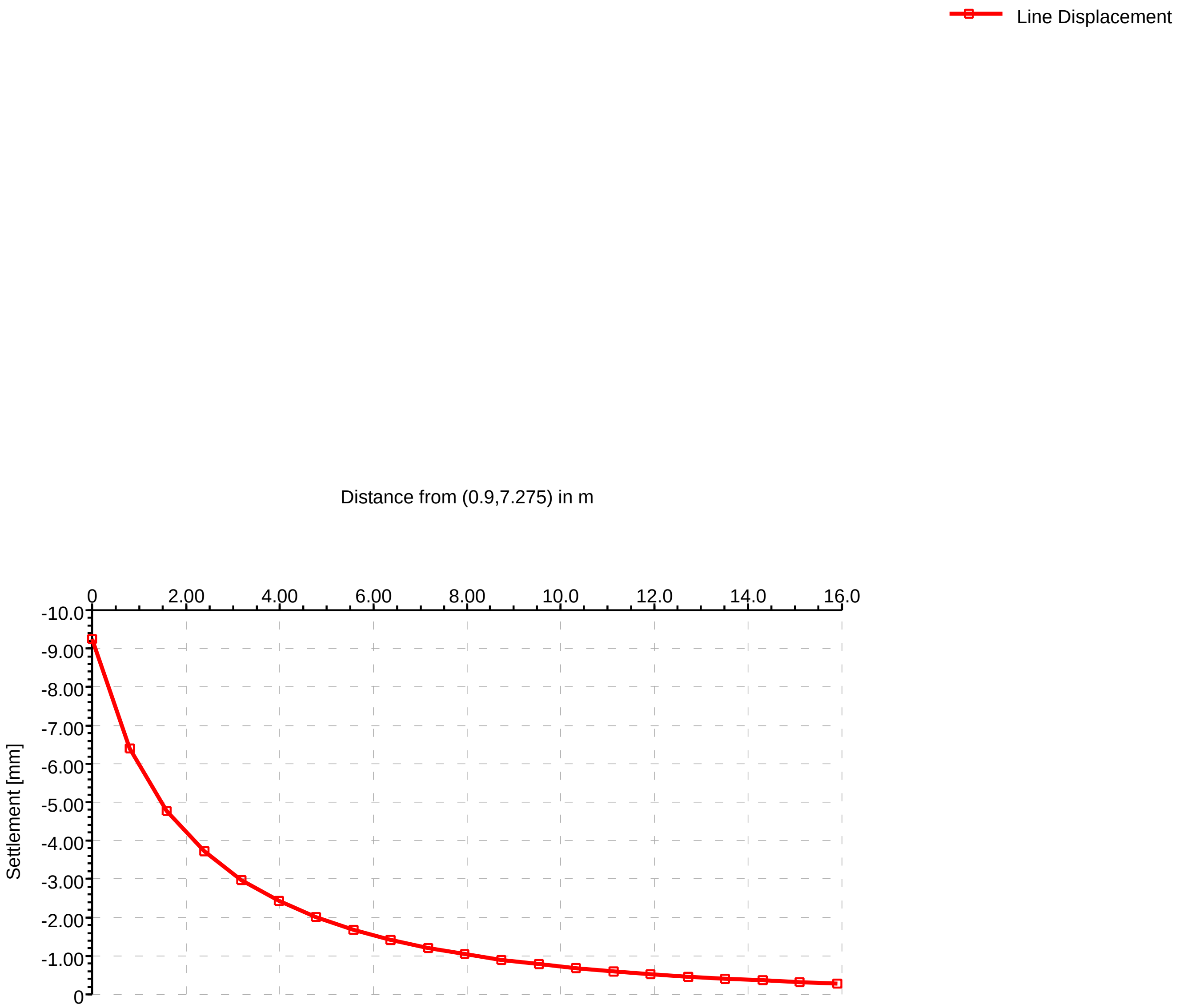
Oasys

SOUTHERN TESTING LABORATORIES

465-467 Finchley Road
Combined Loading -Drained
Figure LV3

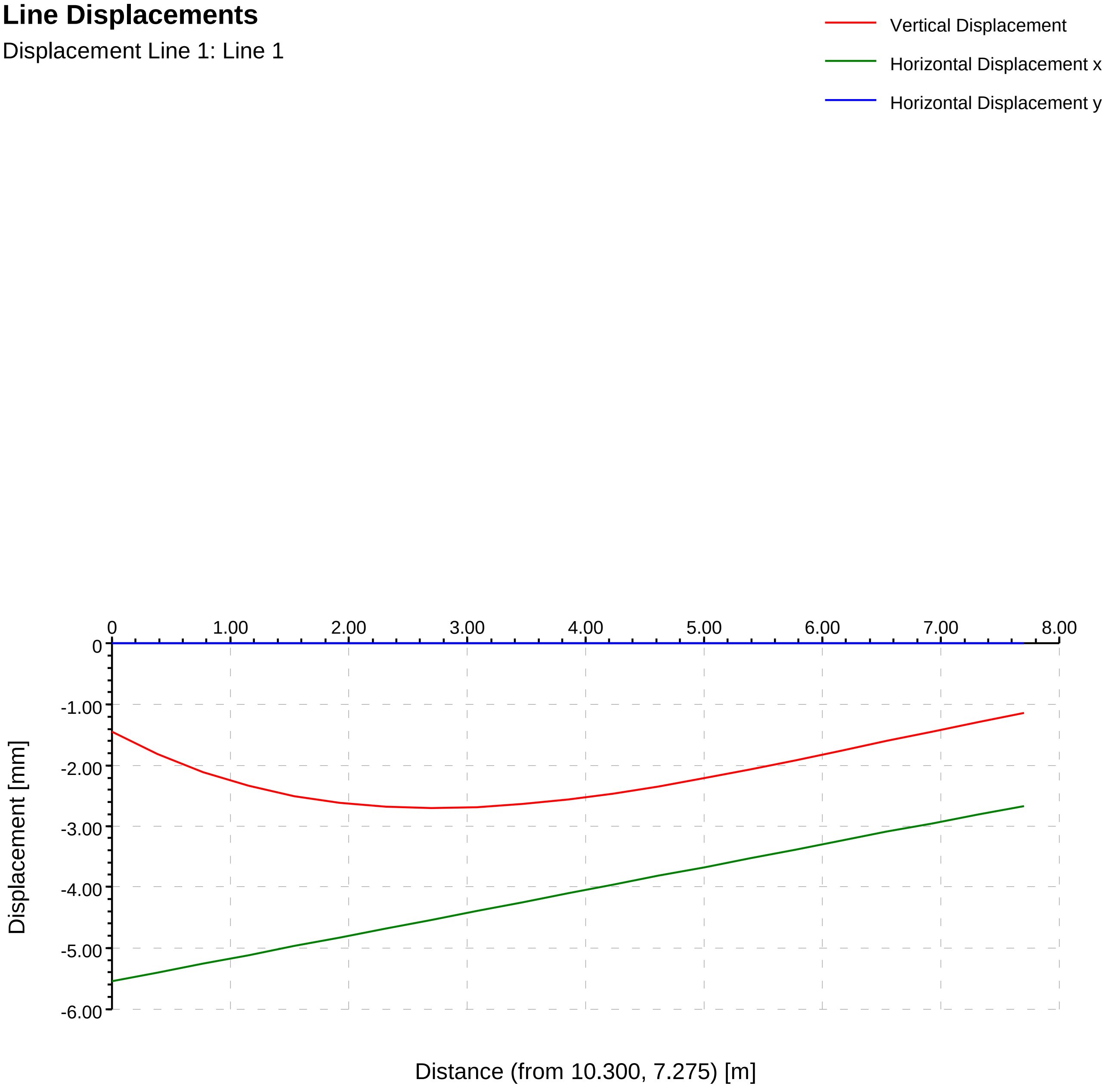
Job No.	Sheet No.	Rev.
j12147		
Drg. Ref.		
Made by	Date	Checked

Displacement for Line 3



Line Displacements

Displacement Line 1: Line 1



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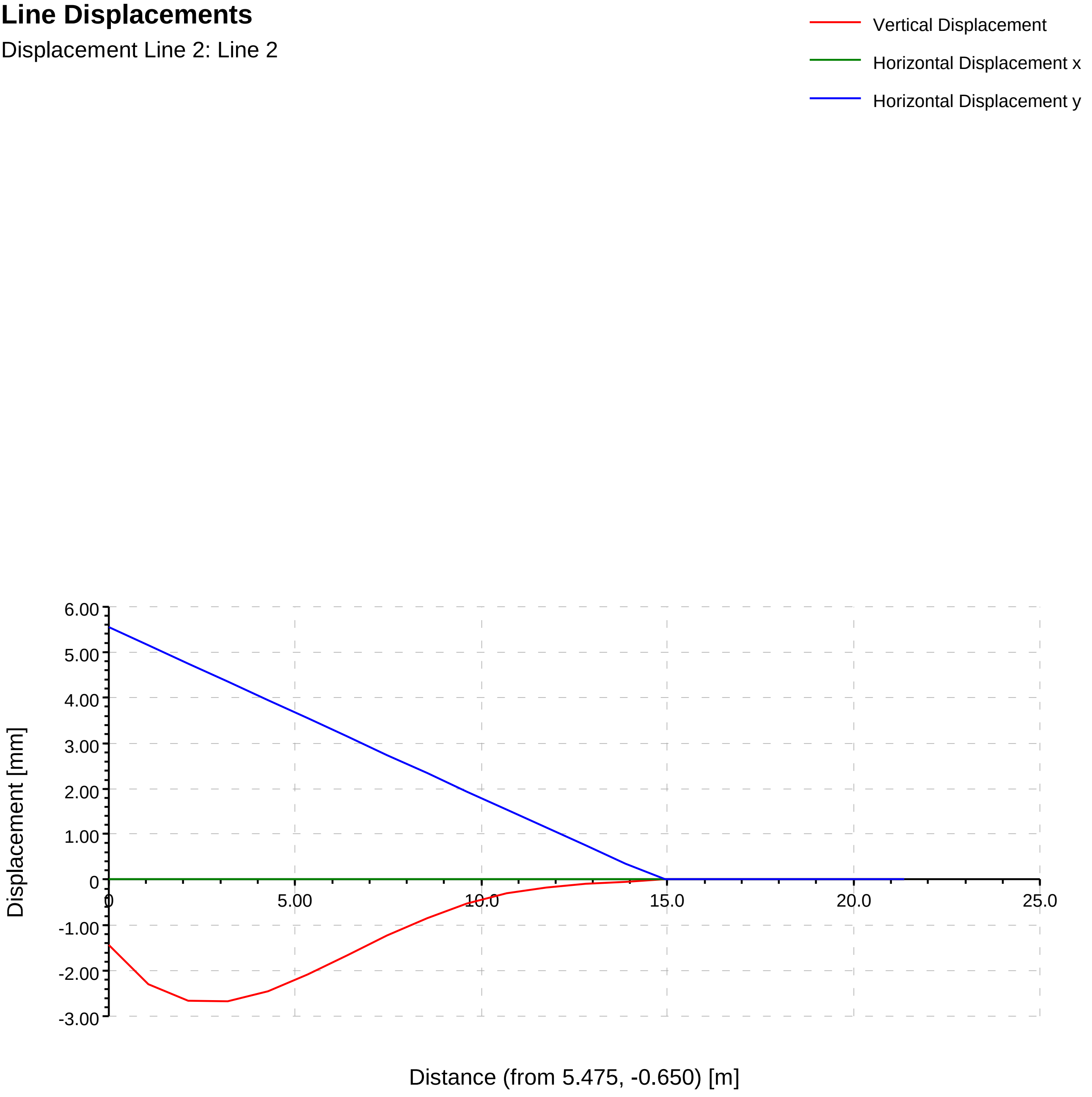
SOUTHERN TESTING LABORATORIES

456-467 Finchley Road
Movement due to Underpinning Construction
Figure EL2

Job No.	Sheet No.	Rev.
J12147		
Drg. Ref.		
Made by DV	Date 11-Nov-2015	Checked

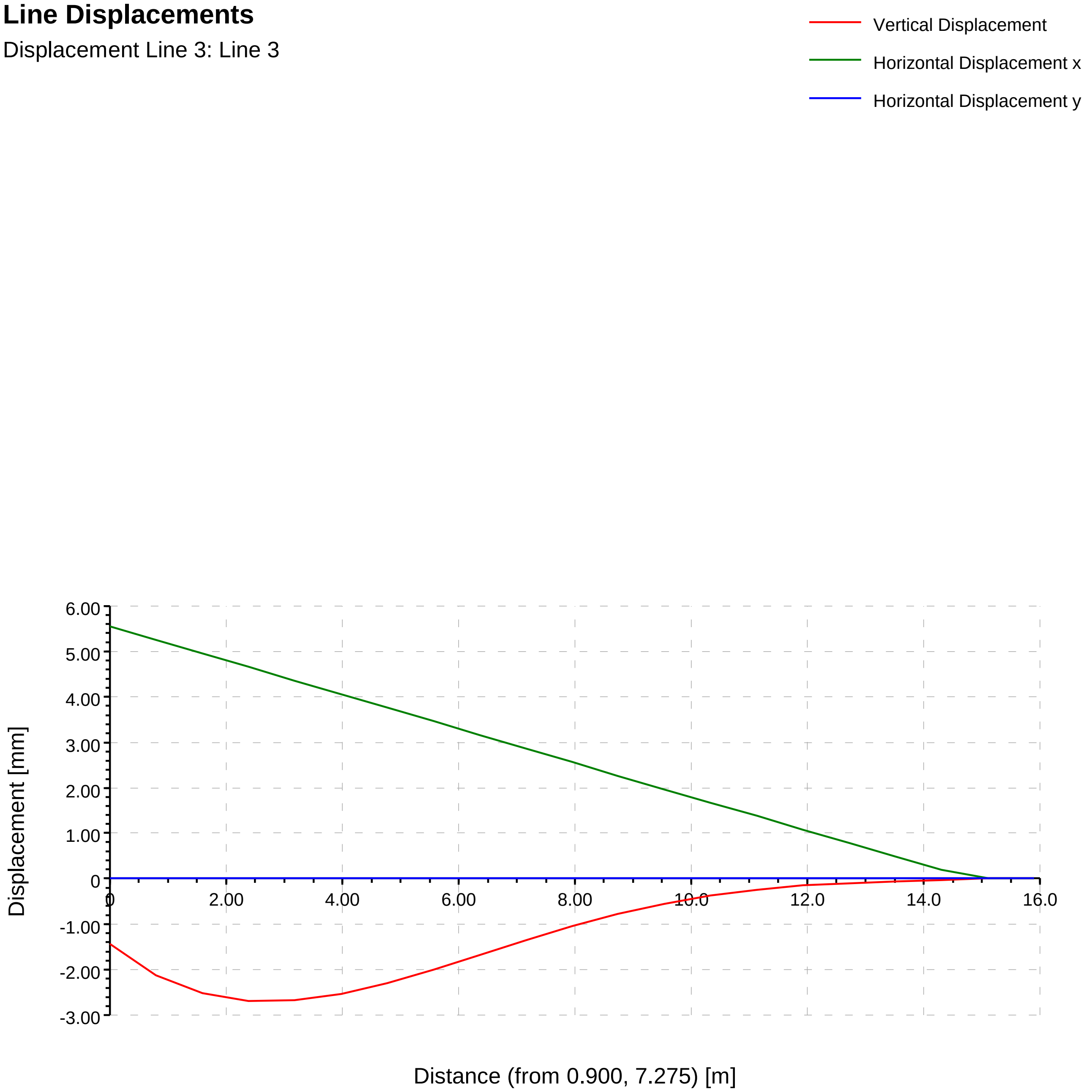
Line Displacements

Displacement Line 2: Line 2



Line Displacements

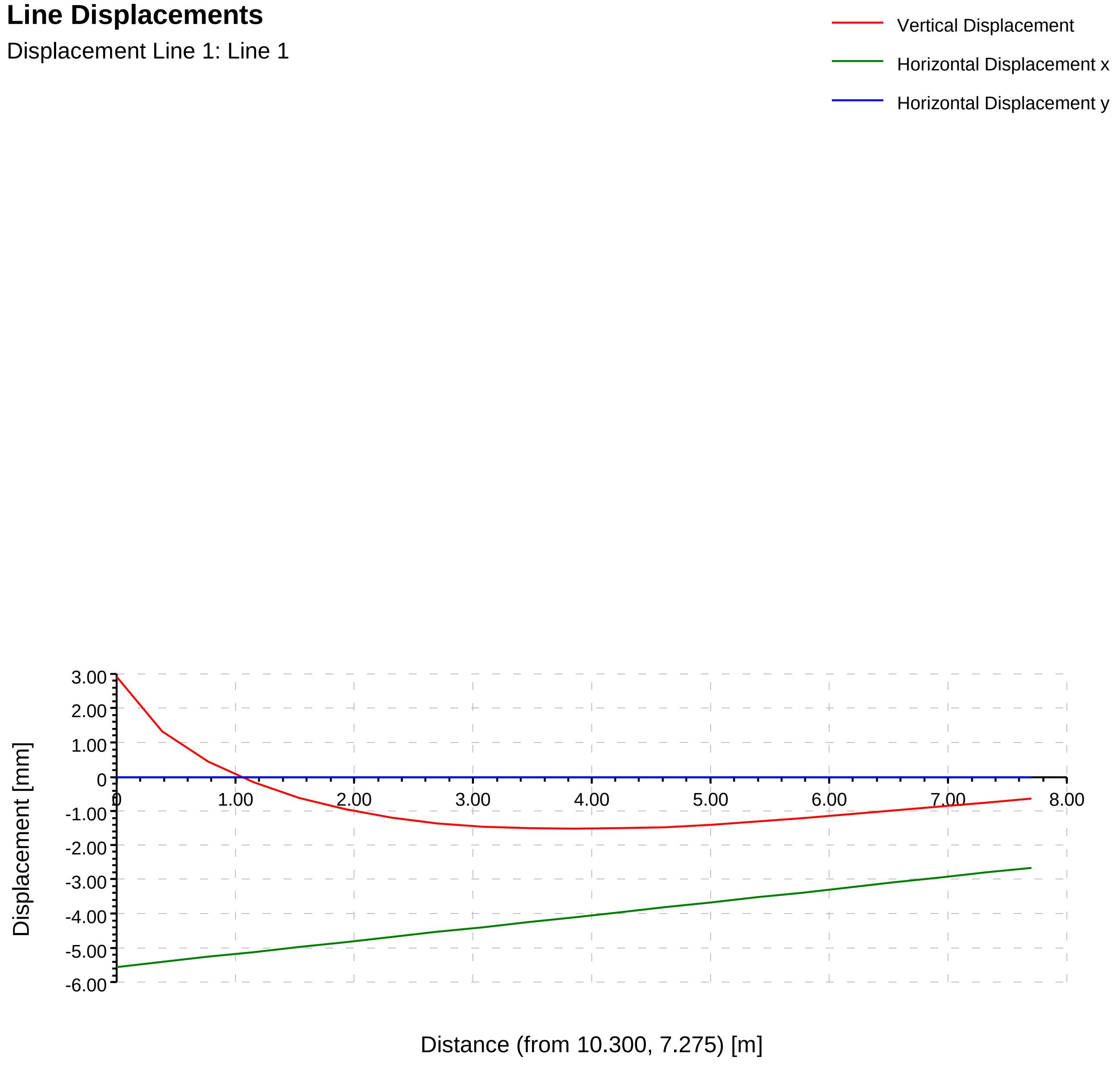
Displacement Line 3: Line 3



Oasys	SOUTHERN TESTING LABORATORIES	Job No.	Sheet No.	Rev.
		J12147		
456-467 Finchley Road		Drg. Ref.		
Long Term Movement due to Basement Construction				
Figure CL1		Made by DV	Date 11-Nov-2015	Checked

Line Displacements

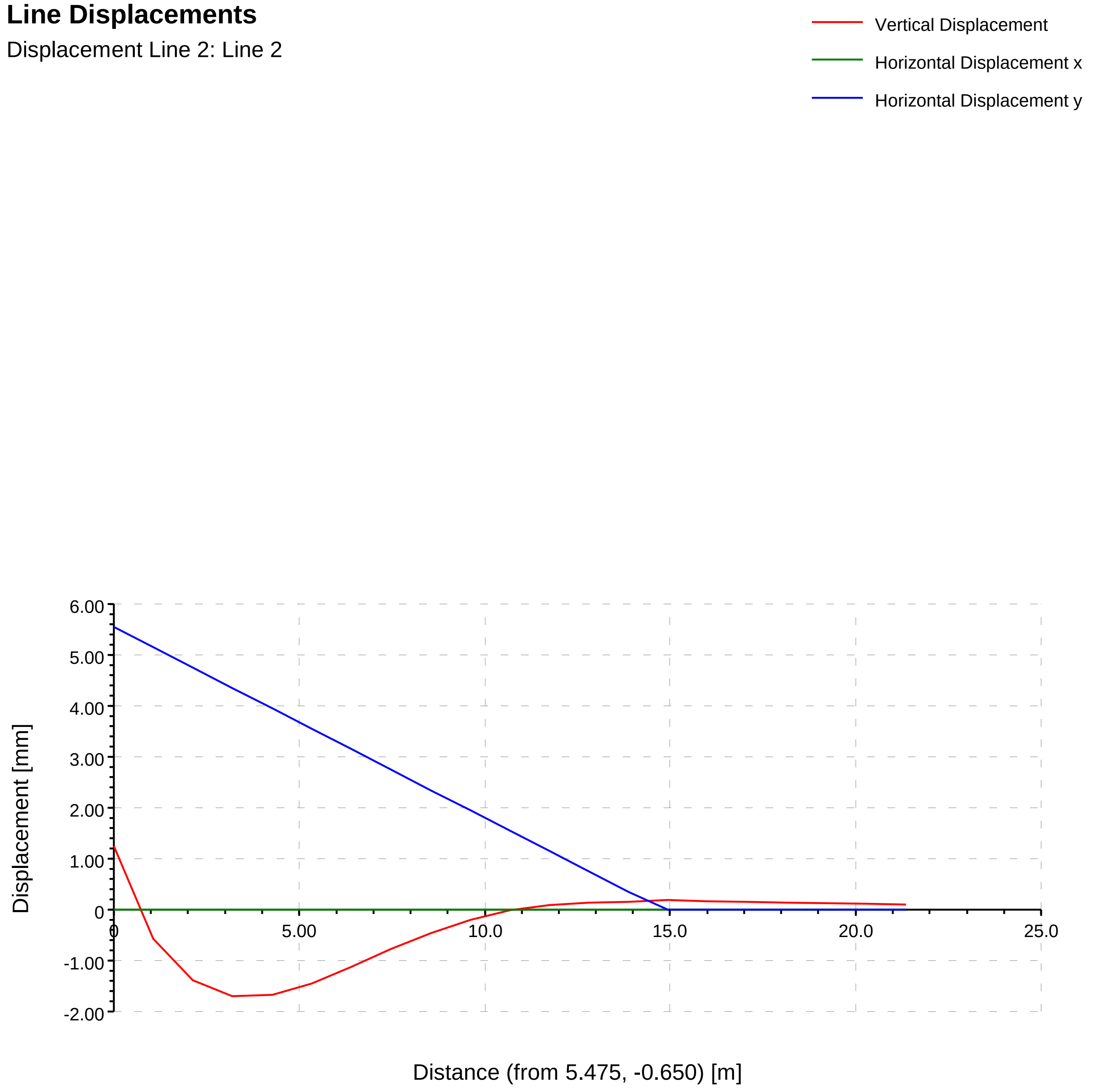
Displacement Line 1: Line 1



456-467 Finchley Road
Long Term Movement due to Basement Construction
Figure CL2

Line Displacements

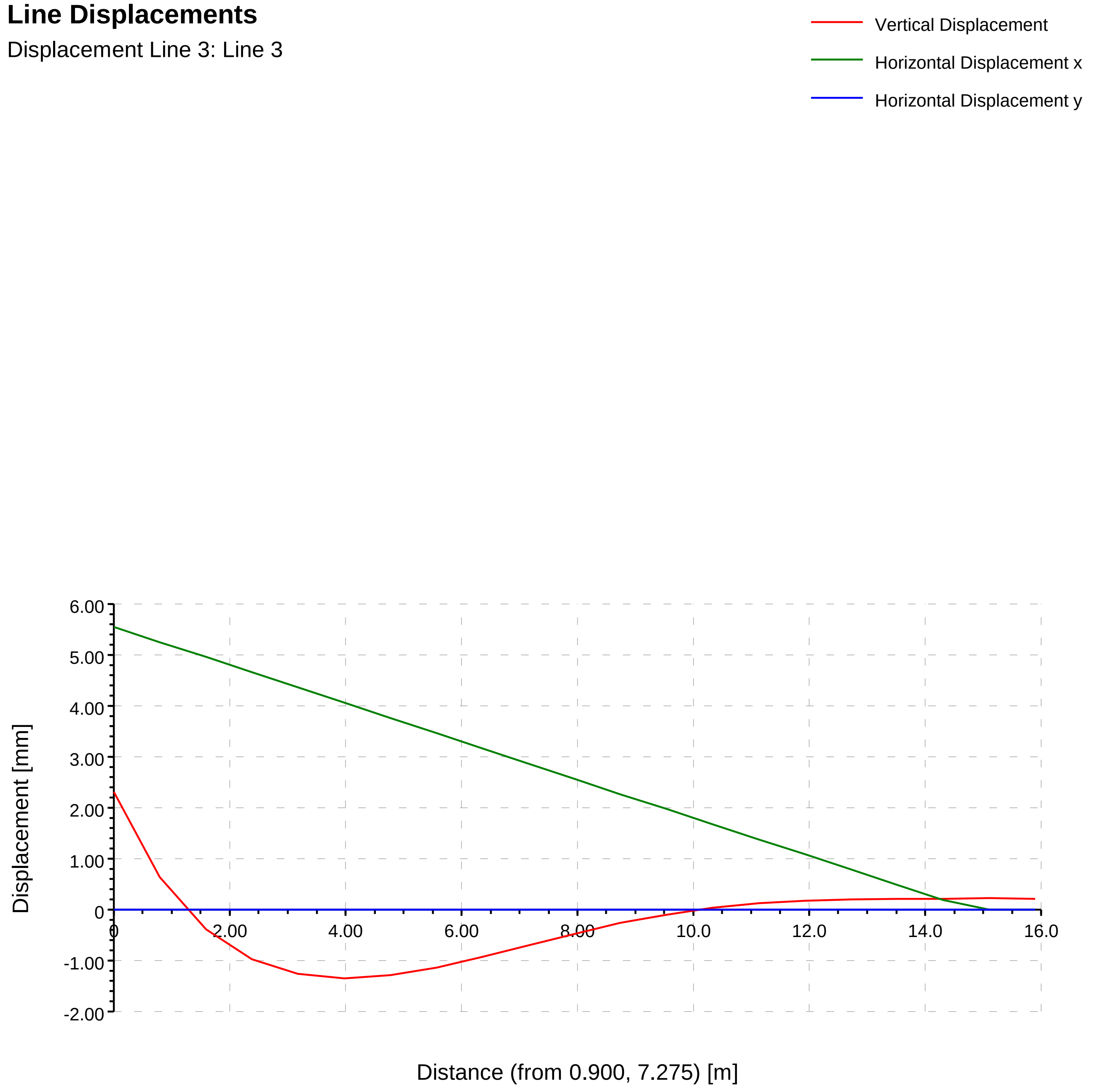
Displacement Line 2: Line 2



456-467 Finchley Road
Long Term Movement due to Basement Construction
Figure CL3

Line Displacements

Displacement Line 3: Line 3



Specific Building Damage Results - Horizontal Displacements

Structure: 469 Party Wall | Sub-structure: Sub 1

Dist.	Coordinates x	Coordinates y	Coordinates z	Displacements x	Displacements y	Displacements Along the Line	Displacements Perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	10.30000	7.27500	0.00000	-5.5500	0.0	-5.5500	0.0
0.38500	10.68500	7.27500	0.00000	-5.4056	0.0	-5.4056	0.0
0.77000	11.07000	7.27500	0.00000	-5.2613	0.0	-5.2613	0.0
1.1550	11.45500	7.27500	0.00000	-5.1169	0.0	-5.1169	0.0
1.5400	11.84000	7.27500	0.00000	-4.9725	0.0	-4.9725	0.0
1.9250	12.22500	7.27500	0.00000	-4.8281	0.0	-4.8281	0.0
2.3100	12.61000	7.27500	0.00000	-4.6838	0.0	-4.6838	0.0
2.6950	12.99500	7.27500	0.00000	-4.5394	0.0	-4.5394	0.0
3.0800	13.38000	7.27500	0.00000	-4.3950	0.0	-4.3950	0.0
3.4650	13.76500	7.27500	0.00000	-4.2506	0.0	-4.2506	0.0
3.8500	14.15000	7.27500	0.00000	-4.1063	0.0	-4.1063	0.0
4.2350	14.53500	7.27500	0.00000	-3.9619	0.0	-3.9619	0.0
4.6200	14.92000	7.27500	0.00000	-3.8175	0.0	-3.8175	0.0
5.0050	15.30500	7.27500	0.00000	-3.6731	0.0	-3.6731	0.0
5.3900	15.69000	7.27500	0.00000	-3.5288	0.0	-3.5288	0.0
5.7750	16.07500	7.27500	0.00000	-3.3844	0.0	-3.3844	0.0
6.1600	16.46000	7.27500	0.00000	-3.2400	0.0	-3.2400	0.0
6.5450	16.84500	7.27500	0.00000	-3.0956	0.0	-3.0956	0.0
6.9300	17.23000	7.27500	0.00000	-2.9513	0.0	-2.9513	0.0
7.3150	17.61500	7.27500	0.00000	-2.8069	0.0	-2.8069	0.0
7.7000	18.00000	7.27500	0.00000	-2.6625	0.0	-2.6625	0.0

Specific Building Damage Results - Vertical Displacements

Structure: 469 Party Wall | Sub-structure: Sub 1

Dist.	Coordinates x	Coordinates y	Coordinates z	Displacements z
[m]	[m]	[m]	[m]	[mm]
Vertical Offset 1				
0.0	10.30000	7.27500	0.00000	1.4426
0.38500	10.68500	7.27500	0.00000	1.8105
0.77000	11.07000	7.27500	0.00000	2.1047
1.1550	11.45500	7.27500	0.00000	2.3321
1.5400	11.84000	7.27500	0.00000	2.4992
1.9250	12.22500	7.27500	0.00000	2.6119
2.3100	12.61000	7.27500	0.00000	2.6763
2.6950	12.99500	7.27500	0.00000	2.6980
3.0800	13.38000	7.27500	0.00000	2.6822
3.4650	13.76500	7.27500	0.00000	2.6341
3.8500	14.15000	7.27500	0.00000	2.5585
4.2350	14.53500	7.27500	0.00000	2.4598
4.6200	14.92000	7.27500	0.00000	2.3422
5.0050	15.30500	7.27500	0.00000	2.2099
5.3900	15.69000	7.27500	0.00000	2.0663
5.7750	16.07500	7.27500	0.00000	1.9150
6.1600	16.46000	7.27500	0.00000	1.7590
6.5450	16.84500	7.27500	0.00000	1.6013
6.9300	17.23000	7.27500	0.00000	1.4444
7.3150	17.61500	7.27500	0.00000	1.2906
7.7000	18.00000	7.27500	0.00000	1.1420

Specific Building Damage Results - All Segments

Structure: 469 Party Wall | Sub-structure: Sub 1

Vertical Offset from Line for Vertical Movement Calculations	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature	Damage Category
[m]		[m]	[m]		[%]	[%]	[%]			[m]	
0	1	0.0	5.4000	Sagging	0.017911	0.037500	0.047738	-374.86E-6	-955.04E-6	1971.5	0 (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: 469 Party Wall | Sub-structure: Sub 1

Vertical Offset from Line for Vertical Movement Calculations	Deflection Ratio	Average Horizontal Strain	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]		[mm]	[%]			[m]	[m]	
0	0.017911	0.037500	-955.04E-6	2.6967	0.047738	-374.86E-6	-955.04E-6	-	1971.5	0 (Negligible)

Specific Building Damage Results - Critical Segments within Each Structure

Structure Name	Parameter	Critical Sub-Structure	Critical Segment	Start	End	Curvature	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
				[m]	[m]			[mm]	[%]	[m]	[m]	
469 Party Wall	Maximum Slope	Sub 1	1	0.0	5.4000	Sagging	**955.04E-6**	2.6967	0.047738	-	1971.5	0 (Negligible)
	Maximum Settlement	Sub 1	1	0.0	5.4000	Sagging	955.04E-6	**2.6967**	0.047738	-	1971.5	0 (Negligible)
	Max. Tensile Strain	Sub 1	1	0.0	5.4000	Sagging	955.04E-6	2.6967	**0.047738**	-	1971.5	0 (Negligible)
	Min. Radius of Curvature (Hogging)		-	-	-	-	-	-	-	-	-	-
	Min. Radius of Curvature (Sagging)	Sub 1	1	0.0	5.4000	Sagging	955.04E-6	2.6967	0.047738	-	**1971.5**	0 (Negligible)

Specific Building Damage Results - All Combined Segments

Structure: 469 Party Wall | Sub-structure: Sub 1

Vertical Offset from Line for Vertical Movement Calculations	Combined Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Damage Category
[m]		[m]	[m]		[%]	[%]	[%]	

No structures have segments combined.

Specific Building Damage Results - Horizontal Displacements

Structure: 469 Party Wall | Sub-structure: Sub 1

Dist.	Coordinates x	Coordinates y	Coordinates z	Displacements x	Displacements y	Displacements Along the Line	Displacements Perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	10.30000	7.27500	0.00000	-5.5500	0.0	-5.5500	0.0 d
0.38500	10.68500	7.27500	0.00000	-5.4056	0.0	-5.4056	0.0 d
0.77000	11.07000	7.27500	0.00000	-5.2613	0.0	-5.2613	0.0 d
1.1550	11.45500	7.27500	0.00000	-5.1169	0.0	-5.1169	0.0 d
1.5400	11.84000	7.27500	0.00000	-4.9725	0.0	-4.9725	0.0 d
1.9250	12.22500	7.27500	0.00000	-4.8281	0.0	-4.8281	0.0 d
2.3100	12.61000	7.27500	0.00000	-4.6838	0.0	-4.6838	0.0 d
2.6950	12.99500	7.27500	0.00000	-4.5394	0.0	-4.5394	0.0 d
3.0800	13.38000	7.27500	0.00000	-4.3950	0.0	-4.3950	0.0 d
3.4650	13.76500	7.27500	0.00000	-4.2506	0.0	-4.2506	0.0 d
3.8500	14.15000	7.27500	0.00000	-4.1063	0.0	-4.1063	0.0 d
4.2350	14.53500	7.27500	0.00000	-3.9619	0.0	-3.9619	0.0 d
4.6200	14.92000	7.27500	0.00000	-3.8175	0.0	-3.8175	0.0 d
5.0050	15.30500	7.27500	0.00000	-3.6731	0.0	-3.6731	0.0 d
5.3900	15.69000	7.27500	0.00000	-3.5288	0.0	-3.5288	0.0 d
5.7750	16.07500	7.27500	0.00000	-3.3844	0.0	-3.3844	0.0 d
6.1600	16.46000	7.27500	0.00000	-3.2400	0.0	-3.2400	0.0 d
6.5450	16.84500	7.27500	0.00000	-3.0956	0.0	-3.0956	0.0 d
6.9300	17.23000	7.27500	0.00000	-2.9513	0.0	-2.9513	0.0 d
7.3150	17.61500	7.27500	0.00000	-2.8069	0.0	-2.8069	0.0 d
7.7000	18.00000	7.27500	0.00000	-2.6625	0.0	-2.6625	0.0 d

d - Displacements include imported displacements.

Specific Building Damage Results - Vertical Displacements

Structure: 469 Party Wall | Sub-structure: Sub 1

Dist.	Coordinates x	Coordinates y	Coordinates z	Displacements z
[m]	[m]	[m]	[m]	[mm]
Vertical Offset 1				
0.0	10.30000	7.27500	0.00000	-2.9107 d
0.38500	10.68500	7.27500	0.00000	-1.3215 d
0.77000	11.07000	7.27500	0.00000	-0.44599 d
1.1550	11.45500	7.27500	0.00000	0.16328 d
1.5400	11.84000	7.27500	0.00000	0.61056 d
1.9250	12.22500	7.27500	0.00000	0.94145 d
2.3100	12.61000	7.27500	0.00000	1.1820 d
2.6950	12.99500	7.27500	0.00000	1.3497 d
3.0800	13.38000	7.27500	0.00000	1.4574 d
3.4650	13.76500	7.27500	0.00000	1.5150 d
3.8500	14.15000	7.27500	0.00000	1.5312 d
4.2350	14.53500	7.27500	0.00000	1.5128 d
4.6200	14.92000	7.27500	0.00000	1.4663 d
5.0050	15.30500	7.27500	0.00000	1.3970 d
5.3900	15.69000	7.27500	0.00000	1.3098 d
5.7750	16.07500	7.27500	0.00000	1.2092 d
6.1600	16.46000	7.27500	0.00000	1.0990 d
6.5450	16.84500	7.27500	0.00000	0.98281 d
6.9300	17.23000	7.27500	0.00000	0.86365 d
7.3150	17.61500	7.27500	0.00000	0.74431 d
7.7000	18.00000	7.27500	0.00000	0.62722 d

d - Displacements include imported displacements.

Specific Building Damage Results - All Segments

Structure: 469 Party Wall | Sub-structure: Sub 1

Vertical Offset from Line for Vertical Movement Calculations	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature	Damage Category
[m]		[m]	[m]		[%]	[%]	[%]			[m]	
0	1	0.0	5.4000	Sagging	0.10776	0.037500	0.12121	-374.86E-6	-0.0041261	179.70	2 (Slight)

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

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

Structure: 469 Party Wall | Sub-structure: Sub 1

Vertical Offset from Line for Vertical Movement Calculations	Deflection Ratio	Average Horizontal Strain	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]		[mm]	[%]			[m]	[m]	
0	0.10776	0.037500	-0.0041261	2.9107	0.12121	-374.86E-6	-0.0041261	-	179.70	2 (Slight)

Specific Building Damage Results - Critical Segments within Each Structure

Structure Name	Parameter	Critical Sub-Structure	Critical Segment	Start	End	Curvature	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
				[m]	[m]			[mm]	[%]	[m]	[m]	
469 Party Wall	Maximum Slope	Sub 1	1	0.0	5.4000	Sagging	**0.0041261**	2.9107	0.12121	-	179.70	2 (Slight)
	Maximum Settlement	Sub 1	1	0.0	5.4000	Sagging	0.0041261	**2.9107**	0.12121	-	179.70	2 (Slight)
	Max. Tensile Strain	Sub 1	1	0.0	5.4000	Sagging	0.0041261	2.9107	**0.12121**	-	179.70	2 (Slight)
	Min. Radius of Curvature (Hogging)		-	-	-	-	-	-	-	-	-	-
	Min. Radius of Curvature (Sagging)	Sub 1	1	0.0	5.4000	Sagging	0.0041261	2.9107	0.12121	-	**179.70**	2 (Slight)

Specific Building Damage Results - All Combined Segments

Structure: 469 Party Wall | Sub-structure: Sub 1

Vertical Offset from Line for Vertical Movement Calculations	Combined Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Damage Category
[m]		[m]	[m]		[%]	[%]	[%]	

No structures have segments combined.