24 Redington Gardens LLP

24 Redington Gardens
Ground Movement &
Building Damage Assessment Report

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Project 1248
24 Redington Gardens
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1 INTRODUCTION

Mr Simon Passer appointed Byland Engineering Limited (BEL) by email on 12th October 2015 to carry out an assessment of ground movements and predicted third party building damage associated with the proposed construction of a basement at 24 Redington Gardens, Hampstead, London, NW3 on behalf of 24 Redington Gardens LLP (RGLLP).

It is proposed to demolish the existing 2 storey detached property and replace it with a new residential dwelling, complete with basement. In plan, the basement is approximately 23m long by 9m in width, under the whole of the proposed superstructure and part of the rear gardens. Existing ground level is approximately 50.0mOD and formation level for the basement is generally 44.0mOD, deepening to 42.4mOD for a swimming pool. Therefore, the retained height is 6.0m generally increasing to 7.8m at the rear of the basement.

The site is accessed from Redington Gardens and comprises a north west to south east aligned narrow rectangular plot. Closely adjacent on the north east boundary is No 25-26 Redington Gardens, which is pair of 2 storey brick built semi-detached properties of similar style and scale. On the south west boundary is 7 Redington Gardens, a detached 2 storey brick built dwelling with a single storey garage closest to the boundary with No. 24.

At present no structural drawings are available for the development, only Architects drawings. However, based on the details presented it is assumed that 24 Redington Gardens will be constructed using an embedded secant piled retaining wall, laterally supported in the temporary condition (during construction) and in the permanent condition by basement and lower ground floor reinforced concrete slabs. Preliminary analyses of the embedded pile wall have been undertaken to enable the probable pile size, spacing and temporary propping demand to be ascertained.

Horizontal and vertical ground movements resulting from the construction of the proposed basement have been determined using the empirical method given in CIRIA Report C580 - Embedded Retaining Walls, Guidance for Economic Design (2003) which uses case history data and the general characteristics and dimensions of the ground and ground support system to estimate ground movements caused by pile installation and basement excavation. In addition, interpolated curves for a reduced stiffness wall are assessed as part of a sensitivity analysis. The C580 method has been applied using the Oasys Xdisp computer program. In addition, an estimate of short and long term uplift (heave) due to removal of the soil mass within the basement is undertaken based on a linear elastic model using the Oasys program Pdisp.

Using the calculated free field ground movements, a building damage prediction for a selection of 3rd party walls adjacent to the excavation has been undertaken using the Xdisp program which automatically implements the method devised by Burland which is detailed in C580.

This report describes the analysis and presents the results along with brief recommendations.

2 SITE LOCATION AND DESCRIPTION

2.1 Location & description

The site is located at 24 Redington Gardens, Hampstead, London, NW3 in the London Borough of Camden. The site is a residential plot which forms a rectangular shape some 46m in length (front to back) and 10m in width.

The existing ground surface is reasonably flat at approximately 50mOD. The front of the site, on the south east boundary, borders the residential street of Redington Gardens. To the south west is No. 7 Redington Gardens and to the north east is No. 25-26 Redington Gardens.

It is understood that planning permission for a similar re-development of No. 25-26 Redington Gardens, with basement, has been granted. However, since construction has not yet started this reports considers the ground movement and their impact on the existing structures. It is assumed that the 3rd party walls are load bearing and supported on conventional strip foundations bearing onto natural strata at shallow depth.

Drawing 1248/001 in Appendix A summarises the site layout and locations of key third party walls that are the subject of the ground movement assessment.

2.2 Proposed development

It is assumed that the new basement will comprise secant piles walls containing a reinforced concrete structure formed of a basement raft slab suspended on bearing piles, reinforced concrete columns, partition and lining walls and a suspended lower ground floor reinforced concrete slab buried at a depth of up to 2m below finished ground level.

The secant piled wall forms an enclosed box and will be propped at the top in the temporary condition using proprietary struts. In the permanent condition the wall will be propped by the basement and lower ground floor slabs.

2.3 Ground conditions

A site specific ground investigation is not yet available for No. 24 Redington Gardens and thus at present this report assumes similar conditions to that reported in the GEA desk study and ground investigation report for No's 25-26 Redington Gardens.

The soil profile indicates by the investigation results is as follows:

- Made Ground - mainly silty gravelly clay, to 1.5m depth
- Alluvium - soft or very soft clay with bands of sand, gravel and peat to 3.5m depth
- Claygate Member - soft becoming firm clay with sand partings to 6m depth
- London Clay - firm becoming stiff and very stiff clay

The Alluvium was found in 2 of the 3 ground investigation boreholes and appears to be related to the former presence of a stream that traversed the north-west corner (rear) of No's 25-26 and crosses No. 24 more centrally.

Groundwater during borehole formation is recorded to have been encountered at 2.4m to 3.0m in sandy layers within the Alluvium in BH2 & BH3 and as a seepage in BH1 at 4.8m depth at the interface of the Claygate Member and London Clay. Monitoring of groundwater installations between 5.6-8.0m depth on two occasions in March 2015 resulted in readings of 1.14m and 1.47m below ground level.

These observations suggest the groundwater could be perched in upper layers, although for wall analysis purposes a water table depth of 1m and 4m will be considered.

3 RETAINING WALL ANALYSIS

A preliminary pile stability analysis has been carried out to determine required pile size, spacing and length and to calculate the approximate pile deflection associated with forming the basement excavation. Selected analysis calculations which include the assumed problem geometry, geotechnical parameters, loading and construction sequence are given in Appendix B. The following summarises the findings:

- Walls are assumed to comprise 600mm diameter continuous flight auger (CFA) bored concrete piles at 800mm centres – alternate and interlocked (secanted) primary firm unreinforced concrete and secondary hard reinforced concrete.
- The piles are generally 9.0m long, except for the deeper swimming pool area where they are 12.0m long.
- All piles terminate at or below existing ground level in a robust reinforced concrete capping beam.
- The capping beam is to be restrained by a stiff temporary propping system which is installed before any part of the basement excavation is deeper than 2m.
- The temporary propping system remains in place until the basement and lower ground floor slabs are installed and up to design strength.

The calculated horizontal deflection of the retaining wall when acted on by full hydrostatic imbalance (water table at 1m depth on active side, at formation level on passive side) and surface surcharge loading of 10kPa is 18mm to 26mm. For a reduced head of groundwater (now 4m deep on active side) and no surface surcharge loading, deflections reduce to 10mm to 15mm. The latter are considered to represent a reasonably cautious estimate of what is likely to occur in practice.

4 CALCULATED GROUND MOVEMENTS

The predicted ground movements associated with the construction of the proposed basement retaining walls have been calculated using the method given in CIRIA C580 – Embedded Retaining Walls Guidance for Economic Design (2003). Section 2.5.2 of C580 provides an empirical chart-based method for predicting free field ground movements associated with the installation and excavation of piled retaining walls constructed in stiff clay. Charts showing the predicted amount of surface ground movement as a function of the wall depth or retained height of the wall are given and are based on a number of case histories, predominantly in London, where movements have been monitored during wall construction. CIRIA C580 Figure 2.8 details horizontal and vertical movements caused by pile installation (contiguous or secant) and Figure 2.11 details horizontal and vertical movements caused during excavation in front of the retaining wall (high or low stiffness) when the retaining wall deflects under the load of the retained ground. The ground movement assessment has been carried out by the Oasys Xdisp program with validation by hand calculation.

4.1 Movement assessment assumptions

Due to the irregular geometry of the basement, it has been necessary to make a number of simplifying assumptions in order to carry out the movement assessment, which are as follows:

1. Existing ground levels at the extremities of the basement are likely to differ slightly but at this stage a single ground level of 50mOD has been taken.
2. The shape of the basement has been simplified to 2 No. overlapping polygons representing the two levels of the basement.
3. The walls have been considered as retaining a stiff clay soil. The case history data on which the curves are based come primarily from London projects and therefore the results using the stiff clay based approach shown are considered to provide an appropriate estimate of ground movements at this site. The curves represent the conservative limit of the data shown in the charts and as such, this inherent conservatism is considered to make suitable allowance for the presence of the Made Ground, Alluvium and Claygate Member beds which are softer and less stiff than the London Clay.
4. Limited data are available on the foundations of adjacent properties. The locations of the walls they support and the length and height of these walls have been estimated based on information in the Architects drawings.

The details and results of the analysis are discussed below.

4.2 CIRIA C580 method by hand

A hand calculation using the charts in C580 is undertaken in the first instance to provide a preliminary assessment of the ground movements of the retained soil at the immediate rear of the secant pile wall. These estimates consider bored piles in stiff clay, top down construction with early high level stiff temporary propping and no reduction for the stiffness provided at plan corners. The results are given in Table 1 below and in Figures 1-2.

Basement depth (m)	Pile length(m)	Installation		Excavation		Combined	
		Vertical (mm)	Horizontal (mm)	Vertical (mm)	Horizontal (mm)	Vertical (mm)	Horizontal (mm)
6.0	9.0	5	7	2	9	7	16
7.8	12.0	6	10	3	12	9	21

Table 1 – Summary of CIRIA C580 hand calculated ground movements

The C580 hand calculated ground movements for excavation show good agreement with the 'low' groundwater retaining wall analysis, which does not consider movements relating to wall installation.

However, whilst the C580 hand calculated ground movements give an indication of horizontal and vertical ground movements at the ground surface based on the depth of the piles and retained height of each of the basement walls, they do not take into account the size and shape of the excavation.

4.3 CIRIA C580 method by Oasys Xdisp

In order to determine free field surface horizontal and vertical ground movements in plan and section, the Oasys program Xdisp has been used. A plan of the model is detailed in Appendix A.

The walls are assigned a horizontal and vertical ground movement curve for the wall/pile type and wall stiffness for excavation. The resulting displacements are calculated at surface level for a grid over the whole site and at lines of section which correspond to the locations of 3rd party walls forming the neighbouring buildings. A summary of the dimensions used to represent the walls is given in Table 2 below:

Wall	Parallel or Perpendicular to Excavation	Location	Assumed Length of Wall (m)	Assumed Height of Wall (m)
No. 7 Wall A	Perpendicular	Front wall of No. 7	17.1	7.0
No. 7 Wall B	Perpendicular	Rear wall of No. 7	17.1	7.0
No. 7 Wall C	Parallel	Near side wall of No. 7	10.0	7.0
No. 7 Wall D	Parallel	Far side wall of No. 7	9.5	7.0
No. 7 Wall E	Perpendicular	Real wall of No. 7 garage	2.6	3.0
No. 7 Wall F	Parallel	Near side wall of No. 7 garage	4.1	3.0
No. 7 Wall G	Perpendicular	Front wall of No. 7 garage	2.6	3.0
No. 25/26 Wall A	Perpendicular	Front Wall of No. 25/26	17.0	9.0
No. 25/26 Wall B	Perpendicular	Rear Wall of No. 25/26	11.9	9.0
No. 25/26 Wall C	Perpendicular	Rear Wall of No. 26	5.0	9.0
No. 25/26 Wall D	Parallel	Near side wall of No. 25	13.0	9.0
No. 25/26 Wall E	Parallel	Party wall of No. 25/26	13.0	9.0
No. 25/26 Wall F	Parallel	Short return wall of No. 26	2.2	9.0
No. 25/26 Wall G	Parallel	Far side wall of No. 26	10.8	9.0

Table 2 – Summary of 3rd party wall geometry

Plots of the horizontal and vertical surface free field ground movements due to pile installation and basement excavation from existing ground surface level as well as combined movements along each of the walls are shown in Figures 3 to 16. Contour plots (in plan) of the displacement at surface over the whole basement footprint and surrounding area are included in Appendix C along with the input data for the model.

The calculated minimum and maximum ground surface displacements recorded along the line of each wall are given in Table 3:

Wall	Parallel or Perpendicular to Excavation	Total Ground Surface Displacement			
		Horizontal (mm)		Vertical (mm)	
		Min	Max	Min	Max
No. 7 Wall A	Perpendicular	2.0	7.0	0.3	5.1
No. 7 Wall B	Perpendicular	3.5	13.6	1.4	9.3
No. 7 Wall C	Parallel	7.0	13.6	5.0	9.3
No. 7 Wall D	Parallel	2.0	3.5	0.3	1.4
No. 7 Wall E	Perpendicular	12.5	15.0	7.8	8.9
No. 7 Wall F	Parallel	14.9	15.0	7.7	7.8
No. 7 Wall G	Perpendicular	12.2	14.9	7.7	8.6
No. 25/26 Wall A	Perpendicular	3.1	10.8	1.1	6.3
No. 25/26 Wall B	Perpendicular	8.6	19.9	6.4	10.5
No. 25/26 Wall C	Perpendicular	4.7	8.2	3.0	6.1
No. 25/26 Wall D	Parallel	10.8	20.1	5.6	9.8
No. 25/26 Wall E	Parallel	6.4	12.0	5.4	9.0
No. 25/26 Wall F	Parallel	8.2	8.6	6.1	6.4
No. 25/26 Wall G	Parallel	3.1	4.7	1.1	3.0

- Horizontal and vertical displacement values do not necessarily occur at same point along wall

Table 3 – Results of Xdisp analyses for a high stiffness wall

The data in Table 3 and Figures 3-16 present the displacements along the 3rd party walls. In general terms the walls which are oriented perpendicular to the excavation record a slight differential displacement along their length whereas it is less on walls which are parallel to the sides of the basement. The major exceptions to the rule are No. 7 Wall C & No. 25/26 Wall D which show a rapid change in displacement at the corners of the excavation, where ground movements are reduced due to the stiffening effect, or where ground movements increase with the basement deepening. Such features are annotated on the Figures.

In general, this distribution of ground movements is in line with expectations since the ground movement curves within C580 show a decay in ground movement as the distance away from the wall increases. The distribution of the ground movements surrounding the basement is shown on a contoured plot as part of the Xdisp output in Appendix C.

In addition to the above analysis which considers the installation of a secant wall in conjunction with excavation in front of a high stiffness wall, for completeness a sensitivity check has been undertaken assuming installation of a secant wall in conjunction with excavation in front of a medium stiffness wall. Movement curves have been generated based on Figures 2.11a and 2.11b in Ciria C580, and adopting a ground movement curve between that for a high stiffness and low stiffness wall. The corresponding total vertical and horizontal surface movements below each wall are detailed in Table 4 overleaf:

Wall	Parallel or Perpendicular to Excavation	Total Ground Surface Displacement			
		Horizontal (mm)		Vertical (mm)	
		Min	Max	Min	Max
No. 7 Wall A	Perpendicular	2.6	10.6	0.6	8.0
No. 7 Wall B	Perpendicular	4.5	19.9	2.0	14.4
No. 7 Wall C	Parallel	10.6	19.9	8.0	14.4
No. 7 Wall D	Parallel	2.6	4.5	0.6	2.0
No. 7 Wall E	Perpendicular	18.9	22.1	14.0	15.6
No. 7 Wall F	Parallel	22.0	22.1	15.5	15.6
No. 7 Wall G	Perpendicular	18.5	22.0	13.7	15.5
No. 25/26 Wall A	Perpendicular	4.4	16.0	1.9	11.3
No. 25/26 Wall B	Perpendicular	12.0	27.1	8.6	17.5
No. 25/26 Wall C	Perpendicular	6.6	11.7	4.2	8.3
No. 25/26 Wall D	Parallel	16.0	27.3	11.3	17.6
No. 25/26 Wall E	Parallel	9.8	16.8	7.5	12.0
No. 25/26 Wall F	Parallel	11.7	12.0	8.3	8.6
No. 25/26 Wall G	Parallel	4.4	6.6	1.9	4.2

Table 4 – Results of Xdisp analyses for a medium stiffness wall

The above movements, show a 30-50% increase when compared to those for a high stiffness wall, as would be anticipated, and are comparable to the 'high' groundwater wall analysis with full back of wall surcharge. These sensitivity analyses are also considered in the building damage assessment in Section 5 below.

4.4 Heave

Excavation of the basement will 'unload' the ground of the weight of soil removed which will lead to heave of the soils below the basement slab and of the surrounding ground. An analysis of the anticipated magnitude of heave has been carried out using the Oasys program Pdisp, which calculates the displacement within a linear elastic soil mass arising from uniform pressure applied to rectangular loaded planes representing the basement plan area.

2 No. load cases are considered as follows :

- Short term (undrained) heave as a result of excavation of the basement. An average soil unit weight of 20kN/m^3 results in an unloading pressure of 120kN/m^2 and 136kN/m^2 for the 6.0m and 6.8m deep basement areas respectively.

- Long term (drained) heave as a result of unloading and then re-loading the ground by the new structure. An assumed positive pressure of 50kN/m^2 is used to model the new structure, so the net unloading pressure is 70-86kN/m^2.

The graphical and tabular input/output statements from the analysis are presented in Appendix D.

The results show that the greatest heave of 16mm occurs below the centre of the basement, as expected. Heave of 1-8mm is calculated under the 3rd party walls in the short term reducing to 1-6mm in the long term.

Since the C580 ground movement curves used in this assessment are based on empirical case history data where actual measurements were recorded throughout the construction they will already account for any heave from basement excavation. Thus, the calculated heave must not be deducted from the ground movements estimated in section 4.3 above. To do so would reduce the total ground movements and potentially under-estimate the building damage classification. It is clear from the C580 data that the net ground movement is one of settlement which is further corroborated by recent local case history data for a similar basement within close proximity to 24 Redington Gardens.

4.5 Local case history data

Monitoring results from the construction of a basement in the Hampstead area adopting identical construction techniques have been reviewed as part of the sensitivity analysis. The site is located on a street parallel to Redington Gardens and within ¼ mile of the site (precise details are covered by a confidentiality agreement). The ground conditions were comparable and the basement was constructed through Made Ground and the Claygate Member and are therefore considered relevant to this site.

The basement is approximately trapezoidal shape, roughly 32m in length (front to back) and 23m in width. The new property comprises a 3 storey detached house with single storey basement, locally deepened for a swimming pool & cinema room. The maximum depth of the basement (temporary) during construction is 7.66m which is comparable to the Redington Gardens site.

The monitoring comprised 3D monitoring points applied to the walls of neighbouring properties and a number of inclinometers cast into the secant pile wall. The monitoring points were located at distances ranging from <1m to 12.5m away from the new basement wall.

The monitoring points show a maximum horizontal movement and settlement of 12mm and 9mm respectively both of which come from a location 1.2m from the basement wall. Inclinometer results indicated horizontal movements towards the basement ranging from 7 to 15mm.

The results, normalised for the height of the basement wall have been plotted on Figures 17-20 and show that for a basement of this type of construction, ground movements are generally within the C580 enveloping curve for secant wall installation and excavation in front of a high stiffness wall in clay.

It is therefore suggested that the curves for a high stiffness wall used in this assessment are a cautious best estimate and the curves for a medium stiffness wall represent a worst credible condition. Both are considered in the building damage assessment to confirm that there are no cliff edge effects associated with slightly increased ground movements.

5 BUILDING DAMAGE ASSESSMENT

In order to assess the likely damage to the neighbouring properties if the predicted ground movements occurred, a building damage assessment has been carried out. This has been done using the Xdisp software which implements the method devised by Burland which is detailed in section 2.5.4 of CIRIA C580. This method considers the building structure (wall and foundations) as a linear elastic beam and utilises the concept of limiting tensile strain. From interaction diagrams showing contours of limiting tensile strain related to the imposed deflection ratio and the horizontal ground strain determined from the ground movement assessment, the damage category can be determined.

In order to carry out the analysis, the following data must be input for each wall:

Damage Category Strains – those suggested by Burland and stored as default values in the program have been adopted for the analysis. The damage category, description of typical damage, approximate crack width and limiting strain values are summarised from C580 in Table 5.

Poisson's Ratio – the Poisson's ratio of the beam that is to represent the building structure wall and foundation. A value of 0.2 has been adopted.

Ratio of Young's Modulus to Shear Modulus E/G – Assuming the beam is solid, isotropic and elastic, a typical value would be based on Poisson's ratio and therefore a value of 2.4 has been used.

Category of damage	Description of typical damage	Approximate crack width (mm)	Limiting tensile strain (%)
0 Negligible	Hairline cracks	<0.1	0 to 0.05
1 Very slight	Isolated slight fractures in building. Cracks in external brick work visible on inspection	<1	0.05 to 0.075
2 Slight	Several slight fractures showing inside building. Cracks visible externally. Doors and windows may stick	<5	0.075 to 0.15
3 Moderate	Doors and windows sticking. Service pipes may fracture. Water tightness often impaired.	5 to 15 or >3 No. cracks	0.15 to 0.3
4 Severe	Windows and door frames distorted, floor sloping noticeably. Walls leaning or bulging noticeably, some loss of bearing in beams. Service pipes disrupted.	15 to 25	>0.3
5 Very severe	Beams lose bearings, walls lean badly and require shoring. Danger of instability	>25	

Table 5 – Strain categories used in damage assessment

The full results of the building damage assessment are included in the Xdisp output included in Appendix C. The results are summarised in Table 6.

Structure Name	Deflection Ratio (%)	Average Horizontal Strain (%)	Max. Tensile Strain (%)	Damage Category
Installation				
No. 7 Wall A	0.002590	0.020043	0.023957	0 (Negligible)
No. 7 Wall B	0.001690	0.036424	0.038351	0 (Negligible)
No. 7 Wall C	0.033060	0.006068	0.032562	0 (Negligible)
No. 7 Wall D	0.000205	0.000000	0.000199	0 (Negligible)
No. 7 Wall E	0.000290	0.067173	0.067498	1 (Very Slight)
No. 7 Wall F	0.000112	0.001777	0.001884	0 (Negligible)
No. 7 Wall G	0.000081	0.072040	0.072131	1 (Very Slight)
No. 25/26 Wall A	0.002705	0.026956	0.031062	0 (Negligible)
No. 25/26 Wall B	0.000094	0.058910	0.059037	1 (Very Slight)
No. 25/26 Wall C	0.000091	0.031982	0.032056	0 (Negligible)
No. 25/26 Wall D	0.026670	-0.085823	0.026524	0 (Negligible)
No. 25/26 Wall E	0.014431	-0.024831	0.016795	0 (Negligible)
No. 25/26 Wall F	0.000331	-0.012539	0.002515	0 (Negligible)
No. 25/26 Wall G	0.000472	0.000000	0.000515	0 (Negligible)
Excavation				
No. 7 Wall A	0.004864	0.032075	0.032075	0 (Negligible)
No. 7 Wall B	0.008353	0.034547	0.036844	0 (Negligible)
No. 7 Wall C	0.023121	0.006681	0.028840	0 (Negligible)
No. 7 Wall D	0.001598	-0.007859	0.003568	0 (Negligible)
No. 7 Wall E	0.007595	0.025662	0.034153	0 (Negligible)
No. 7 Wall F	0.000039	0.001870	0.001926	0 (Negligible)
No. 7 Wall G	0.007568	0.032144	0.040604	0 (Negligible)
No. 25/26 Wall A	0.011441	0.019970	0.034361	0 (Negligible)
No. 25/26 Wall B	0.014778	0.037177	0.057867	1 (Very Slight)
No. 25/26 Wall C	0.001139	0.036257	0.036743	0 (Negligible)
No. 25/26 Wall D	0.016818	-0.091568	0.018656	0 (Negligible)
No. 25/26 Wall E	0.018480	-0.055522	0.018519	0 (Negligible)
No. 25/26 Wall F	0.000561	-0.037074	0.007422	0 (Negligible)
No. 25/26 Wall G	0.002407	-0.009012	0.001812	0 (Negligible)

Table 6 – Individual results of building damage assessment (high stiffness wall)

The results show that negligible or very slight damage is separately predicted for all walls as a result of ground movements linked to installation of the piles and to excavation of the basement void in front of the high stiffness retaining wall.

The combined damage classification, when the movements related to pile installation and basement excavation are summed, is presented in Table 7 below.

Structure Name	Installation Max. Tensile Strain (%)	Excavation Max. Tensile Strain (%)	Combined Max. Tensile Strain (%)	Damage Category
No. 7 Wall A	0.023957	0.032075	0.056032	1 (Very Slight)
No. 7 Wall B	0.038351	0.036844	0.075195	2 (Slight)
No. 7 Wall C	0.032562	0.028840	0.061402	1 (Very Slight)
No. 7 Wall D	0.000199	0.003568	0.003767	0 (Negligible)
No. 7 Wall E	0.067498	0.034153	0.101651	2 (Slight)
No. 7 Wall F	0.001884	0.001926	0.003810	0 (Negligible)
No. 7 Wall G	0.072131	0.040604	0.112735	2 (Slight)
No. 25/26 Wall A	0.031062	0.034361	0.065423	1 (Very Slight)
No. 25/26 Wall B	0.059037	0.057867	0.116904	2 (Slight)
No. 25/26 Wall C	0.032056	0.036743	0.068799	1 (Very Slight)
No. 25/26 Wall D	0.026524	0.018656	0.045180	0 (Negligible)
No. 25/26 Wall E	0.016795	0.018519	0.035314	0 (Negligible)
No. 25/26 Wall F	0.002515	0.007422	0.009937	0 (Negligible)
No. 25/26 Wall G	0.000515	0.001812	0.002327	0 (Negligible)

Table 7 – Combined results of building damage assessment (high stiffness wall)

The combined building damage results show that negligible damage is recorded for all walls which are parallel to the proposed basement, with the exception of No. 7 Wall C where the stiffening effect of the corner produces a sharp change in ground movements inducing greater strain in the foundation/walls. For the walls which are perpendicular to the proposed basement a combined classification of very slight to slight is recorded, with the greatest tensile strains recorded in those walls which are closest to the basement, especially the deeper part of the excavation.

As noted in section 4.3, a sensitivity analysis assuming a medium stiffness wall has been undertaken to establish its effect on the building damage assessment as detailed in Table 8 overleaf.

Structure Name	Installation Max. Tensile Strain (%)	Excavation Max. Tensile Strain (%)	Combined Max. Tensile Strain (%)	Damage Category
No. 7 Wall A	0.023957	0.036824	0.060781	1 (Very Slight)
No. 7 Wall B	0.038351	0.067573	0.105924	2 (Slight)
No. 7 Wall C	0.032562	0.058525	0.091087	2 (Slight)
No. 7 Wall D	0.000199	0.008140	0.008339	0 (Negligible)
No. 7 Wall E	0.067498	0.057246	0.124744	2 (Slight)
No. 7 Wall F	0.001884	0.001926	0.003810	0 (Negligible)
No. 7 Wall G	0.072131	0.063829	0.135960	2 (Slight)
No. 25/26 Wall A	0.031062	0.042954	0.074016	1 (Very Slight)
No. 25/26 Wall B	0.059037	0.070077	0.129114	2 (Slight)
No. 25/26 Wall C	0.032056	0.067751	0.099807	2 (Slight)
No. 25/26 Wall D	0.026524	0.055753	0.082277	2 (Slight)
No. 25/26 Wall E	0.016795	0.034046	0.050841	1 (Very Slight)
No. 25/26 Wall F	0.002515	0.010331	0.012846	0 (Negligible)
No. 25/26 Wall G	0.000515	0.008722	0.009236	0 (Negligible)

Table 8 – Combined results of building damage assessment (medium stiffness wall)

From the results above it can be seen that a modelling a less stiff wall with a greater degree of ground movement results in an increase in the excavation induced tensile strains and an increase in building damage classification for 4 of the 14 No. 3rd party walls considered. The increase in classification for these walls appears to be attributable to the increase in ground movements from a less stiff wall in comparison to the significantly reduced movements which occur at the stiff corners of the basement, resulting in an increase differential displacement when compared to the high stiffness wall results. However, the predicted damage category remain at negligible to very slight or slight.

6 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

This report presents the results of a ground movement study and building damage assessment for the purposes of planning approval associated with the proposed construction of a residential basement at 24 Redington Gardens, London, NW3. The assessment is based on the available Architects drawings only, which is considered to be satisfactory at this stage. However, the assessment may require to be updated once the Structural Engineers drawings are produced.

The assessment considers ground movements that may arise from the installation of an assumed secant pile embedded retaining wall and also from the deflection of the piles and relaxation of the ground as the excavation is made in front of the wall.

Preliminary design calculations indicate 600mm diameter bored continuous flight auger (CFA) concrete piles at 800mm centres, 9m and 12m deep are required for the 6.0m and 7.8m depth of excavation respectively. The analytical wall stability calculations, assuming near full height hydrostatic imbalance, indicate 18-26mm of lateral wall deflection following excavation of the basement. However, such analyses based on worst credible groundwater levels and back of wall surcharge pressures are likely to over predict wall deflections. Additional analyses, which consider a lower hydrostatic groundwater pressure imbalance and zero surcharge pressure acting on the retained soil surface yield 10mm to 15mm of wall deflection. This is considered to yield typical results which are more typical of movement likely to occur.

The method of ground movement prediction is an empirical one based on the case history data and approach detailed in CIRIA Report C580. Combined movements, that is movements arising out of both pile installation and of wall deflection and ground relaxation during excavation of the basement have been calculated. Hand calculations for pile installation and excavation induced ground movement using the C580 case history data suggest combined vertical and horizontal movements at the immediate back of wall will be of the order of 10mm to 20mm and are comparable to the wall analysis results.

An estimate of the short and long term heave associated with removal of the soil mass within the basement has been undertaken using Pdisp based on a linear elastic soil model. The results show a maximum short team heave of 16mm at the centre of the basement and in the range 1-8mm at the location of 3rd party walls. In the long term, the weight of the new structure reduces the net ‘uplift’ and associated heave displacements by approximately 25%. Since the C580 ground movement curves are based on empirical case history data, they will already account for heave and as such the Pdisp results must not be deducted from the ground movements calculated using the C580 method. The net displacement of the ground surrounding the basement is one of settlement, as shown by the C580 curves and local case history data.

The computer program Xdisp has been used to automate the calculation of the free field ground movements around a model basement which comprises 3D prisms representing the basement footprint and depth and the required pile length. The deflection along a series of lines, representing surrounding 3rd party walls has been ascertained. The Xdisp input/output is presented in Appendix C and the movements along the length of the 3rd party walls is presented in Figures 3-16. The predicted vertical movement is 0-10mm and the predicted horizontal movement is 10-20mm when considering a stiff wall. A sensitivity analysis based on a medium stiffness wall results in a 30/50% increase in predicted ground movements. Both sets of analyses show a reasonable agreement to the ‘low’ and ‘high’ groundwater analysis models as well as the hand calculations.

The Xdisp program output also calculates strains along a series of lines which coincide with the positions of the 3rd party existing building walls which are adjacent to the basement. The calculated strains form the basis of a building damage assessment in which limiting tensile strain values are used to categorise the damage in masonry walls likely to emanate from the relevant strain value being experienced by the wall and its foundation at ground surface level.

Conclusions

The building damage assessment undertaken for the properties adjacent to the proposed excavation at 24 Redington Gardens generally indicates that, with due allowance for conservative assumptions and assuming a good standard of construction practice, in our professional opinion, **negligible, very slight or slight damage** is to be expected within the 3rd party walls adjacent to the proposed excavation.

The typical damage associated with the definitions of negligible, very slight or slight damage is as follows:

> ***Category 0 - Negligible*** *: Hairline cracks of less than about 0.1mm wide*
>
> ***Category 1 - Very Slight*** *: Fine cracks that can easily be treated during normal redecoration. Perhaps isolated slight fracture in building. Cracks in external brickwork visible on inspection.*
>
> ***Category 2 - Slight*** *: Cracks easily filled. Redecoration probably required. Several slight fractures showing inside building. Cracks are visible externally and some re-pointing may be required externally to ensure weather tightness. Doors and windows may stick slightly.*

The assessment in this report is necessarily approximate and based on a number of assumptions, chief of which are:

- It is assumed that a perimeter retaining wall is formed using embedded secant piles
- The neighbouring building walls are assumed to be of plain masonry construction and their height has been estimated from various drawings and photographs. Any error in the height estimation is expected to be small and have a minimal impact on the resulting building damage classification.
- The ground assessment is based on excavation within a stiff clay soil as the data on which the C580 method is based are taken mainly from case histories of sites around London. At No. 24 Redington Gardens, Made Ground, soft Alluvium and soft to firm clay of the Claygate Member are present down to a depth of about 6m with firm becoming stiff or very stiff London Clay thereafter. These site conditions are considered reasonably comparable to many of the case history sites in London where Made Ground, Alluvium & River Terrace Deposits soils overlie London Clay and as such the relationship lines from C580, which represent a conservative bound to the data, can be expected to provide a reasonable database for prediction of ground movements at this site.
- The ground movements assume a stiffly propped retaining wall is used. In the absence of Structural Engineers drawings it is assumed that construction comprises a reinforced concrete box which in the permanent case provides props at the basement and lower ground floor levels. The preliminary design

calculations assume early stiff high level temporary propping will be applied before any excavation below 2m depth is made and will remain in position until permanent lateral support is fully effective.

A sensitivity analysis has been undertaken assuming a wall of medium stiffness which shows a slight increase in tensile strains and building damage classification in selected walls which start/end close to the corners of the basement where the expected ground movements reduce significantly due to the stiffening corner effect.

Recommendations

The Camden Planning Guidance for Basements indicates that where predicted structural damage is greater than slight, mitigation measures should be included in the proposed scheme which may include underpinning of the neighbouring properties or setting the basement back from neighbouring properties. The predicted strains induced in the walls by these ground movements range from the negligible to the slight category, even assuming a reduced stiffness wall. Therefore, in practice no more than slight damage is expected and it is considered unnecessary to identify any mitigation measures at this time.

The following are recommended to control and mitigate the ground movements and damage categories identified in this report:

- Carefully consider the permitted methods of pile formation so that an appropriate piling technique which offers full temporary support to the ground during construction is used.
- Carefully implement the agreed construction sequence, in particular ensuring early high level stiff temporary propping of the wall is provided.
- Good and speedy workmanship as per the design construction sequence.
- Careful control of ground works to avoid over excavation.
- Blinding of excavated formation in order to prevent premature softening.

Regular monitoring of wall deflections should be carried out and the results should be compared to the predictions in this assessment to enable appropriate interventions to be identified if necessary.

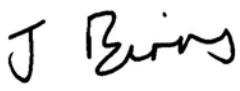
Condition surveys (internal and external) should be carried out prior to construction and an agreed record kept of existing condition, defects and damage.

A ground & retaining wall deflection monitoring plan should be prepared before the works commence which should be allied to this assessment and the retaining wall design. The plan should include a traffic light system which identifies safe (green), trigger (amber) and action (red) values of ground or wall deflection. Precise surveys of ground markers and targets fixed to building walls and the basement capping beam and pile deflection measurements using inclinometers cast into a few wall piles are recommended.

The monitoring plan should identify specific measures to be implemented should specific thresholds be met in order to minimise any problems to neighbouring properties.

A particular specification for piling based on the ICE specification for piling and embedded retaining walls 2nd edition (SPERW2) should be prepared. The specification should include the movement monitoring requirements.

Author



James Binns

BSc MSc CEng MICE FGS

Reviewer

John Gannon

BSc MSc CEng MICE

7 REFERENCES

BS 8004 (2015) – Foundations, BSI, London

BS 8002 (2015) – Earth Retaining Structures, BSI, London

BS 8102 (2009) – Protection of below ground structures against water from the ground, BSI, London

BS EN 1536 (1999) - Execution of special geotechnical work - Bored piles, BSI, London

CIRIA C580 (2003) - Embedded Retaining Walls, Guidance for Economic Design

ICE Specification for Piling and Embedded Retaining Walls (2007) – 2nd edition (SPERW2)

Oasys X Disp Manual (2015) version 19.3

Provided Information

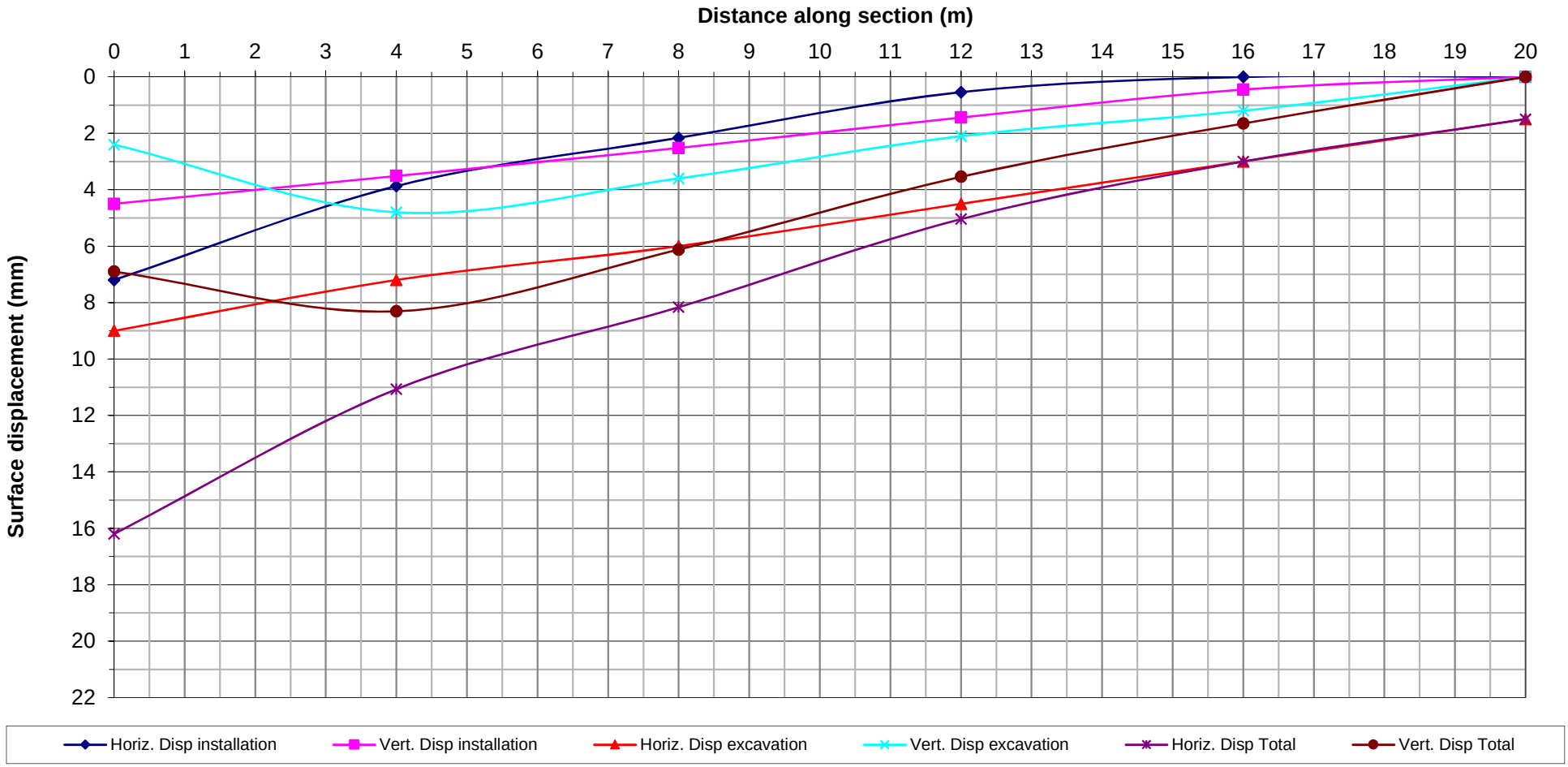
The following documentation has been provided for the assessment:

1. Geotechnical Engineering Associates Desk Study & Ground Investigation Report J15031 Issue 2 3rd June 2015

2. De Metz Forbes Knight Architects drawings
   i. Basement Plan Proposed - 2028-A100 Rev. –
   ii. Lower Ground Floor Proposed - 2028-A101 Rev. -
   iii. Upper Ground Proposed - 2028-A102 Rev. -
   iv. First Floor Plan Proposed - 2028-A103 Rev. -
   v. Second Floor Plan Proposed - 2028-A104 Rev. -
   vi. Roof Plan Proposed - 2028-A105 Rev. -
   vii. Elevation A-A' Proposed - 2028-A150 Rev. -
   viii. Elevation B-B' Proposed - 2028-A151 Rev. -
   ix. Elevation C-C' Proposed - 2028-A152 Rev. -
   x. Elevation D-D' Proposed - 2028-A153 Rev. -
   xi. Elevation A-A' from Pavement Proposed - 2028-A154 Rev. -
   xii. Elevation A-A' with Existing Adjacent Building Shown Proposed - 2028-A155 Rev. -
   xiii. Elevation B-B' with Existing Adjacent Building Shown Proposed - 2028-A156 Rev. -
   xiv. Section A-A' Proposed - 2028-A160 Rev. -
   xv. Section B-B' Proposed - 2028-A161 Rev. -

Figures

Client	24 Redington Gardens LLP
Job	24 Redington Gardens
Title	Surface horizontal and vertical displacements along Section A by hand



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APPRVD	JAG	DATE	Nov-15

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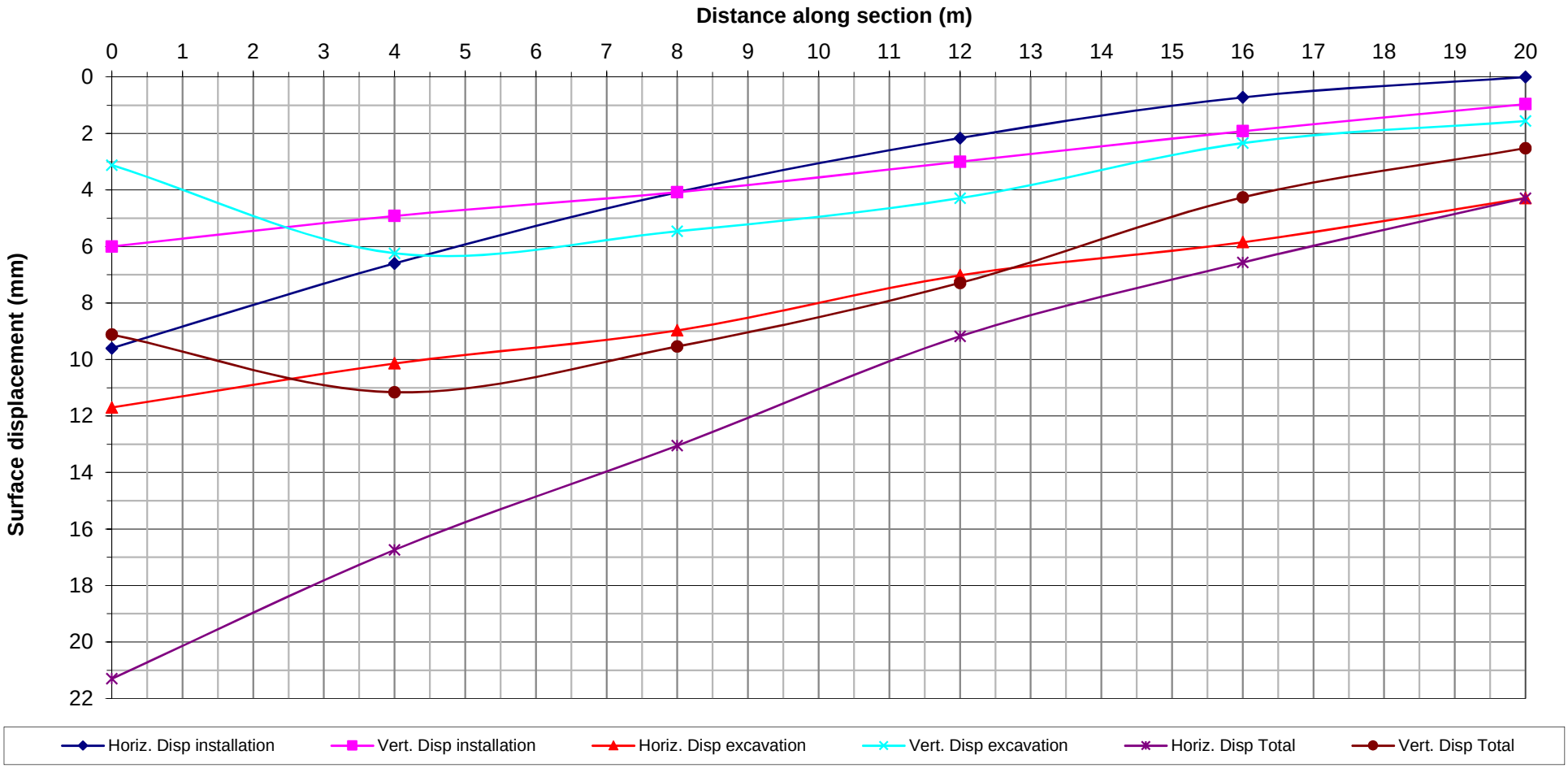

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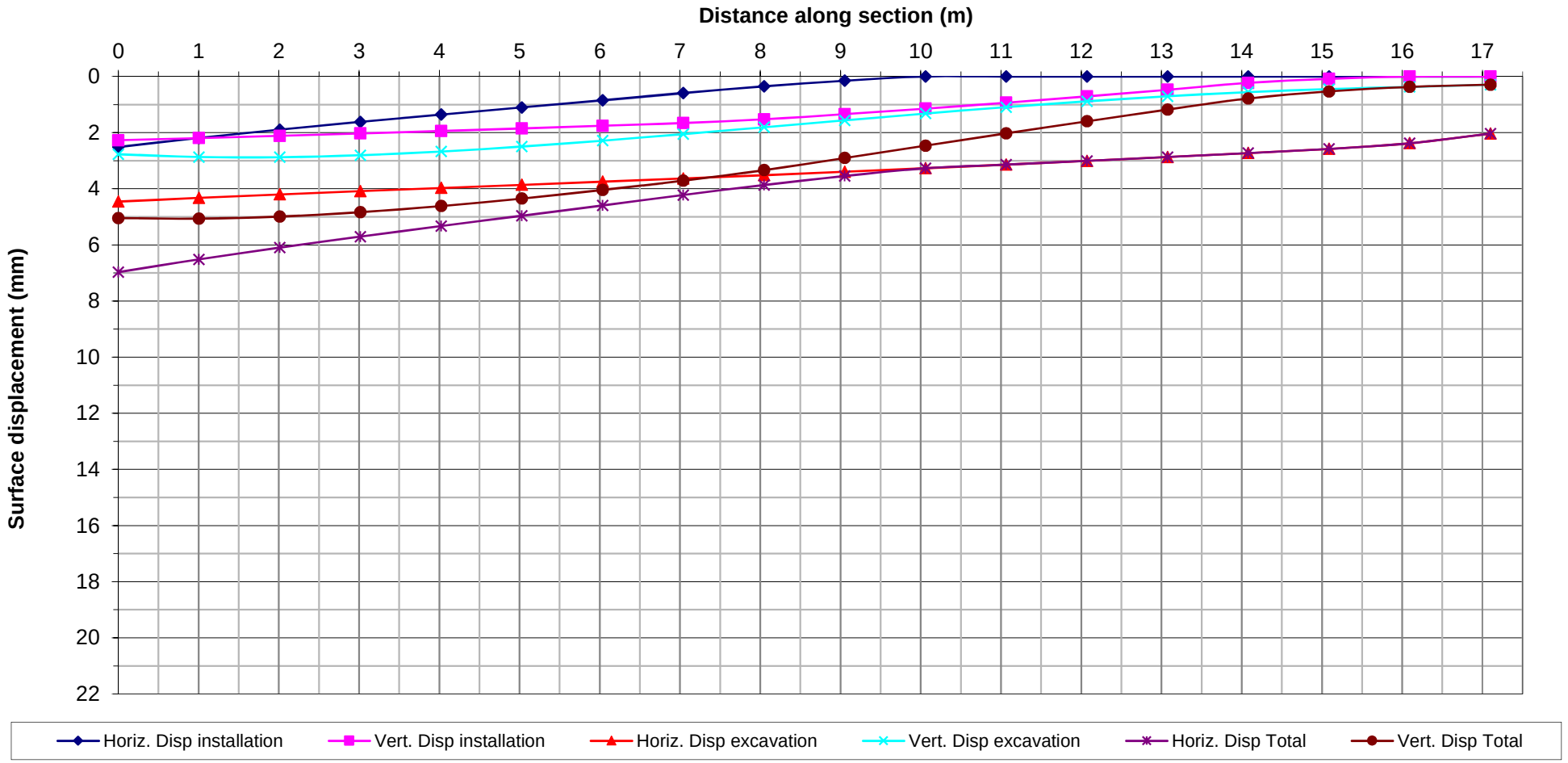

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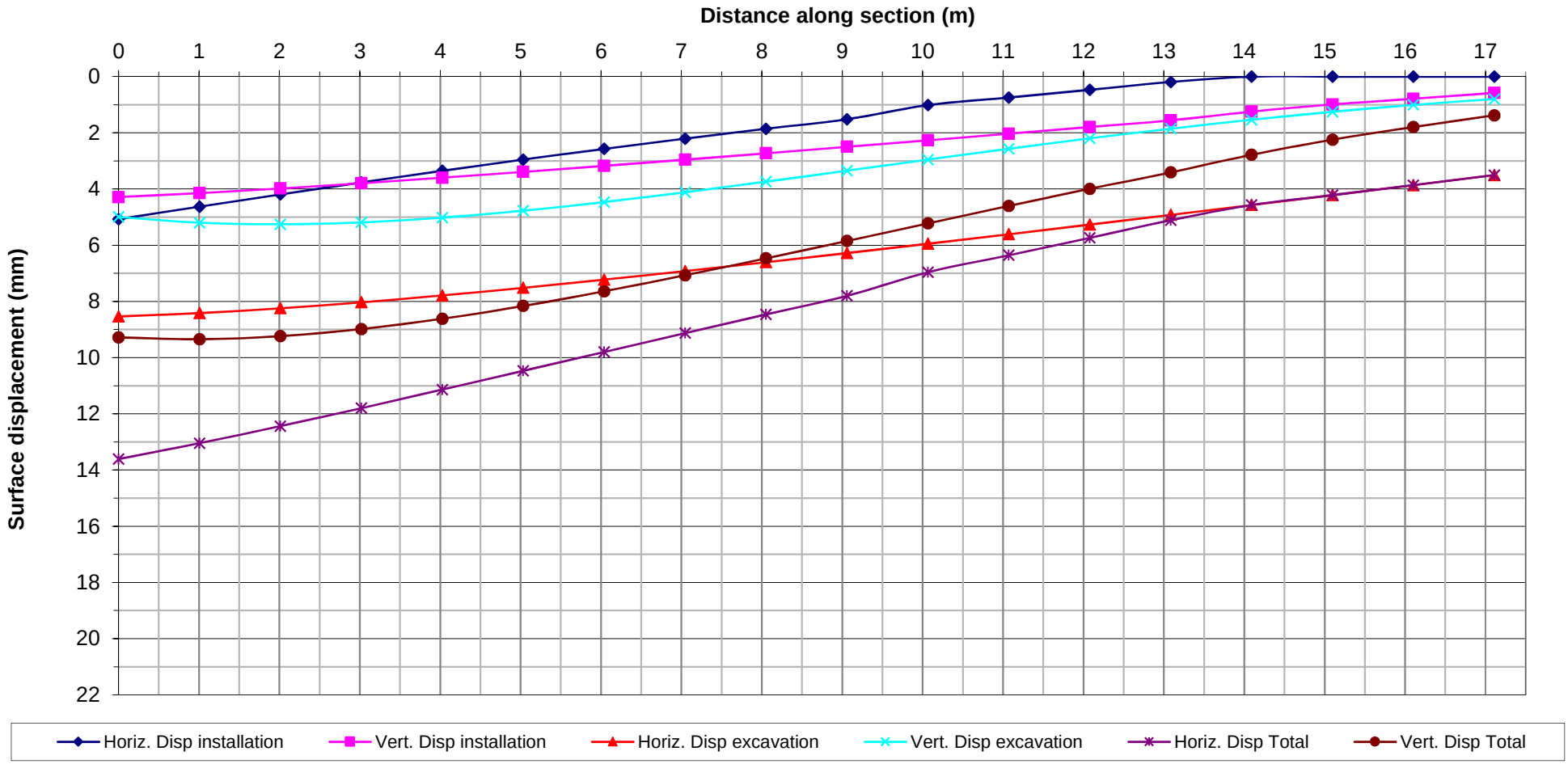

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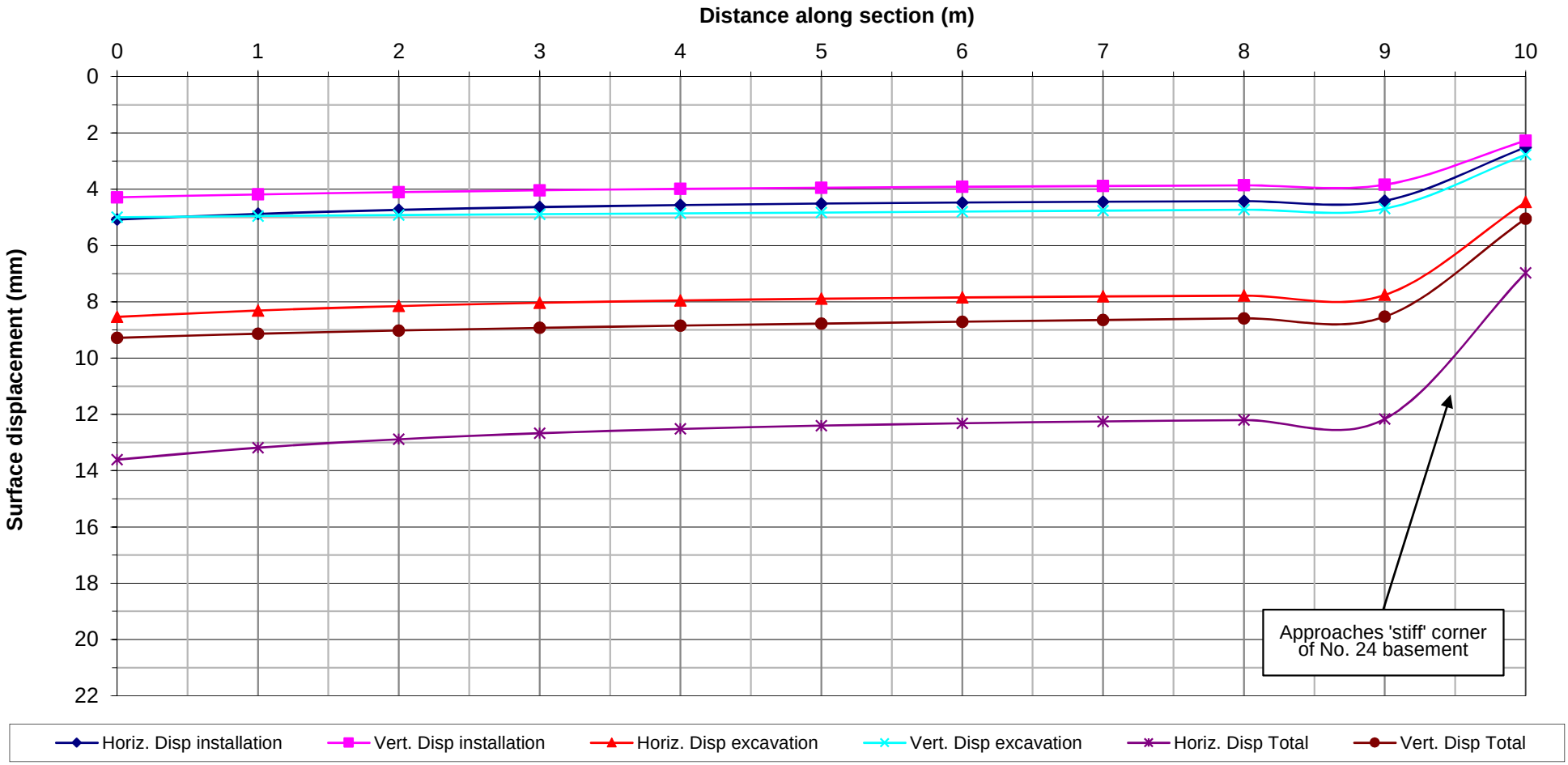

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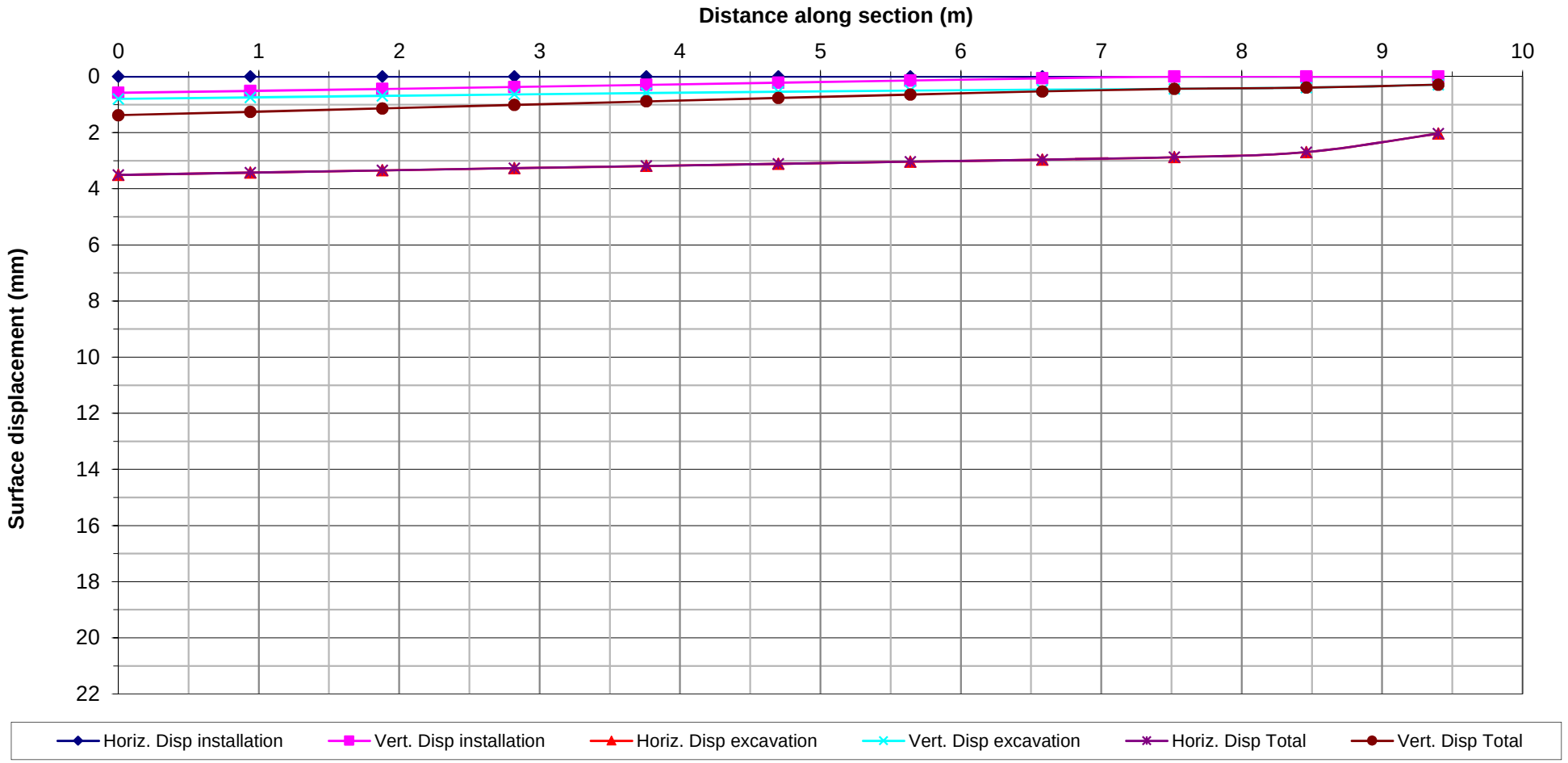

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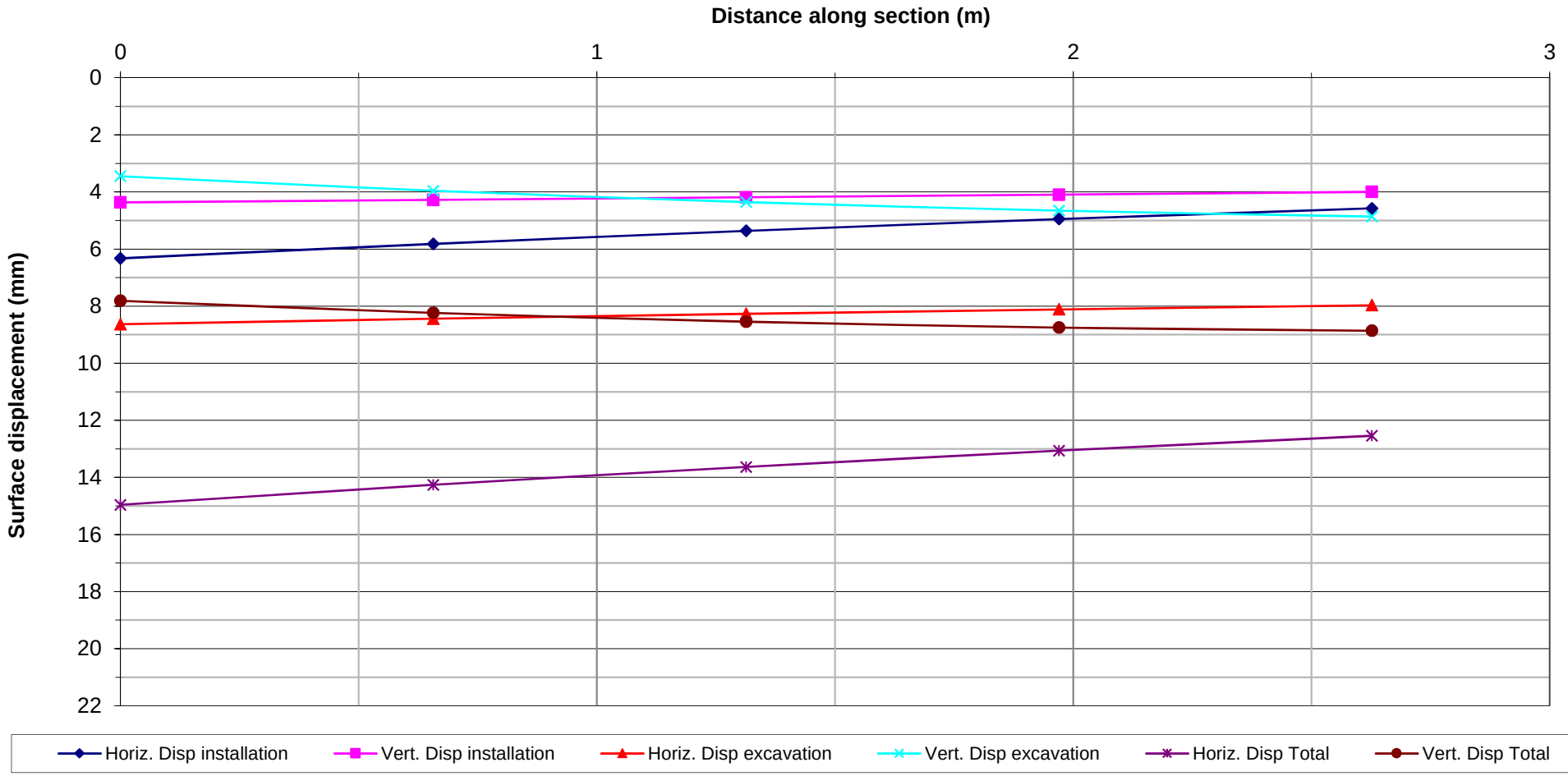

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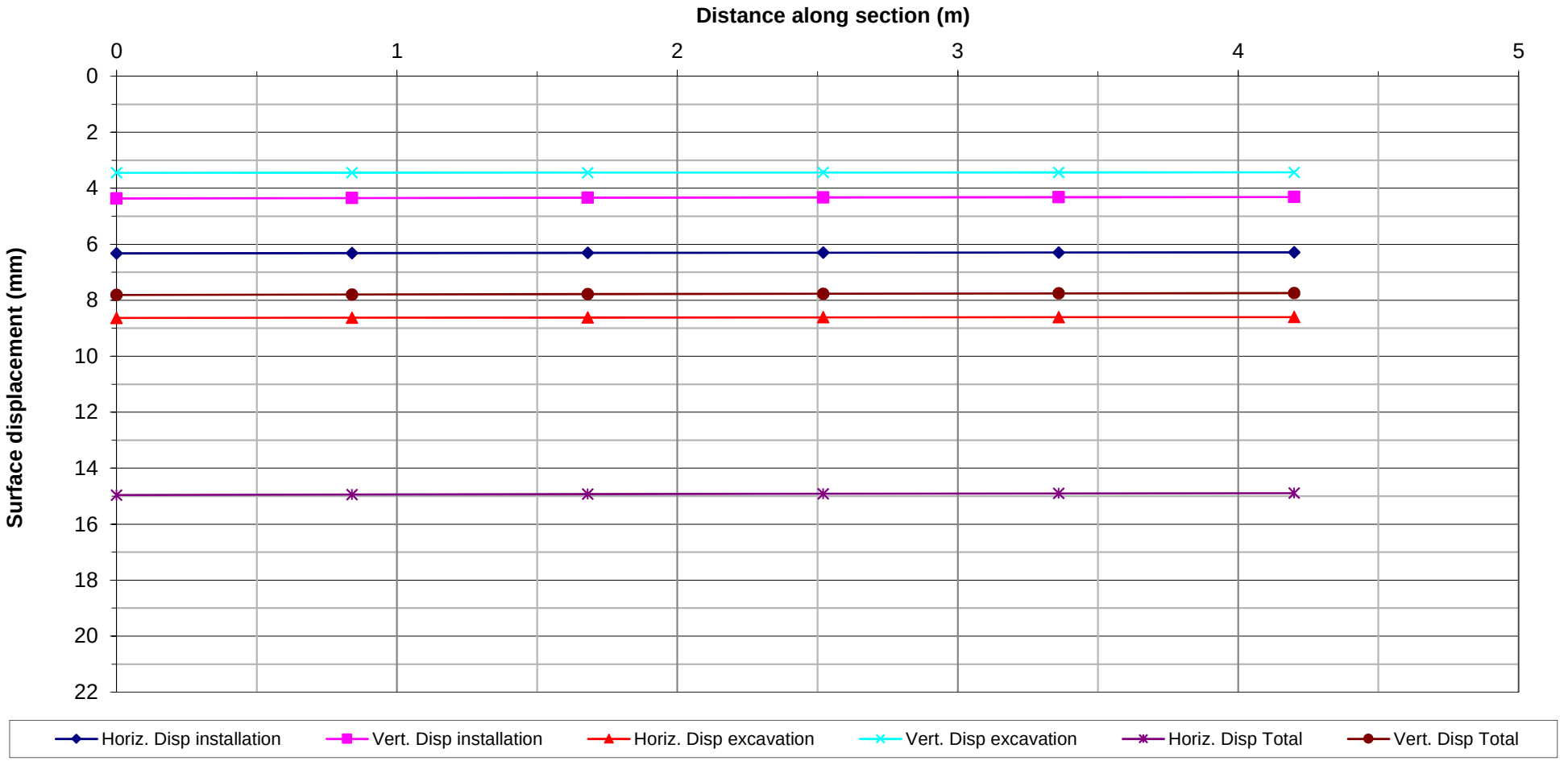

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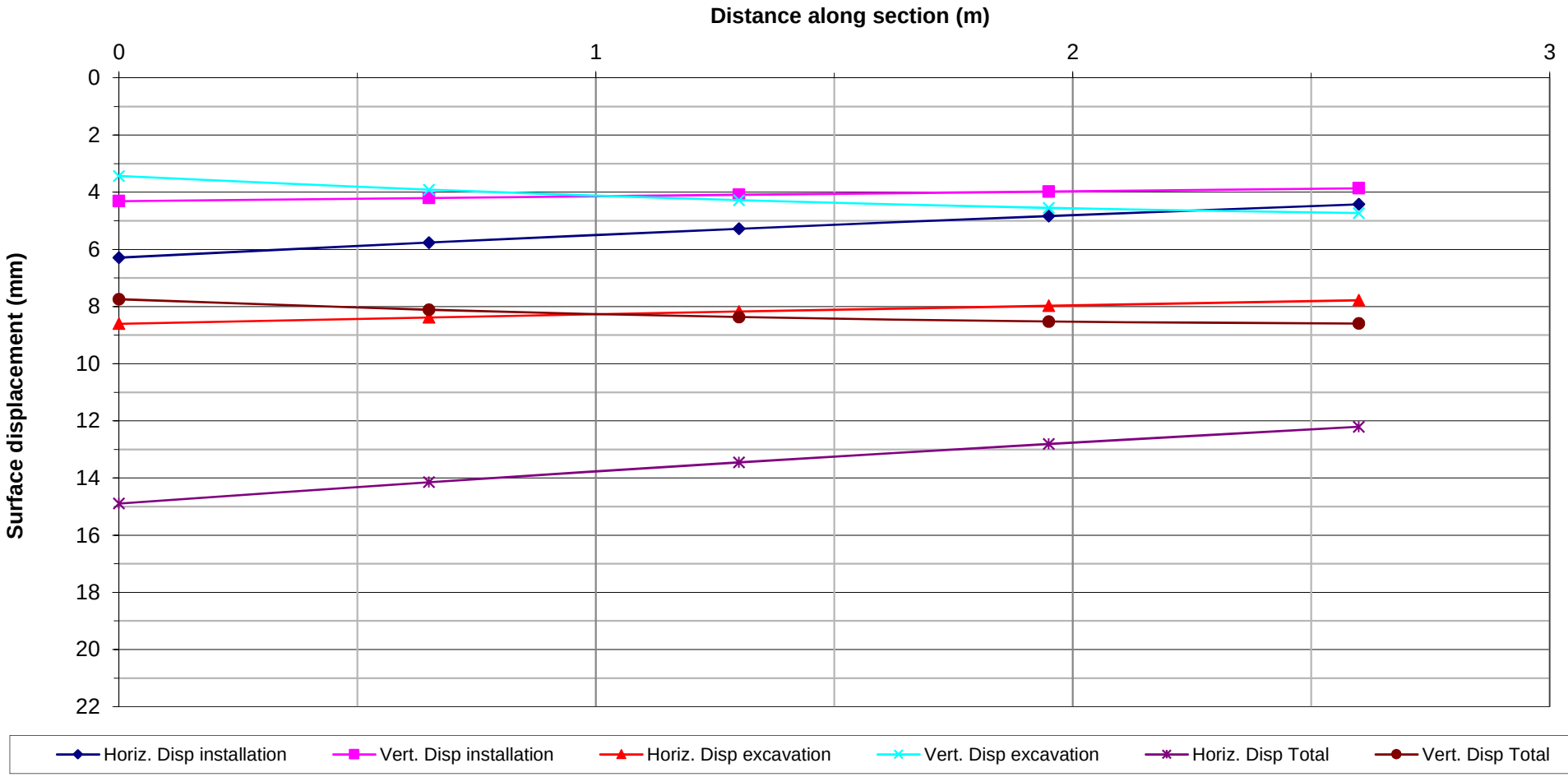

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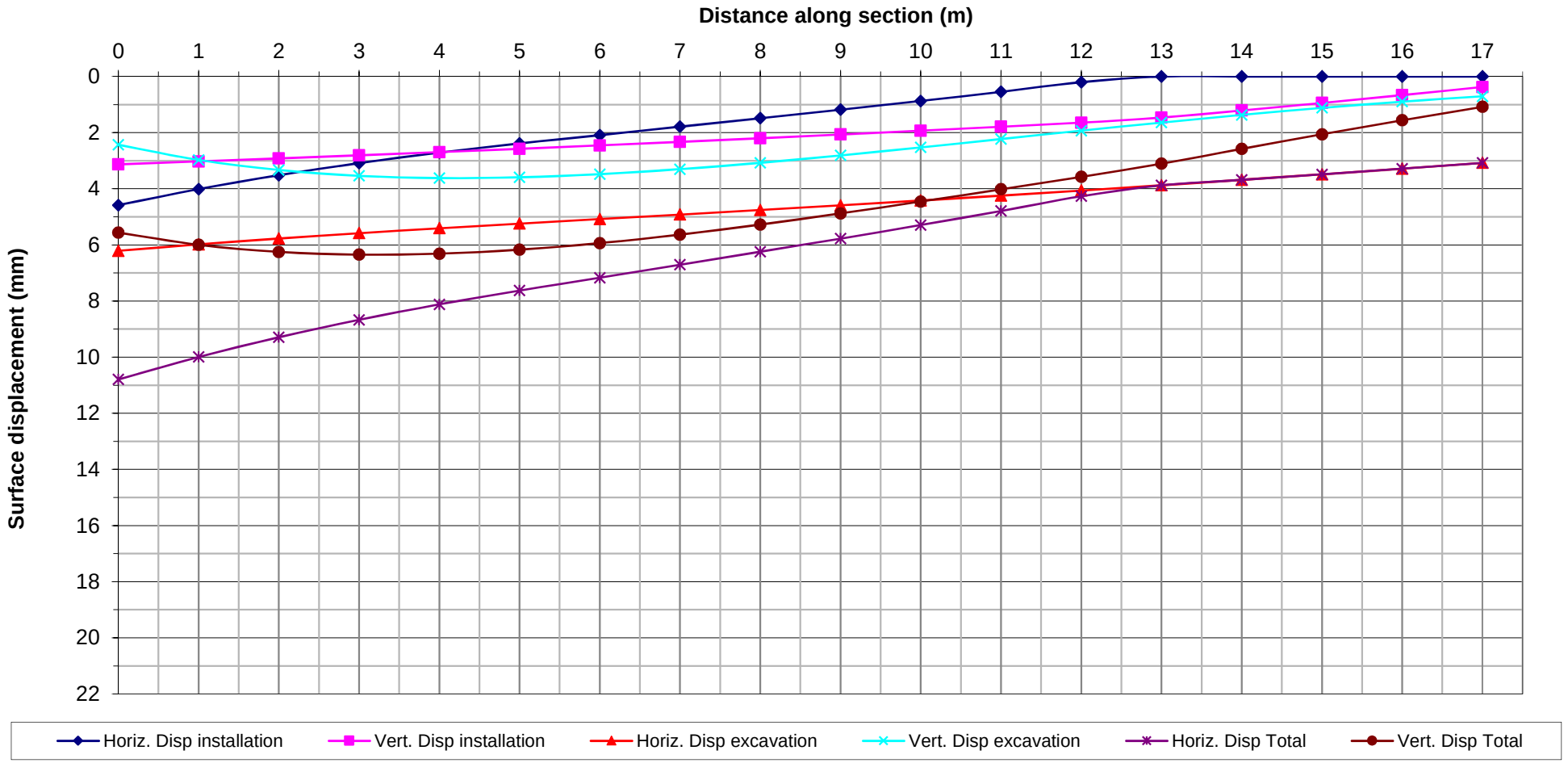

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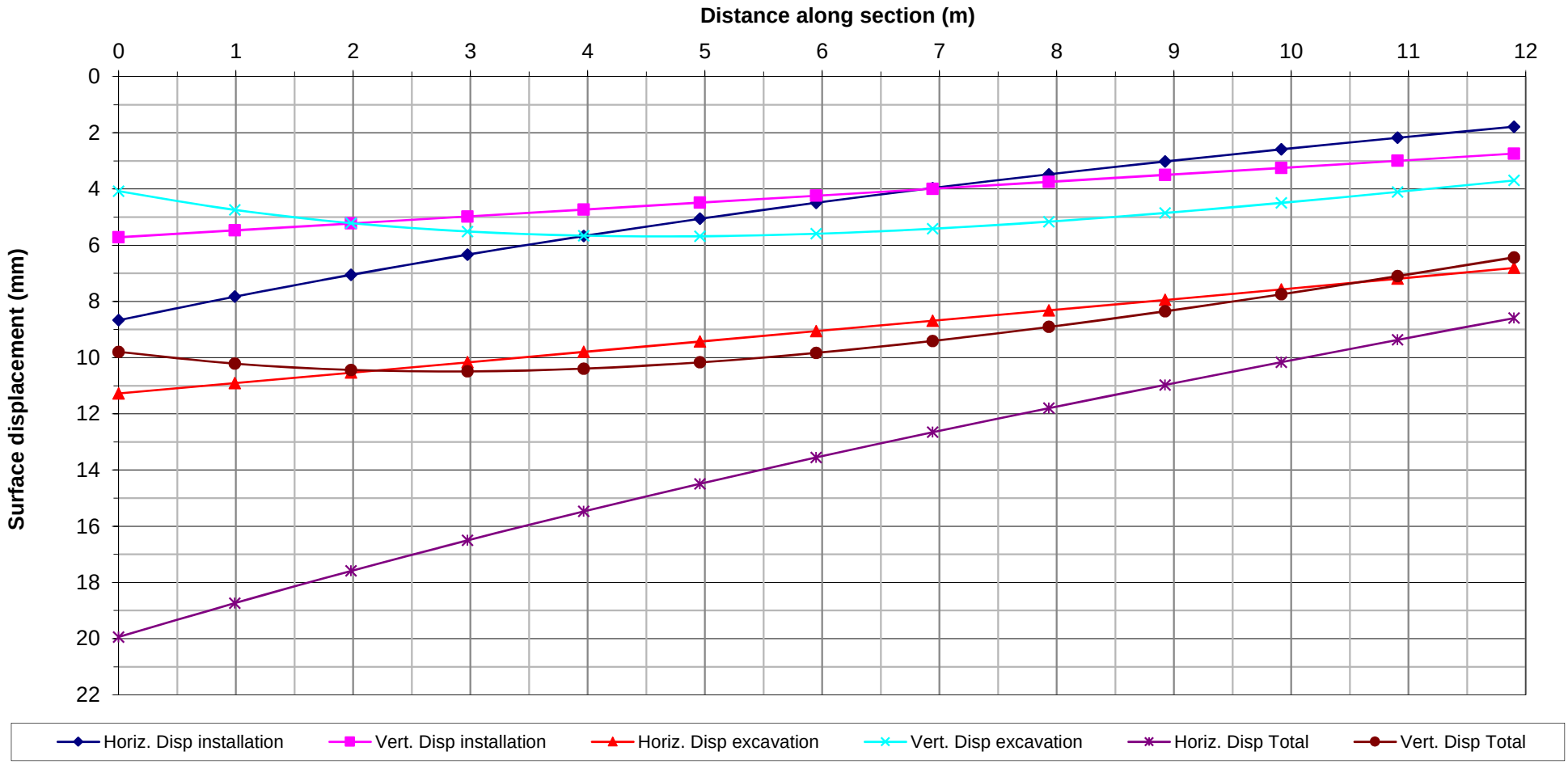

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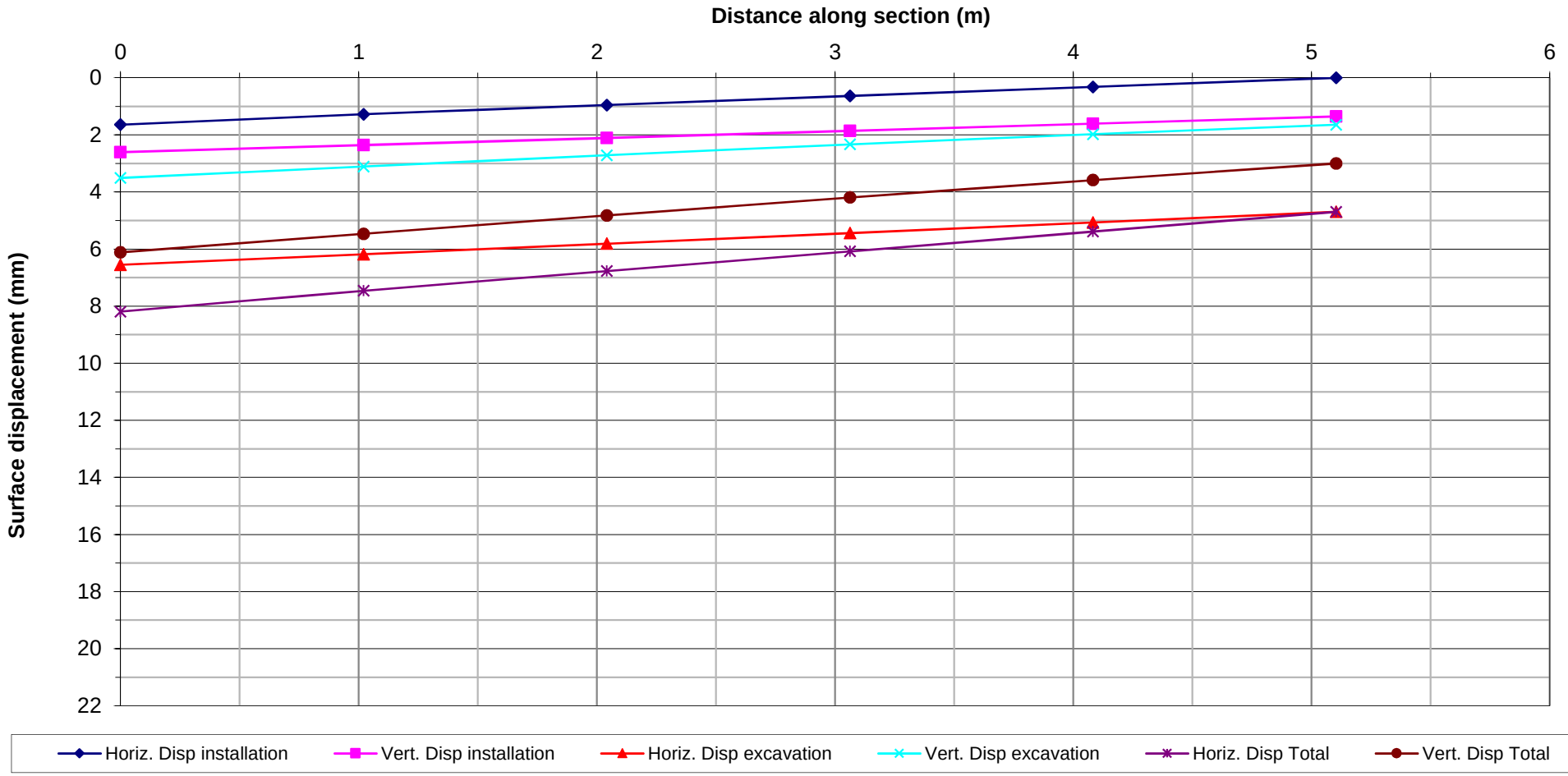

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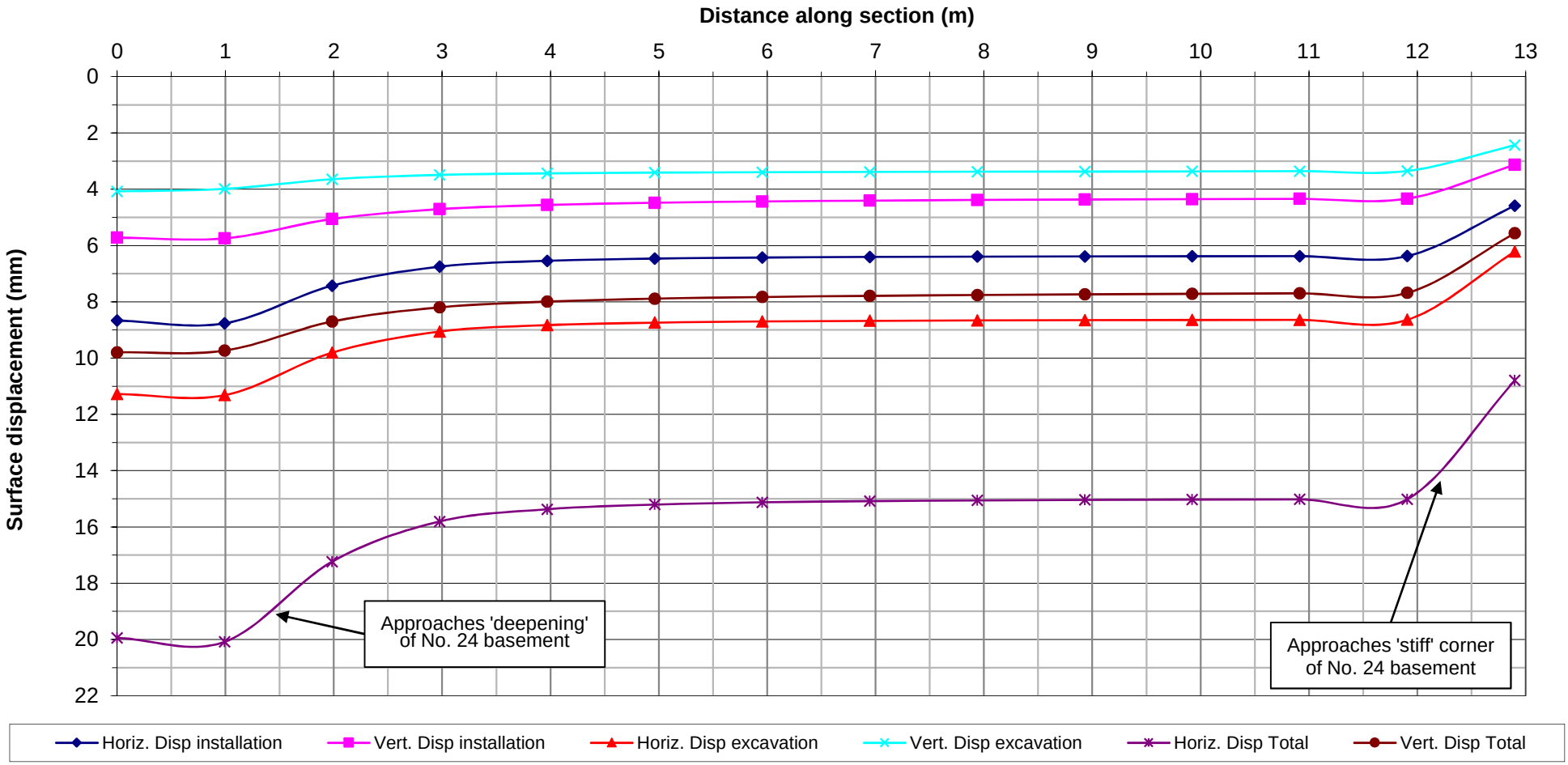

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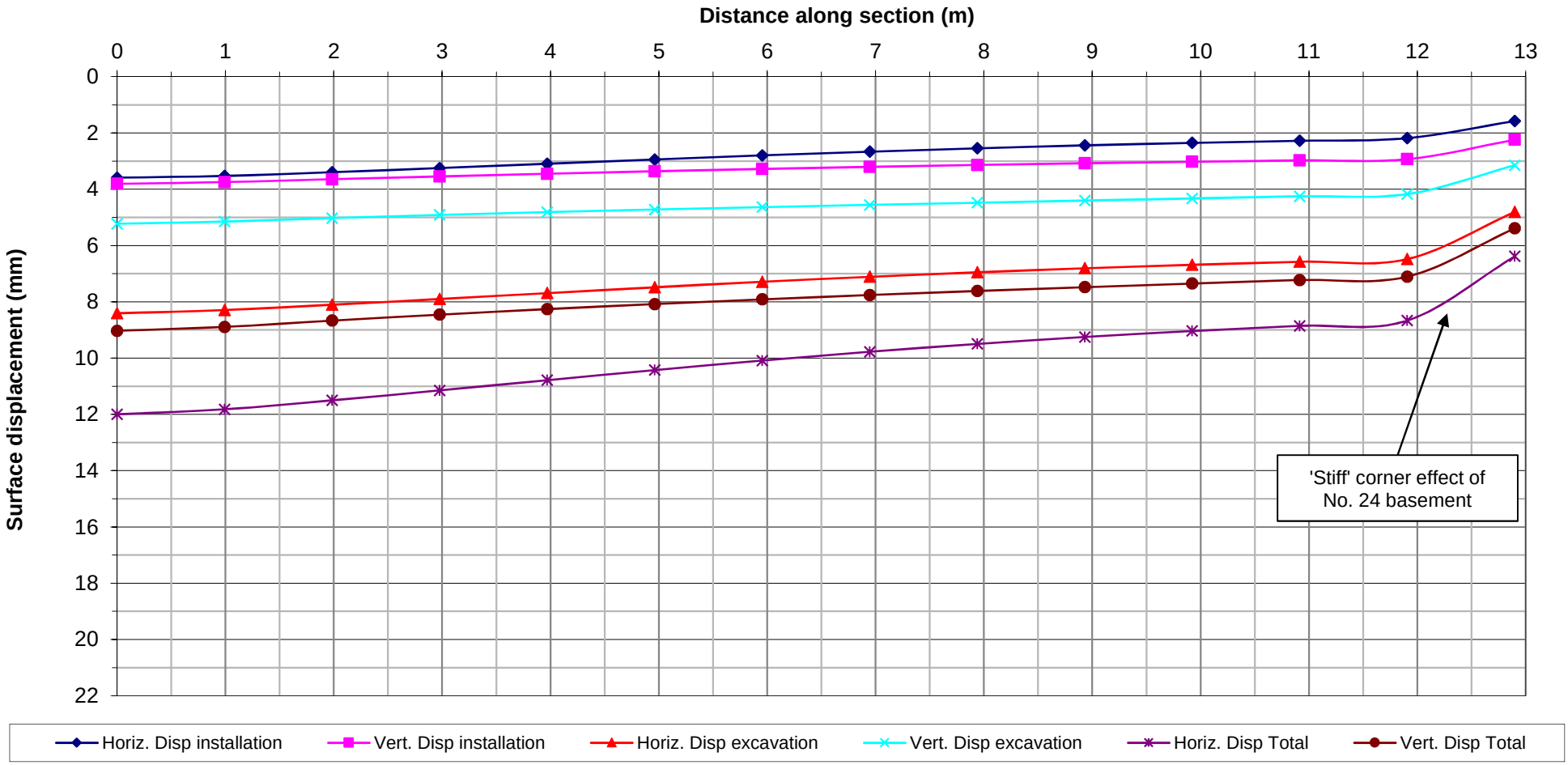

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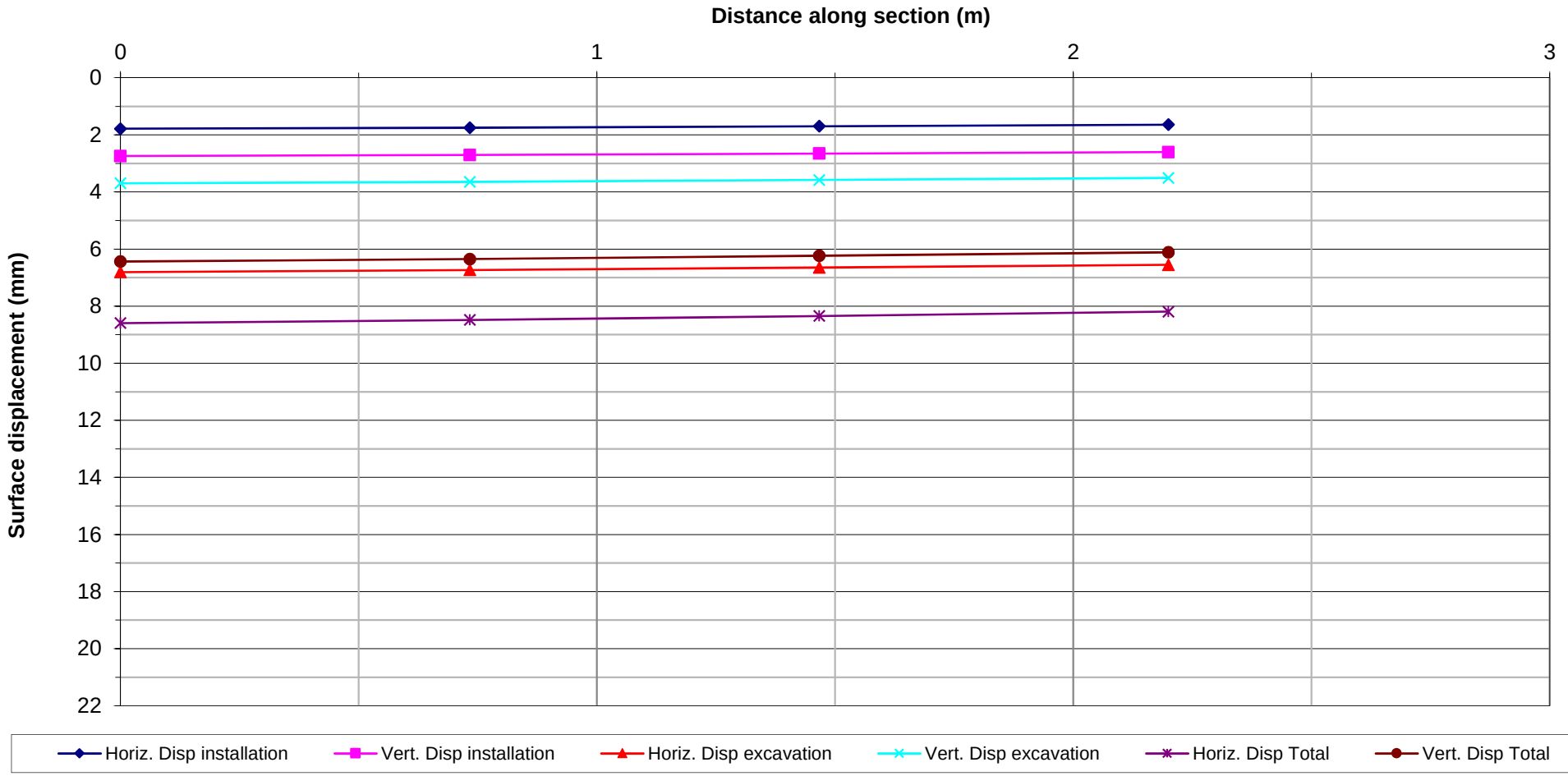

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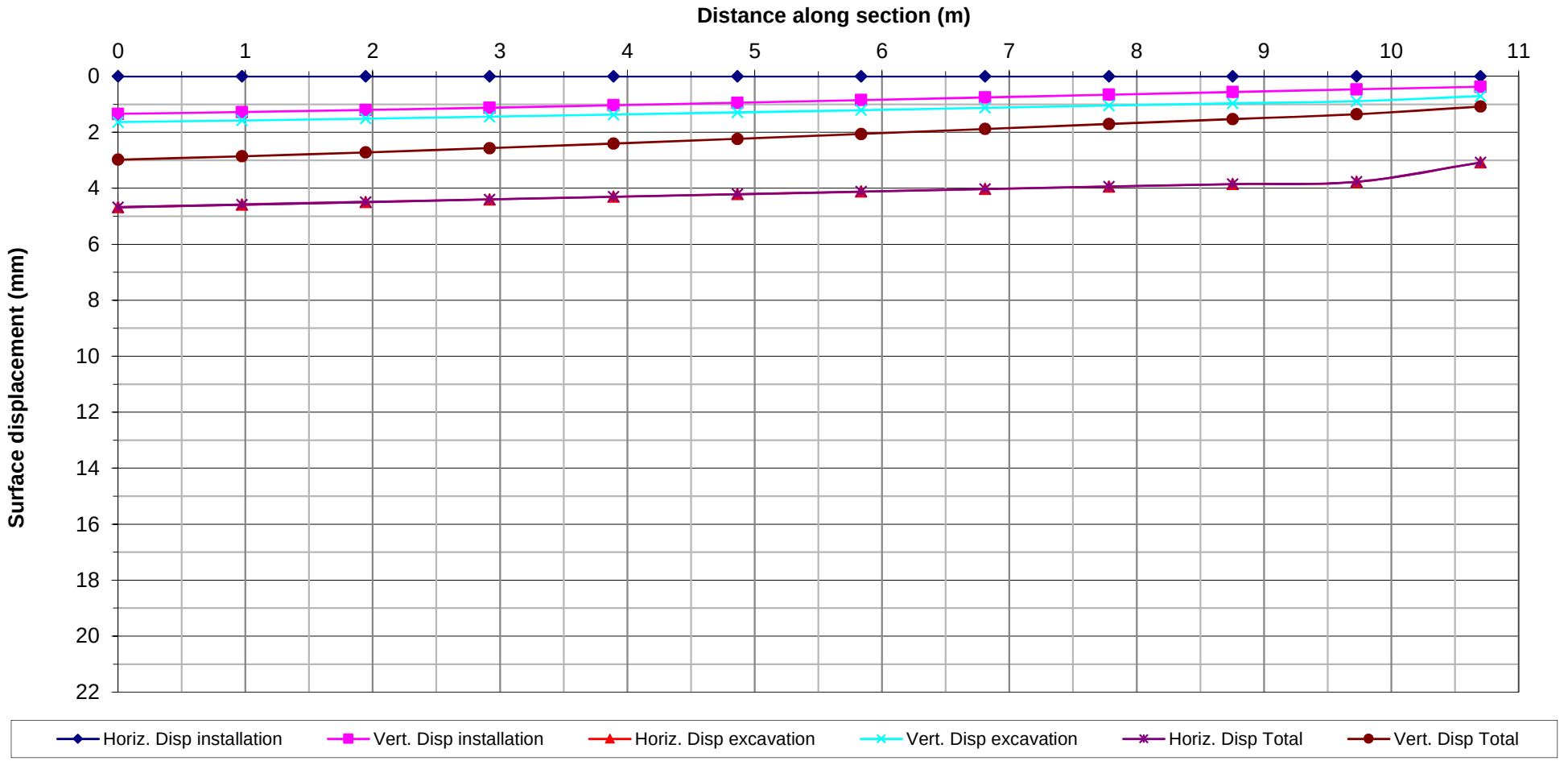

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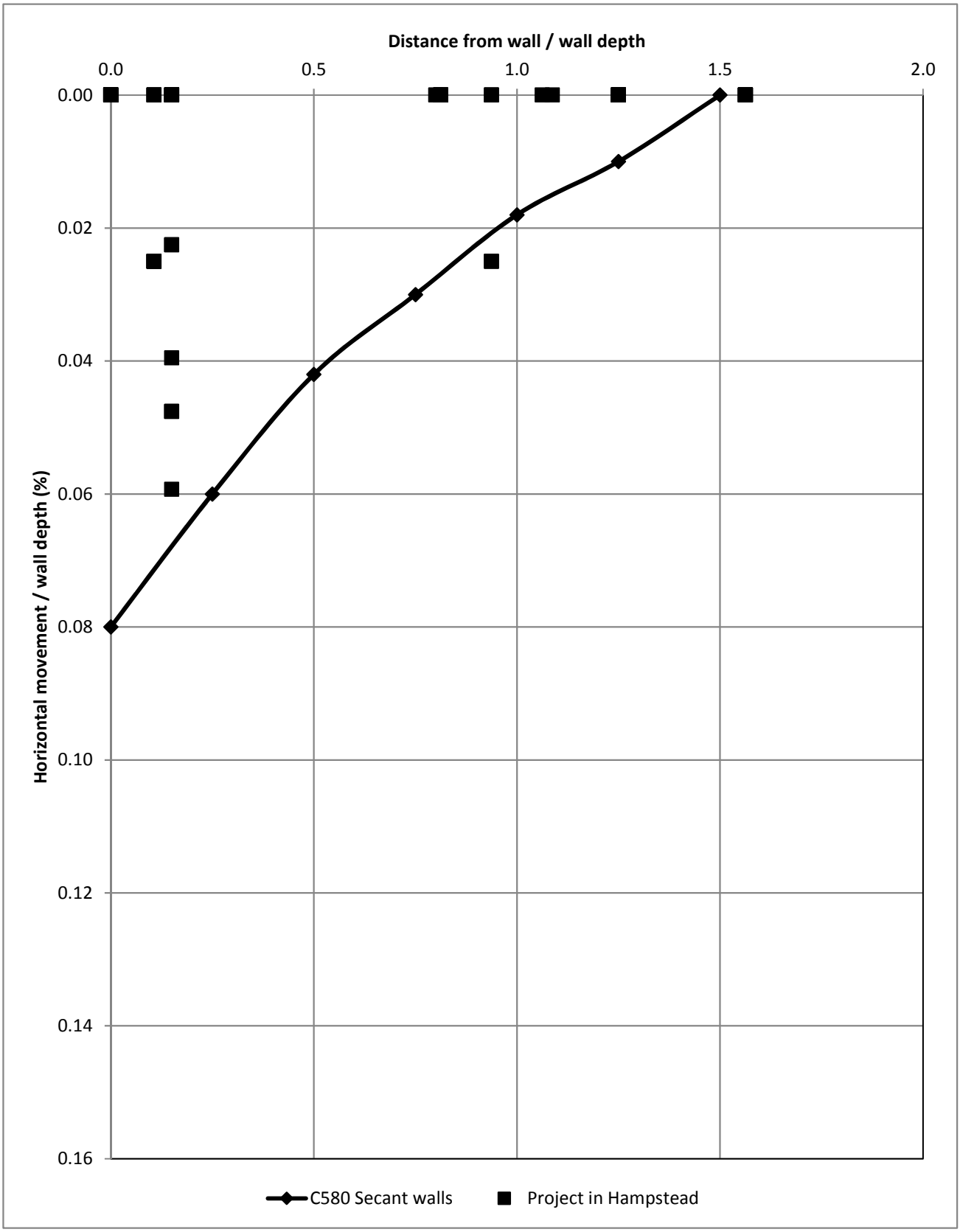

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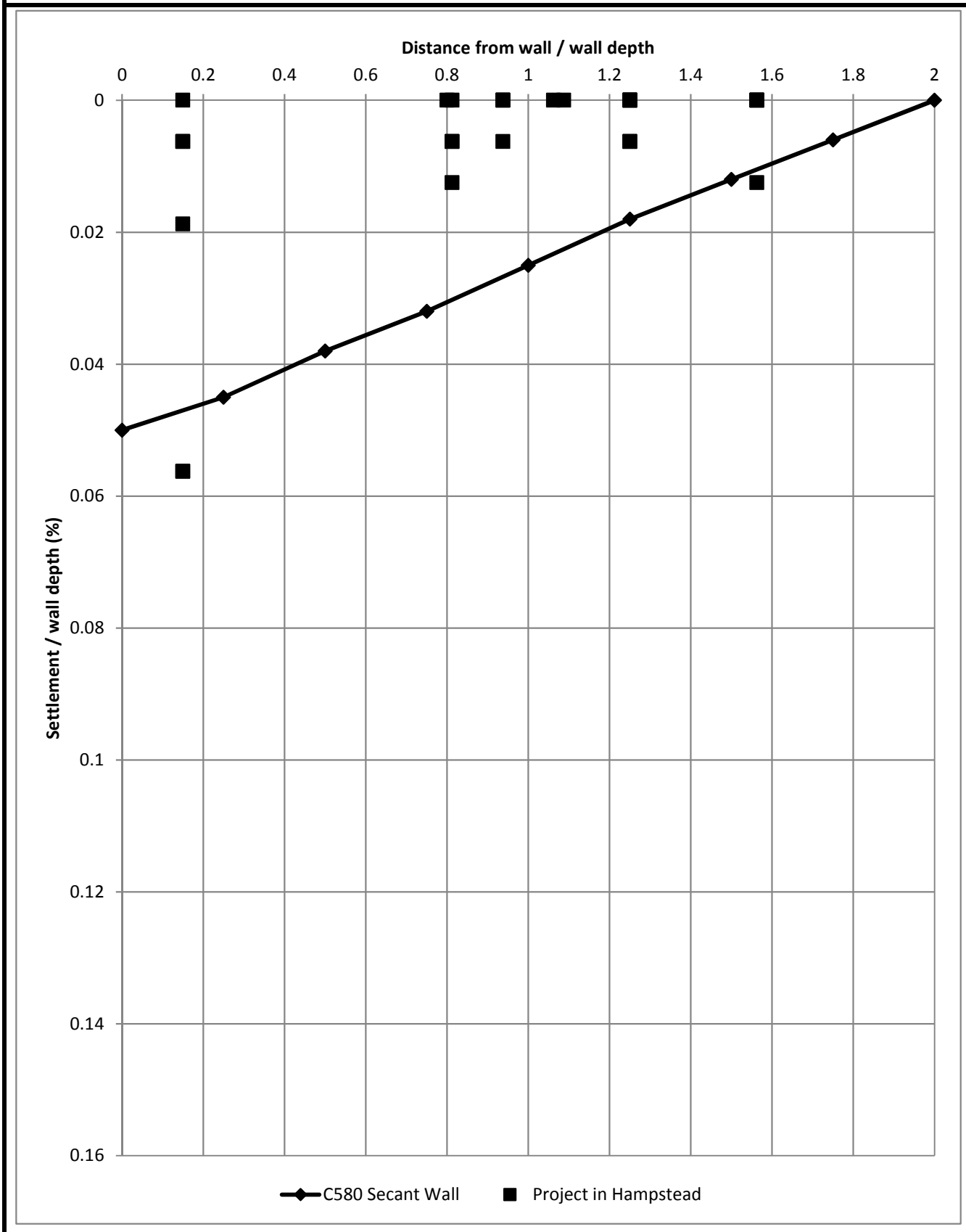
Title	Vertical ground surface movements from installation (based on C580 Fig 2.8b)



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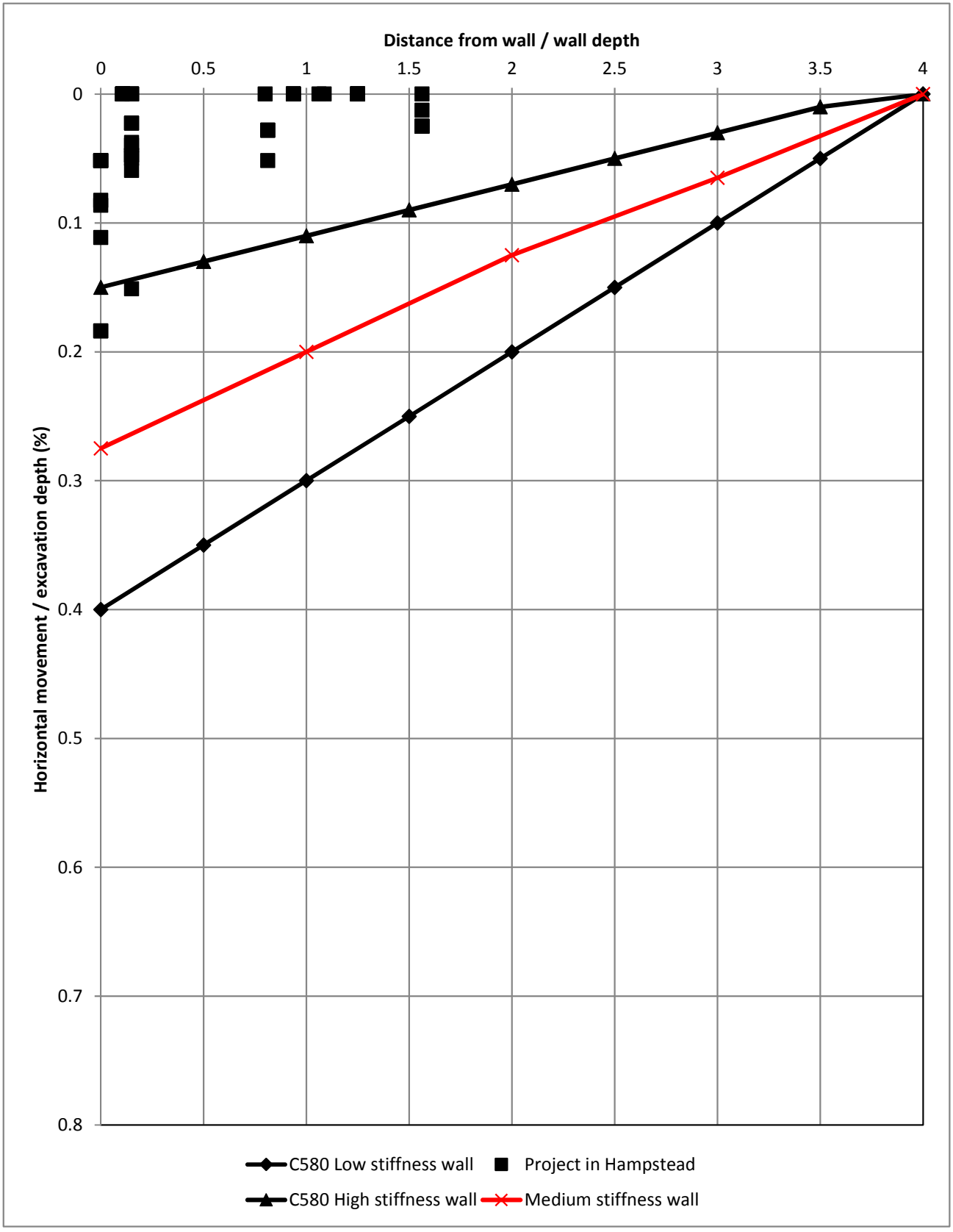
Job	24 Redington Gardens
Title	Horizontal ground surface movements from excavation (based on C580 Fig 2.11a)



REV. 0

Byland

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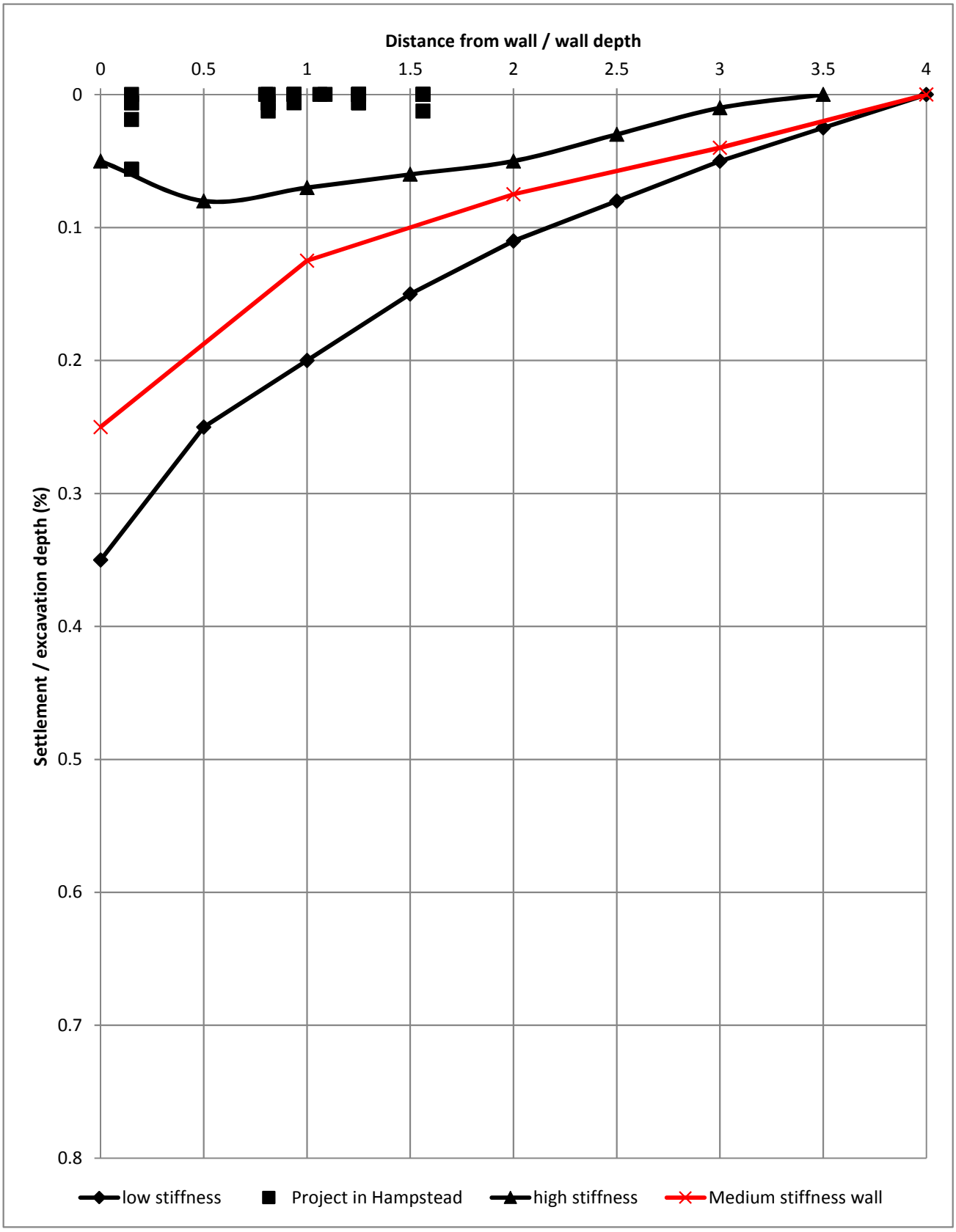
Job	24 Redington Gardens
Title	Vertical ground surface movements from excavation (based on C580 Fig 2.11b)



REV. 0

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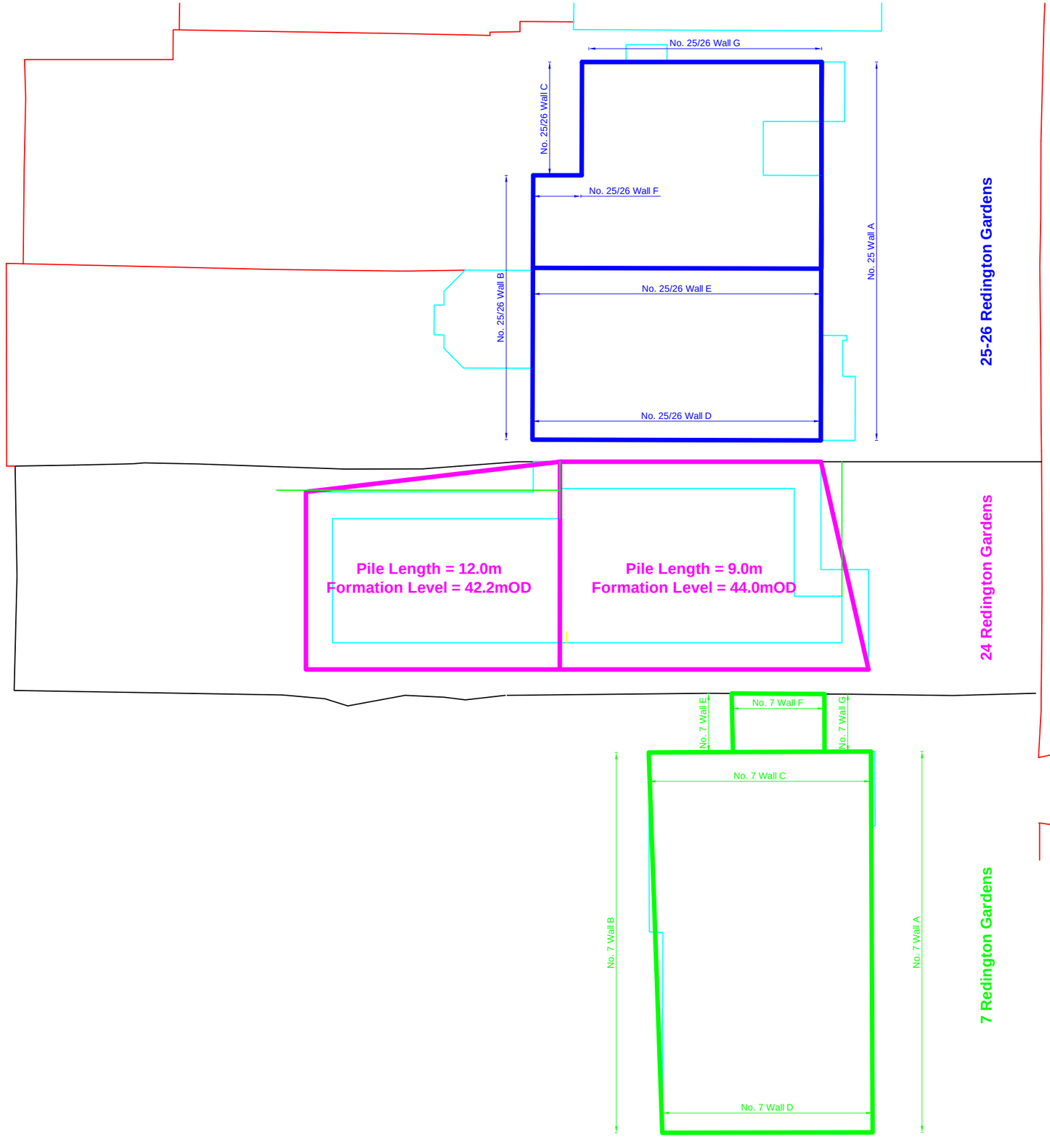
APPRVD	JAG	DATE	Nov-15

Appendices

Appendix A
Drawing 1248/001 Xdisp model plan



NOTES :

General

All dimensions mm UNO

All elevations mOD UNO

Do not scale, use figured dimensions only

REV.	AMENDMENTS	DRAWN	CHECK	DATE
-	-	-	-	-
-	-	-	-	-

Byland engineering limited

Geotechnical Design Engineers

Client:

24 Redington Gardens LLP

Project :

24 Redington Gardens

Title :

Xdisp model plan

Drawing Status :

FOR INFORMATION

	INITIALS	DATE	SCALE	DRAWING NUMBER
DRAWN	JMB	06/11/15	1:200	1248/001
CHECKED	JAG	10/11/15		
DATE : November 2015			ORIGINAL SHEET SIZE A3	REVISION : 0

Appendix B
Preliminary secant pile wall analysis – selected input & output

BYLAND ENGINEERING LIMITED | Sheet No.
Program: WALLAP Version 6.05 Revision A45.B58.R49 | Job No. 1248
Licensed from GEOSOLVE | Made by : JB
Data filename/Run ID: 1248 - 24 RG - DS-1 - C1 |
24 Redington Gardens | Date: 6-11-2015
SPW Prelim Analysis - 600 @ 800 - C1 | Checked :

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Active side	Passive side
1	50.00	1 MG	1 MG
2	48.50	2 Alluvium Drained	2 Alluvium Drained
3	47.00	3 CGM Drained	3 CGM Drained
4	45.00	5 LC Undrained	5 LC Undrained

SOIL PROPERTIES (Unfactored SLS soil strengths)

No.	Soil type Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
1	MG	17.00	12000	0.580	OC	0.351	3.253	
					(0.200)	(0.000)	(0.000)	
2	Alluvium Drained	17.00	12000	0.530	NC	0.309	3.868	0.0d
					(0.200)	(1.300)	(5.394)	
3	CGM Drained (45.00)	19.00	28800 (3000)	0.560	OC (0.200)	0.337 (1.360)	3.442 (5.007)	2.000d
4	LC Drained (45.00)	20.00	48000 (4000)	1.000	OC (0.200)	0.366 (1.423)	3.077 (4.665)	5.000d
5	LC Undrai.. (45.00)	20.00	60000 (5000)	1.000	OC (0.490)	1.000 (2.389)	1.000 (2.390)	60.00u (5.000)

Additional soil parameters associated with Ka and Kp

No.	Soil type Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	MG	25.00	0.670	0.00	25.00	0.500	0.00
2	Alluvium Drained	28.00	0.670	0.00	28.00	0.500	0.00
3	CGM Drained	26.00	0.670	0.00	26.00	0.500	0.00
4	LC Drained	24.00	0.670	0.00	24.00	0.500	0.00
5	LC Undrained	0.00	0.500	0.00	0.00	0.500	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Active side	Passive side
Initial water table elevation	49.00	49.00

Automatic water pressure balancing at toe of wall : No

Water press. profile no.	Active side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	Passive side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2
1	1	49.00	49.00	0.0	1	43.50	43.50	0.0 MC+WC

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 41.00
Maximum finite element length = 0.50 m
Youngs modulus of wall E = 2.5000E+07 kN/m2
Moment of inertia of wall I = 7.9522E-03 m4/m run
E.I = 198805 kN.m2/m run
Yield Moment of wall = Not defined

STRUTS and ANCHORS

Strut/anchor no.	Elev.	Strut spacing m	X-section area of strut sq.m	Youngs modulus kN/m2	Free length m	Inclin-ation (degs)	Pre-stress /strut kN	Tension allowed
1	49.50	6.00	0.012000	1.600E+06	0.60	0.00	0	No
	44.25	1.00	0.500000	2.000E+07	5.00	0.00	0	No
3	48.00	1.00	1.350000	2.000E+07	5.00	0.00	0	No

SURCHARGE LOADS

Surcharge no.	Elev.	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge kN/m2 Near edge	Far edge	Equiv. soil type	Partial factor/ Category
1	50.00	0.00(A)	20.00	20.00	10.00	=	N/A	1.10 Var

Note: A = Active side, P = Passive side
Limit State Categories P/U = Permanent Unfavourable
P/F = Permanent Favourable
Var = Variable (unfavourable)

CONSTRUCTION STAGES

Construction stage no.	Stage description
1	Apply surcharge no.1 at elevation 50.00
2	Excavate to elevation 49.00 on PASSIVE side
3	Install strut or anchor no.1 at elevation 49.50
4	Apply water pressure profile no.1 (Mod. Conserv.) No analysis at this stage
5	Excavate to elevation 43.50 on PASSIVE side
6	Install strut or anchor no.2 at elevation 44.25
7	Install strut or anchor no.3 at elevation 48.00
8	Remove strut or anchor no.1 at elevation 49.50
9	Change properties of soil type 5 to soil type 4 Ko pressures will not be reset

FACTORS OF SAFETY and ANALYSIS OPTIONS

Limit State options: ULS DA1 Combination 1
Water pressures : Moderately Conservative
Partial factor on C' = 1.000
Partial factor on Phi' = 1.000
Partial factor on Cu = 1.000
Partial factor on Soil Modulus = 1.000
Partial factor on Permanent Unfavourable loads = 1.000
Partial factor on Permanent Favourable loads = 1.000
Partial factor on Permanent Variable loads = 1.100
Design factor on calculated Bending Moments = 1.350

Parameters for undrained strata:
Minimum equivalent fluid density = 5.00 kN/m3
Maximum depth of water filled tension crack = 0.00 m

Bending moment and displacement calculation:
Method - Subgrade reaction model using Influence Coefficients
Open Tension Crack analysis? - No
Non-linear Modulus Parameter (L) = 0 m

Boundary conditions:
Length of wall (normal to plane of analysis) = 20.00 m

Width of excavation on active side of wall = 20.00 m
Width of excavation on passive side of wall = 20.00 m

Distance to rigid boundary on active side = 20.00 m
Distance to rigid boundary on passive side = 20.00 m

Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 20.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Active side 20.00 from wall
Passive side 20.00 from wall

Limit State: ULS DA1 Combination 1

Calculated Bending Moments and Strut Forces have been multiplied by a factor of 1.35 to obtain values for structural design.

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement max.	Displacement min.	Bending moment Calculated max.	Bending moment Calculated min.	Bending moment Factored max.	Bending moment Factored min.	Shear force Calculated max.	Shear force Calculated min.	Shear force Factored max.	Shear force Factored min.
		m	m	kN.m/m		kN.m/m		kN/m	kN/m	kN/m	kN/m
1	50.00	0.021	0.000	0	0	0	0	0	0	0	0
2	49.50	0.020	0.000	1	0	1	0	3	-75	4	-101
3	49.00	0.019	0.000	3	-36	4	-48	7	-71	9	-95
4	48.50	0.018	0.000	8	-70	11	-94	13	-64	18	-87
5	48.00	0.017	0.000	17	-100	23	-135	22	-88	30	-119
6	47.50	0.017	0.000	16	-125	21	-168	8	-76	11	-103
7	47.00	0.016	0.000	20	-143	27	-193	9	-61	12	-82
8	46.50	0.016	0.000	23	-153	31	-206	4	-42	6	-57
9	46.00	0.015	0.000	24	-153	33	-207	14	-20	19	-27
10	45.50	0.014	0.000	24	-143	32	-193	40	-2	54	-3
11	45.00	0.012	0.000	22	-120	30	-162	69	-5	93	-6
12	44.63	0.011	0.000	35	-95	47	-129	90	-6	121	-8
13	44.25	0.010	0.000	73	-67	98	-91	113	-96	153	-130
14	43.88	0.010	0.000	41	-35	55	-47	92	-71	124	-96
15	43.50	0.009	0.000	21	-0	29	-0	104	-44	140	-59
16	43.00	0.008	0.000	39	0	53	0	43	-22	59	-29
17	42.50	0.007	0.000	53	0	71	0	0	-9	0	-12
18	42.00	0.007	0.000	37	0	50	0	3	-39	4	-53
19	41.50	0.006	0.000	14	0	19	0	5	-37	7	-50
20	41.00	0.005	0.000	0	-0	0	-0	0	-0	0	-0

Maximum and minimum bending moment and shear force at each stage

Stage no.	Bending moment Calculated max.	elev.	min.	elev.	Bending moment Factored max.	min.	Shear force Calculated max.	elev.	min.	elev.	Shear force Factored max.	min.
	kN.m/m		kN.m/m		kN.m/m		kN/m		kN/m		kN/m	kN/m
1	6	45.50	0	50.00	8	0	4	47.00	-2	43.50	5	-3
2	24	46.00	-0	41.00	33	-0	9	48.50	-8	43.88	12	-10
3	No calculation at this stage											
4	No calculation at this stage											
5	53	42.50	-153	46.00	71	-207	104	43.50	-75	49.50	140	-101
6	No calculation at this stage											
7	No calculation at this stage											
8	44	42.50	-104	45.50	60	-141	90	43.50	-88	48.00	121	-119
9	73	44.25	-36	46.50	98	-49	113	44.25	-96	44.25	153	-130

Summary of results (continued)

Maximum and minimum displacement at each stage

Stage no.	Displacement maximum	elev.	Displacement minimum	elev.	Stage description
	m		m		
1	0.001	50.00	0.000	50.00	Apply surcharge no.1 at elev. 50.00
2	0.004	50.00	0.000	50.00	Excav. to elev. 49.00 on PASSIVE side
3	No calculation at this stage				Install strut no.1 at elev. 49.50
4	No calculation at this stage				Apply water pressure profile no.1
5	0.018	50.00	0.000	50.00	Excav. to elev. 43.50 on PASSIVE side
6	No calculation at this stage				Install strut no.2 at elev. 44.25
7	No calculation at this stage				Install strut no.3 at elev. 48.00
8	0.020	50.00	0.000	50.00	Remove strut no.1 at elev. 49.50
9	0.021	50.00	0.000	50.00	Change soil type 5 to soil type 4

Strut forces at each stage (horizontal components)

Stage no.	Strut no. 1 at elev. 49.50 Calculated kN per m run	Strut no. 1 Factored kN per strut	Strut no. 2 at elev. 44.25 Calculated kN per m run	Strut no. 2 Factored kN per strut	Strut no. 3 at elev. 48.00 Calculated kN per m run	Strut no. 3 Factored kN per strut
5	78	465	628	---	---	---	---	---	---	---
8	---	---	---	slack	slack	slack	110	110	149
9	---	---	---	210	210	283	78	78	106

* Indicates that the total force shown is the sum of the force in the strut plus a force applied at the same elevation which may represent temperature load or other forces which are part of the strut load. Force components are listed in the detailed results for individual stages.

BYLAND ENGINEERING LIMITED | Sheet No.
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Data filename/Run ID: 1248 - 24 RG - DS-1 - C2 |
24 Redington Gardens | Date: 6-11-2015
SPW Prelim Analysis - 600 @ 800 - C2 | Checked :

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Active side	Passive side
1	50.00	1 MG	1 MG
2	48.50	2 Alluvium Drained	2 Alluvium Drained
3	47.00	3 CGM Drained	3 CGM Drained
4	45.00	5 LC Undrained	5 LC Undrained

SOIL PROPERTIES (Unfactored SLS soil strengths)

No.	Soil type Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
1	MG	17.00	12000	0.580	OC	0.351	3.253	
					(0.200)	(0.000)	(0.000)	
2	Alluvium Drained	17.00	12000	0.530	NC	0.309	3.868	0.0d
					(0.200)	(1.300)	(5.394)	
3	CGM Drained (45.00)	19.00	28800 (3000)	0.560	OC (0.200)	0.337 (1.360)	3.442 (5.007)	2.000d
4	LC Drained (45.00)	20.00	48000 (4000)	1.000	OC (0.200)	0.366 (1.423)	3.077 (4.665)	5.000d
5	LC Undrai.. (45.00)	20.00	60000 (5000)	1.000	OC (0.490)	1.000 (2.389)	1.000 (2.390)	60.00u (5.000)

Additional soil parameters associated with Ka and Kp

No.	Soil type Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	MG	25.00	0.670	0.00	25.00	0.500	0.00
2	Alluvium Drained	28.00	0.670	0.00	28.00	0.500	0.00
3	CGM Drained	26.00	0.670	0.00	26.00	0.500	0.00
4	LC Drained	24.00	0.670	0.00	24.00	0.500	0.00
5	LC Undrained	0.00	0.500	0.00	0.00	0.500	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Active side	Passive side
Initial water table elevation	49.00	49.00

Automatic water pressure balancing at toe of wall : No

Water press. profile no.	Active side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	Passive side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2
1	1	49.00	49.00	0.0	1	43.50	43.50	0.0 MC+WC

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 41.00
Maximum finite element length = 0.50 m
Youngs modulus of wall E = 2.5000E+07 kN/m2
Moment of inertia of wall I = 7.9522E-03 m4/m run
E.I = 198805 kN.m2/m run
Yield Moment of wall = Not defined

STRUTS and ANCHORS

Strut/ anchor	Strut m	X-section area t sq.m	Youngs modulus kN/m2	Free length m	Inclin -ation (degs)	Pre-stress /strut kN	Tension allowed
1	49.50	6.00	0.012000	1.600E+06	0.60	0.00	0 No
2	44.25	1.00	0.500000	2.000E+07	5.00	0.00	0 No
3	48.00	1.00	1.350000	2.000E+07	5.00	0.00	0 No

SURCHARGE LOADS

Surch -arge no.	Elev.	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge kN/m2 Near edge	Far edge	Equiv. soil type	Partial factor/ Category
1	50.00	0.00(A)	20.00	20.00	10.00	=	N/A	1.30 Var

Note: A = Active side, P = Passive side
Limit State Categories P/U = Permanent Unfavourable
P/F = Permanent Favourable
Var = Variable (unfavourable)

CONSTRUCTION STAGES

Construction stage no.	Stage description
1	Apply surcharge no.1 at elevation 50.00
2	Excavate to elevation 49.00 on PASSIVE side
3	Install strut or anchor no.1 at elevation 49.50
4	Apply water pressure profile no.1 (Worst Cred.) No analysis at this stage
5	Excavate to elevation 43.50 on PASSIVE side
6	Install strut or anchor no.2 at elevation 44.25
7	Install strut or anchor no.3 at elevation 48.00
8	Remove strut or anchor no.1 at elevation 49.50
9	Change properties of soil type 5 to soil type 4 Ko pressures will not be reset

FACTORS OF SAFETY and ANALYSIS OPTIONS

Limit State options: ULS DA1 Combination 2
Water pressures : Worst Credible
Partial factor on C' = 1.250
Partial factor on Phi' = 1.250
Partial factor on Cu = 1.400
Partial factor on Soil Modulus = 1.000
Partial factor on Permanent Unfavourable loads = 1.000
Partial factor on Permanent Favourable loads = 1.000
Partial factor on Permanent Variable loads = 1.300

Stability analysis:
Method of analysis - Strength Factor method
Overall factor on soil strength for calculating wall depth = 1.00

Parameters for undrained strata:
Minimum equivalent fluid density = 5.00 kN/m3
Maximum depth of water filled tension crack = 0.00 m

Bending moment and displacement calculation:
Method - Subgrade reaction model using Influence Coefficients
Open Tension Crack analysis? - No
Non-linear Modulus Parameter (L) = 0 m

Boundary conditions:
Length of wall (normal to plane of analysis) = 20.00 m

Width of excavation on active side of wall = 20.00 m
Width of excavation on passive side of wall = 20.00 m

Distance to rigid boundary on active side = 20.00 m
Distance to rigid boundary on passive side = 20.00 m

Units: kN,m

Summary of results

LIMIT STATE PARAMETERS

Limit State: ULS DA1 Combination 2
Water pressures : Worst Credible
Partial factor on C' = 1.250
Partial factor on Phi' = 1.250
Partial factor on Cu = 1.400
Partial factor on Soil Modulus = 1.000
Partial factor on Permanent Unfavourable loads = 1.000
Partial factor on Permanent Favourable loads = 1.000
Partial factor on Permanent Variable loads = 1.300

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method

Factor of safety on soil strength

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	Overall FoS for toe elev. = 41.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation
1	50.00	50.00	Cant.	Conditions not suitable for FoS calc.			
2	50.00	49.00	Cant.	2.400	42.12	45.64	3.36
3	50.00	49.00		No analysis at this stage			
4	50.00	49.00		No analysis at this stage			
5	50.00	43.50	49.50	1.440	n/a	42.44	1.06
6	50.00	43.50		No analysis at this stage			

All remaining stages have more than one strut - FoS calculation n/a

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Data filename/Run ID: 1248 - 24 RG - DS-1 - C2 |
24 Redington Gardens | Date: 6-11-2015
SPW Prelim Analysis - 600 @ 800 - C2 | Checked :

Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 20.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Active side 20.00 from wall
Passive side 20.00 from wall

Limit State: ULS DA1 Combination 2

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement maximum m	Displacement minimum m	Bending moment maximum kN.m/m	Bending moment minimum kN.m/m	Shear force maximum kN/m	Shear force minimum kN/m
1	50.00	0.027	0.000	0.0	-0.0	0.0	0.0
2	49.50	0.026	0.000	1.0	0.0	3.7	-91.9
3	49.00	0.024	0.000	4.1	-43.7	9.1	-86.4
4	48.50	0.023	0.000	10.5	-85.1	17.1	-78.4
5	48.00	0.022	0.000	21.8	-121.6	27.6	-108.2
6	47.50	0.022	0.000	23.5	-152.4	12.4	-94.4
7	47.00	0.021	0.000	29.6	-175.4	11.6	-77.0
8	46.50	0.020	0.000	34.2	-189.5	18.9	-56.0
9	46.00	0.019	0.000	36.6	-193.0	46.0	-31.1
10	45.50	0.018	0.000	50.1	-184.2	76.7	-2.8
11	45.00	0.016	0.000	97.0	-161.2	110.1	-5.0
12	44.63	0.015	0.000	142.6	-136.7	133.8	-8.5
13	44.25	0.014	0.000	197.5	-108.4	159.6	-159.5
14	43.88	0.013	0.000	142.8	-76.0	92.1	-131.7
15	43.50	0.013	0.000	98.9	-43.7	103.9	-101.9
16	43.00	0.012	0.000	59.8	-4.1	60.1	-71.4
17	42.50	0.012	0.000	30.1	0.0	20.2	-45.9
18	42.00	0.012	0.000	23.1	0.0	0.0	-25.6
19	41.50	0.012	0.000	12.9	0.0	0.0	-27.8
20	41.00	0.011	0.000	0.0	0.0	0.0	-0.0

Maximum and minimum bending moment and shear force at each stage

Stage no.	Bending moment maximum kN.m/m	elev.	Bending moment minimum kN.m/m	elev.	Shear force maximum kN/m	elev.	Shear force minimum kN/m	elev.
1	10.1	45.50	0.0	50.00	4.9	47.00	-3.3	43.50
2	36.9	45.50	-0.0	50.00	13.7	48.50	-12.3	43.50
3	No calculation at this stage							
4	No calculation at this stage							
5	23.8	42.50	-193.0	46.00	103.9	43.50	-91.9	49.50
6	No calculation at this stage							
7	No calculation at this stage							
8	21.8	48.00	-136.2	45.50	86.6	43.50	-108.2	48.00
9	197.5	44.25	0.0	50.00	159.6	44.25	-159.5	44.25

Summary of results (continued)

Maximum and minimum displacement at each stage

Stage no.	Displacement maximum m	elev.	minimum m	elev.	Stage description
1	0.002	50.00	0.000	50.00	Apply surcharge no.1 at elev. 50.00
2	0.005	50.00	0.000	50.00	Excav. to elev. 49.00 on PASSIVE side
3	No calculation at this stage				Install strut no.1 at elev. 49.50
4	No calculation at this stage				Apply water pressure profile no.1
5	0.023	50.00	0.000	50.00	Excav. to elev. 43.50 on PASSIVE side
6	No calculation at this stage				Install strut no.2 at elev. 44.25
7	No calculation at this stage				Install strut no.3 at elev. 48.00
8	0.026	50.00	0.000	50.00	Remove strut no.1 at elev. 49.50
9	0.027	50.00	0.000	50.00	Change soil type 5 to soil type 4

Strut forces at each stage (horizontal components)

Stage no.	Strut no. 1 at elev. 49.50 kN/m run	Strut no. 1 kN/strut	Strut no. 2 at elev. 44.25 kN/m run	Strut no. 2 kN/strut	Strut no. 3 at elev. 48.00 kN/m run	Strut no. 3 kN/strut
5	95.58	573.49	---	---	---	---
8	---	---	slack	slack	135.85	135.85
9	---	---	319.14	319.14	63.79	63.79

* Indicates that the total force shown is the sum of the force in the strut plus a force applied at the same elevation which may represent temperature load or other forces which are part of the strut load. Force components are listed in the detailed results for individual stages.

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Program: WALLAP Version 6.05 Revision A45.B58.R49 | Job No. 1248
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Data filename/Run ID: 1248 - 24 RG - DS-1 - SLS |
24 Redington Gardens | Date: 6-11-2015
SPW Prelim Analysis - 600 @ 800 - SLS | Checked :

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Active side	Passive side
1	50.00	1 MG	1 MG
2	48.50	2 Alluvium Drained	2 Alluvium Drained
3	47.00	3 CGM Drained	3 CGM Drained
4	45.00	5 LC Undrained	5 LC Undrained

SOIL PROPERTIES

-- Soil type -- No.	Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
1	MG	17.00	12000	0.580	OC	0.351	3.253	
					(0.200)	(0.000)	(0.000)	
2	Alluvium Drained	17.00	12000	0.530	NC	0.309	3.868	0.0d
					(0.200)	(1.300)	(5.394)	
3	CGM Drained (45.00)	19.00	28800 (3000)	0.560	OC (0.200)	0.337 (1.360)	3.442 (5.007)	2.000d
4	LC Drained (45.00)	20.00	48000 (4000)	1.000	OC (0.200)	0.366 (1.423)	3.077 (4.665)	5.000d
5	LC Undrai.. (45.00)	20.00	60000 (5000)	1.000	OC (0.490)	1.000 (2.389)	1.000 (2.390)	60.00u (5.000)

Additional soil parameters associated with Ka and Kp

------- Soil type ------- No.	Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	MG	25.00	0.670	0.00	25.00	0.500	0.00
2	Alluvium Drained	28.00	0.670	0.00	28.00	0.500	0.00
3	CGM Drained	26.00	0.670	0.00	26.00	0.500	0.00
4	LC Drained	24.00	0.670	0.00	24.00	0.500	0.00
5	LC Undrained	0.00	0.500	0.00	0.00	0.500	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Active side	Passive side
Initial water table elevation	49.00	49.00

Automatic water pressure balancing at toe of wall : No

Water press. profile no.	Active side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	Passive side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2
1	1	49.00	49.00	0.0	1	44.00	44.00	0.0

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 41.00
Maximum finite element length = 0.50 m
Youngs modulus of wall E = 2.5000E+07 kN/m2
Moment of inertia of wall I = 7.9522E-03 m4/m run
E.I = 198805 kN.m2/m run
Yield Moment of wall = Not defined

STRUTS and ANCHORS

Strut/ anchor no.	Elev.	Strut spacing m	X-section area of strut sq.m	Youngs modulus kN/m2	Free length m	Inclin -ation (degs)	Pre-stress /strut kN	Tension allowed
1	49.50	6.00	0.012000	1.600E+06	0.60	0.00	0	No
2	44.25	1.00	0.500000	2.000E+07	5.00	0.00	0	No
3	48.00	1.00	1.350000	2.000E+07	5.00	0.00	0	No

SURCHARGE LOADS

Surch -arge no.	Elev.	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge kN/m2 Near edge	Far edge	Equiv. soil type	Partial factor/ Category
1	50.00	0.00(A)	20.00	20.00	10.00	=	N/A	N/A

Note: A = Active side, P = Passive side

CONSTRUCTION STAGES

Construction stage no.	Stage description
1	Apply surcharge no.1 at elevation 50.00
2	Excavate to elevation 49.00 on PASSIVE side
3	Install strut or anchor no.1 at elevation 49.50
4	Apply water pressure profile no.1 No analysis at this stage
5	Excavate to elevation 44.00 on PASSIVE side
6	Install strut or anchor no.2 at elevation 44.25
7	Install strut or anchor no.3 at elevation 48.00
8	Remove strut or anchor no.1 at elevation 49.50
9	Change properties of soil type 5 to soil type 4 Ko pressures will not be reset

FACTORS OF SAFETY and ANALYSIS OPTIONS

Stability analysis:
Method of analysis - Strength Factor method
Factor on soil strength for calculating wall depth = 1.00

Parameters for undrained strata:
Minimum equivalent fluid density = 5.00 kN/m3
Maximum depth of water filled tension crack = 0.00 m

Bending moment and displacement calculation:
Method - Subgrade reaction model using Influence Coefficients
Open Tension Crack analysis? - No
Non-linear Modulus Parameter (L) = 0 m

Boundary conditions:
Length of wall (normal to plane of analysis) = 20.00 m

Width of excavation on active side of wall = 20.00 m
Width of excavation on passive side of wall = 20.00 m

Distance to rigid boundary on active side = 20.00 m
Distance to rigid boundary on passive side = 20.00 m

Units: kN,m

Summary of results

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method
Factor of safety on soil strength

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	FoS for toe elev. = 41.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation
1	50.00	50.00	Cant.	Conditions not suitable for FoS calc.			
2	50.00	49.00	Cant.	3.434	42.15	46.80	2.20
3	50.00	49.00		No analysis at this stage			
4	50.00	49.00		No analysis at this stage			
5	50.00	44.00	49.50	2.285	n/a	43.34	0.66
6	50.00	44.00		No analysis at this stage			

All remaining stages have more than one strut - FoS calculation n/a

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Data filename/Run ID: 1248 - 24 RG - DS-1 - SLS |
24 Redington Gardens | Date: 6-11-2015
SPW Prelim Analysis - 600 @ 800 - SLS | Checked :

Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
Analysis options
Length of wall perpendicular to section = 20.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Active side 20.00 from wall
Passive side 20.00 from wall

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement maximum	Displacement minimum	Bending moment maximum	Bending moment minimum	Shear force maximum	Shear force minimum
		m	m	kN.m/m	kN.m/m	kN/m	kN/m
1	50.00	0.018	0.000	0.0	0.0	0.0	0.0
2	49.50	0.017	0.000	0.6	0.0	2.5	-62.2
3	49.00	0.016	0.000	2.9	-29.4	6.5	-58.2
4	48.50	0.015	0.000	7.6	-57.1	12.8	-51.9
5	48.00	0.014	0.000	16.0	-81.0	21.5	-71.1
6	47.50	0.014	0.000	14.8	-99.9	7.8	-59.2
7	47.00	0.013	0.000	18.7	-112.0	8.2	-44.0
8	46.50	0.013	0.000	21.8	-116.2	4.2	-25.8
9	46.00	0.012	0.000	23.0	-111.0	20.9	-4.1
10	45.50	0.011	0.000	22.6	-94.8	44.6	-2.0
11	45.00	0.010	0.000	21.0	-66.0	71.5	-4.4
12	44.63	0.009	0.000	19.0	-37.4	82.0	-5.9
13	44.25	0.008	0.000	52.0	-5.1	105.2	-60.4
14	44.00	0.007	0.000	39.7	0.0	99.6	-43.8
15	43.50	0.006	0.000	60.1	0.0	41.0	-24.9
16	43.00	0.006	0.000	66.3	0.0	0.0	-12.8
17	42.50	0.005	0.000	53.7	0.0	0.0	-34.5
18	42.00	0.004	0.000	31.8	0.0	0.0	-43.0
19	41.50	0.003	0.000	10.6	0.0	0.0	-31.8
20	41.00	0.002	0.000	0.0	0.0	0.0	-0.0

Maximum and minimum bending moment and shear force at each stage

Stage no.	Bending moment maximum kN.m/m	elev.	minimum kN.m/m	elev.	Shear force maximum kN/m	elev.	minimum kN/m	elev.
1	5.4	45.50	0.0	50.00	3.3	47.00	-1.8	43.50
2	23.0	46.00	0.0	50.00	8.7	48.50	-7.1	43.50
3	No calculation at this stage							
4	No calculation at this stage							
5	66.3	43.00	-116.2	46.50	99.6	44.00	-62.2	49.50
6	No calculation at this stage							
7	No calculation at this stage							
8	58.9	43.00	-68.1	46.00	83.7	44.00	-71.1	48.00
9	52.0	44.25	-43.1	46.00	105.2	44.25	-60.4	44.25

Summary of results (continued)

Maximum and minimum displacement at each stage

Stage no.	Displacement maximum m	elev.	minimum m	elev.	Stage description
1	0.001	50.00	0.000	50.00	Apply surcharge no.1 at elev. 50.00
2	0.003	50.00	0.000	50.00	Excav. to elev. 49.00 on PASSIVE side
3	No calculation at this stage				Install strut no.1 at elev. 49.50
4	No calculation at this stage				Apply water pressure profile no.1
5	0.015	50.00	0.000	50.00	Excav. to elev. 44.00 on PASSIVE side
6	No calculation at this stage				Install strut no.2 at elev. 44.25
7	No calculation at this stage				Install strut no.3 at elev. 48.00
8	0.017	50.00	0.000	50.00	Remove strut no.1 at elev. 49.50
9	0.018	50.00	0.000	50.00	Change soil type 5 to soil type 4

Strut forces at each stage (horizontal components)

Stage no.	Strut no. 1 at elev. 49.50 kN/m run	Strut no. 1 kN/strut	Strut no. 2 at elev. 44.25 kN/m run	Strut no. 2 kN/strut	Strut no. 3 at elev. 48.00 kN/m run	Strut no. 3 kN/strut
5	64.69	388.12	---	---	---	---
8	---	---	slack	slack	92.58	92.58
9	---	---	165.59	165.59	80.12	80.12

* Indicates that the total force shown is the sum of the force in the strut plus a force applied at the same elevation which may represent temperature load or other forces which are part of the strut load. Force components are listed in the detailed results for individual stages.

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Program: WALLAP Version 6.05 Revision A45.B58.R49 | Job No. 1248
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Data filename/Run ID: 1248 - 24 RG - DS-2 - C1 |
24 Redington Gardens | Date: 6-11-2015
SPW Prelim Analysis - 600 @ 800 - DS-2 - C1 | Checked :

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Active side	Passive side
1	50.00	1 MG	1 MG
2	48.50	2 Alluvium Drained	2 Alluvium Drained
3	47.00	3 CGM Drained	3 CGM Drained
4	45.00	5 LC Undrained	5 LC Undrained

SOIL PROPERTIES (Unfactored SLS soil strengths)

-- Soil type -- No.	Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
1	MG	17.00	12000	0.580	OC	0.351	3.253	
					(0.200)	(0.000)	(0.000)	
2	Alluvium Drained	17.00	12000	0.530	NC	0.309	3.868	0.0d
					(0.200)	(1.300)	(5.394)	
3	CGM Drained (45.00)	19.00	28800 (3000)	0.560	OC (0.200)	0.337 (1.360)	3.442 (5.007)	2.000d
4	LC Drained (45.00)	20.00	48000 (4000)	1.000	OC (0.200)	0.366 (1.423)	3.077 (4.665)	5.000d
5	LC Undrai.. (45.00)	20.00	60000 (5000)	1.000	OC (0.490)	1.000 (2.389)	1.000 (2.390)	60.00u (5.000)

Additional soil parameters associated with Ka and Kp

------- Soil type ------- No.	Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	MG	25.00	0.670	0.00	25.00	0.500	0.00
2	Alluvium Drained	28.00	0.670	0.00	28.00	0.500	0.00
3	CGM Drained	26.00	0.670	0.00	26.00	0.500	0.00
4	LC Drained	24.00	0.670	0.00	24.00	0.500	0.00
5	LC Undrained	0.00	0.500	0.00	0.00	0.500	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Active side	Passive side
Initial water table elevation	49.00	49.00

Automatic water pressure balancing at toe of wall : No

Water press. profile no.	Active side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	Passive side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2
1	1	49.00	49.00	0.0	1	41.70	41.70	0.0 MC+WC

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 38.00
Maximum finite element length = 0.60 m
Youngs modulus of wall E = 2.5000E+07 kN/m2
Moment of inertia of wall I = 7.9522E-03 m4/m run
E.I = 198805 kN.m2/m run
Yield Moment of wall = Not defined

STRUTS and ANCHORS

Strut/anchor no.	Elev.	Strut spacing m	X-section area of strut sq.m	Youngs modulus kN/m2	Free length m	Inclin-ation (degs)	Pre-stress /strut kN	Tension allowed
1	49.50	6.00	0.012000	1.600E+06	0.60	0.00	0	No
2	44.25	1.00	0.500000	2.000E+07	5.00	0.00	0	No
3	48.00	1.00	1.350000	2.000E+07	5.00	0.00	0	No
4	42.40	1.00	0.400000	2.000E+07	5.00	0.00	0	No

SURCHARGE LOADS

Surch-arge no.	Elev.	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge kN/m2 Near edge	Far edge	Equiv. soil type	Partial factor/ Category
1	50.00	0.00(A)	20.00	20.00	10.00	=	N/A	1.10 Var

Note: A = Active side, P = Passive side
Limit State Categories P/U = Permanent Unfavourable
P/F = Permanent Favourable
Var = Variable (unfavourable)

CONSTRUCTION STAGES

Construction stage no.	Stage description
1	Apply surcharge no.1 at elevation 50.00
2	Excavate to elevation 49.00 on PASSIVE side
3	Install strut or anchor no.1 at elevation 49.50
4	Apply water pressure profile no.1 (Mod. Conserv.)
	No analysis at this stage
5	Excavate to elevation 41.70 on PASSIVE side
6	Install strut or anchor no.4 at elevation 42.40
7	Install strut or anchor no.2 at elevation 44.25
8	Install strut or anchor no.3 at elevation 48.00
9	Remove strut or anchor no.1 at elevation 49.50
10	Change properties of soil type 5 to soil type 4
	Ko pressures will not be reset

FACTORS OF SAFETY and ANALYSIS OPTIONS

Limit State options: ULS DA1 Combination 1
Water pressures : Moderately Conservative
Partial factor on C' = 1.000
Partial factor on Phi' = 1.000
Partial factor on Cu = 1.000
Partial factor on Soil Modulus = 1.000
Partial factor on Permanent Unfavourable loads = 1.000
Partial factor on Permanent Favourable loads = 1.000
Partial factor on Permanent Variable loads = 1.100
Design factor on calculated Bending Moments = 1.350

Parameters for undrained strata:
Minimum equivalent fluid density = 5.00 kN/m3
Maximum depth of water filled tension crack = 0.00 m

Bending moment and displacement calculation:
Method - Subgrade reaction model using Influence Coefficients
Open Tension Crack analysis? - No
Non-linear Modulus Parameter (L) = 0 m

Boundary conditions:
Length of wall (normal to plane of analysis) = 20.00 m

Width of excavation on active side of wall = 10.00 m
Width of excavation on passive side of wall = 10.00 m

Distance to rigid boundary on active side = 10.00 m
Distance to rigid boundary on passive side = 10.00 m

Summary of results (continued)

Calculated Bending Moments and Strut Forces have been multiplied by a factor of 1.35 to obtain values for structural design.

Maximum and minimum bending moment and shear force at each stage

Stage	Bending moment						Shear force				
	Calculated				Factored		Calculated				Factored
no.	max.	elev.	min.	elev.	max.	min.	max.	elev.	min.	elev.	max. min.
	kN.m/m		kN.m/m		kN.m/m		kN/m		kN/m		kN/m kN/m
1	6	45.60	-0	50.00	8	-0	3	47.00	-2	43.20	5 -2
2	23	46.20	-0	39.00	31	-0	9	48.50	-7	43.73	12 -9
3	No calculation at this stage										
4	No calculation at this stage										
5	183	40.80	-217	45.60	247	-293	152	41.70	-97	39.60	205 -131
6	No calculation at this stage										
7	No calculation at this stage										
8	No calculation at this stage										
9	170	40.20	-174	45.00	230	-235	150	41.70	-116	48.00	203 -156
10	178	42.40	-134	45.60	241	-180	219	42.40	-167	42.40	296 -226

Maximum and minimum displacement at each stage

Stage	Displacement				Stage description
no.	maximum	elev.	minimum	elev.	
	m		m		
1	0.001	50.00	0.000	50.00	Apply surcharge no.1 at elev. 50.00
2	0.003	50.00	0.000	50.00	Excav. to elev. 49.00 on PASSIVE side
3	No calculation at this stage				Install strut no.1 at elev. 49.50
4	No calculation at this stage				Apply water pressure profile no.1
5	0.022	47.00	0.000	50.00	Excav. to elev. 41.70 on PASSIVE side
6	No calculation at this stage				Install strut no.4 at elev. 42.40
7	No calculation at this stage				Install strut no.2 at elev. 44.25
8	No calculation at this stage				Install strut no.3 at elev. 48.00
9	0.023	50.00	0.000	50.00	Remove strut no.1 at elev. 49.50
10	0.024	50.00	0.000	50.00	Change soil type 5 to soil type 4

Run ID. 1248 - 24 RG - DS-2 - C1 | Sheet No.
24 Redington Gardens | Date: 6-11-2015
SPW Prelim Analysis - 600 @ 800 - DS-2 - C1 | Checked :

Summary of results (continued)

Calculated Bending Moments and Strut Forces have been multiplied by a factor of 1.35 to obtain values for structural design.

Strut forces at each stage (horizontal components)

Stage	Strut no. 1 at elev. 49.50			Strut no. 2 at elev. 44.25			Strut no. 3 at elev. 48.00		
	Calculated		Factored	Calculated		Factored	Calculated		Factored
no.	kN per m run	kN per strut	kN per strut	kN per m run	kN per strut	kN per strut	kN per m run	kN per strut	kN per strut
5	96	575	776	---	---	---	---	---	---
9	---	---	---	slack	slack	slack	138	138	186
10	---	---	---	slack	slack	slack	125	125	168

Stage	Strut no. 4 at elev. 42.40		
	Calculated		Factored
no.	kN per m run	kN per strut	kN per strut
9	slack	slack	slack
10	386	386	522

* Indicates that the total force shown is the sum of the force in the strut plus a force applied at the same elevation which may represent temperature load or other forces which are part of the strut load. Force components are listed in the detailed results for individual stages.

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Program: WALLAP Version 6.05 Revision A45.B58.R49 | Job No. 1248
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Data filename/Run ID: 1248 - 24 RG - DS-2 - C2 |
24 Redington Gardens | Date:10-11-2015
SPW Prelim Analysis - 600 @ 800 - DS-2 - C2 | Checked :

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Active side	Passive side
1	50.00	1 MG	1 MG
2	48.50	2 Alluvium Drained	2 Alluvium Drained
3	47.00	3 CGM Drained	3 CGM Drained
4	45.00	5 LC Undrained	5 LC Undrained

SOIL PROPERTIES (Unfactored SLS soil strengths)

-- Soil type -- No.	Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
1	MG	17.00	12000	0.580	OC	0.351	3.253	
					(0.200)	(0.000)	(0.000)	
2	Alluvium Drained	17.00	12000	0.530	NC	0.309	3.868	0.0d
					(0.200)	(1.300)	(5.394)	
3	CGM Drained (45.00)	19.00	28800 (3000)	0.560	OC (0.200)	0.337 (1.360)	3.442 (5.007)	2.000d
4	LC Drained (45.00)	20.00	48000 (4000)	1.000	OC (0.200)	0.366 (1.423)	3.077 (4.665)	5.000d
5	LC Undrai.. (45.00)	20.00	60000 (5000)	1.000	OC (0.490)	1.000 (2.389)	1.000 (2.390)	60.00u (5.000)

Additional soil parameters associated with Ka and Kp

------- Soil type ------- No.	Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	MG	25.00	0.670	0.00	25.00	0.500	0.00
2	Alluvium Drained	28.00	0.670	0.00	28.00	0.500	0.00
3	CGM Drained	26.00	0.670	0.00	26.00	0.500	0.00
4	LC Drained	24.00	0.670	0.00	24.00	0.500	0.00
5	LC Undrained	0.00	0.500	0.00	0.00	0.500	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Active side	Passive side
Initial water table elevation	49.00	49.00

Automatic water pressure balancing at toe of wall : No

Water press. profile no.	Active side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	Passive side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2
1	1	49.00	49.00	0.0	1	41.70	41.70	0.0 MC+WC

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 38.00
Maximum finite element length = 0.60 m
Youngs modulus of wall E = 2.5000E+07 kN/m2
Moment of inertia of wall I = 7.9522E-03 m4/m run
E.I = 198805 kN.m2/m run
Yield Moment of wall = Not defined

STRUTS and ANCHORS

Strut/anchor no.	Elev.	Strut spacing m	X-section area of strut sq.m	Youngs modulus kN/m2	Free length m	Inclin-ation (degs)	Pre-stress /strut kN	Tension allowed
1	49.50	6.00	0.012000	1.600E+06	0.60	0.00	0	No
2	44.25	1.00	0.500000	2.000E+07	5.00	0.00	0	No
3	48.00	1.00	1.350000	2.000E+07	5.00	0.00	0	No
4	42.40	1.00	0.400000	2.000E+07	5.00	0.00	0	No

SURCHARGE LOADS

Surch-arge no.	Elev.	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge kN/m2 Near edge	Far edge	Equiv. soil type	Partial factor/ Category
1	50.00	0.00(A)	20.00	20.00	10.00	=	N/A	1.30 Var

Note: A = Active side, P = Passive side
Limit State Categories P/U = Permanent Unfavourable
P/F = Permanent Favourable
Var = Variable (unfavourable)

CONSTRUCTION STAGES

Construction stage no.	Stage description
1	Apply surcharge no.1 at elevation 50.00
2	Excavate to elevation 49.00 on PASSIVE side
3	Install strut or anchor no.1 at elevation 49.50
4	Apply water pressure profile no.1 (Worst Cred.)
	No analysis at this stage
5	Excavate to elevation 41.70 on PASSIVE side
6	Install strut or anchor no.4 at elevation 42.40
7	Install strut or anchor no.2 at elevation 44.25
8	Install strut or anchor no.3 at elevation 48.00
9	Remove strut or anchor no.1 at elevation 49.50
10	Change properties of soil type 5 to soil type 4
	Ko pressures will not be reset

FACTORS OF SAFETY and ANALYSIS OPTIONS

Limit State options: ULS DA1 Combination 2
Water pressures : Worst Credible
Partial factor on C' = 1.250
Partial factor on Phi' = 1.250
Partial factor on Cu = 1.400
Partial factor on Soil Modulus = 1.000
Partial factor on Permanent Unfavourable loads = 1.000
Partial factor on Permanent Favourable loads = 1.000
Partial factor on Permanent Variable loads = 1.300

Stability analysis:
Method of analysis - Strength Factor method
Overall factor on soil strength for calculating wall depth = 1.00

Parameters for undrained strata:
Minimum equivalent fluid density = 5.00 kN/m3
Maximum depth of water filled tension crack = 0.00 m

Bending moment and displacement calculation:
Method - Subgrade reaction model using Influence Coefficients
Open Tension Crack analysis? - No
Non-linear Modulus Parameter (L) = 0 m

Boundary conditions:
Length of wall (normal to plane of analysis) = 20.00 m

Width of excavation on active side of wall = 10.00 m
Width of excavation on passive side of wall = 10.00 m

Distance to rigid boundary on active side = 10.00 m
Distance to rigid boundary on passive side = 10.00 m

Units: kN,m

Summary of results

LIMIT STATE PARAMETERS

Limit State: ULS DA1 Combination 2
Water pressures : Worst Credible
Partial factor on C' = 1.250
Partial factor on Phi' = 1.250
Partial factor on Cu = 1.400
Partial factor on Soil Modulus = 1.000
Partial factor on Permanent Unfavourable loads = 1.000
Partial factor on Permanent Favourable loads = 1.000
Partial factor on Permanent Variable loads = 1.300

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method

Factor of safety on soil strength

Stage No.	--- G.L. --- Act.	Pass.	Strut Elev.	Overall FoS for toe elev. = 38.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation
1	50.00	50.00	Cant.	Conditions not suitable for FoS calc.			
2	50.00	49.00	Cant.	3.531	39.55	45.69	3.31
3	50.00	49.00		No analysis at this stage			
4	50.00	49.00		No analysis at this stage			
5	50.00	41.70	49.50	1.413	n/a	40.43	1.27
6	50.00	41.70		No analysis at this stage			

All remaining stages have more than one strut - FoS calculation n/a

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24 Redington Gardens | Date:10-11-2015
SPW Prelim Analysis - 600 @ 800 - DS-2 - C2 | Checked :

Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 20.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Active side 10.00 from wall
Passive side 10.00 from wall

Limit State: ULS DA1 Combination 2

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement maximum m	Displacement minimum m	Bending moment maximum kN.m/m	Bending moment minimum kN.m/m	Shear force maximum kN/m	Shear force minimum kN/m
1	50.00	0.031	0.000	0.0	-0.0	0.0	0.0
2	49.50	0.030	0.000	1.0	0.0	3.7	-112.5
3	49.00	0.030	0.000	4.1	-54.0	9.1	-107.0
4	48.50	0.029	0.000	10.5	-105.7	17.1	-99.0
5	48.00	0.028	0.000	21.8	-152.5	27.6	-139.9
6	47.50	0.028	0.000	23.4	-193.5	12.1	-126.0
7	47.00	0.029	0.000	29.3	-226.8	11.2	-108.3
8	46.60	0.029	0.000	32.9	-247.2	7.5	-91.2
9	46.20	0.028	0.000	35.2	-260.9	4.0	-71.5
10	45.60	0.028	0.000	36.0	-267.4	28.7	-37.6
11	45.00	0.026	0.000	34.3	-253.9	78.3	-5.0
12	44.63	0.025	0.000	31.7	-237.1	106.9	-8.2
13	44.25	0.024	0.000	30.3	-216.6	136.5	-10.0
14	43.73	0.022	0.000	113.2	-183.1	179.1	-10.9
15	43.20	0.020	0.000	220.1	-146.6	223.2	-10.3
16	42.80	0.018	0.000	316.5	-110.5	258.9	-9.2
17	42.40	0.017	0.000	427.6	-67.3	296.9	-265.9
18	42.05	0.017	0.000	340.7	-23.7	135.7	-230.8
19	41.70	0.017	0.000	266.3	0.0	149.9	-193.9
20	41.25	0.017	0.000	188.3	0.0	111.2	-154.7
21	40.80	0.018	0.000	140.3	0.0	66.8	-119.7
22	40.20	0.019	0.000	163.8	0.0	0.0	-79.4
23	39.60	0.020	0.000	138.0	-0.2	0.0	-67.6
24	39.00	0.021	0.000	90.4	-0.2	0.2	-101.6
25	38.50	0.022	0.000	35.9	-0.1	0.2	-93.4
26	38.00	0.023	0.000	0.0	-0.0	0.0	0.0

Maximum and minimum bending moment and shear force at each stage

Stage no.	Bending moment maximum kN.m/m	elev.	Bending moment minimum kN.m/m	elev.	Shear force maximum kN/m	elev.	Shear force minimum kN/m	elev.
1	9.5	45.60	-0.0	50.00	4.7	47.00	-2.7	43.73
2	36.0	45.60	-0.2	39.60	13.7	48.50	-10.9	43.73
3	No calculation at this stage							
4	No calculation at this stage							
5	163.8	40.20	-267.4	45.60	149.9	41.70	-112.5	49.50
6	No calculation at this stage							
7	No calculation at this stage							
8	No calculation at this stage							
9	152.9	40.20	-220.4	45.00	148.0	41.70	-139.9	48.00
10	427.6	42.40	-85.2	46.20	296.9	42.40	-265.9	42.40

Summary of results (continued)

Maximum and minimum displacement at each stage

Stage no.	Displacement maximum m	elev.	minimum m	elev.	Stage description
1	0.001	50.00	0.000	50.00	Apply surcharge no.1 at elev. 50.00
2	0.004	50.00	0.000	50.00	Excav. to elev. 49.00 on PASSIVE side
3	No calculation at this stage				Install strut no.1 at elev. 49.50
4	No calculation at this stage				Apply water pressure profile no.1
5	0.029	47.00	0.000	50.00	Excav. to elev. 41.70 on PASSIVE side
6	No calculation at this stage				Install strut no.4 at elev. 42.40
7	No calculation at this stage				Install strut no.2 at elev. 44.25
8	No calculation at this stage				Install strut no.3 at elev. 48.00
9	0.028	50.00	0.000	50.00	Remove strut no.1 at elev. 49.50
10	0.031	50.00	0.000	50.00	Change soil type 5 to soil type 4

Run ID. 1248 - 24 RG - DS-2 - C2 | Sheet No.
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SPW Prelim Analysis - 600 @ 800 - DS-2 - C2 | Checked :

Summary of results (continued)

Strut forces at each stage (horizontal components)

Stage no.	Strut no. 1 at elev. 49.50 kN/m run	kN/strut	Strut no. 2 at elev. 44.25 kN/m run	kN/strut	Strut no. 3 at elev. 48.00 kN/m run	kN/strut
5	116.18	697.08	---	---	---	---
9	---	---	slack	slack	167.52	167.52
10	---	---	slack	slack	119.43	119.43

Stage no.	Strut no. 4 at elev. 42.40 kN/m run	kN/strut
9	slack	slack
10	562.80	562.80

* Indicates that the total force shown is the sum of the force in the strut plus a force applied at the same elevation which may represent temperature load or other forces which are part of the strut load. Force components are listed in the detailed results for individual stages.

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Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types Active side	Passive side
1	50.00	1 MG	1 MG
2	48.50	2 Alluvium Drained	2 Alluvium Drained
3	47.00	3 CGM Drained	3 CGM Drained
4	45.00	5 LC Undrained	5 LC Undrained

SOIL PROPERTIES

-- Soil type -- No.	Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
1	MG	17.00	12000	0.580	OC	0.351	3.253	
					(0.200)	(0.000)	(0.000)	
2	Alluvium Drained	17.00	12000	0.530	NC	0.309	3.868	0.0d
					(0.200)	(1.300)	(5.394)	
3	CGM Drained (45.00)	19.00	28800 (3000)	0.560	OC (0.200)	0.337 (1.360)	3.442 (5.007)	2.000d
4	LC Drained (45.00)	20.00	48000 (4000)	1.000	OC (0.200)	0.366 (1.423)	3.077 (4.665)	5.000d
5	LC Undrai.. (45.00)	20.00	60000 (5000)	1.000	OC (0.490)	1.000 (2.389)	1.000 (2.390)	60.00u (5.000)

Additional soil parameters associated with Ka and Kp

------- Soil type ------- No.	Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	MG	25.00	0.670	0.00	25.00	0.500	0.00
2	Alluvium Drained	28.00	0.670	0.00	28.00	0.500	0.00
3	CGM Drained	26.00	0.670	0.00	26.00	0.500	0.00
4	LC Drained	24.00	0.670	0.00	24.00	0.500	0.00
5	LC Undrained	0.00	0.500	0.00	0.00	0.500	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Active side	Passive side
Initial water table elevation	49.00	49.00

Automatic water pressure balancing at toe of wall : No

Water press. profile no.	Active side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	Passive side Point no.	Elev. m	Piezo elev. m	Water press. kN/m2
1	1	49.00	49.00	0.0	1	42.20	42.20	0.0

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 38.00
Maximum finite element length = 0.60 m
Youngs modulus of wall E = 2.5000E+07 kN/m2
Moment of inertia of wall I = 7.9522E-03 m4/m run
E.I = 198805 kN.m2/m run
Yield Moment of wall = Not defined

STRUTS and ANCHORS

Strut/ anchor no.	Elev.	Strut spacing m	X-section area of strut sq.m	Youngs modulus kN/m2	Free length m	Inclin -ation (degs)	Pre-stress /strut kN	Tension allowed
1	49.50	6.00	0.012000	1.600E+06	0.60	0.00	0	No
2	44.25	1.00	0.500000	2.000E+07	5.00	0.00	0	No
3	48.00	1.00	1.350000	2.000E+07	5.00	0.00	0	No
4	42.40	1.00	0.400000	2.000E+07	5.00	0.00	0	No

SURCHARGE LOADS

Surch -arge no.	Elev.	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge kN/m2 Near edge	Far edge	Equiv. soil type	Partial factor/ Category
1	50.00	0.00(A)	20.00	20.00	10.00	=	N/A	N/A

Note: A = Active side, P = Passive side

CONSTRUCTION STAGES

Construction stage no.	Stage description
1	Apply surcharge no.1 at elevation 50.00
2	Excavate to elevation 49.00 on PASSIVE side
3	Install strut or anchor no.1 at elevation 49.50
4	Apply water pressure profile no.1 No analysis at this stage
5	Excavate to elevation 42.20 on PASSIVE side
6	Install strut or anchor no.4 at elevation 42.40
7	Install strut or anchor no.2 at elevation 44.25
8	Install strut or anchor no.3 at elevation 48.00
9	Remove strut or anchor no.1 at elevation 49.50
10	Change properties of soil type 5 to soil type 4 Ko pressures will not be reset

FACTORS OF SAFETY and ANALYSIS OPTIONS

Stability analysis:
Method of analysis - Strength Factor method
Factor on soil strength for calculating wall depth = 1.00

Parameters for undrained strata:
Minimum equivalent fluid density = 5.00 kN/m3
Maximum depth of water filled tension crack = 0.00 m

Bending moment and displacement calculation:
Method - Subgrade reaction model using Influence Coefficients
Open Tension Crack analysis? - No
Non-linear Modulus Parameter (L) = 0 m

Boundary conditions:
Length of wall (normal to plane of analysis) = 20.00 m

Width of excavation on active side of wall = 10.00 m
Width of excavation on passive side of wall = 10.00 m

Distance to rigid boundary on active side = 10.00 m
Distance to rigid boundary on passive side = 10.00 m

Units: kN,m

Summary of results

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method
Factor of safety on soil strength

Stage No.	G.L. Act.	G.L. Pass.	Strut Elev.	FoS for toe elev. = 38.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr -ation
1	50.00	50.00	Cant.	Conditions not suitable for FoS calc.			
2	50.00	49.00	Cant.	5.219	39.58	46.79	2.21
3	50.00	49.00		No analysis at this stage			
4	50.00	49.00		No analysis at this stage			
5	50.00	42.20	49.50	2.175	n/a	41.39	0.81
6	50.00	42.20		No analysis at this stage			

All remaining stages have more than one strut - FoS calculation n/a

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Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
Analysis options
Length of wall perpendicular to section = 20.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No

Rigid boundaries: Active side 10.00 from wall
Passive side 10.00 from wall

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement maximum	Displacement minimum	Bending moment maximum	Bending moment minimum	Shear force maximum	Shear force minimum
		m	m	kN.m/m	kN.m/m	kN/m	kN/m
1	50.00	0.021	0.000	0.0	0.0	0.0	0.0
2	49.50	0.020	0.000	0.6	0.0	2.5	-82.2
3	49.00	0.020	0.000	2.9	-39.5	6.5	-78.2
4	48.50	0.019	0.000	7.6	-77.1	12.8	-71.9
5	48.00	0.019	0.000	16.0	-111.1	21.5	-100.7
6	47.50	0.019	0.000	14.5	-140.0	7.3	-88.7
7	47.00	0.019	0.000	18.2	-162.2	7.7	-73.3
8	46.60	0.018	0.000	20.6	-174.2	4.5	-58.5
9	46.20	0.018	0.000	21.8	-180.5	1.7	-41.4
10	45.60	0.017	0.000	21.6	-177.3	19.6	-11.6
11	45.00	0.016	0.000	19.8	-156.3	51.4	-4.2
12	44.63	0.015	0.000	17.9	-135.3	61.1	-5.5
13	44.25	0.014	0.000	15.6	-110.4	72.5	-6.2
14	43.73	0.012	0.000	12.2	-70.9	108.3	-6.3
15	43.20	0.011	0.000	31.5	-26.7	147.8	-5.7
16	42.80	0.009	0.000	97.1	0.0	180.4	-5.0
17	42.40	0.008	0.000	176.1	0.0	215.1	-125.8
18	42.20	0.008	0.000	152.8	0.0	141.0	-107.6
19	41.80	0.007	0.000	151.7	0.0	85.2	-82.2
20	41.40	0.006	0.000	173.9	0.0	32.8	-61.2
21	40.80	0.005	0.000	177.8	0.0	0.0	-37.9
22	40.20	0.004	0.000	139.4	0.0	0.0	-74.3
23	39.60	0.004	0.000	88.5	-0.0	0.0	-82.4
24	39.00	0.003	0.000	40.4	-0.0	0.1	-67.6
25	38.50	0.003	0.000	11.7	-0.0	0.1	-40.3
26	38.00	0.002	0.000	0.0	-0.0	0.0	0.0

Maximum and minimum bending moment and shear force at each stage

Stage no.	Bending moment maximum	elev.	minimum	elev.	Shear force maximum	elev.	minimum	elev.
	kN.m/m		kN.m/m		kN/m		kN/m	
1	5.1	45.00	0.0	50.00	3.2	47.00	-1.4	43.20
2	21.8	46.20	-0.0	39.00	8.7	48.50	-6.3	43.73
3	No calculation at this stage							
4	No calculation at this stage							
5	177.8	40.80	-180.5	46.20	141.0	42.20	-82.4	39.60
6	No calculation at this stage							
7	No calculation at this stage							
8	No calculation at this stage							
9	166.8	40.80	-135.1	45.60	136.7	42.20	-100.7	48.00
10	176.1	42.40	-126.0	45.60	215.1	42.40	-125.8	42.40

Summary of results (continued)

Maximum and minimum displacement at each stage

Stage no.	Displacement maximum	elev.	minimum	elev.	Stage description
	m		m		
1	0.001	50.00	0.000	50.00	Apply surcharge no.1 at elev. 50.00
2	0.003	50.00	0.000	50.00	Excav. to elev. 49.00 on PASSIVE side
3	No calculation at this stage				Install strut no.1 at elev. 49.50
4	No calculation at this stage				Apply water pressure profile no.1
5	0.019	48.00	0.000	50.00	Excav. to elev. 42.20 on PASSIVE side
6	No calculation at this stage				Install strut no.4 at elev. 42.40
7	No calculation at this stage				Install strut no.2 at elev. 44.25
8	No calculation at this stage				Install strut no.3 at elev. 48.00
9	0.021	50.00	0.000	50.00	Remove strut no.1 at elev. 49.50
10	0.021	50.00	0.000	50.00	Change soil type 5 to soil type 4

Run ID. 1248 - 24 RG - DS-2 - SLS | Sheet No.
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Summary of results (continued)

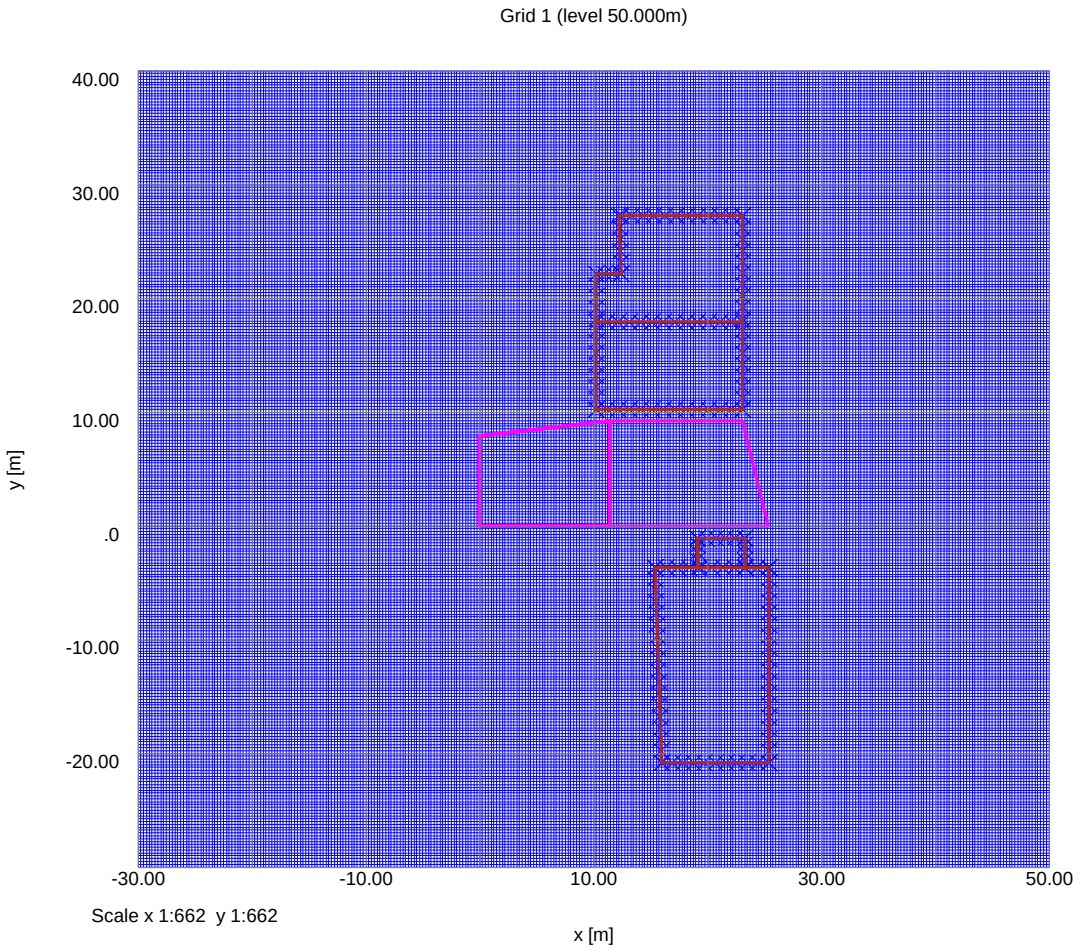
Strut forces at each stage (horizontal components)

Stage no.	Strut no. 1 at elev. 49.50		Strut no. 2 at elev. 44.25		Strut no. 3 at elev. 48.00	
	kN/m run	kN/strut	kN/m run	kN/strut	kN/m run	kN/strut
5	84.73	508.39	---	---	---	---
9	---	---	slack	slack	122.21	122.21
10	---	---	slack	slack	118.68	118.68

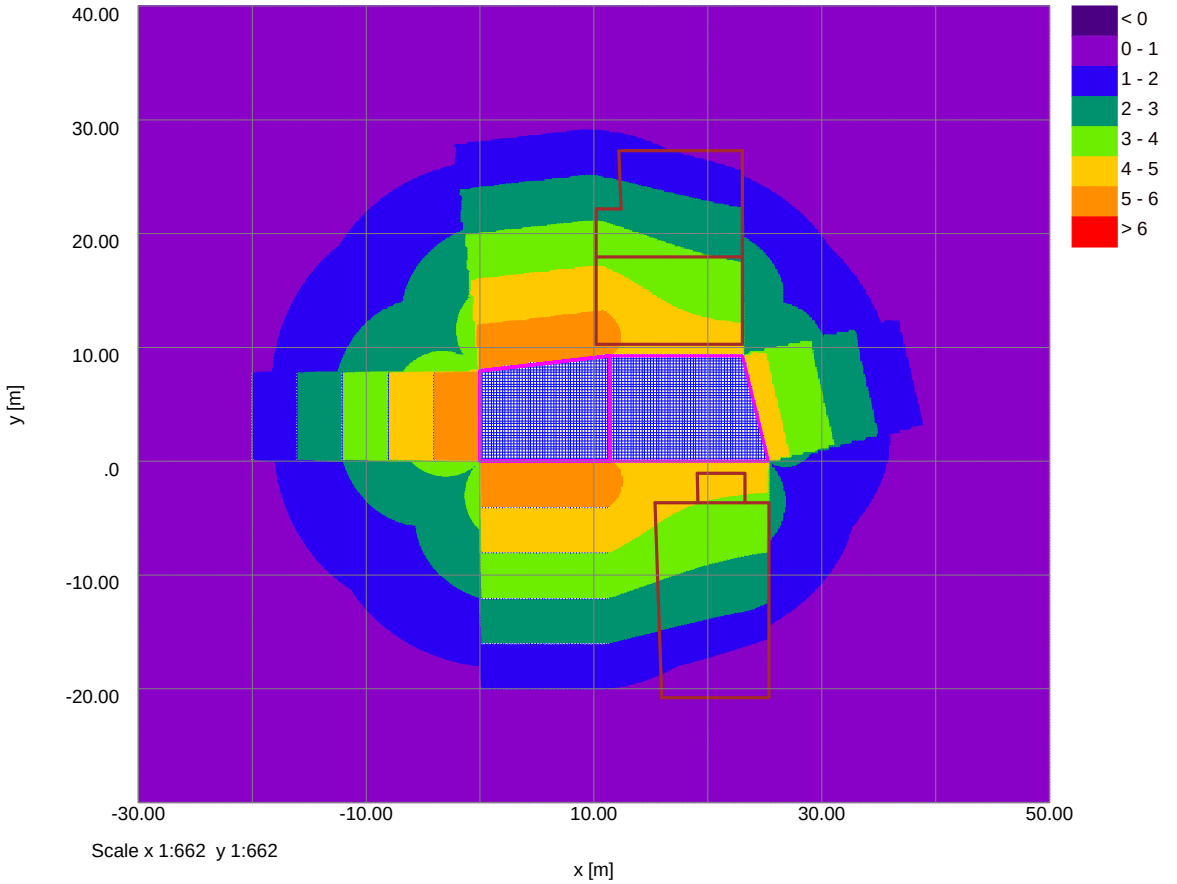
Stage no.	Strut no. 4 at elev. 42.40	
	kN/m run	kN/strut
9	slack	slack
10	340.93	340.93

* Indicates that the total force shown is the sum of the force in the strut plus a force applied at the same elevation which may represent temperature load or other forces which are part of the strut load. Force components are listed in the detailed results for individual stages.

Appendix C
Oasys Xdisp input & output

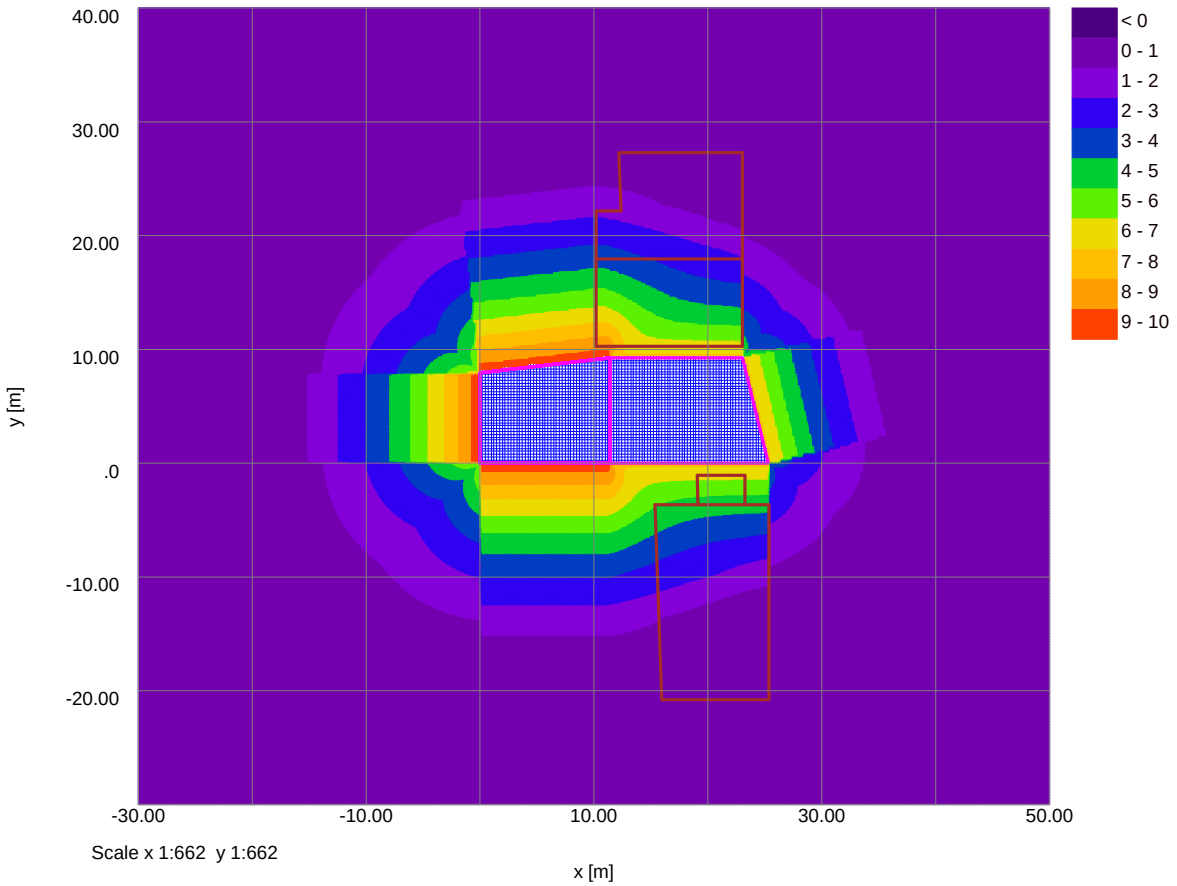

Grid 1 (level 50.000m)
40.00
30.00
20.00
10.00
.0
-10.00
-20.00
y [m]
-30.00
-10.00
10.00
30.00
50.00
Scale x 1:662 y 1:662
x [m]

Vertical Settlement Contours: Grid 1 (level 50.000m) (Interval 1mm)



Scale x 1:662 y 1:662

Horizontal Displacement Contours: Grid 1 (level 50.000m) Interval 1mm



Problem Type

Problem Type : Tunnelling and Embedded Wall Excavations

Displacement Data

Type	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
			First point			Second point							
			X [m]	Y [m]	Z(level) [m]	X [m]	Y [m]	Z(level) [m]		[m]			
Line	No. 7 Wall A	-	25.40000	-3.70000	50.00000	25.40000	-20.80000	50.00000	17	-	-	Yes	Surface
Line	No. 7 Wall B	-	15.40000	-3.70000	50.00000	16.00000	-20.80000	50.00000	17	-	-	Yes	Surface
Line	No. 7 Wall C	-	15.40000	-3.70000	50.00000	25.40000	-3.70000	50.00000	10	-	-	Yes	Surface
Line	No. 7 Wall D	-	16.00000	-20.80000	50.00000	25.40000	-20.80000	50.00000	10	-	-	Yes	Surface
Line	No. 7 Wall E	-	19.10000	-1.07500	50.00000	19.20000	-3.70000	50.00000	4	-	-	Yes	Surface
Line	No. 7 Wall F	-	19.10000	-1.07500	50.00000	23.30000	-1.10000	50.00000	5	-	-	Yes	Surface
Line	No. 7 Wall G	-	23.30000	-1.10000	50.00000	23.30000	-3.70000	50.00000	4	-	-	Yes	Surface
Line	No. 25/26 Wall A	-	23.10000	10.30000	50.00000	23.10000	27.30000	50.00000	17	-	-	Yes	Surface
Line	No. 25/26 Wall B	-	10.20000	10.30000	50.00000	10.20000	22.20000	50.00000	12	-	-	Yes	Surface
Line	No. 25/26 Wall C	-	12.40000	22.20000	50.00000	12.20000	27.30000	50.00000	5	-	-	Yes	Surface
Line	No. 25/26 Wall D	-	10.20000	10.30000	50.00000	23.10000	10.30000	50.00000	13	-	-	Yes	Surface
Line	No. 25/26 Wall E	-	10.20000	18.00000	50.00000	23.10000	18.00000	50.00000	13	-	-	Yes	Surface
Line	No. 25/26 Wall F	-	10.20000	22.20000	50.00000	12.40000	22.20000	50.00000	3	-	-	Yes	Surface
Line	No. 25/26 Wall G	-	12.40000	27.30000	50.00000	23.10000	27.30000	50.00000	11	-	-	Yes	Surface

Vertical Ground Movement Curves

Curve Name: **No vertical ground movement**
Coordinates: [Distance from wall / wall depth or max. excavation depth (x), Depth / wall depth or max. excavation depth (y), Settlement / wall depth or max. excavation depth (z)(%)]
[0.000,0.000,0.000][1.000,0.000,0.000][0.000,1.000,0.000][1.000,1.000,0.000]
Curve Fitting Method: Polynomial
x Order: 1
y Order: 0
Polynomial: z = 0.0x + 0.0
Coeff. of Determination: -2147483648.E+2147483647

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 Method: Polynomial
x Order: 1
y Order: 0
Polynomial: z = -2.5E-2x + 5.0E-2
Coeff. of Determination: 1.0

Horizontal Ground Movement Curves

Curve Name: **No horizontal ground movement**
Coordinates: [Distance from wall / wall depth or max. excavation depth (x), Depth / wall depth or max. excavation depth (y), Horizontal movement / wall depth or max. excavation depth (z)(%)]
[0.000,0.000,0.000][1.000,0.000,0.000][0.000,1.000,0.000][1.000,1.000,0.000]
Curve Fitting Method: Polynomial
x Order: 0
y Order: 0
Polynomial: z = 0.0
Coeff. of Determination: -2147483648.E+2147483647

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)(%)]
[0.000,0.000,0.081][0.050,0.000,0.076][0.100,0.000,0.072][0.150,0.000,0.067]
[0.200,0.000,0.063][0.250,0.000,0.059][0.300,0.000,0.056][0.350,0.000,0.052]
[0.400,0.000,0.049][0.450,0.000,0.045][0.500,0.000,0.043][0.550,0.000,0.040]
[0.600,0.000,0.037][0.650,0.000,0.034][0.700,0.000,0.032][0.750,0.000,0.029]
[0.800,0.000,0.027][0.850,0.000,0.024][0.900,0.000,0.022][0.950,0.000,0.020]
[1.000,0.000,0.018][1.050,0.000,0.016][1.100,0.000,0.014][1.150,0.000,0.012]
[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]
Curve Fitting Method: Polynomial
x Order: 3
y Order: 0
Polynomial: z = $-1.0610E\text{-}2x^3 + 4.4203E\text{-}2x^2 - 9.6358E\text{-}2x + 8.0901E\text{-}2$
Coeff. of Determination: 1.0000

Polygonal Excavations

Excavation Name: **GENERAL - FL=44.0**
Surface level [m]: 50.000
Contribution: Positive
Enabled: Yes

Corner	x [m]	y [m]	Base Level [m]	Stiffened	Previous Side d [m]	Previous Side p1 [%]	Previous Side p2* [%]	Next Side d [m]	Next Side p1 [%]	Next Side p2* [%]
1	0.0	0.0	41.000	Yes	0.0	67.000	25.000	0.0	67.000	25.000
2	0.0	8.0000	41.000	Yes	0.0	67.000	25.000	0.0	67.000	25.000
3	11.400	9.3000	41.000	No	-	-	-	-	-	-
4	23.100	9.3000	41.000	Yes	0.0	67.000	25.000	0.0	67.000	25.000
5	25.300	0.0	41.000	Yes	0.0	67.000	25.000	0.0	67.000	25.000

Side	Corner 1 x [m]	Corner 1 y [m]	Corner 2 x [m]	Corner 2 y [m]	Ground Movement Curve: Vertical	Ground Movement Curve: Horizontal
1	0.0	0.0	0.0	8.0000	Installation of secant bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(b))	Installation of secant bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(a))
2	0.0	8.0000	11.400	9.3000	Installation of secant bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(b))	Installation of secant bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(a))
3	11.400	9.3000	23.100	9.3000	Installation of secant bored pile wall in stiff clay (CIRIA	Installation of secant bored pile wall in stiff clay (CIRIA

Side	Corner 1 x [m]	Corner 1 y [m]	Corner 2 x [m]	Corner 2 y [m]	Ground Movement Curve Vertical	Ground Movement Curve Horizontal
					580 Fig. 2.8(b))	580 Fig. 2.8(a))
4	23.100	9.3000	25.300	0.0	Installation of secant bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(b))	Installation of secant bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(a))
5	25.300	0.0	0.0	0.0	Installation of secant bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(b))	Installation of secant bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(a))

Excavation Name: **SWIMMING POOL - FL=42.2**
Surface level [m]: 50.000
Contribution: Positive
Enabled: Yes

Corner	x [m]	y [m]	Base Level [m]	Stiffened	Previous Side d [m]	Previous Side p1 [%]	Previous Side p2* [%]	Next Side d [m]	Next Side p1 [%]	Next Side p2* [%]
1	0.0	0.0	38.000	Yes	0.0	67.000	25.000	0.0	67.000	25.000
2	0.0	8.0000	38.000	Yes	0.0	67.000	25.000	0.0	67.000	25.000
3	11.400	9.3000	38.000	No	-	-	-	-	-	-
4	11.400	0.0	38.000	No	-	-	-	-	-	-

Side	Corner 1 x [m]	Corner 1 y [m]	Corner 2 x [m]	Corner 2 y [m]	Ground Movement Curve Vertical	Ground Movement Curve Horizontal
1	0.0	0.0	0.0	8.0000	Installation of secant bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(b))	Installation of secant bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(a))
2	0.0	8.0000	11.400	9.3000	Installation of secant bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(b))	Installation of secant bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(a))
3	11.400	9.3000	11.400	0.0	No vertical ground movement	No horizontal ground movement
4	11.400	0.0	0.0	0.0	Installation of secant bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(b))	Installation of secant bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(a))

Excavation Name: **NEG SWIMMING POOL**
Surface level [m]: 50.000
Contribution: Negative
Enabled: Yes

Corner	x [m]	y [m]	Base Level [m]	Stiffened	Previous Side d [m]	Previous Side p1 [%]	Previous Side p2* [%]	Next Side d [m]	Next Side p1 [%]	Next Side p2* [%]
1	0.0	0.0	41.000	Yes	0.0	67.000	25.000	0.0	67.000	25.000
2	0.0	8.0000	41.000	Yes	0.0	67.000	25.000	0.0	67.000	25.000
3	11.400	9.3000	41.000	No	-	-	-	-	-	-
4	11.400	0.0	41.000	No	-	-	-	-	-	-

Side	Corner 1 x [m]	Corner 1 y [m]	Corner 2 x [m]	Corner 2 y [m]	Ground Movement Curve Vertical	Ground Movement Curve Horizontal
1	0.0	0.0	0.0	8.0000	Installation of secant bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(b))	Installation of secant bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(a))
2	0.0	8.0000	11.400	9.3000	Installation of secant bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(b))	Installation of secant bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(a))
3	11.400	9.3000	11.400	0.0	No vertical ground movement	No horizontal ground movement
4	11.400	0.0	0.0	0.0	Installation of secant bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(b))	Installation of secant bored pile wall in stiff clay (CIRIA 580 Fig. 2.8(a))

Damage Category Strains

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

Specific Structures - Geometry

Structure Name	Sub-Structure Name	Displacement Line	Start Distance Along Line [m]	End Distance Along Line [m]	Vertical Offsets from Line for Vertical Movement Calculations [m]	Vertical Displacement Limit Sensitivity [mm]	Damage Category Strains	Poisson's Ratio	E/G
No. 7 Wall A	No. 7 Wall A	No. 7 Wall A	0.00000	17.10000	0.0	0.00100	Burland Strain Limits	0.20000	2.6000
No. 7 Wall B	No. 7 Wall B	No. 7 Wall B	0.00000	17.10000	0.0	0.00100	Burland Strain Limits	0.20000	2.6000
No. 7 Wall C	No. 7 Wall C	No. 7 Wall C	0.00000	9.90000	0.0	0.00100	Burland Strain Limits	0.20000	2.6000
No. 7 Wall D	No. 7 Wall D	No. 7 Wall D	0.00000	9.30000	0.0	0.00100	Burland Strain Limits	0.20000	2.6000
No. 7 Wall E	No. 7 Wall E	No. 7 Wall E	0.00000	2.60000	0.0	0.00100	Burland Strain Limits	0.20000	2.6000
No. 7 Wall F	No. 7 Wall F	No. 7 Wall F	0.00000	4.20000	0.0	0.00100	Burland Strain Limits	0.20000	2.6000
No. 7 Wall G	No. 7 Wall G	No. 7 Wall G	0.00000	2.60000	0.0	0.00100	Burland Strain Limits	0.20000	2.6000
No. 25/26 Wall A	No. 25/26 Wall A	No. 25/26 Wall A	0.00000	17.00000	0.0	0.00100	Burland Strain Limits	0.20000	2.6000
No. 25/26 Wall B	No. 25/26 Wall B	No. 25/26 Wall B	0.00000	11.80000	0.0	0.00100	Burland Strain Limits	0.20000	2.6000
No. 25/26 Wall C	No. 25/26 Wall C	No. 25/26 Wall C	0.00000	5.10000	0.0	0.00100	Burland Strain Limits	0.20000	2.6000
No. 25/26 Wall D	No. 25/26 Wall D	No. 25/26 Wall D	0.00000	12.90000	0.0	0.00100	Burland Strain Limits	0.20000	2.6000
No. 25/26 Wall E	No. 25/26 Wall E	No. 25/26 Wall E	0.00000	12.90000	0.0	0.00100	Burland Strain Limits	0.20000	2.6000
No. 25/26 Wall F	No. 25/26 Wall F	No. 25/26 Wall F	0.00000	2.20000	0.0	0.00100	Burland Strain Limits	0.20000	2.6000
No. 25/26 Wall G	No. 25/26 Wall G	No. 25/26 Wall G	0.00000	10.70000	0.0	0.00100	Burland Strain Limits	0.20000	2.6000

Specific Structures - Bending Parameters

Structure Name	Sub-Structure Name	Height [m]	Default Properties	Hogging 2nd Moment of Area (per unit width) [m³]	Hogging Distance of Bending Strain from N.A. [m]	Hogging Distance from Edge of Beam in Tension [m]	Sagging 2nd Moment of Area (per unit width) [m³]	Sagging Distance of Bending Strain from N.A. [m]	Sagging Distance of N.A. from Edge of Beam in Tension [m]
No. 7 Wall A	No. 7 Wall A	7.0000	Yes	114.33	7.0000	7.0000	28.583	3.5000	3.5000
No. 7 Wall B	No. 7 Wall B	7.0000	Yes	114.33	7.0000	7.0000	28.583	3.5000	3.5000
No. 7 Wall C	No. 7 Wall C	7.0000	Yes	114.33	7.0000	7.0000	28.583	3.5000	3.5000
No. 7 Wall D	No. 7 Wall D	7.0000	Yes	114.33	7.0000	7.0000	28.583	3.5000	3.5000
No. 7 Wall E	No. 7 Wall E	3.0000	Yes	9.0000	3.0000	3.0000	2.2500	1.5000	1.5000
No. 7 Wall F	No. 7 Wall F	3.0000	Yes	9.0000	3.0000	3.0000	2.2500	1.5000	1.5000
No. 7 Wall G	No. 7 Wall G	3.0000	Yes	9.0000	3.0000	3.0000	2.2500	1.5000	1.5000
No. 25/26 Wall A	No. 25/26 Wall A	9.0000	Yes	243.00	9.0000	9.0000	60.750	4.5000	4.5000
No. 25/26 Wall B	No. 25/26 Wall B	9.0000	Yes	243.00	9.0000	9.0000	60.750	4.5000	4.5000
No. 25/26 Wall C	No. 25/26 Wall C	9.0000	Yes	243.00	9.0000	9.0000	60.750	4.5000	4.5000
No. 25/26 Wall D	No. 25/26 Wall D	9.0000	Yes	243.00	9.0000	9.0000	60.750	4.5000	4.5000

Structure Name	Sub-Structure Name	Height	Default Properties	Hogging			Sagging		
				2nd Moment of Area	Distance of Bending	Distance of N.A.	2nd Moment of Area	Distance of Bending	Distance of N.A.
E	E								
No. 25/26 Wall	No. 25/26 Wall	9.0000	Yes	243.00	9.0000	9.0000	60.750	4.5000	4.5000
F	F								
No. 25/26 Wall	No. 25/26 Wall	9.0000	Yes	243.00	9.0000	9.0000	60.750	4.5000	4.5000
G	G								

Building Segment Combinations

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

No structures have segments combined.

Displacement and Strain Results

Type/No. Name	Dist.	Coordinates x	y	z	Displacements x	y	z	Horizontal dispalcement along the Line	Horizontal displacement perpendicular to Line	Angle of Line to x Axis
	[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]	[mm]	[°]
No. 7 Wall Line 1 A		25.40000	-3.70000	50.00000	-0.26361	2.4995	2.2721	-2.4995	-0.26361	270.00
	1.0059	25.40000	-4.70588	50.00000	-0.26725	2.1725	2.1956	-2.1725	-0.26725	270.00
	2.0118	25.40000	-5.71176	50.00000	-0.26250	1.8752	2.1150	-1.8752	-0.26250	270.00
	3.0176	25.40000	-6.71765	50.00000	-0.24532	1.6004	2.0307	-1.6004	-0.24532	270.00
	4.0235	25.40000	-7.72353	50.00000	-0.21455	1.3410	1.9427	-1.3410	-0.21455	270.00
	5.0294	25.40000	-8.72941	50.00000	-0.17048	1.0898	1.8513	-1.0898	-0.17048	270.00
	6.0353	25.40000	-9.73529	50.00000	-0.11417	0.84040	1.7564	-0.84040	-0.11417	270.00
	7.0412	25.40000	-10.74118	50.00000	-0.046966	0.58679	1.6582	-0.58679	-0.046966	270.00
	8.0471	25.40000	-11.74706	50.00000	-0.0029861	0.35078	1.5263	-0.35078	-0.0029861	270.00
	9.0529	25.40000	-12.75294	50.00000	-0.0011773	0.15013	1.3425	-0.15013	-0.0011773	270.00
	10.059	25.40000	-13.75882	50.00000	0.0	0.0	1.1444	0.0	0.0	270.00
	11.065	25.40000	-14.76471	50.00000	0.0	0.0	0.93294	0.0	0.0	270.00
	12.071	25.40000	-15.77059	50.00000	0.0	0.0	0.70910	0.0	0.0	270.00
	13.076	25.40000	-16.77647	50.00000	0.0	0.0	0.47375	0.0	0.0	270.00
	14.082	25.40000	-17.78235	50.00000	0.0	0.0	0.22775	0.0	0.0	270.00
	15.088	25.40000	-18.78824	50.00000	0.0	0.0	0.084301	0.0	0.0	270.00
	16.094	25.40000	-19.79412	50.00000	0.0	0.0	0.0	0.0	0.0	270.00
	17.100	25.40000	-20.80000	50.00000	0.0	0.0	0.0	0.0	0.0	270.00
No. 7 Wall Line 2 B		15.40000	-3.70000	50.00000	-0.75184	5.0173	4.2878	-5.0406	-0.57544	272.01
	1.0065	15.43529	-4.70588	50.00000	-0.74716	4.5691	4.1466	-4.5925	-0.58648	272.01
	2.0130	15.47059	-5.71176	50.00000	-0.71048	4.1326	3.9808	-4.1549	-0.56513	272.01
	3.0195	15.50588	-6.71765	50.00000	-0.66027	3.7077	3.7967	-3.7286	-0.52985	272.01
	4.0260	15.54118	-7.72353	50.00000	-0.60669	3.2967	3.5991	-3.3160	-0.49071	272.01
	5.0325	15.57647	-8.72941	50.00000	-0.55508	2.9012	3.3915	-2.9188	-0.45301	272.01
	6.0390	15.61176	-9.73529	50.00000	-0.50820	2.5214	3.1763	-2.5376	-0.41947	272.01
	7.0455	15.64706	-10.74118	50.00000	-0.46742	2.1565	2.9551	-2.1716	-0.39152	272.01
	8.0520	15.68235	-11.74706	50.00000	-0.43341	1.8049	2.7294	-1.8190	-0.36985	272.01
	9.0585	15.71765	-12.75294	50.00000	-0.40643	1.4642	2.5000	-1.4775	-0.35484	272.01
	10.065	15.75294	-13.75882	50.00000	-0.30584	0.96670	2.2677	-0.97683	-0.27175	272.01
	11.072	15.78824	-14.76471	50.00000	-0.21226	0.71418	2.0329	-0.72119	-0.18709	272.01
	12.078	15.82353	-15.77059	50.00000	-0.12716	0.45336	1.7962	-0.45754	-0.11119	272.01
	13.085	15.85882	-16.77647	50.00000	-0.048715	0.18329	1.5578	-0.18489	-0.042258	272.01
	14.091	15.89412	-17.78235	50.00000	0.0	0.0	1.2461	0.0	0.0	272.01
	15.098	15.92941	-18.78824	50.00000	0.0	0.0	0.99242	0.0	0.0	272.01
	16.104	15.96471	-19.79412	50.00000	0.0	0.0	0.78862	0.0	0.0	272.01
	17.111	16.00000	-20.80000	50.00000	0.0	0.0	0.58092	0.0	0.0	272.01
No. 7 Wall Line 3 C		15.40000	-3.70000	50.00000	-0.75184	5.0173	4.2878	-0.75184	5.0173	0.0
	1.0000	16.40000	-3.70000	50.00000	-0.68134	4.8261	4.1834	-0.68134	4.8261	0.0
	2.0000	17.40000	-3.70000	50.00000	-0.60414	4.6944	4.1027	-0.60414	4.6944	0.0
	3.0000	18.40000	-3.70000	50.00000	-0.53140	4.6028	4.0393	-0.53140	4.6028	0.0
	4.0000	19.40000	-3.70000	50.00000	-0.46696	4.5379	3.9887	-0.46696	4.5379	0.0
	5.0000	20.40000	-3.70000	50.00000	-0.41165	4.4911	3.9475	-0.41165	4.4911	0.0
	6.0000	21.40000	-3.70000	50.00000	-0.36515	4.4570	3.9134	-0.36515	4.4570	0.0
	7.0000	22.40000	-3.70000	50.00000	-0.32678	4.4318	3.8849	-0.32678	4.4318	0.0
	8.0000	23.40000	-3.70000	50.00000	-0.29578	4.4131	3.8606	-0.29578	4.4131	0.0
	9.0000	24.40000	-3.70000	50.00000	-0.27069	4.3989	3.8398	-0.27069	4.3989	0.0
	10.000	25.40000	-3.70000	50.00000	-0.26361	2.4995	2.2721	-0.26361	2.4995	0.0
No. 7 Wall Line 4 D		16.00000	-20.80000	50.00000	0.0	0.0	0.58092	0.0	0.0	0.0
	0.94000	16.94000	-20.80000	50.00000	0.0	0.0	0.51619	0.0	0.0	0.0
	1.8800	17.88000	-20.80000	50.00000	0.0	0.0	0.44708	0.0	0.0	0.0
	2.8200	18.82000	-20.80000	50.00000	0.0	0.0	0.37454	0.0	0.0	0.0
	3.7600	19.76000	-20.80000	50.00000	0.0	0.0	0.29943	0.0	0.0	0.0
	4.7000	20.70000	-20.80000	50.00000	0.0	0.0	0.22255	0.0	0.0	0.0
	5.6400	21.64000	-20.80000	50.00000	0.0	0.0	0.14459	0.0	0.0	0.0
	6.5800	22.58000	-20.80000	50.00000	0.0	0.0	0.066160	0.0	0.0	0.0
	7.5200	23.52000	-20.80000	50.00000	0.0	0.0	0.0	0.0	0.0	0.0
	8.4600	24.46000	-20.80000	50.00000	0.0	0.0	0.0	0.0	0.0	0.0
	9.4000	25.40000	-20.80000	50.00000	0.0	0.0	0.0	0.0	0.0	0.0
No. 7 Wall Line 5 E		19.10000	-1.07500	50.00000	-0.17091	6.3242	4.3637	-6.3262	0.069963	272.18
	0.65673	19.12500	-1.73125	50.00000	-0.26595	5.8129	4.2777	-5.8188	-0.044470	272.18
	1.3135	19.15000	-2.38750	50.00000	-0.35003	5.3505	4.1885	-5.3600	-0.14609	272.18
	1.9702	19.17500	-3.04375	50.00000	-0.42130	4.9312	4.0954	-4.9437	-0.23328	272.18
	2.6269	19.20000	-3.70000	50.00000	-0.47912	4.5492	3.9980	-4.5641	-0.30560	272.18
No. 7 Wall Line 6 F		19.10000	-1.07500	50.00000	-0.17091	6.3242	4.3637	-0.20855	6.3231	359.66
	0.84001	19.94000	-1.08000	50.00000	-0.14959	6.3150	4.3501	-0.18717	6.3140	359.66
	1.6800	20.78000	-1.08500	50.00000	-0.13216	6.3071	4.3387	-0.16970	6.3062	359.66
	2.5200	21.62000	-1.09000	50.00000	-0.11785	6.3000	4.3290	-0.15535	6.2992	359.66
	3.3601	22.46000	-1.09500	50.00000	-0.10610	6.2937	4.3205	-0.14356	6.2929	359.66
	4.2001	23.30000	-1.10000	50.00000	-0.096501	6.2878	4.3130	-0.13393	6.2871	359.66
No. 7 Wall Line 7 G		23.30000	-1.10000	50.00000	-0.096501	6.2878	4.3130	-6.2878	-0.096501	270.00
	0.65000	23.30000	-1.75000	50.00000	-0.15155	5.7605	4.2019	-5.7605	-0.15155	270.00
	1.3000	23.30000	-2.40000	50.00000	-0.20402	5.2745	4.0900	-5.2745	-0.20402	270.00
	1.9500	23.30000	-3.05000	50.00000	-0.25321	4.8268	3.9771	-4.8268	-0.25321	270.00
	2.6000	23.30000	-3.70000	50.00000	-0.29857	4.4147	3.8629	-4.4147	-0.29857	270.00
No. 25/26 Wall A	Line 8	23.10000	10.30000	50.00000	-0.083819	-4.5826	3.1308	-4.5826	0.083819	90.000
	1.0000	23.10000	11.30000	50.00000	-0.16402	-4.0101	3.0260	-4.0101	0.16402	90.000
	2.0000	23.10000	12.30000	50.00000	-0.23754	-3.5090	2.9190	-3.5090	0.23754	90.000
	3.0000	23.10000	13.30000	50.00000	-0.30223	-3.0711	2.8092	-3.0711	0.30223	90.000
	4.0000	23.10000	14.30000	50.00000	-0.35711	-2.6881	2.6958	-2.6881	0.35711	90.000
	5.0000	23.10000	15.30000	50.00000	-0.40227	-2.3518	2.5784	-2.3518	0.40227	90.000
	6.0000	23.10000	16.30000	50.00000	-0.42594	-2.0471	2.4569	-2.0471	0.42594	90.000
	7.0000	23.10000	17.30000	50.00000	-0.39764	-1.7420	2.3311	-1.7420	0.39764	90.000
	8.0000	23.10000	18.30000	50.00000	-0.35209	-1.4441	2.2012	-1.4441	0.35209	90.000
	9.0000	23.10000	19.30000	50.00000	-0.29273	-1.1465	2.0674	-1.1465	0.29273	90.000
	10.000	23.10000	20.30000	50.00000	-0.22268	-0.84274	1.9299	-0.84274	0.22268	90.000
	11.000	23.10000	21.30000	50.00000	-0.14455	-0.52720	1.7889	-0.52720	0.14455	90.000
	12.000	23.10000	22.30000	50.00000	-0.060346	-0.19439	1.6448	-0.19439	0.060346	90.000
	13.000	23.10000	23.30000	50.00000	0.0	0.0	1.4659	0.0	0.0	90.000
	14.000	23.10000	24.30000	50.00000	0.0	0.0	1.2101	0.0	0.0	90.000
	15.000	23.10000	25.30000	50.00000	0.0	0.0	0.94202	0.0	0.0	90.000
	16.000	23.10000	26.30000	50.00000	0.0	0.0	0.66287	0.0	0.0	90.000
	17.000	23.10000	27.30000	50.00000	0.0	0.0	0.37367	0.0	0.0	90.000
No. 25/26 Wall B	Line 9	10.20000	10.30000	50.00000	0.98183	-8.6099	5.7176	-8.6099	-0.98183	90.000
	0.99167	10.20000	11.29167	50.00000	0.88693	-7.7777	5.4713	-7.7777	-0.88693	90.000
	1.9833	10.20000	12.28333	50.00000	0.79911	-7.0076	5.2250	-7.0076	-0.79911	90.000

Type/No. Name	Dist.	Coordinates x	y	z	Displacements x	y	z	Horizontal dispalcement	Horizontal displacement	Angle of Line to x Axis
	2.9750	10.20000	13.27500	50.00000	0.71789	-6.2953	4.9787	-6.2953	-0.71789	90.000
	3.9667	10.20000	14.26667	50.00000	0.64278	-5.6367	4.7323	-5.6367	-0.64278	90.000
	4.9583	10.20000	15.25833	50.00000	0.57331	-5.0275	4.4860	-5.0275	-0.57331	90.000
	5.9500	10.20000	16.25000	50.00000	0.50900	-4.4635	4.2397	-4.4635	-0.50900	90.000
	6.9417	10.20000	17.24167	50.00000	0.44937	-3.9406	3.9934	-3.9406	-0.44937	90.000
	7.9333	10.20000	18.23333	50.00000	0.39393	-3.4545	3.7471	-3.4545	-0.39393	90.000
	8.9250	10.20000	19.22500	50.00000	0.34222	-3.0010	3.5007	-3.0010	-0.34222	90.000
	9.9167	10.20000	20.21667	50.00000	0.28284	-2.5730	3.2508	-2.5730	-0.28284	90.000
	10.908	10.20000	21.20833	50.00000	0.21817	-2.1651	2.9962	-2.1651	-0.21817	90.000
	11.900	10.20000	22.20000	50.00000	0.16534	-1.7774	2.7426	-1.7774	-0.16534	90.000
No. 25/26 Wall C	Line 10	12.40000	22.20000	50.00000	-0.11052	-1.6379	2.6050	-1.6323	0.17462	92.246
	1.0208	12.36000	23.22000	50.00000	-0.087933	-1.2750	2.3576	-1.2706	0.13783	92.246
	2.0416	12.32000	24.24000	50.00000	-0.058772	-0.95441	2.1091	-0.95137	0.096126	92.246
	3.0624	12.28000	25.26000	50.00000	-0.035099	-0.63657	1.8598	-0.63470	0.060016	92.246
	4.0831	12.24000	26.28000	50.00000	-0.015741	-0.31818	1.6099	-0.31732	0.028197	92.246
	5.1039	12.20000	27.30000	50.00000	0.0	0.0	1.3553	0.0	0.0	92.246
No. 25/26 Wall D	Line 11	10.20000	10.30000	50.00000	0.98183	-8.6099	5.7176	0.98183	-8.6099	0.0
	0.99231	11.19231	10.30000	50.00000	0.99313	-8.7090	5.7457	0.99313	-8.7090	0.0
	1.9846	12.18462	10.30000	50.00000	-0.79923	-7.3840	5.0564	-0.79923	-7.3840	0.0
	2.9769	13.17692	10.30000	50.00000	-0.63144	-6.7207	4.7065	-0.63144	-6.7207	0.0
	3.9692	14.16923	10.30000	50.00000	-0.45189	-6.5285	4.5586	-0.45189	-6.5285	0.0
	4.9615	15.16154	10.30000	50.00000	-0.33915	-6.4555	4.4814	-0.33915	-6.4555	0.0
	5.9538	16.15385	10.30000	50.00000	-0.26537	-6.4211	4.4346	-0.26537	-6.4211	0.0
	6.9462	17.14615	10.30000	50.00000	-0.21397	-6.4026	4.4034	-0.21397	-6.4026	0.0
	7.9385	18.13846	10.30000	50.00000	-0.17636	-6.3915	4.3812	-0.17636	-6.3915	0.0
	8.9308	19.13077	10.30000	50.00000	-0.14788	-6.3845	4.3646	-0.14788	-6.3845	0.0
	9.9231	20.12308	10.30000	50.00000	-0.12579	-6.3797	4.3516	-0.12579	-6.3797	0.0
	10.915	21.11538	10.30000	50.00000	-0.10841	-6.3765	4.3413	-0.10841	-6.3765	0.0
	11.908	22.10769	10.30000	50.00000	-0.094665	-6.3742	4.3329	-0.094665	-6.3742	0.0
	12.900	23.10000	10.30000	50.00000	-0.083819	-4.5826	3.1308	-0.083819	-4.5826	0.0
No. 25/26 Wall E	Line 12	10.20000	18.00000	50.00000	0.40662	-3.5658	3.8050	0.40662	-3.5658	0.0
	0.99231	11.19231	18.00000	50.00000	0.084173	-3.5259	3.7445	0.084173	-3.5259	0.0
	1.9846	12.18462	18.00000	50.00000	-0.14784	-3.3922	3.6438	-0.14784	-3.3922	0.0
	2.9769	13.17692	18.00000	50.00000	-0.30262	-3.2345	3.5445	-0.30262	-3.2345	0.0
	3.9692	14.16923	18.00000	50.00000	-0.41828	-3.0670	3.4494	-0.41828	-3.0670	0.0
	4.9615	15.16154	18.00000	50.00000	-0.49638	-2.9010	3.3605	-0.49638	-2.9010	0.0
	5.9538	16.15385	18.00000	50.00000	-0.54214	-2.7451	3.2785	-0.54214	-2.7451	0.0
	6.9462	17.14615	18.00000	50.00000	-0.56256	-2.6046	3.2041	-0.56256	-2.6046	0.0
	7.9385	18.13846	18.00000	50.00000	-0.56477	-2.4821	3.1370	-0.56477	-2.4821	0.0
	8.9308	19.13077	18.00000	50.00000	-0.55515	-2.3777	3.0769	-0.55515	-2.3777	0.0
	9.9231	20.12308	18.00000	50.00000	-0.53889	-2.2904	3.0233	-0.53889	-2.2904	0.0
	10.915	21.11538	18.00000	50.00000	-0.51999	-2.2185	2.9754	-0.51999	-2.2185	0.0
	11.908	22.10769	18.00000	50.00000	-0.46867	-2.1337	2.9326	-0.46867	-2.1337	0.0
	12.900	23.10000	18.00000	50.00000	-0.36736	-1.5332	2.2406	-0.36736	-1.5332	0.0
No. 25/26 Wall F	Line 13	10.20000	22.20000	50.00000	0.16534	-1.7774	2.7426	0.16534	-1.7774	0.0
	0.73333	10.93333	22.20000	50.00000	0.063223	-1.7477	2.7040	0.063223	-1.7477	0.0
	1.4667	11.66667	22.20000	50.00000	-0.030697	-1.6972	2.6555	-0.030697	-1.6972	0.0
	2.2000	12.40000	22.20000	50.00000	-0.11052	-1.6379	2.6050	-0.11052	-1.6379	0.0
No. 25/26 Wall G	Line 14	12.40000	27.30000	50.00000	0.0	0.0	1.3432	0.0	0.0	0.0
	0.97273	13.37273	27.30000	50.00000	0.0	0.0	1.2783	0.0	0.0	0.0
	1.9455	14.34545	27.30000	50.00000	0.0	0.0	1.2044	0.0	0.0	0.0
	2.9182	15.31818	27.30000	50.00000	0.0	0.0	1.1231	0.0	0.0	0.0
	3.8909	16.29091	27.30000	50.00000	0.0	0.0	1.0361	0.0	0.0	0.0
	4.8636	17.26364	27.30000	50.00000	0.0	0.0	0.94489	0.0	0.0	0.0
	5.8364	18.23636	27.30000	50.00000	0.0	0.0	0.85074	0.0	0.0	0.0
	6.8091	19.20909	27.30000	50.00000	0.0	0.0	0.75491	0.0	0.0	0.0
	7.7818	20.18182	27.30000	50.00000	0.0	0.0	0.65846	0.0	0.0	0.0
	8.7545	21.15455	27.30000	50.00000	0.0	0.0	0.56230	0.0	0.0	0.0
	9.7273	22.12727	27.30000	50.00000	0.0	0.0	0.46717	0.0	0.0	0.0
	10.700	23.10000	27.30000	50.00000	0.0	0.0	0.37367	0.0	0.0	0.0

Specific Building Damage Results - Horizontal Displacements

Structure: No. 7 Wall A | Sub-structure: No. 7 Wall A

Dist.	Coordinates x	y	z	Displacements x	y	Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	25.40000	-3.70000	50.00000	-0.26361	2.4995	-2.4995	-0.26361
1.0059	25.40000	-4.70588	50.00000	-0.26725	2.1725	-2.1725	-0.26725
2.0118	25.40000	-5.71176	50.00000	-0.26250	1.8752	-1.8752	-0.26250
3.0176	25.40000	-6.71765	50.00000	-0.24532	1.6004	-1.6004	-0.24532
4.0235	25.40000	-7.72353	50.00000	-0.21455	1.3410	-1.3410	-0.21455
5.0294	25.40000	-8.72941	50.00000	-0.17048	1.0898	-1.0898	-0.17048
6.0353	25.40000	-9.73529	50.00000	-0.11417	0.84040	-0.84040	-0.11417
7.0412	25.40000	-10.74118	50.00000	-0.046966	0.58679	-0.58679	-0.046966
8.0471	25.40000	-11.74706	50.00000	-0.0029861	0.35078	-0.35078	-0.0029861
9.0529	25.40000	-12.75294	50.00000	-0.0011773	0.15013	-0.15013	-0.0011773
10.059	25.40000	-13.75882	50.00000	0.0	0.0	0.0	0.0
11.065	25.40000	-14.76471	50.00000	0.0	0.0	0.0	0.0
12.071	25.40000	-15.77059	50.00000	0.0	0.0	0.0	0.0
13.076	25.40000	-16.77647	50.00000	0.0	0.0	0.0	0.0
14.082	25.40000	-17.78235	50.00000	0.0	0.0	0.0	0.0
15.088	25.40000	-18.78824	50.00000	0.0	0.0	0.0	0.0
16.094	25.40000	-19.79412	50.00000	0.0	0.0	0.0	0.0
17.100	25.40000	-20.80000	50.00000	0.0	0.0	0.0	0.0

Structure: No. 7 Wall B | Sub-structure: No. 7 Wall B

Dist.	Coordinates x	y	z	Displacements x	y	Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	15.40000	-3.70000	50.00000	-0.75184	5.0173	-5.0406	-0.57544
1.0065	15.43529	-4.70588	50.00000	-0.74716	4.5691	-4.5925	-0.58648
2.0130	15.47059	-5.71176	50.00000	-0.71048	4.1326	-4.1549	-0.56513
3.0195	15.50588	-6.71765	50.00000	-0.66027	3.7077	-3.7286	-0.52985
4.0260	15.54118	-7.72353	50.00000	-0.60669	3.2967	-3.3160	-0.49071
5.0325	15.57647	-8.72941	50.00000	-0.55508	2.9012	-2.9188	-0.45301
6.0390	15.61176	-9.73529	50.00000	-0.50820	2.5214	-2.5376	-0.41947
7.0455	15.64706	-10.74118	50.00000	-0.46742	2.1565	-2.1716	-0.39152
8.0520	15.68235	-11.74706	50.00000	-0.43341	1.8049	-1.8190	-0.36985
9.0585	15.71765	-12.75294	50.00000	-0.40643	1.4642	-1.4775	-0.35484
10.065	15.75294	-13.75882	50.00000	-0.30584	0.96670	-0.97683	-0.27175
11.072	15.78824	-14.76471	50.00000	-0.21226	0.71418	-0.72119	-0.18709
12.078	15.82353	-15.77059	50.00000	-0.12716	0.45336	-0.45754	-0.11119
13.085	15.85882	-16.77647	50.00000	-0.048715	0.18329	-0.18489	-0.042258
14.091	15.89412	-17.78235	50.00000	0.0	0.0	0.0	0.0
15.098	15.92941	-18.78824	50.00000	0.0	0.0	0.0	0.0
16.104	15.96471	-19.79412	50.00000	0.0	0.0	0.0	0.0
17.111	16.00000	-20.80000	50.00000	0.0	0.0	0.0	0.0

Structure: No. 7 Wall C | Sub-structure: No. 7 Wall C

Dist.	Coordinates x	y	z	Displacements x	y	Horizontal displacement along the	Horizontal displacement perpendicular

							Line	to Line
[m]	[m]	[m]	[m]	[mm]	[mm]		[mm]	[mm]
0.0	15.40000	-3.70000	50.00000	-0.75184	5.0173		-0.75184	5.0173
1.0000	16.40000	-3.70000	50.00000	-0.68134	4.8261		-0.68134	4.8261
2.0000	17.40000	-3.70000	50.00000	-0.60414	4.6944		-0.60414	4.6944
3.0000	18.40000	-3.70000	50.00000	-0.53140	4.6028		-0.53140	4.6028
4.0000	19.40000	-3.70000	50.00000	-0.46696	4.5379		-0.46696	4.5379
5.0000	20.40000	-3.70000	50.00000	-0.41165	4.4911		-0.41165	4.4911
6.0000	21.40000	-3.70000	50.00000	-0.36515	4.4570		-0.36515	4.4570
7.0000	22.40000	-3.70000	50.00000	-0.32678	4.4318		-0.32678	4.4318
8.0000	23.40000	-3.70000	50.00000	-0.29578	4.4131		-0.29578	4.4131
9.0000	24.40000	-3.70000	50.00000	-0.27069	4.3989		-0.27069	4.3989
10.000	25.40000	-3.70000	50.00000	-0.26361	2.4995		-0.26361	2.4995

Structure: No. 7 Wall D | Sub-structure: No. 7 Wall D

Dist.	Coordinates			Displacements			
	x	y	z	x	y	Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	16.00000	-20.80000	50.00000	0.0	0.0	0.0	0.0
0.94000	16.94000	-20.80000	50.00000	0.0	0.0	0.0	0.0
1.8800	17.88000	-20.80000	50.00000	0.0	0.0	0.0	0.0
2.8200	18.82000	-20.80000	50.00000	0.0	0.0	0.0	0.0
3.7600	19.76000	-20.80000	50.00000	0.0	0.0	0.0	0.0
4.7000	20.70000	-20.80000	50.00000	0.0	0.0	0.0	0.0
5.6400	21.64000	-20.80000	50.00000	0.0	0.0	0.0	0.0
6.5800	22.58000	-20.80000	50.00000	0.0	0.0	0.0	0.0
7.5200	23.52000	-20.80000	50.00000	0.0	0.0	0.0	0.0
8.4600	24.46000	-20.80000	50.00000	0.0	0.0	0.0	0.0
9.4000	25.40000	-20.80000	50.00000	0.0	0.0	0.0	0.0

Structure: No. 7 Wall E | Sub-structure: No. 7 Wall E

Dist.	Coordinates			Displacements			
	x	y	z	x	y	Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	19.10000	-1.07500	50.00000	-0.17091	6.3242	-6.3262	0.069963
0.65673	19.12500	-1.73125	50.00000	-0.26595	5.8129	-5.8188	-0.044470
1.3135	19.15000	-2.38750	50.00000	-0.35003	5.3505	-5.3600	-0.14609
1.9702	19.17500	-3.04375	50.00000	-0.42130	4.9312	-4.9437	-0.23328
2.6269	19.20000	-3.70000	50.00000	-0.47912	4.5492	-4.5641	-0.30560

Structure: No. 7 Wall F | Sub-structure: No. 7 Wall F

Dist.	Coordinates			Displacements			
	x	y	z	x	y	Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	19.10000	-1.07500	50.00000	-0.17091	6.3242	-0.20855	6.3231
0.84001	19.94000	-1.08000	50.00000	-0.14959	6.3150	-0.18717	6.3140
1.6800	20.78000	-1.08500	50.00000	-0.13216	6.3071	-0.16970	6.3062
2.5200	21.62000	-1.09000	50.00000	-0.11785	6.3000	-0.15535	6.2992
3.3601	22.46000	-1.09500	50.00000	-0.10610	6.2937	-0.14356	6.2929
4.2001	23.30000	-1.10000	50.00000	-0.096501	6.2878	-0.13393	6.2871

Structure: No. 7 Wall G | Sub-structure: No. 7 Wall G

Dist.	Coordinates			Displacements			
	x	y	z	x	y	Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	23.30000	-1.10000	50.00000	-0.096501	6.2878	-6.2878	-0.096501
0.65000	23.30000	-1.75000	50.00000	-0.15155	5.7605	-5.7605	-0.15155
1.3000	23.30000	-2.40000	50.00000	-0.20402	5.2745	-5.2745	-0.20402
1.9500	23.30000	-3.05000	50.00000	-0.25321	4.8268	-4.8268	-0.25321
2.6000	23.30000	-3.70000	50.00000	-0.29857	4.4147	-4.4147	-0.29857

Structure: No. 25/26 Wall A | Sub-structure: No. 25/26 Wall A

Dist.	Coordinates			Displacements			
	x	y	z	x	y	Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	23.10000	10.30000	50.00000	-0.083819	-4.5826	-4.5826	0.083819
1.0000	23.10000	11.30000	50.00000	-0.16402	-4.0101	-4.0101	0.16402
2.0000	23.10000	12.30000	50.00000	-0.23754	-3.5090	-3.5090	0.23754
3.0000	23.10000	13.30000	50.00000	-0.30223	-3.0711	-3.0711	0.30223
4.0000	23.10000	14.30000	50.00000	-0.35711	-2.6881	-2.6881	0.35711
5.0000	23.10000	15.30000	50.00000	-0.40227	-2.3518	-2.3518	0.40227
6.0000	23.10000	16.30000	50.00000	-0.42594	-2.0471	-2.0471	0.42594
7.0000	23.10000	17.30000	50.00000	-0.39764	-1.7420	-1.7420	0.39764
8.0000	23.10000	18.30000	50.00000	-0.35209	-1.4441	-1.4441	0.35209
9.0000	23.10000	19.30000	50.00000	-0.29273	-1.1465	-1.1465	0.29273
10.000	23.10000	20.30000	50.00000	-0.22268	-0.84274	-0.84274	0.22268
11.000	23.10000	21.30000	50.00000	-0.14455	-0.52720	-0.52720	0.14455
12.000	23.10000	22.30000	50.00000	-0.060346	-0.19439	-0.19439	0.060346
13.000	23.10000	23.30000	50.00000	0.0	0.0	0.0	0.0
14.000	23.10000	24.30000	50.00000	0.0	0.0	0.0	0.0
15.000	23.10000	25.30000	50.00000	0.0	0.0	0.0	0.0
16.000	23.10000	26.30000	50.00000	0.0	0.0	0.0	0.0
17.000	23.10000	27.30000	50.00000	0.0	0.0	0.0	0.0

Structure: No. 25/26 Wall B | Sub-structure: No. 25/26 Wall B

Dist.	Coordinates			Displacements			
	x	y	z	x	y	Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	10.20000	10.30000	50.00000	0.98183	-8.6099	-8.6099	-0.98183
0.99167	10.20000	11.29167	50.00000	0.88693	-7.7777	-7.7777	-0.88693
1.9833	10.20000	12.28333	50.00000	0.79911	-7.0076	-7.0076	-0.79911
2.9750	10.20000	13.27500	50.00000	0.71789	-6.2953	-6.2953	-0.71789
3.9667	10.20000	14.26667	50.00000	0.64278	-5.6367	-5.6367	-0.64278
4.9583	10.20000	15.25833	50.00000	0.57331	-5.0275	-5.0275	-0.57331
5.9500	10.20000	16.25000	50.00000	0.50900	-4.4635	-4.4635	-0.50900
6.9417	10.20000	17.24167	50.00000	0.44937	-3.9406	-3.9406	-0.44937
7.9333	10.20000	18.23333	50.00000	0.39393	-3.4545	-3.4545	-0.39393
8.9250	10.20000	19.22500	50.00000	0.34222	-3.0010	-3.0010	-0.34222
9.9167	10.20000	20.21667	50.00000	0.28284	-2.5730	-2.5730	-0.28284
10.908	10.20000	21.20833	50.00000	0.21817	-2.1651	-2.1651	-0.21817
11.900	10.20000	22.20000	50.00000	0.16534	-1.7774	-1.7774	-0.16534

Dist.	Coordinates x	y	z	Displacements x	y	Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	12.40000	22.20000	50.00000	-0.11052	-1.6379	-1.6323	0.17462
1.0208	12.36000	23.22000	50.00000	-0.087933	-1.2750	-1.2706	0.13783
2.0416	12.32000	24.24000	50.00000	-0.058772	-0.95441	-0.95137	0.096126
3.0624	12.28000	25.26000	50.00000	-0.035099	-0.63657	-0.63470	0.060016
4.0831	12.24000	26.28000	50.00000	-0.015741	-0.31818	-0.31732	0.028197
5.1039	12.20000	27.30000	50.00000	0.0	0.0	0.0	0.0

Structure: No. 25/26 Wall C | Sub-structure: No. 25/26 Wall C

Dist.	Coordinates x	y	z	Displacements x	y	Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	10.20000	10.30000	50.00000	0.98183	-8.6099	0.98183	-8.6099
0.99231	11.19231	10.30000	50.00000	0.99313	-8.7090	0.99313	-8.7090
1.9846	12.18462	10.30000	50.00000	-0.79923	-7.3840	-0.79923	-7.3840
2.9769	13.17692	10.30000	50.00000	-0.63144	-6.7207	-0.63144	-6.7207
3.9692	14.16923	10.30000	50.00000	-0.45189	-6.5285	-0.45189	-6.5285
4.9615	15.16154	10.30000	50.00000	-0.33915	-6.4555	-0.33915	-6.4555
5.9538	16.15385	10.30000	50.00000	-0.26537	-6.4211	-0.26537	-6.4211
6.9462	17.14615	10.30000	50.00000	-0.21397	-6.4026	-0.21397	-6.4026
7.9385	18.13846	10.30000	50.00000	-0.17636	-6.3915	-0.17636	-6.3915
8.9308	19.13077	10.30000	50.00000	-0.14788	-6.3845	-0.14788	-6.3845
9.9231	20.12308	10.30000	50.00000	-0.12579	-6.3797	-0.12579	-6.3797
10.915	21.11538	10.30000	50.00000	-0.10841	-6.3765	-0.10841	-6.3765
11.908	22.10769	10.30000	50.00000	-0.094665	-6.3742	-0.094665	-6.3742
12.900	23.10000	10.30000	50.00000	-0.083819	-4.5826	-0.083819	-4.5826

Structure: No. 25/26 Wall D | Sub-structure: No. 25/26 Wall D

Dist.	Coordinates x	y	z	Displacements x	y	Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	10.20000	18.00000	50.00000	0.40662	-3.5658	0.40662	-3.5658
0.99231	11.19231	18.00000	50.00000	0.084173	-3.5259	0.084173	-3.5259
1.9846	12.18462	18.00000	50.00000	-0.14784	-3.3922	-0.14784	-3.3922
2.9769	13.17692	18.00000	50.00000	-0.30262	-3.2345	-0.30262	-3.2345
3.9692	14.16923	18.00000	50.00000	-0.41828	-3.0670	-0.41828	-3.0670
4.9615	15.16154	18.00000	50.00000	-0.49638	-2.9010	-0.49638	-2.9010
5.9538	16.15385	18.00000	50.00000	-0.54214	-2.7451	-0.54214	-2.7451
6.9462	17.14615	18.00000	50.00000	-0.56256	-2.6046	-0.56256	-2.6046
7.9385	18.13846	18.00000	50.00000	-0.56477	-2.4821	-0.56477	-2.4821
8.9308	19.13077	18.00000	50.00000	-0.55515	-2.3777	-0.55515	-2.3777
9.9231	20.12308	18.00000	50.00000	-0.53889	-2.2904	-0.53889	-2.2904
10.915	21.11538	18.00000	50.00000	-0.51999	-2.2185	-0.51999	-2.2185
11.908	22.10769	18.00000	50.00000	-0.46867	-2.1337	-0.46867	-2.1337
12.900	23.10000	18.00000	50.00000	-0.36736	-1.5332	-0.36736	-1.5332

Structure: No. 25/26 Wall E | Sub-structure: No. 25/26 Wall E

Dist.	Coordinates x	y	z	Displacements x	y	Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	10.20000	22.20000	50.00000	0.16534	-1.7774	0.16534	-1.7774
0.73333	10.93333	22.20000	50.00000	0.063223	-1.7477	0.063223	-1.7477
1.4667	11.66667	22.20000	50.00000	-0.030697	-1.6972	-0.030697	-1.6972
2.2000	12.40000	22.20000	50.00000	-0.11052	-1.6379	-0.11052	-1.6379

Structure: No. 25/26 Wall F | Sub-structure: No. 25/26 Wall F

Dist.	Coordinates x	y	z	x	y	Displacements Horizontal displacement along the Line	Horizontal displacement perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	12.40000	27.30000	50.00000	0.0	0.0	0.0	0.0
0.97273	13.37273	27.30000	50.00000	0.0	0.0	0.0	0.0
1.9455	14.34545	27.30000	50.00000	0.0	0.0	0.0	0.0
2.9182	15.31818	27.30000	50.00000	0.0	0.0	0.0	0.0
3.8909	16.29091	27.30000	50.00000	0.0	0.0	0.0	0.0
4.8636	17.26364	27.30000	50.00000	0.0	0.0	0.0	0.0
5.8364	18.23636	27.30000	50.00000	0.0	0.0	0.0	0.0
6.8091	19.20909	27.30000	50.00000	0.0	0.0	0.0	0.0
7.7818	20.18182	27.30000	50.00000	0.0	0.0	0.0	0.0
8.7545	21.15455	27.30000	50.00000	0.0	0.0	0.0	0.0
9.7273	22.12727	27.30000	50.00000	0.0	0.0	0.0	0.0
10.700	23.10000	27.30000	50.00000	0.0	0.0	0.0	0.0

Specific Building Damage Results - Vertical Displacements

Structure: No. 7 Wall A | Sub-structure: No. 7 Wall A

Dist.	Coordinates x	y	z	Displacements z
[m]	[m]	[m]	[m]	[mm]
Vertical Offset 1				
0.0	25.40000	-3.70000	50.00000	2.2721
1.0059	25.40000	-4.70588	50.00000	2.1956
2.0118	25.40000	-5.71176	50.00000	2.1150
3.0176	25.40000	-6.71765	50.00000	2.0307
4.0235	25.40000	-7.72353	50.00000	1.9427
5.0294	25.40000	-8.72941	50.00000	1.8513
6.0353	25.40000	-9.73529	50.00000	1.7564
7.0412	25.40000	-10.74118	50.00000	1.6582
8.0471	25.40000	-11.74706	50.00000	1.5263
9.0529	25.40000	-12.75294	50.00000	1.3425
10.059	25.40000	-13.75882	50.00000	1.1444
11.065	25.40000	-14.76471	50.00000	0.93294
12.071	25.40000	-15.77059	50.00000	0.70910
13.076	25.40000	-16.77647	50.00000	0.47375
14.082	25.40000	-17.78235	50.00000	0.22775
15.088	25.40000	-18.78824	50.00000	0.084301
16.094	25.40000	-19.79412	50.00000	0.0
17.100	25.40000	-20.80000	50.00000	0.0

Dist.	Coordinates x	y	z	Displacements z
[m]	[m]	[m]	[m]	[mm]

Structure: No. 7 Wall B | Sub-structure: No. 7 Wall B

Dist.	Coordinates x	y	z	Displacements z
[m]	[m]	[m]	[m]	[mm]
Vertical Offset 1				
0.0	15.40000	-3.70000	50.00000	4.2878
1.0065	15.43529	-4.70588	50.00000	4.1466
2.0130	15.47059	-5.71176	50.00000	3.9808
3.0195	15.50588	-6.71765	50.00000	3.7967
4.0260	15.54118	-7.72353	50.00000	3.5991
5.0325	15.57647	-8.72941	50.00000	3.3915
6.0390	15.61176	-9.73529	50.00000	3.1763
7.0455	15.64706	-10.74118	50.00000	2.9551
8.0520	15.68235	-11.74706	50.00000	2.7294
9.0585	15.71765	-12.75294	50.00000	2.5000
10.065	15.75294	-13.75882	50.00000	2.2677
11.072	15.78824	-14.76471	50.00000	2.0329
12.078	15.82353	-15.77059	50.00000	1.7962
13.085	15.85882	-16.77647	50.00000	1.5578
14.091	15.89412	-17.78235	50.00000	1.2461
15.098	15.92941	-18.78824	50.00000	0.99242
16.104	15.96471	-19.79412	50.00000	0.78862
17.111	16.00000	-20.80000	50.00000	0.58092

Structure: No. 7 Wall C | Sub-structure: No. 7 Wall C

Dist.	Coordinates x	y	z	Displacements z
[m]	[m]	[m]	[m]	[mm]
Vertical Offset 1				
0.0	15.40000	-3.70000	50.00000	4.2878
1.0000	16.40000	-3.70000	50.00000	4.1834
2.0000	17.40000	-3.70000	50.00000	4.1027
3.0000	18.40000	-3.70000	50.00000	4.0393
4.0000	19.40000	-3.70000	50.00000	3.9887
5.0000	20.40000	-3.70000	50.00000	3.9475
6.0000	21.40000	-3.70000	50.00000	3.9134
7.0000	22.40000	-3.70000	50.00000	3.8849
8.0000	23.40000	-3.70000	50.00000	3.8606
9.0000	24.40000	-3.70000	50.00000	3.8398
10.000	25.40000	-3.70000	50.00000	2.2721

Structure: No. 7 Wall D | Sub-structure: No. 7 Wall D

Dist.	Coordinates x	y	z	Displacements z
[m]	[m]	[m]	[m]	[mm]
Vertical Offset 1				
0.0	16.00000	-20.80000	50.00000	0.58092
0.94000	16.94000	-20.80000	50.00000	0.51619
1.8800	17.88000	-20.80000	50.00000	0.44708
2.8200	18.82000	-20.80000	50.00000	0.37454
3.7600	19.76000	-20.80000	50.00000	0.29943
4.7000	20.70000	-20.80000	50.00000	0.22255
5.6400	21.64000	-20.80000	50.00000	0.14459
6.5800	22.58000	-20.80000	50.00000	0.066160
7.5200	23.52000	-20.80000	50.00000	0.0
8.4600	24.46000	-20.80000	50.00000	0.0
9.4000	25.40000	-20.80000	50.00000	0.0

Structure: No. 7 Wall E | Sub-structure: No. 7 Wall E

Dist.	Coordinates x	y	z	Displacements z
[m]	[m]	[m]	[m]	[mm]
Vertical Offset 1				
0.0	19.10000	-1.07500	50.00000	4.3637
0.65673	19.12500	-1.73125	50.00000	4.2777
1.3135	19.15000	-2.38750	50.00000	4.1885
1.9702	19.17500	-3.04375	50.00000	4.0954
2.6269	19.20000	-3.70000	50.00000	3.9980

Structure: No. 7 Wall F | Sub-structure: No. 7 Wall F

Dist.	Coordinates x	y	z	Displacements z
[m]	[m]	[m]	[m]	[mm]
Vertical Offset 1				
0.0	19.10000	-1.07500	50.00000	4.3637
0.84001	19.94000	-1.08000	50.00000	4.3501
1.6800	20.78000	-1.08500	50.00000	4.3387
2.5200	21.62000	-1.09000	50.00000	4.3290
3.3601	22.46000	-1.09500	50.00000	4.3205
4.2001	23.30000	-1.10000	50.00000	4.3130

Structure: No. 7 Wall G | Sub-structure: No. 7 Wall G

Dist.	Coordinates x	y	z	Displacements z
[m]	[m]	[m]	[m]	[mm]
Vertical Offset 1				
0.0	23.30000	-1.10000	50.00000	4.3130
0.65000	23.30000	-1.75000	50.00000	4.2019
1.3000	23.30000	-2.40000	50.00000	4.0900
1.9500	23.30000	-3.05000	50.00000	3.9771
2.6000	23.30000	-3.70000	50.00000	3.8629

Structure: No. 25/26 Wall A | Sub-structure: No. 25/26 Wall A

Dist.	Coordinates x	y	z	Displacements z
[m]	[m]	[m]	[m]	[mm]
Vertical Offset 1				
0.0	23.10000	10.30000	50.00000	3.1308
1.0000	23.10000	11.30000	50.00000	3.0260
2.0000	23.10000	12.30000	50.00000	2.9190
3.0000	23.10000	13.30000	50.00000	2.8092
4.0000	23.10000	14.30000	50.00000	2.6958
5.0000	23.10000	15.30000	50.00000	2.5784
6.0000	23.10000	16.30000	50.00000	2.4569
7.0000	23.10000	17.30000	50.00000	2.3311
8.0000	23.10000	18.30000	50.00000	2.2012
9.0000	23.10000	19.30000	50.00000	2.0674
10.000	23.10000	20.30000	50.00000	1.9299
11.000	23.10000	21.30000	50.00000	1.7889
12.000	23.10000	22.30000	50.00000	1.6448
13.000	23.10000	23.30000	50.00000	1.4659

Dist.	Coordinates x	y	z	Displacements z
[m]	[m]	[m]	[m]	[mm]
14.000	23.10000	24.30000	50.00000	1.2101
15.000	23.10000	25.30000	50.00000	0.94202
16.000	23.10000	26.30000	50.00000	0.66287
17.000	23.10000	27.30000	50.00000	0.37367

Structure: No. 25/26 Wall B | Sub-structure: No. 25/26 Wall B

Dist.	Coordinates x	y	z	Displacements z
[m]	[m]	[m]	[m]	[mm]
Vertical Offset 1				
0.0	10.20000	10.30000	50.00000	5.7176
0.99167	10.20000	11.29167	50.00000	5.4713
1.9833	10.20000	12.28333	50.00000	5.2250
2.9750	10.20000	13.27500	50.00000	4.9787
3.9667	10.20000	14.26667	50.00000	4.7323
4.9583	10.20000	15.25833	50.00000	4.4860
5.9500	10.20000	16.25000	50.00000	4.2397
6.9417	10.20000	17.24167	50.00000	3.9934
7.9333	10.20000	18.23333	50.00000	3.7471
8.9250	10.20000	19.22500	50.00000	3.5007
9.9167	10.20000	20.21667	50.00000	3.2508
10.908	10.20000	21.20833	50.00000	2.9962
11.900	10.20000	22.20000	50.00000	2.7426

Structure: No. 25/26 Wall C | Sub-structure: No. 25/26 Wall C

Dist.	Coordinates x	y	z	Displacements z
[m]	[m]	[m]	[m]	[mm]
Vertical Offset 1				
0.0	12.40000	22.20000	50.00000	2.6050
1.0208	12.36000	23.22000	50.00000	2.3576
2.0416	12.32000	24.24000	50.00000	2.1091
3.0624	12.28000	25.26000	50.00000	1.8598
4.0831	12.24000	26.28000	50.00000	1.6099
5.1039	12.20000	27.30000	50.00000	1.3553

Structure: No. 25/26 Wall D | Sub-structure: No. 25/26 Wall D

Dist.	Coordinates x	y	z	Displacements z
[m]	[m]	[m]	[m]	[mm]
Vertical Offset 1				
0.0	10.20000	10.30000	50.00000	5.7176
0.99231	11.19231	10.30000	50.00000	5.7457
1.9846	12.18462	10.30000	50.00000	5.0564
2.9769	13.17692	10.30000	50.00000	4.7065
3.9692	14.16923	10.30000	50.00000	4.5586
4.9615	15.16154	10.30000	50.00000	4.4814
5.9538	16.15385	10.30000	50.00000	4.4346
6.9462	17.14615	10.30000	50.00000	4.4034
7.9385	18.13846	10.30000	50.00000	4.3812
8.9308	19.13077	10.30000	50.00000	4.3646
9.9231	20.12308	10.30000	50.00000	4.3516
10.915	21.11538	10.30000	50.00000	4.3413
11.908	22.10769	10.30000	50.00000	4.3329
12.900	23.10000	10.30000	50.00000	3.1308

Structure: No. 25/26 Wall E | Sub-structure: No. 25/26 Wall E

Dist.	Coordinates x	y	z	Displacements z
[m]	[m]	[m]	[m]	[mm]
Vertical Offset 1				
0.0	10.20000	18.00000	50.00000	3.8050
0.99231	11.19231	18.00000	50.00000	3.7445
1.9846	12.18462	18.00000	50.00000	3.6438
2.9769	13.17692	18.00000	50.00000	3.5445
3.9692	14.16923	18.00000	50.00000	3.4494
4.9615	15.16154	18.00000	50.00000	3.3605
5.9538	16.15385	18.00000	50.00000	3.2785
6.9462	17.14615	18.00000	50.00000	3.2041
7.9385	18.13846	18.00000	50.00000	3.1370
8.9308	19.13077	18.00000	50.00000	3.0769
9.9231	20.12308	18.00000	50.00000	3.0233
10.915	21.11538	18.00000	50.00000	2.9754
11.908	22.10769	18.00000	50.00000	2.9326
12.900	23.10000	18.00000	50.00000	2.2406

Structure: No. 25/26 Wall F | Sub-structure: No. 25/26 Wall F

Dist.	Coordinates x	y	z	Displacements z
[m]	[m]	[m]	[m]	[mm]
Vertical Offset 1				
0.0	10.20000	22.20000	50.00000	2.7426
0.73333	10.93333	22.20000	50.00000	2.7040
1.4667	11.66667	22.20000	50.00000	2.6555
2.2000	12.40000	22.20000	50.00000	2.6050

Structure: No. 25/26 Wall G | Sub-structure: No. 25/26 Wall G

Dist.	Coordinates x	y	z	Displacements z
[m]	[m]	[m]	[m]	[mm]
Vertical Offset 1				
0.0	12.40000	27.30000	50.00000	1.3432
0.97273	13.37273	27.30000	50.00000	1.2783
1.9455	14.34545	27.30000	50.00000	1.2044
2.9182	15.31818	27.30000	50.00000	1.1231
3.8909	16.29091	27.30000	50.00000	1.0361
4.8636	17.26364	27.30000	50.00000	0.94489
5.8364	18.23636	27.30000	50.00000	0.85074
6.8091	19.20909	27.30000	50.00000	0.75491
7.7818	20.18182	27.30000	50.00000	0.65846
8.7545	21.15455	27.30000	50.00000	0.56230
9.7273	22.12727	27.30000	50.00000	0.46717
10.700	23.10000	27.30000	50.00000	0.37367

Specific Building Damage Results - All Segments

Structure: No. 7 Wall A | Sub-structure: No. 7 Wall A

Vertical Offset from Line for Vertical Movement	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement	Maximum Gradient of Vertical Displacement	Min. Radius of Curvature	Damage Category

Vertical Offset from Line for Vertical Movement Calculations [m]	Segment	Start [m]	Length [m]	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 [m]	Damage Category
0.0	1	0.0	12.471	Sagging	0.0025904	0.020043	0.023957	-324.94E-6	233.97E-6	26793.	0 (Negligible)
	2	12.471	2.6174	Hogging	0.0023153	0.0	0.0022947	0.0	244.56E-6	13263.	0 (Negligible)

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

Structure: No. 7 Wall B | Sub-structure: No. 7 Wall B

Vertical Offset from Line for Vertical Movement Calculations [m]	Segment	Start [m]	Length [m]	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 [m]	Damage Category
0.0	1	0.0	13.582	Sagging	0.0012682	0.036424	0.038351	-497.20E-6	309.64E-6	38551.	0 (Negligible)
	2	13.582	2.8744	Hogging	0.0016901	0.0032548	0.0038728	-183.66E-6	309.64E-6	26408.	0 (Negligible)
	3	16.456	0.64392	None	0.0	0.0	0.0	0.0	206.36E-6	58542.	0 (Negligible)

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

Structure: No. 7 Wall C | Sub-structure: No. 7 Wall C

Vertical Offset from Line for Vertical Movement Calculations [m]	Segment	Start [m]	Length [m]	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 [m]	Damage Category
0.0	1	0.0	7.0107	Hogging	0.0010810	0.0060678	0.0068503	-77.188E-6	104.45E-6	39388.	0 (Negligible)
	2	7.0107	2.8893	Sagging	0.033060	0.0021501	0.032562	-30.995E-6	0.0015677	496.34	0 (Negligible)

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

Structure: No. 7 Wall D | Sub-structure: No. 7 Wall D

Vertical Offset from Line for Vertical Movement Calculations [m]	Segment	Start [m]	Length [m]	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 [m]	Damage Category
0.0	1	0.0	4.9823	Sagging	204.81E-6	0.0	198.52E-6	0.0	82.939E-6	191560.	0 (Negligible)
	2	4.9823	1.5977	Sagging	11.962E-6	0.0	11.837E-6	0.0	83.435E-6	39170.	0 (Negligible)

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

Structure: No. 7 Wall E | Sub-structure: No. 7 Wall E

Vertical Offset from Line for Vertical Movement Calculations [m]	Segment	Start [m]	Length [m]	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 [m]	Damage Category
0.0	1	0.0	2.6000	Sagging	289.98E-6	0.067173	0.067498	-771.93E-6	148.26E-6	95277.	1 (Very Slight)

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

Structure: No. 7 Wall F | Sub-structure: No. 7 Wall F

Vertical Offset from Line for Vertical Movement Calculations [m]	Segment	Start [m]	Length [m]	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 [m]	Damage Category
0.0	1	0.0	4.2000	Hogging	112.09E-6	0.0017768	0.0018840	-25.450E-6	16.173E-6	305340.	0 (Negligible)

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

Structure: No. 7 Wall G | Sub-structure: No. 7 Wall G

Vertical Offset from Line for Vertical Movement Calculations [m]	Segment	Start [m]	Length [m]	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 [m]	Damage Category
0.0	1	0.0	2.6000	Sagging	80.905E-6	0.072040	0.072131	-810.50E-6	175.63E-6	314530.	1 (Very Slight)

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

Structure: No. 25/26 Wall A | Sub-structure: No. 25/26 Wall A

Vertical Offset from Line for Vertical Movement Calculations [m]	Segment	Start [m]	Length [m]	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 [m]	Damage Category
0.0	1	0.0	17.000	Sagging	0.0027054	0.026956	0.031062	-572.10E-6	289.21E-6	20354.	0 (Negligible)

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

Structure: No. 25/26 Wall B | Sub-structure: No. 25/26 Wall B

Vertical Offset from Line for Vertical Movement Calculations [m]	Segment	Start [m]	Length [m]	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 [m]	Damage Category
0.0	1	0.0	11.003	Sagging	93.509E-6	0.058910	0.059037	-838.45E-6	256.65E-6	329260.	1 (Very Slight)
	2	11.003	0.79700	Sagging	0.0	0.039091	0.039091	-390.76E-6	255.63E-6	405730.	0 (Negligible)

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

Structure: No. 25/26 Wall C | Sub-structure: No. 25/26 Wall C

Vertical Offset from Line for Vertical Movement Calculations [m]	Segment	Start [m]	Length [m]	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 [m]	Damage Category

[m]		[m]	[m]		[%]	[%]	[%]			[m]	
0.0	1	0.0	5.1000	Sagging	91.071E-6	0.031982	0.032056	-354.24E-6	249.30E-6	186840.	0 (Negligible)

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

Structure: No. 25/26 Wall D | Sub-structure: No. 25/26 Wall D

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]	
0.0	1	0.0	1.9026	Sagging	0.017949	-0.085823	0.020137	0.0018095	695.92E-6	1000.0	0 (Negligible)
	2	1.9026	8.0295	Hogging	0.0044581	0.0065431	0.0094540	0.0018095	695.92E-6	4908.3	0 (Negligible)
	3	9.9321	2.9679	Sagging	0.026670	0.0014087	0.026524	-17.510E-6	0.0012114	659.73	0 (Negligible)

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

Structure: No. 25/26 Wall E | Sub-structure: No. 25/26 Wall E

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]	
0.0	1	0.0	2.6525	Sagging	935.23E-6	-0.024831	0.0049942	325.06E-6	101.54E-6	19433.	0 (Negligible)
	2	2.6525	7.3055	Hogging	649.36E-6	-0.0039177	864.71E-6	156.00E-6	100.11E-6	134000.	0 (Negligible)
	3	9.9580	2.9420	Sagging	0.014431	0.0058079	0.016795	-102.09E-6	697.31E-6	1211.6	0 (Negligible)

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

Structure: No. 25/26 Wall F | Sub-structure: No. 25/26 Wall F

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]	
0.0	1	0.0	2.2000	Sagging	330.52E-6	-0.012539	0.0025149	139.27E-6	68.859E-6	45213.	0 (Negligible)

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

Structure: No. 25/26 Wall G | Sub-structure: No. 25/26 Wall G

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]	
0.0	1	0.0	7.5175	Sagging	472.02E-6	0.0	514.52E-6	0.0	99.150E-6	100820.	0 (Negligible)
	2	7.5175	3.1825	Hogging	48.821E-6	0.0	48.459E-6	0.0	99.150E-6	531430.	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: No. 7 Wall A | Sub-structure: No. 7 Wall A

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	0.0025904	0.020043	244.56E-6	2.2721	0.023957	-324.94E-6	244.56E-6	13263.	26793.	0 (Negligible)

Structure: No. 7 Wall B | Sub-structure: No. 7 Wall B

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	0.0016901	0.036424	309.64E-6	4.2878	0.038351	-497.20E-6	309.64E-6	26408.	38551.	0 (Negligible)

Structure: No. 7 Wall C | Sub-structure: No. 7 Wall C

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	0.033060	0.0060678	0.0015677	4.2878	0.032562	-77.188E-6	0.0015677	39388.	496.34	0 (Negligible)

Structure: No. 7 Wall D | Sub-structure: No. 7 Wall D

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	204.81E-6	0.0	83.435E-6	0.58092	198.52E-6	0.0	83.435E-6	-	39170.	0 (Negligible)

Structure: No. 7 Wall E | Sub-structure: No. 7 Wall E

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	289.98E-6	0.067173	148.26E-6	4.3637	0.067498	-771.93E-6	148.26E-6	-	95277.	1 (Very Slight)

Vertical Offset from Line for Vertical	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	112.09E-6	0.0017768	16.173E-6	4.3637	0.0018840	-25.450E-6	16.173E-6	305340.	-	0 (Negligible)

Structure: No. 7 Wall G | Sub-structure: No. 7 Wall G

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	80.905E-6	0.072040	175.63E-6	4.3130	0.072131	-810.50E-6	175.63E-6	-	314530.	1 (Very Slight)

Structure: No. 25/26 Wall A | Sub-structure: No. 25/26 Wall A

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	0.0027054	0.026956	289.21E-6	3.1308	0.031062	-572.10E-6	289.21E-6	-	20354.	0 (Negligible)

Structure: No. 25/26 Wall B | Sub-structure: No. 25/26 Wall B

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	93.509E-6	0.058910	256.65E-6	5.7176	0.059037	-838.45E-6	256.65E-6	-	329260.	1 (Very Slight)

Structure: No. 25/26 Wall C | Sub-structure: No. 25/26 Wall C

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	91.071E-6	0.031982	249.30E-6	2.6050	0.032056	-354.24E-6	249.30E-6	-	186840.	0 (Negligible)

Structure: No. 25/26 Wall D | Sub-structure: No. 25/26 Wall D

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	0.026670	-0.085823	0.0012114	5.7454	0.026524	0.0018095	0.0012114	4908.3	659.73	0 (Negligible)

Structure: No. 25/26 Wall E | Sub-structure: No. 25/26 Wall E

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	0.014431	-0.024831	697.31E-6	3.8050	0.016795	325.06E-6	697.31E-6	134000.	1211.6	0 (Negligible)

Structure: No. 25/26 Wall F | Sub-structure: No. 25/26 Wall F

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	330.52E-6	-0.012539	68.859E-6	2.7426	0.0025149	139.27E-6	68.859E-6	-	45213.	0 (Negligible)

Structure: No. 25/26 Wall G | Sub-structure: No. 25/26 Wall G

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	472.02E-6	0.0	99.150E-6	1.3432	514.52E-6	0.0	99.150E-6	531430.	100820.	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]	
No. 7 Wall A	Maximum Slope	No. 7 Wall A	2	12.471	15.088	Hogging	**244.56E-6**	0.61546	0.0022947	13263.	-	0 (Negligible)
	Maximum Settlement	No. 7 Wall A	1	0.0	12.471	Sagging	233.97E-6	**2.2721**	0.023957	-	26793.	0 (Negligible)
	Max. Tensile Strain	No. 7 Wall A	1	0.0	12.471	Sagging	233.97E-6	2.2721	**0.023957**	-	26793.	0 (Negligible)
	Min. Radius of Curvature (Hogging)	No. 7 Wall A	2	12.471	15.088	Hogging	244.56E-6	0.61546	0.0022947	**13263.**	-	0 (Negligible)
	Min. Radius of Curvature (Sagging)	No. 7 Wall A	1	0.0	12.471	Sagging	233.97E-6	2.2721	0.023957	-	**26793.**	0 (Negligible)
No. 7 Wall B	Maximum Slope	No. 7 Wall B	1	0.0	13.582	Sagging	**309.64E-6**	4.2878	0.038351	-	38551.	0 (Negligible)

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
	Maximum Settlement	No. 7 Wall B	1	0.0	13.582	Sagging	309.64E-6	**4.2878**	0.038351	-	38551.	0 (Negligible)
	Max. Tensile Strain	No. 7 Wall B	1	0.0	13.582	Sagging	309.64E-6	4.2878	**0.038351**	-	38551.	0 (Negligible)
	Min. Radius of Curvature (Hogging)	No. 7 Wall B	2	13.582	16.456	Hogging	309.64E-6	1.4038	0.0038728	**26408.**	-	0 (Negligible)
	Min. Radius of Curvature (Sagging)	No. 7 Wall B	1	0.0	13.582	Sagging	309.64E-6	4.2878	0.038351	-	**38551.**	0 (Negligible)
No. 7 Wall C	Maximum Slope	No. 7 Wall C	2	7.0107	9.9000	Sagging	**0.0015677**	3.8846	0.032562	-	496.34	0 (Negligible)
	Maximum Settlement	No. 7 Wall C	1	0.0	7.0107	Hogging	104.45E-6	**4.2878**	0.0068503	39388.	-	0 (Negligible)
	Max. Tensile Strain	No. 7 Wall C	2	7.0107	9.9000	Sagging	0.0015677	3.8846	**0.032562**	-	496.34	0 (Negligible)
	Min. Radius of Curvature (Hogging)	No. 7 Wall C	1	0.0	7.0107	Hogging	104.45E-6	4.2878	0.0068503	**39388.**	-	0 (Negligible)
	Min. Radius of Curvature (Sagging)	No. 7 Wall C	2	7.0107	9.9000	Sagging	0.0015677	3.8846	0.032562	-	**496.34**	0 (Negligible)
No. 7 Wall D	Maximum Slope	No. 7 Wall D	2	4.9823	6.5800	Sagging	**83.435E-6**	0.19913	11.837E-6	-	39170.	0 (Negligible)
	Maximum Settlement	No. 7 Wall D	1	0.0	4.9823	Sagging	82.939E-6	**0.58092**	198.52E-6	-	191560.	0 (Negligible)
	Max. Tensile Strain	No. 7 Wall D	1	0.0	4.9823	Sagging	82.939E-6	0.58092	**198.52E-6**	-	191560.	0 (Negligible)
	Min. Radius of Curvature (Hogging)		-	-	-	-	-	-	-	-	-	-
	Min. Radius of Curvature (Sagging)	No. 7 Wall D	2	4.9823	6.5800	Sagging	83.435E-6	0.19913	11.837E-6	-	**39170.**	0 (Negligible)
No. 7 Wall E	Maximum Slope	No. 7 Wall E	1	0.0	2.6000	Sagging	**148.26E-6**	4.3637	0.067498	-	95277.	1 (Very Slight)
	Maximum Settlement	No. 7 Wall E	1	0.0	2.6000	Sagging	148.26E-6	**4.3637**	0.067498	-	95277.	1 (Very Slight)
	Max. Tensile Strain	No. 7 Wall E	1	0.0	2.6000	Sagging	148.26E-6	4.3637	**0.067498**	-	95277.	1 (Very Slight)
	Min. Radius of Curvature (Hogging)		-	-	-	-	-	-	-	-	-	-
	Min. Radius of Curvature (Sagging)	No. 7 Wall E	1	0.0	2.6000	Sagging	148.26E-6	4.3637	0.067498	-	**95277.**	1 (Very Slight)
No. 7 Wall F	Maximum Slope	No. 7 Wall F	1	0.0	4.2000	Hogging	**16.173E-6**	4.3637	0.0018840	305340.	-	0 (Negligible)
	Maximum Settlement	No. 7 Wall F	1	0.0	4.2000	Hogging	16.173E-6	**4.3637**	0.0018840	305340.	-	0 (Negligible)
	Max. Tensile Strain	No. 7 Wall F	1	0.0	4.2000	Hogging	16.173E-6	4.3637	**0.0018840**	305340.	-	0 (Negligible)
	Min. Radius of Curvature (Hogging)	No. 7 Wall F	1	0.0	4.2000	Hogging	16.173E-6	4.3637	0.0018840	**305340.**	-	0 (Negligible)
	Min. Radius of Curvature (Sagging)		-	-	-	-	-	-	-	-	-	-
No. 7 Wall G	Maximum Slope	No. 7 Wall G	1	0.0	2.6000	Sagging	**175.63E-6**	4.3130	0.072131	-	314530.	1 (Very Slight)
	Maximum Settlement	No. 7 Wall G	1	0.0	2.6000	Sagging	175.63E-6	**4.3130**	0.072131	-	314530.	1 (Very Slight)
	Max. Tensile Strain	No. 7 Wall G	1	0.0	2.6000	Sagging	175.63E-6	4.3130	**0.072131**	-	314530.	1 (Very Slight)
	Min. Radius of Curvature (Hogging)		-	-	-	-	-	-	-	-	-	-
	Min. Radius of Curvature (Sagging)	No. 7 Wall G	1	0.0	2.6000	Sagging	175.63E-6	4.3130	0.072131	-	**314530.**	1 (Very Slight)
No. 25#26 Wall A	Maximum Slope	No. 25/26 Wall A	1	0.0	17.000	Sagging	**289.21E-6**	3.1308	0.031062	-	20354.	0 (Negligible)
	Maximum Settlement	No. 25/26 Wall A	1	0.0	17.000	Sagging	289.21E-6	**3.1308**	0.031062	-	20354.	0 (Negligible)
	Max. Tensile Strain	No. 25/26 Wall A	1	0.0	17.000	Sagging	289.21E-6	3.1308	**0.031062**	-	20354.	0 (Negligible)
	Min. Radius of Curvature (Hogging)		-	-	-	-	-	-	-	-	-	-
	Min. Radius of Curvature (Sagging)	No. 25/26 Wall A	1	0.0	17.000	Sagging	289.21E-6	3.1308	0.031062	-	**20354.**	0 (Negligible)
No. 25#26 Wall B	Maximum Slope	No. 25/26 Wall B	1	0.0	11.003	Sagging	**256.65E-6**	5.7176	0.059037	-	329260.	1 (Very Slight)
	Maximum Settlement	No. 25/26 Wall B	1	0.0	11.003	Sagging	256.65E-6	**5.7176**	0.059037	-	329260.	1 (Very Slight)
	Max. Tensile Strain	No. 25/26 Wall B	1	0.0	11.003	Sagging	256.65E-6	5.7176	**0.059037**	-	329260.	1 (Very Slight)
	Min. Radius of Curvature (Hogging)		-	-	-	-	-	-	-	-	-	-
	Min. Radius of Curvature (Sagging)	No. 25/26 Wall B	1	0.0	11.003	Sagging	256.65E-6	5.7176	0.059037	-	**329260.**	1 (Very Slight)
No. 25#26 Wall C	Maximum Slope	No. 25/26 Wall C	1	0.0	5.1000	Sagging	**249.30E-6**	2.6050	0.032056	-	186840.	0 (Negligible)
	Maximum Settlement	No. 25/26 Wall C	1	0.0	5.1000	Sagging	249.30E-6	**2.6050**	0.032056	-	186840.	0 (Negligible)
	Max. Tensile Strain	No. 25/26 Wall C	1	0.0	5.1000	Sagging	249.30E-6	2.6050	**0.032056**	-	186840.	0 (Negligible)
	Min. Radius of Curvature (Hogging)		-	-	-	-	-	-	-	-	-	-
	Min. Radius of Curvature (Sagging)	No. 25/26 Wall C	1	0.0	5.1000	Sagging	249.30E-6	2.6050	0.032056	-	**186840.**	0 (Negligible)
No. 25#26 Wall D	Maximum Slope	No. 25/26 Wall D	3	9.9321	12.900	Sagging	**0.0012114**	4.3516	0.026524	-	659.73	0 (Negligible)
	Maximum Settlement	No. 25/26 Wall D	1	0.0	1.9026	Sagging	695.92E-6	**5.7454**	0.020137	-	1000.0	0 (Negligible)
	Max. Tensile Strain	No. 25/26 Wall D	3	9.9321	12.900	Sagging	0.0012114	4.3516	**0.026524**	-	659.73	0 (Negligible)
	Min. Radius of Curvature (Hogging)	No. 25/26 Wall D	2	1.9026	9.9321	Hogging	695.92E-6	5.1134	0.0094540	**4908.3**	-	0 (Negligible)
	Min. Radius of Curvature (Sagging)	No. 25/26 Wall D	3	9.9321	12.900	Sagging	0.0012114	4.3516	0.026524	-	**659.73**	0 (Negligible)
No. 25#26 Wall E	Maximum Slope	No. 25/26 Wall E	3	9.9580	12.900	Sagging	**697.31E-6**	3.0216	0.016795	-	1211.6	0 (Negligible)
	Maximum Settlement	No. 25/26 Wall E	1	0.0	2.6525	Sagging	101.54E-6	**3.8050**	0.0049942	-	19433.	0 (Negligible)
	Max. Tensile Strain	No. 25/26 Wall E	3	9.9580	12.900	Sagging	697.31E-6	3.0216	**0.016795**	-	1211.6	0 (Negligible)
	Min. Radius of Curvature (Hogging)	No. 25/26 Wall E	2	2.6525	9.9580	Hogging	100.11E-6	3.5769	864.71E-6	**134000.**	-	0 (Negligible)
	Min. Radius of Curvature (Sagging)	No. 25/26 Wall E	3	9.9580	12.900	Sagging	697.31E-6	3.0216	0.016795	-	**1211.6**	0 (Negligible)
No. 25#26 Wall F	Maximum Slope	No. 25/26 Wall F	1	0.0	2.2000	Sagging	**68.859E-6**	2.7426	0.0025149	-	45213.	0 (Negligible)
	Maximum Settlement	No. 25/26 Wall F	1	0.0	2.2000	Sagging	68.859E-6	**2.7426**	0.0025149	-	45213.	0 (Negligible)
	Max. Tensile	No. 25/26 Wall	1	0.0	2.2000	Sagging	68.859E-6	2.7426	**0.0025149**	-	45213.	0 (Negligible)

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
	Strain	F										
	Min. Radius of Curvature (Hogging)		-	-	- -		-	-	-	-	- -	
	Min. Radius of Curvature (Sagging)	No. 25/26 Wall F	1	0.0	2.2000	Sagging	68.859E-6	2.7426	0.0025149	-	**45213.**	0 (Negligible)
No. 25#26 Wall G	Maximum Slope	No. 25/26 Wall G	1	0.0	7.5175	Sagging	**99.150E-6**	1.3432	514.52E-6	-	100820.	0 (Negligible)
	Maximum Settlement	No. 25/26 Wall G	1	0.0	7.5175	Sagging	99.150E-6	**1.3432**	514.52E-6	-	100820.	0 (Negligible)
	Max. Tensile Strain	No. 25/26 Wall G	1	0.0	7.5175	Sagging	99.150E-6	1.3432	**514.52E-6**	-	100820.	0 (Negligible)
	Min. Radius of Curvature (Hogging)	No. 25/26 Wall G	2	7.5175	10.700	Hogging	99.150E-6	0.68467	48.459E-6	**531430.**	-	0 (Negligible)
	Min. Radius of Curvature (Sagging)	No. 25/26 Wall G	1	0.0	7.5175	Sagging	99.150E-6	1.3432	514.52E-6	-	**100820.**	0 (Negligible)

Specific Building Damage Results - All Combined Segments

Structure: No. 7 Wall A | Sub-structure: No. 7 Wall A

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.

Structure: No. 7 Wall B | Sub-structure: No. 7 Wall B

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.

Structure: No. 7 Wall C | Sub-structure: No. 7 Wall C

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.

Structure: No. 7 Wall D | Sub-structure: No. 7 Wall D

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.

Structure: No. 7 Wall E | Sub-structure: No. 7 Wall E

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.

Structure: No. 7 Wall F | Sub-structure: No. 7 Wall F

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.

Structure: No. 7 Wall G | Sub-structure: No. 7 Wall G

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.

Structure: No. 25/26 Wall A | Sub-structure: No. 25/26 Wall A

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.

Structure: No. 25/26 Wall B | Sub-structure: No. 25/26 Wall B

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]		[%]	[%]	[%]	

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

No structures have segments combined.

Structure: No. 25/26 Wall C | Sub-structure: No. 25/26 Wall C

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

No structures have segments combined.

Structure: No. 25/26 Wall D | Sub-structure: No. 25/26 Wall D

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

No structures have segments combined.

Structure: No. 25/26 Wall E | Sub-structure: No. 25/26 Wall E

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

No structures have segments combined.

Structure: No. 25/26 Wall F | Sub-structure: No. 25/26 Wall F

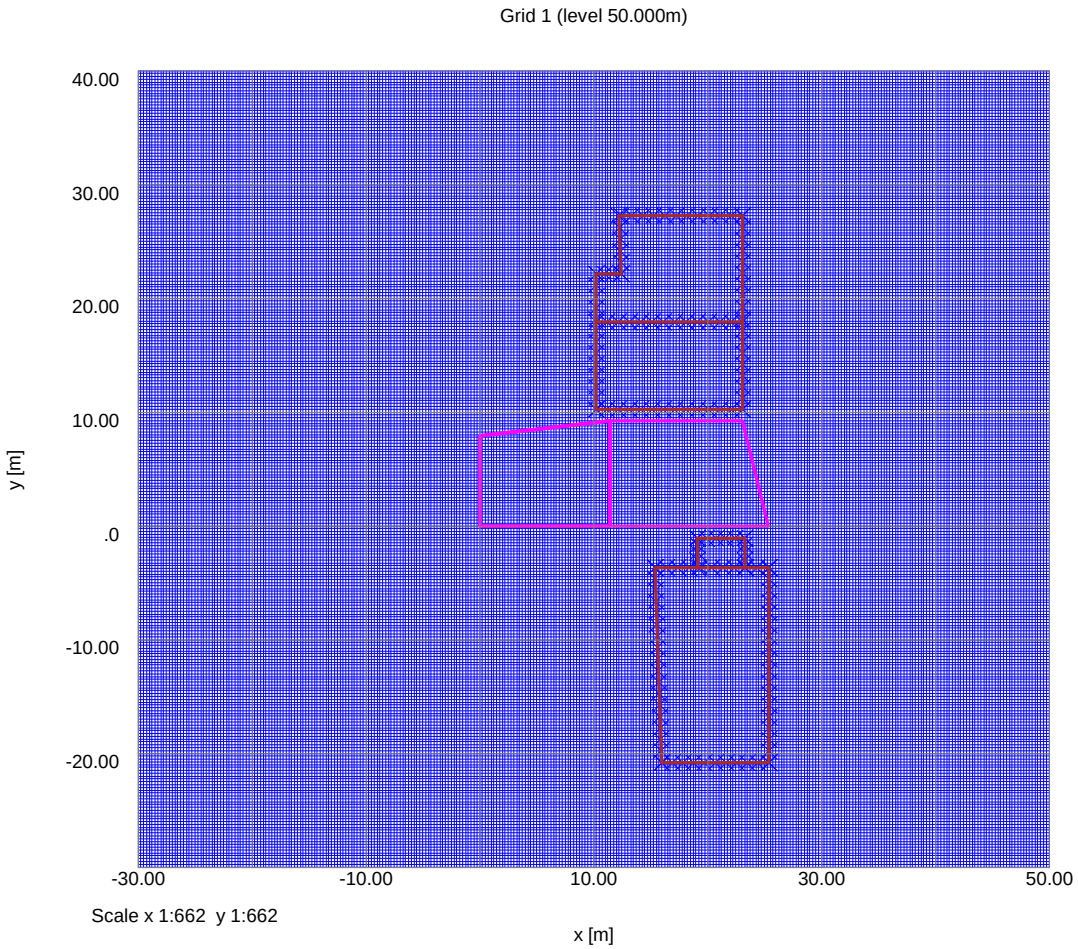
Vertical Offset from Line for Vertical Movement Calculations	Combined Segment	Start	Length	Curvature Ratio	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Damage Category
		[m]	[m]	[%]	[%]	[%]	[%]	

No structures have segments combined.

Structure: No. 25/26 Wall G | Sub-structure: No. 25/26 Wall G

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

No structures have segments combined.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