A-squared Studio

Harrington Square

Ground Movement Assessment (Neighbouring Buildings)

September 2023

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Project Name	Harrington Square
Project Number	2874
Client	Salboy (Mornington Crescent) Limited
Document Name	Ground Movement Assessment (Neighbouring Buildings)

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2874-A2S-XX-XX-RP-Y-0002-01	Second Issue	Minor amendments	01	NH	04.09.23
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Appendices

1. Introduction

A-Squared Studio Engineers has been appointed by Salboy (Mornington Crescent) Limited to undertake a Ground Movement Assessment (GMA) for the proposed development at the land adjacent to Hurdwick House, Harrington Square, Camden, London, NW1 2JE (herein called the 'site'). The scope comprises an assessment of the potential impact of ground movement imposed by the development on the neighbouring buildings located at 5 Hurdwick Place and Hurdwick House.

1.1. Study Aims and Objectives

A ground movement and impact assessment has been carried out to estimate the potential impact of the proposed development construction works at Harrington Square on the neighbouring buildings located north and south of the site. The proposed scheme comprises the construction of a multi-storey residential building including the excavation of a single-storey basement level over part of the footprint and the installation of reinforced concrete retaining walls and temporary sheet piling in order to support the excavation.

The GMA study provides an estimate of greenfield ground movements, which are unlikely to be exceeded. The adopted methodology provides a robust and conservative assessment, representative of the current industry best practice as detailed in Section 5.

The assessment carried out and described herein aims to:

- Assess the impact of ground movements induced by the proposed works on the buildings directly neighbouring the site (5 Hurdwick Place and Hurdwick House).

This report provides a detailed description of the:

- Site and proposed development.
- Modelling parameters input.
- Analyses and results.

2. The Site and Development

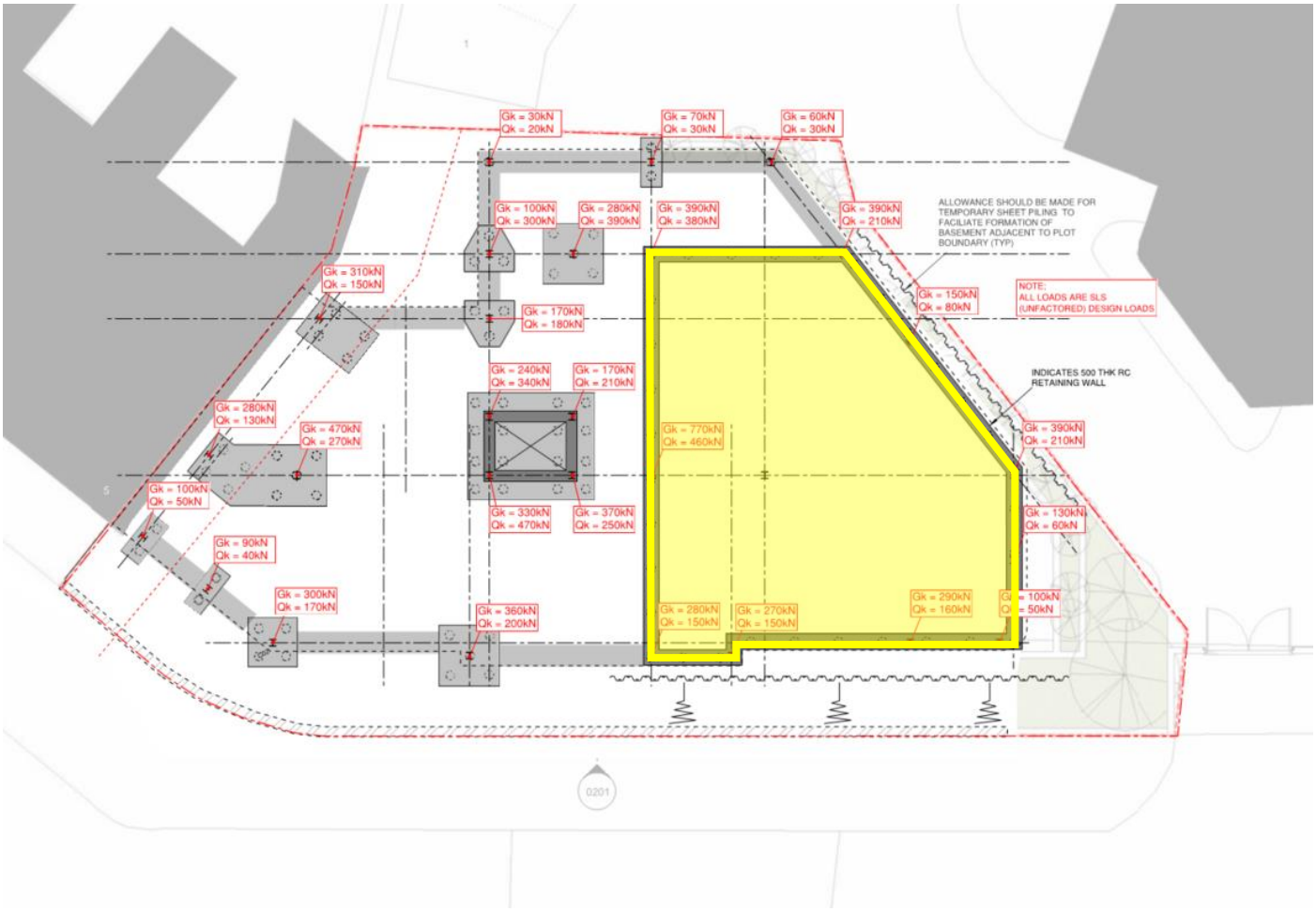
The proposed development is located at the land adjacent to Hurdwick House, Harrington Square, Camden, London, NW1 2JE (see Figure 2.1). The site is currently occupied by a private car park with soft landscaping. The proposed scheme comprises the construction of a multi-storey residential building including the excavation of a single-storey basement level (over part of the footprint of the structure). The excavation will be supported by reinforced concrete retaining walls and temporary sheet piling. The new structure will be founded on piled foundations. The site is bounded by two neighbouring buildings; 5 Hurdwick Place to the north-west and Hurdwick House to the south-east.

Key dimensions and levels assumed in the analysis, based on the information provided by Renaissance Associates Ltd (Renaissance) and are outlined in the following.

- The proposed basement formation level is +20.425mOD, based on a 500mm thick basement slab.
- The piled foundations have an assumed toe level of +9.00mOD for both the ground floor and basement level.
- A proposed load of 6300kN at basement level and 6960kN at ground floor level has been assumed. The arrangement of the proposed basement footprint in relation to the proposed building is presented in Figure 2.2.

Approximate site boundary marked in red. Source: Google Earth.

Figure 2.1 Location of the proposed development



Site boundary marked in red. Basement footprint outlined in yellow

Figure 2.2 Proposed basement arrangement

3. Neighbouring Buildings

A number of adjacent properties lie within the zone of influence of the ground movement induced by the development, as shown in Figure 3.1 and detailed in Section 2. The site is bounded by two neighbouring buildings; 5 Hurdwick Place to the north-west and Hurdwick House to the south-east.

5 Hurdwick Place is a five-storey residential terraced building. Hurdwick House is a four-storey residential apartment building.

As the maximum ground movements occur at ground level, for the sake of conservatism any existing basements (e.g. the semi-basement at 5 Hurdwick Place) have been ignored and it is assumed that all assessed buildings are founded at ground level. Greenfield movements have conservatively been used to determine impacts.

Approximate site boundary marked in red. Source: Google Earth.

Figure 3.1 Plan of neighbouring buildings

4. Ground Model

The ground model and soil parameters adopted as part of this study presented herein are based on site-specific ground investigation undertaken in June 2023 as presented in the *Factual Report* by A2 Site Investigation Limited (ref: 33023-A2SI-XX-XX-RP-X-0001-01). An interpretation of the findings of the ground investigation is presented in the A2 Site Investigation Geotechnical Interpretive Report (ref. 33023-A2SI-XX-XX-RP-Y-0002-00). This is summarised in Table 4.1.

Table 4.1 Ground model and geotechnical parameters

Stratum	Top of stratum (mOD)	Thickness (m)	Unit Weight, γ_b (kN/m^3)	Undrained Young's Modulus, E_u (kPa)	Drained Young's Modulus, E' (kPa)
Made Ground	24.70	2.50	19	-	14,000
London Clay	22.20	22.50	20	26,000 + 3,600z[1]	20,800 + 2,900z[1]

1. z refers to depth below top of stratum

5. Impact Assessment Methodology

The impact assessment has been carried out using the commercially available software programs Oasys PDisp and XDisp.

Ground movement will occur due to the excavation of a new basement level installation of reinforced concrete retaining walls and temporary sheet piling to support the excavation and subsequent associated loading of the proposed structure. These works will cause settlements across the footprint of the load and over a given zone of influence surrounding the footprint.

The analysis strategy can be summarised as follows:

1. Model the short-term excavation unloading effects in Oasys PDisp.
2. Model the excavation and associated wall installation in Oasys XDisp.
3. Model the long-term proposed loading on-site in Oasys PDisp.
4. Calculate greenfield ground movements at the adjacent building locations for critical combinations of ground movements.
5. Carry out a damage assessment for the adjacent structures using Oasys Xdisp, following the well-established Burland damage assessment methodology.

A uniform value of 83kPa has been used to model the proposed unloading resulting from ground excavation, derived from the soil unit weight presented in Section 4 (i.e. an excavation depth of 4.3mbgl).

To simulate the proposed building construction in Oasys PDisp, the loads have been applied using the "equivalent raft" approach (i.e. as a uniformly distributed load at a level equivalent to two-thirds the foundation pile-toe depth, with a 1H-in-4V lateral load spread). This approach results in applied pressures of 19.4kPa at +13.5mOD and 47.9kPa at +12.8mOD for the ground floor and basement respectively.

The Xdisp analysis used to assess the ground movements resulting from the proposed excavation and installation of the retaining wall in the two properties, used the following curves adopted from CIRIA C760:

- *Reinforced Concrete Retaining Wall and Sheet Pile Wall installation:* Installation of contiguous bored pile wall in stiff clay.
- *Excavation to formation*: Excavation in front of a high stiffness wall in stiff clay.

The contiguous bored pile wall CIRIA C760 installation curves are considered to be a conservative assumption to estimate the ground movements associated with the installation of sheet pile walls and reinforced concrete retaining walls. The modelled wall has an assumed toe level of +16.000mOD. It has been assumed that temporary sheet piling will be used along the full perimeter of the basement.

Two models have been analysed examining the impact of key combinations of the different sources of ground movement. These are:

1. Short-term heave resulting from excavation of the proposed basement.
2. Long-term settlement due to wall installation, basement excavation and structural loading.

Indicative views of the PDisp and XDisp models are presented in Figure 5.1 and Figure 5.2 respectively.

The neighbouring buildings have been analysed as representative walls situated along their perimeters. The walls have been assumed to behave as elastic beams subject to bending/shear and axial elongation mechanisms, for the purpose of the damage assessment. The buildings are assumed to be in good condition with no existing damage. A wall height of 14m for both 5 Hurdwick Place and Hurdwick House has been assumed.

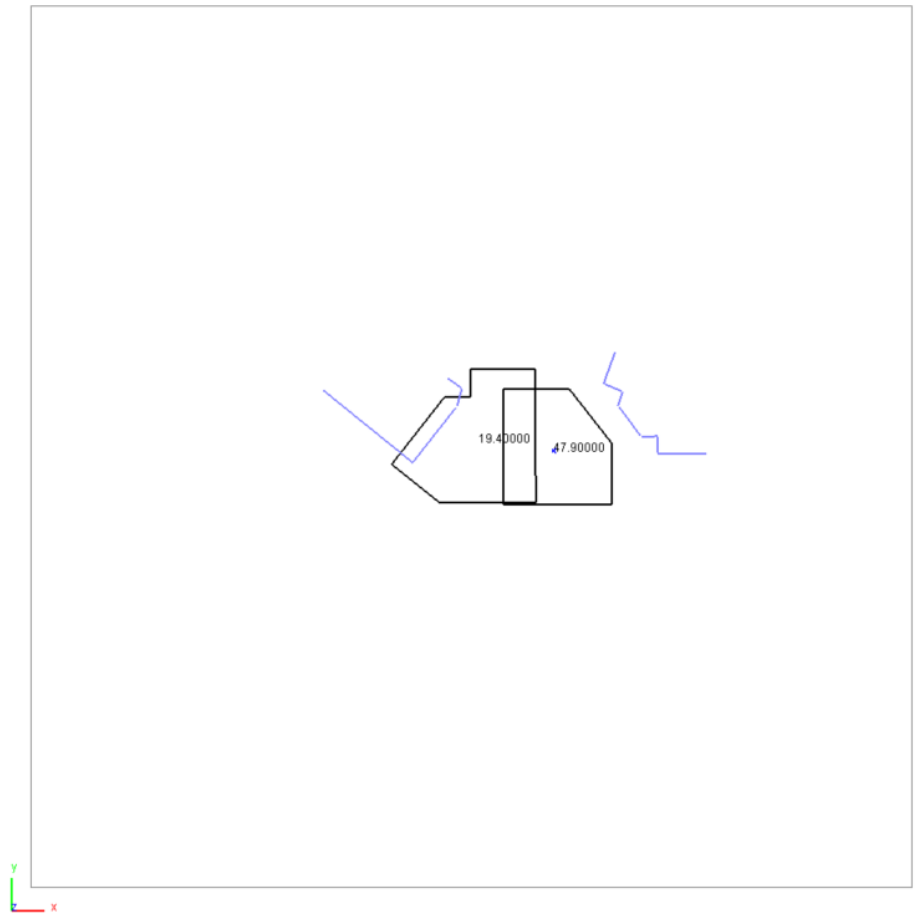


Figure 5.1 PDisp model (loading). Location of adjacent structures indicated by blue lines.

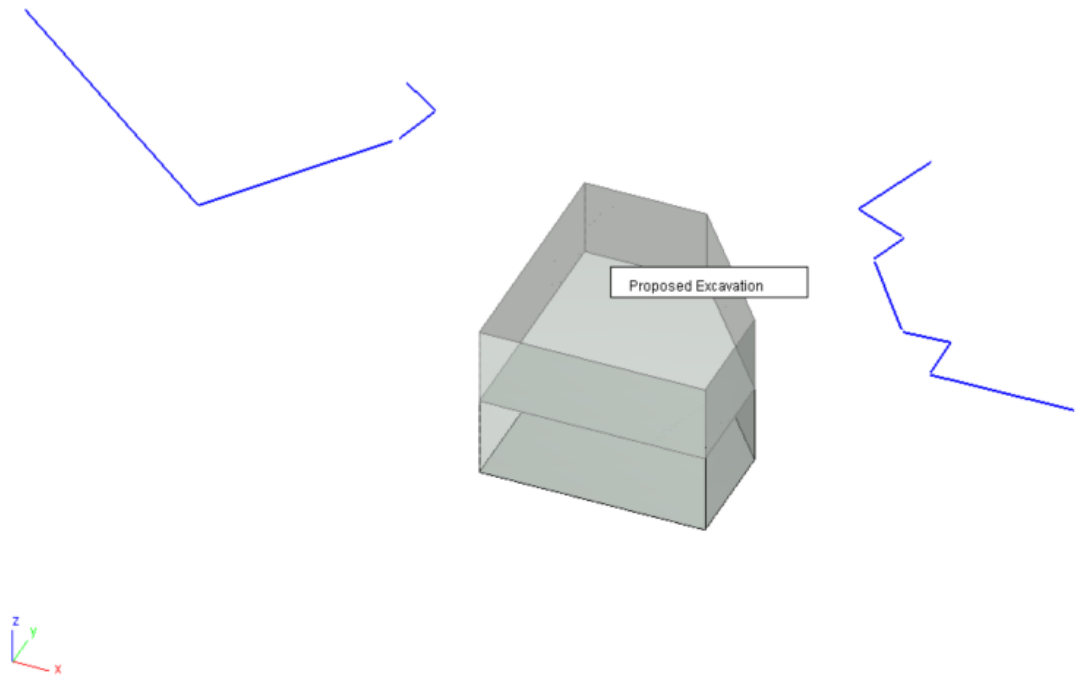


Figure 5.2 XDisp model (excavation) . Location of adjacent structures indicated by blue lines.

6. Impact Assessment Results

The ground settlement contours in the short-term and long-term analyses are presented in Figure 6.1 and Figure 6.2 respectively.

The building damage assessment results estimate that there will be 'Negligible' damage to most of the modelled representative walls for the neighbouring buildings, with the exception of two Hurdwick House walls, which are estimated to have 'Very Slight' damage. The results of the building damage assessment carried out in XDisp are detailed in Table 6.1.

The displacement graphs for each wall analysed are presented in Appendix A. A summary of the Burland building damage categories is presented in Figure 6.3. The Burland damage assessment considers the maximum tensile strain induced by both horizontal and vertical movement.

It is assumed that the excavation will be supported by means of temporary propping. It is recommended that any proposed temporary propping remains in place until the permanent floor slabs are installed in order to effectively limit the ground movements.

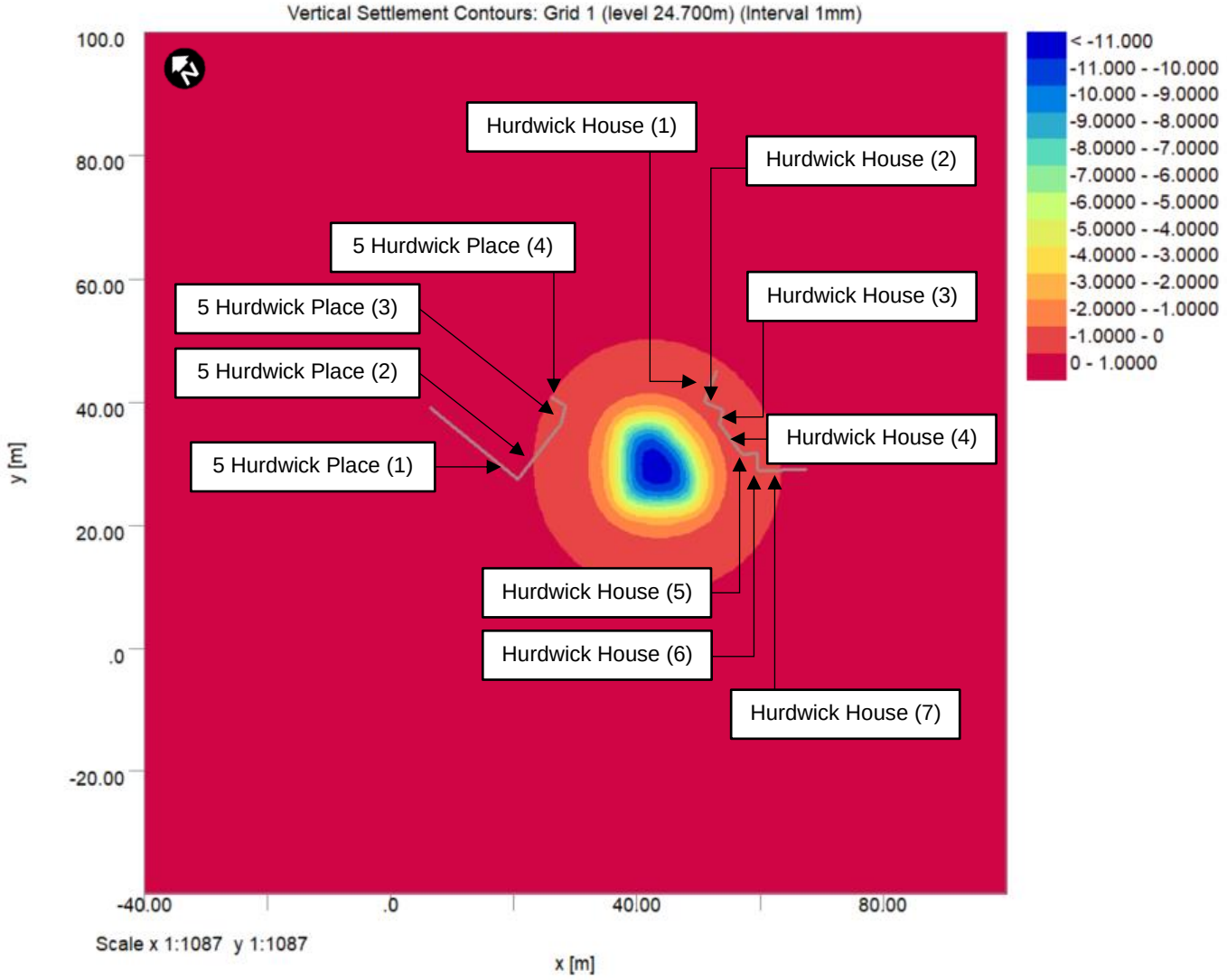


Figure 6.1 Short-term settlement results

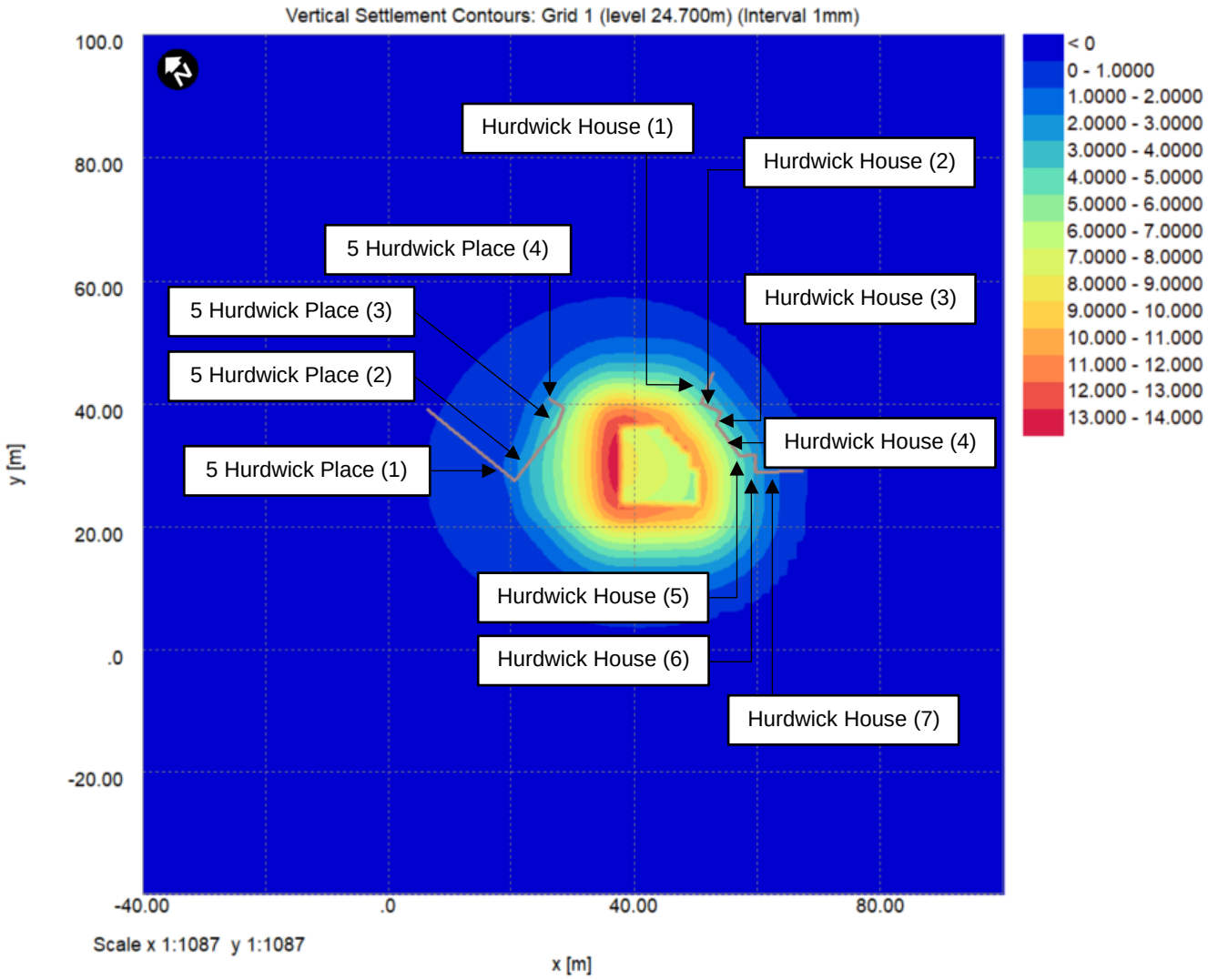


Figure 6.2 Long-term settlement results

Table 6.1 Building Damage Assessment results summary

	Wall	Maximum Settlement (mm)	Maximum Tensile Strain (%)	Damage Category
Short-term	5 Hurdwick Place (1)	<0.1	<0.01	Category 0 – *Negligible*
	5 Hurdwick Place (2)	0.2	<0.01	Category 0 – *Negligible*
	5 Hurdwick Place (3)	0.2	<0.01	Category 0 – *Negligible*
	5 Hurdwick Place (4)	0.1	<0.01	Category 0 – *Negligible*
	Hurdwick House (1)	0.5	<0.01	Category 0 – *Negligible*
	Hurdwick House (2)	0.5	<0.01	Category 0 – *Negligible*

	Wall	Maximum Settlement (mm)	Maximum Tensile Strain (%)	Damage Category
	Hurdwick House (3)	0.6	<0.01	Category 0 – *Negligible*
	Hurdwick House (4)	0.6	<0.01	Category 0 – *Negligible*
	Hurdwick House (5)	0.4	<0.01	Category 0 – *Negligible*
	Hurdwick House (6)	0.2	<0.01	Category 0 – *Negligible*
	Hurdwick House (7)	0.2	<0.01	Category 0 – *Negligible*
Long-term	5 Hurdwick Place (1)	1.6	<0.01	Category 0 – *Negligible*
	5 Hurdwick Place (2)	4.7	0.02	Category 0 – *Negligible*
	5 Hurdwick Place (3)	4.8	<0.01	Category 0 – *Negligible*
	5 Hurdwick Place (4)	4.3	0.04	Category 0 – *Negligible*
	Hurdwick House (1)	4.7	0.04	Category 0 – *Negligible*
	Hurdwick House (2)	4.6	0.01	Category 0 – *Negligible*
	Hurdwick House (3)	5.0	0.04	Category 0 – *Negligible*
	Hurdwick House (4)	5.0	0.01	Category 0 – *Negligible*
	Hurdwick House (5)	4.4	0.05	Category 1 – *Very Slight*
	Hurdwick House (6)	2.8	<0.01	Category 0 – *Negligible*
	Hurdwick House (7)	2.8	0.05	Category 1 – *Very Slight*

Building / Structure Damage Risk Classification (Burland (1997))

Damage Category	Category of damage	Description of typical damage* (Ease of repair is underlined)	Approx. crack width* (mm)	Limiting tensile strain (%)
0	Negligible	Hairline cracks	< 0.1	< 0.05
1	Very Slight	Fine cracks that can easily be treated during normal decoration. Perhaps isolated slight fracture in buildings. Cracks in external brickwork visible on inspection.	< 1	0.05 - 0.075
2	Slight	Cracks easily filled. Redecorating probably required. Several slight fractures showing inside of building. Cracks are visible externally and some repointing may be required externally to ensure weather tightness. Doors and windows may stick slightly.	< 5	0.075 - 0.15
3	Moderate	The cracks require some opening up and can be patched by a mason. Recurrent cracks can be masked by suitable linings. Repointing of external brickwork and possibly a small amount of brickwork to be replaced. Doors and windows sticking. Service pipes may fracture. Weather tightness often impaired.	5 - 15 or a number of cracks > 3	0.15 – 0.3
4	Severe	Extensive repair work involving breaking out and replacing sections of walls, especially over doors and windows. Windows and door frames distorted, floor sloping noticeably. Walls leaning and bulging noticeably, some loss of bearing in beams. Service pipes disrupted.	15 - 25 but also depends on number of cracks	> 0.3
5	Very Severe	This requires a major repair job involving partial or complete rebuilding. Beams lose bearing, walls lean badly and require shoring. Windows broken due to distortion. Danger of instability.	Usually > 25 but depends on number of cracks.	-

Figure 6.3 Burland building damage classification

7. Conclusions and Recommendations

A-Squared Studio Engineers Ltd has been appointed by Salboy (Mornington Crescent) Limited to undertake a Ground Movement Assessment (GMA) for the proposed development at the land adjacent to Hurdwick House, Harrington Square, Camden, London, NW1 2JE. The scope comprises an assessment of the potential impact of ground movement imposed by the development on the neighbouring buildings located at 5 Hurdwick Place and Hurdwick House.

The proposed works can generally be described as the construction of a multi-storey residential building including the excavation of a single-storey basement level and the installation of reinforced concrete retaining walls and temporary sheet piling in order to support the excavation.

The proposed development construction operations comprise three stages: wall installation, bulk excavation and proposed building construction (long-term loading). The impact of the various construction stage has been reviewed, evaluating the effects of unloading/loading using PDisp and simulating the excavation and wall installation induced ground movement fields using empirical CIRIA curves in XDisp.

The impact assessment has been carried out with Oasys software PDisp and XDisp. The damage has been assessed along representative walls situated along the perimeter of each building. The existing buildings are assumed to be in good condition with no existing damage. The assumptions made as part of this assessment should be reviewed based on the contractor's proposed scheme.

The building damage assessment results estimate that there will be 'Negligible' damage to most of the neighbouring buildings, with the exception of two Hurdwick House walls, which are estimated to have 'Very Slight' damage. This level of impact is considered to be acceptable.

It is assumed that the excavation will be supported by means of temporary propping, as required. It is recommended that any proposed temporary propping remains in place until the permanent floor slabs are installed in order to effectively limit the ground movements.

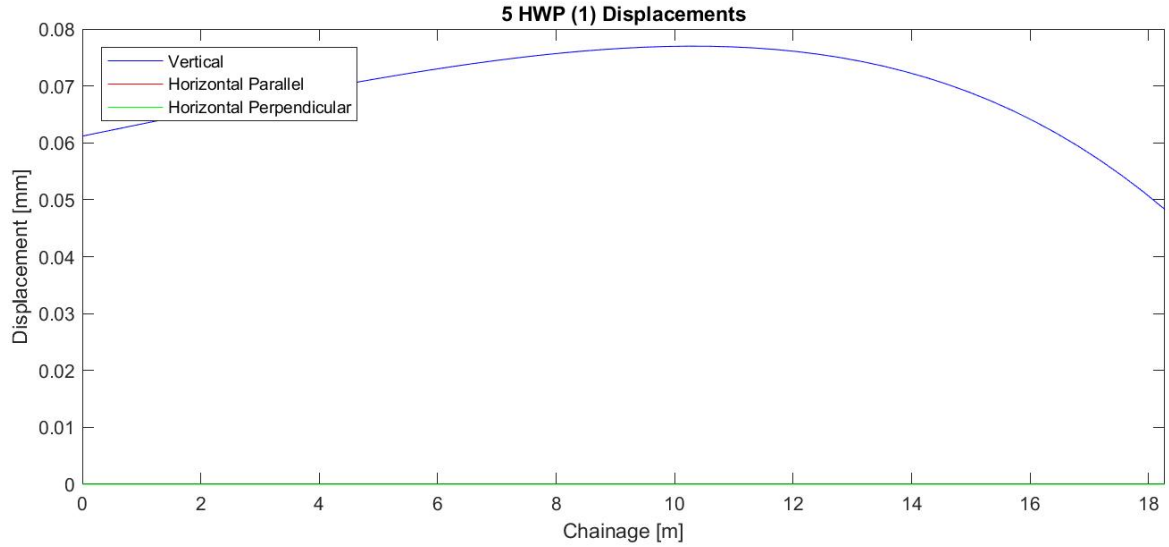
It is worth noting that the predicted movements are likely to be conservative, in view of the greenfield nature of the predicted movements, the relatively cautious assumptions in relation to the ground model and the simplifications in the analysis software.

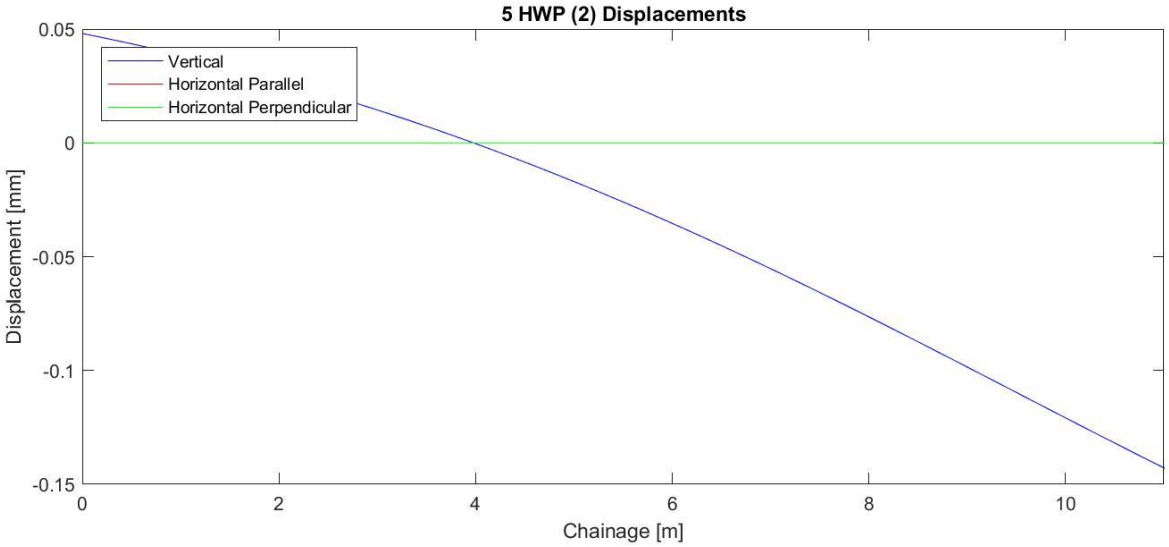
It is recommended that this report is reviewed and understood in full by the project team and major stakeholders. Where significant changes are made to items such as construction sequencing and scheme design, the engineer should thoroughly review the discrepancy and evaluate any potential impacts on ground movements and adjacent structures. This is particularly relevant in relation to any temporary works/sequencing adopted as part of the initial enabling works phase (potentially involving excavation/filling earthworks to form working platforms, etc) and with regards to plant loading during construction. If necessary, the GMA results should be re-evaluated, including these temporary works items.

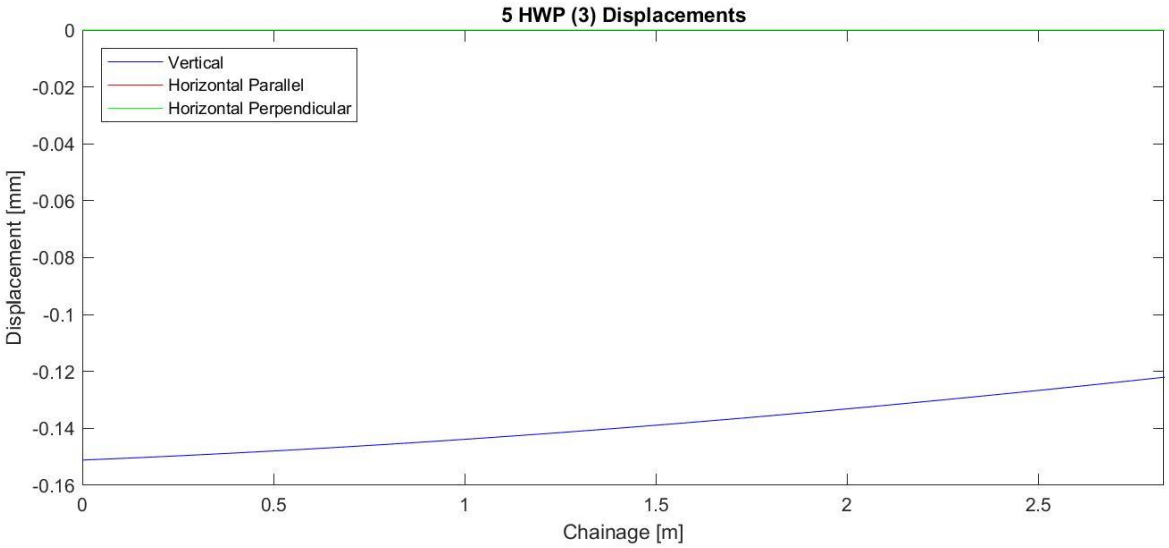
It is critical that the permanent and temporary works designs are carried out in a coordinated manner, with the aim to ensure that such design elements are in alignment with the assumptions/findings of the GMA and overall design intent. The assessment presented herein is dependent and reliant on the works being undertaken by an experienced contractor, high quality workmanship, and appropriate supervision of construction means and methods by experienced personnel.

Appendix A: Building Displacement Profiles

Short-term



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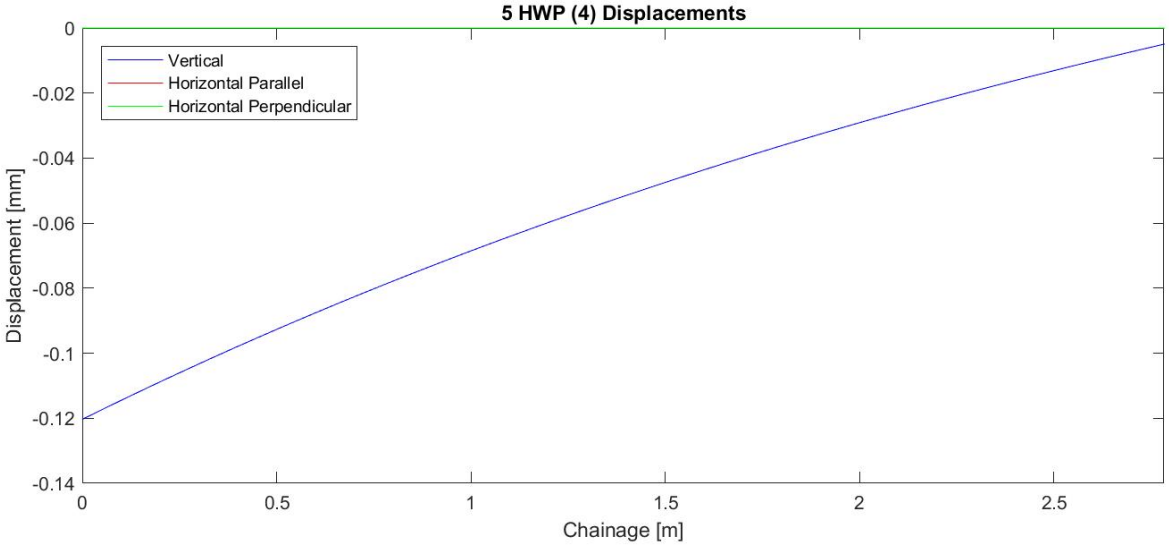
Chainage [m]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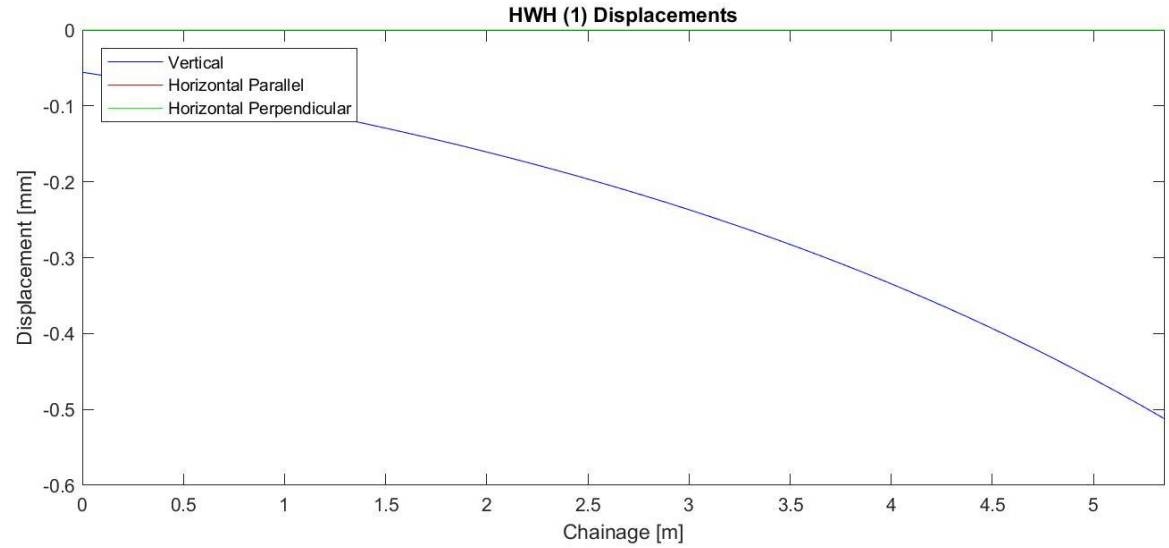
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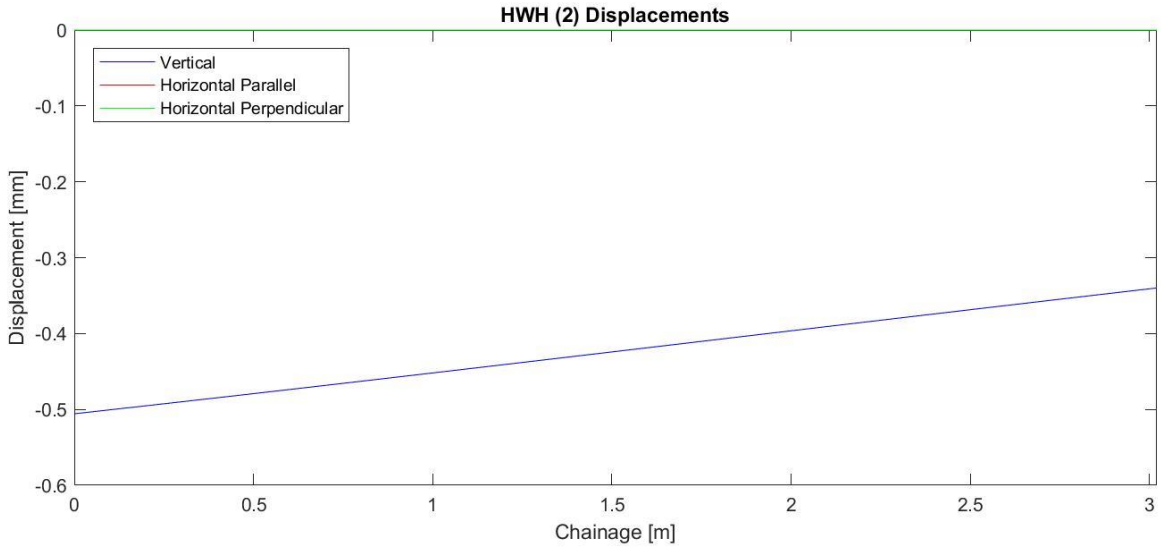
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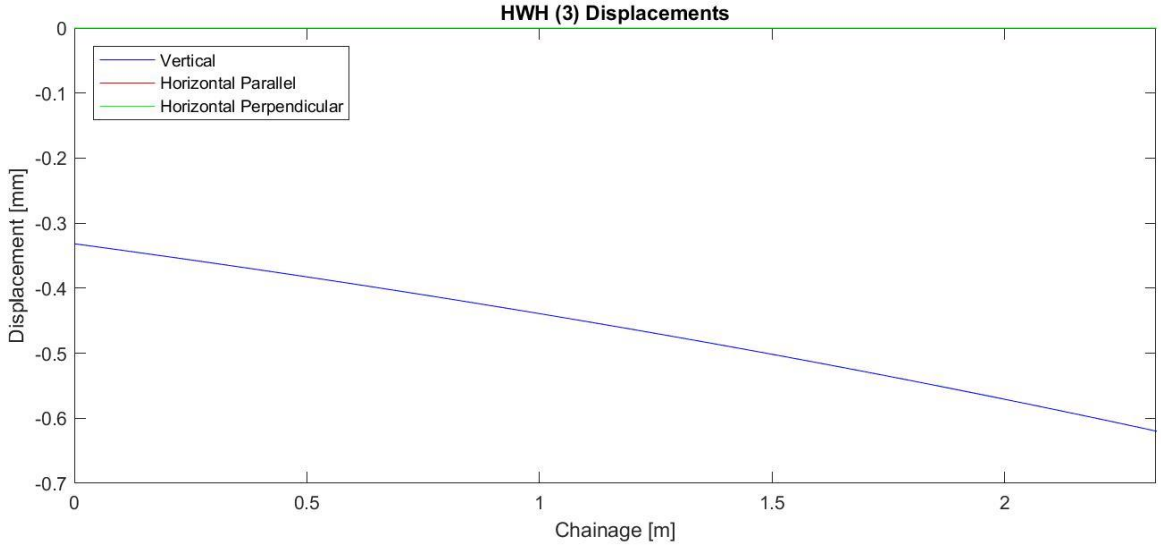
2.5
3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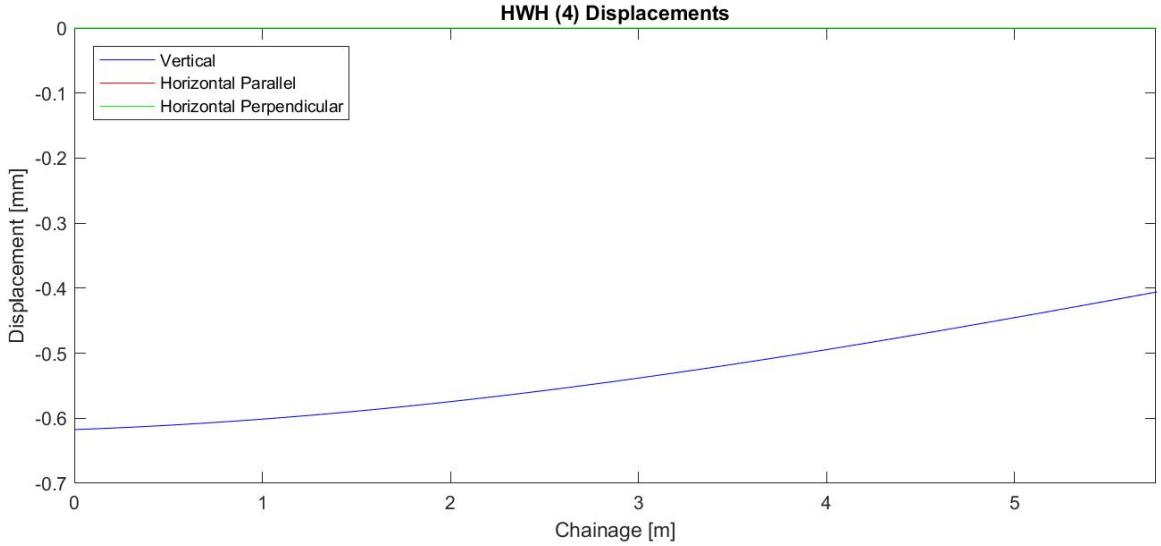
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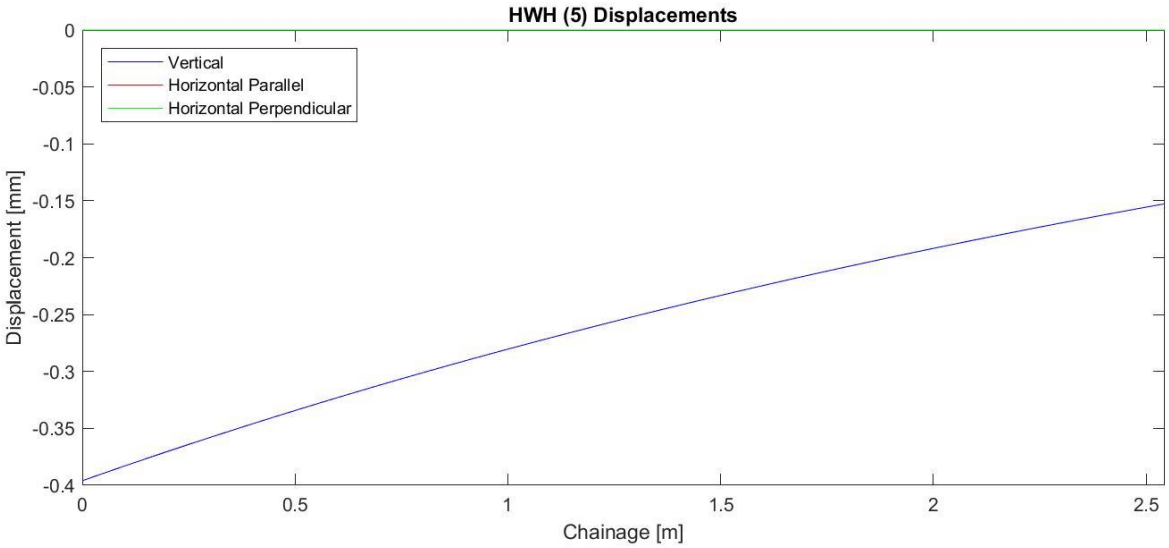
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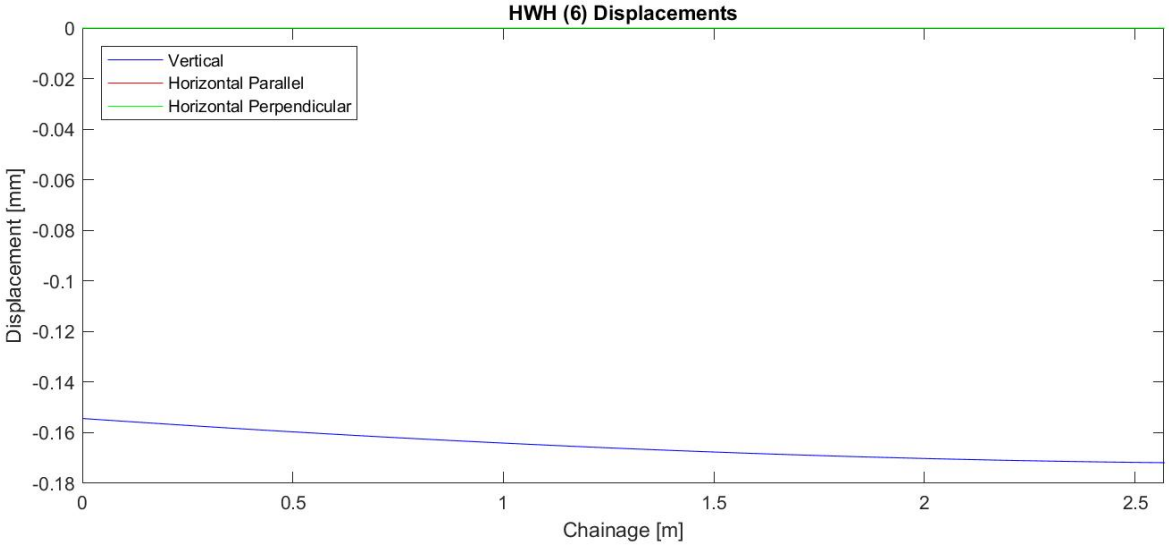
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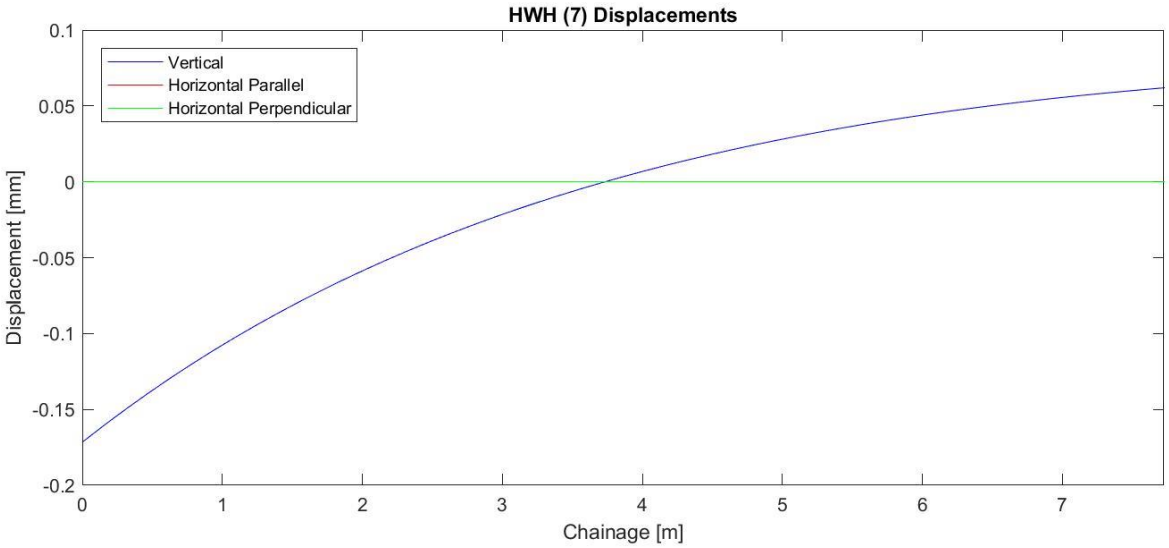
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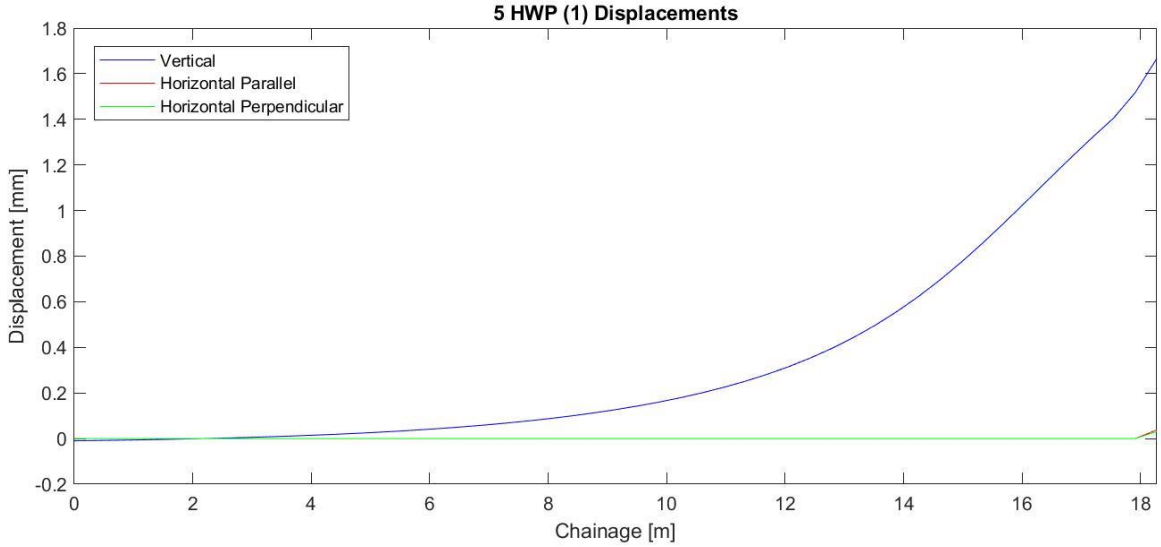
Long-term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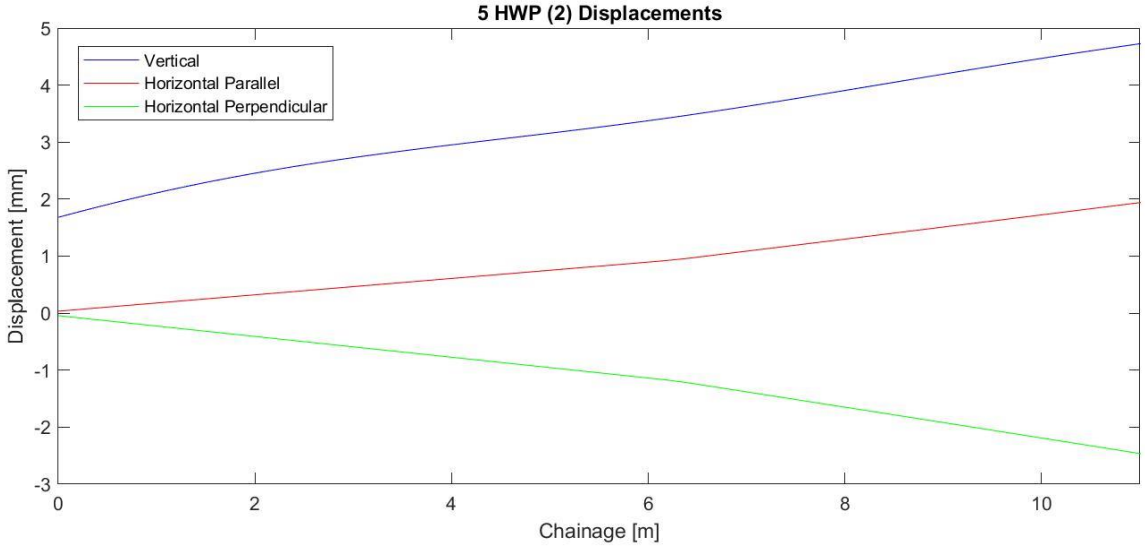
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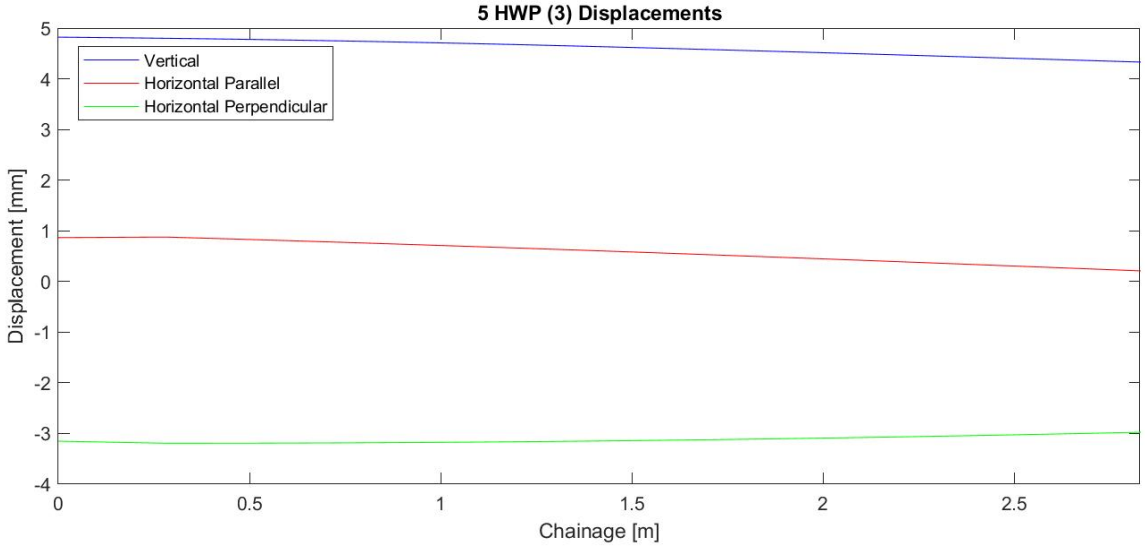
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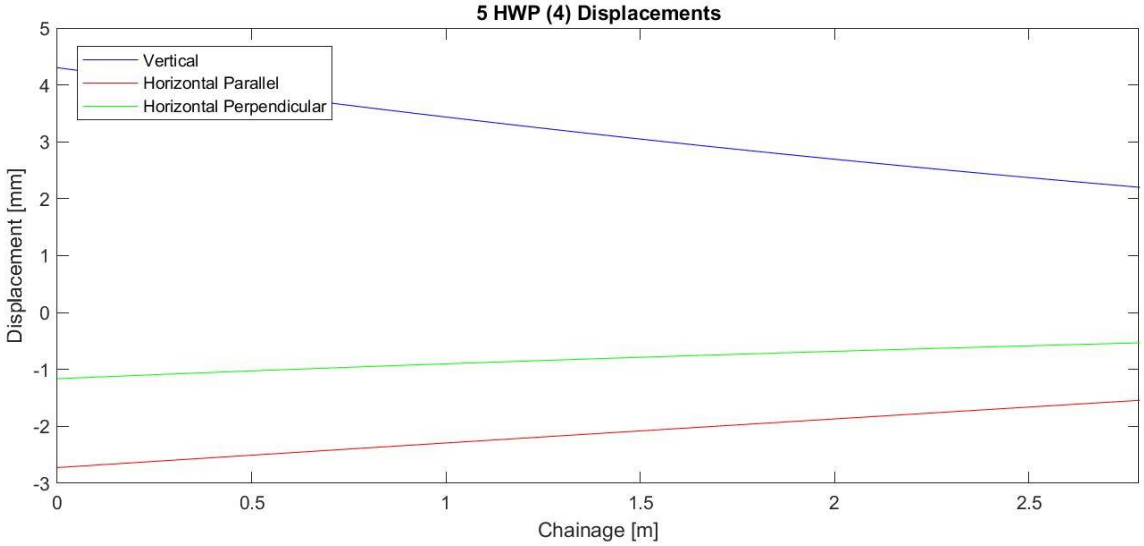
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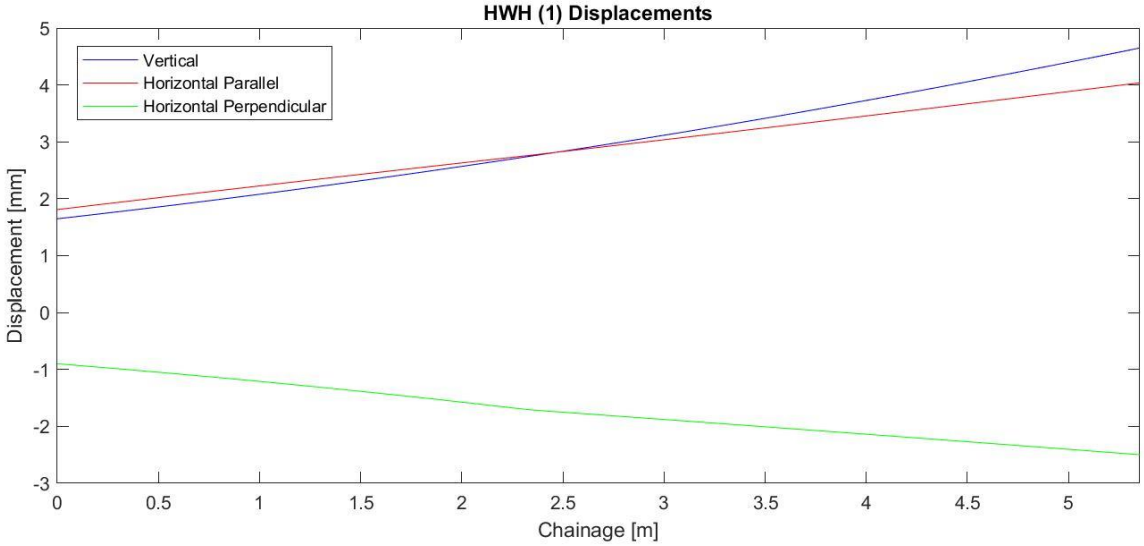
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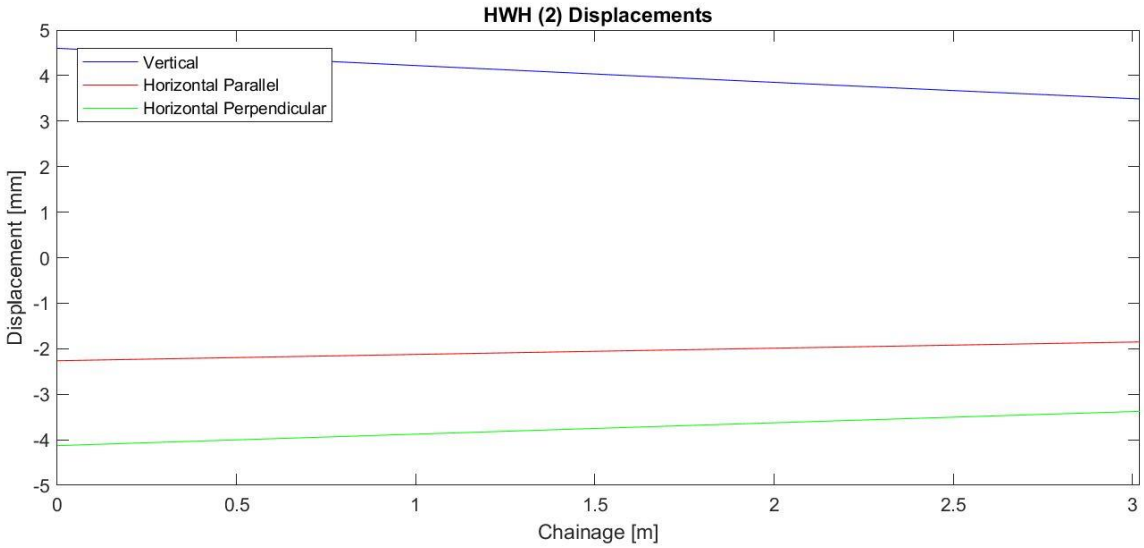
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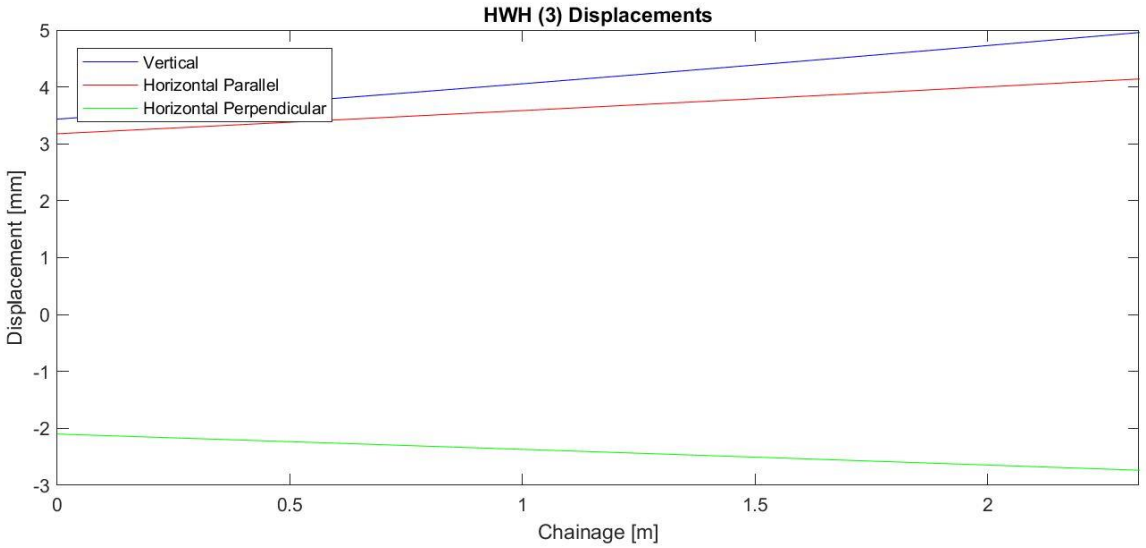
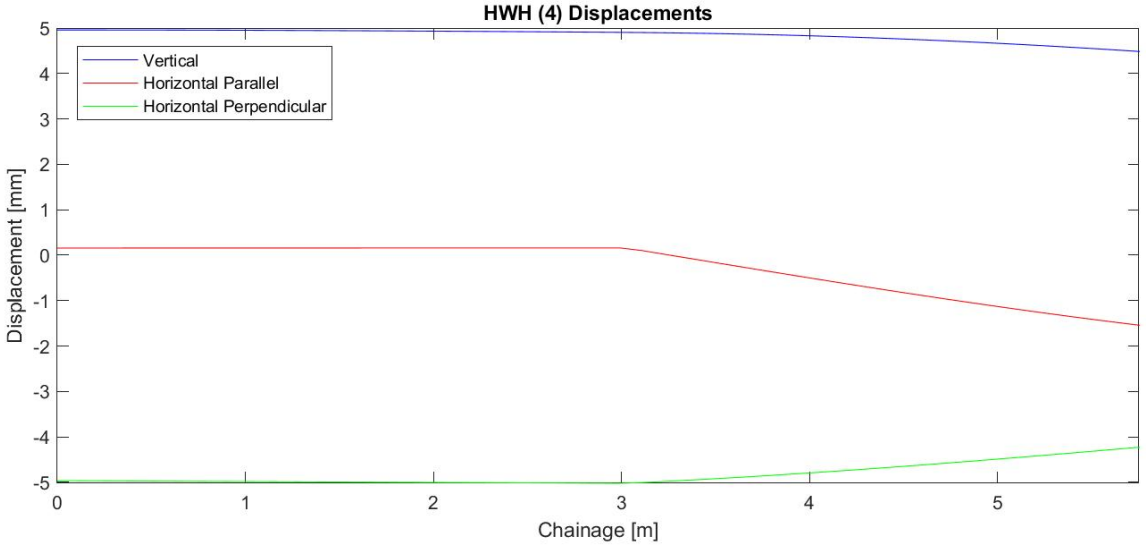
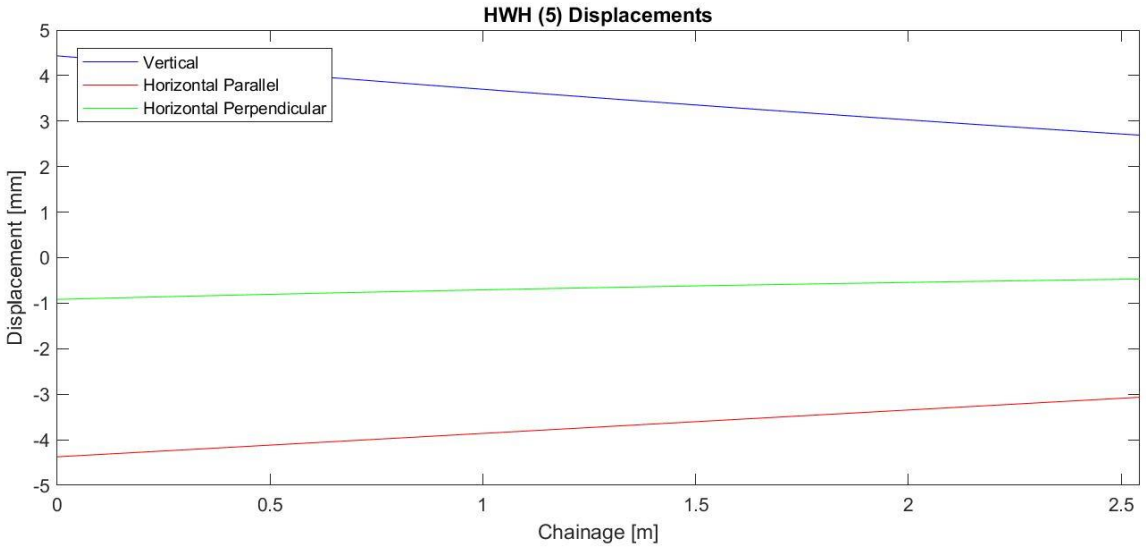
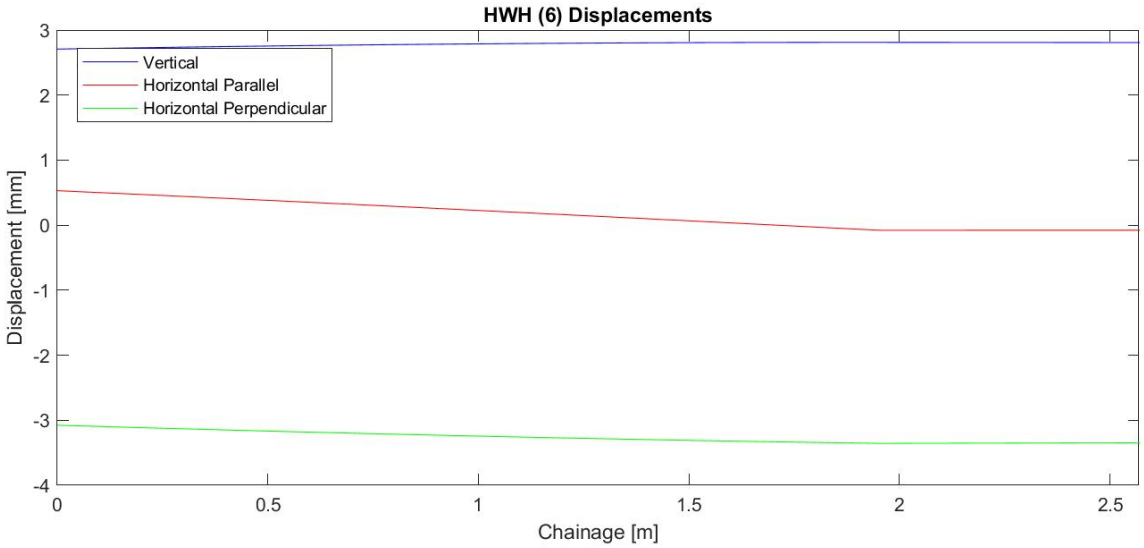
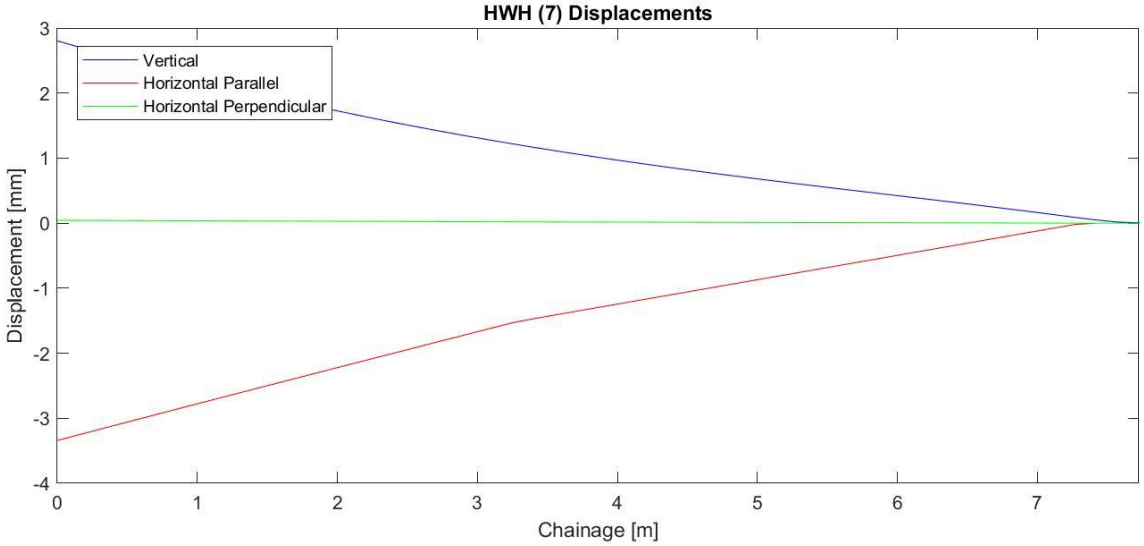
Displacement [mm]
Chainage [m]


HWH (3) Displacements
Vertical
Horizontal Parallel
Horizontal Perpendicular
Displacement [mm]
Chainage [m]


HWH (4) Displacements
Vertical
Horizontal Parallel
Horizontal Perpendicular
Displacement [mm]
Chainage [m]


HWH (5) Displacements
Vertical
Horizontal Parallel
Horizontal Perpendicular
Displacement [mm]
Chainage [m]


HWH (6) Displacements
Vertical
Horizontal Parallel
Horizontal Perpendicular
Displacement [mm]
Chainage [m]
3
2
1
0
-1
-2
-3
-4
0
0.5
1
1.5
2
2.5


HWH (7) Displacements
Vertical
Horizontal Parallel
Horizontal Perpendicular
Displacement [mm]
Chainage [m]
3
2
1
0
-1
-2
-3
-4
0
1
2
3
4
5
6
7

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