SUPPLEMENTARY BASEMENT IMPACT ASSESSMENT REPORT

10 Downside Crescent
London
NW3 2AP

Client: Mr Asif Noor

J17190

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GEA Geotechnical & Environmental Associates

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This report is intended as a Ground Investigation Report (GIR) as defined in BS EN1997-2, unless specifically noted otherwise. The report is not a Geotechnical Design Report (GDR) as defined in EN1997-2 and recommendations made within this report are for guidance only.

CONTENTS

EXECUTIVE SUMMARY

This executive summary contains an overview of the key findings and conclusions. No reliance should be placed on any part of the executive summary until the whole of the report has been read. Other sections of the report may contain information that puts into context the findings that are summarised in the executive summary.

BRIEF

This report describes the findings of a supplementary basement impact assessment and ground movement assessment carried out by Geotechnical and Environmental Associates Limited (GEA), on the instructions of Mr Asif Noor, with respect to the proposed development at No 10 Downside Crescent. The proposed construction comprises of a new single storey extension to the rear of the existing house, which also includes a single level basement. A number of reports have previously been produced by others, including a desk study report, a ground investigation report and three basement impact assessment reports. The documents have been the subject of an ongoing audit by Campbell Reith, on behalf of the London Borough of Camden (LBC). The findings of the audit and subsequent audit document reviews, highlighted a number of points, including the requirement for the sign off of the land stability section of the basement impact assessment by a suitably qualified person, a ground movement assessment and utility services search. This report forms a review of the previous documentation, sign off for the outstanding section of the basement impact assessment and a ground movement assessment to comply with the LBC Planning Guidance CPG4. A contamination assessment did not form part of the project brief.

SITE HISTORY

The historical maps indicate that the existing building was constructed between 1915 and 1934, with minor changes to the house thereafter. The surrounding area has been residential from 1896, with a number of industrial sites in the wider area, including garages, a cardboard box works, warehouses, depots and a hospital.

A review of the historical maps provided by Site Analytical Services (SAS) indicates that the site was undeveloped at the time of the first map, dated 1850. The 1871 map indicates the southeast of the site was occupied by a large house named Haverstock Lodge, which extended further towards the south. The house was surrounded by open grounds with a driveway and footpaths leading from Haverstock Hill to the southwest and Lawn Road to the east. The lodge was cleared prior to 1919 and the surrounding grounds were gradually developed between 1895 and 1919 with housing on Downside Crescent to the west although the site itself remained undeveloped at that time. By 1934 the site had been developed with the existing house and the site and surrounding area have since remained largely unchanged.

GROUND CONDITIONS

The SAS investigation encountered made ground over Head Deposits, which were underlain by the London Clay which was proved to the full depth investigated, of 15.0 m. Below a surface covering of brick paving and concrete, the made ground comprised dark brown slightly silty slightly gravelly sand and clayey sand with brick fragments and extended to depths of 0.60 m and 1.80 m. Below this, the Head Deposits were found to comprise firm brown silty very sandy slightly gravelly clay to depths of 2.4 m and 2.7 m. The Head Deposits were underlain by the London Clay that comprised stiff becoming very stiff brown becoming grey silty sandy clay with gypsum crystals. Groundwater was not encountered during the investigation. However, groundwater was measured within the standpipes at depths of 2.24 m and 1.86 m, approximately four weeks after the fieldwork.

BASEMENT IMPACT ASSESSMENT

The BIA has not indicated any concerns with regard to land stability from the effects of the proposed basement construction on the site and surrounding area.

GROUND MOVEMENT ASSESSMENT CONCLUSIONS

The analysis has concluded that the proposed development will not result in any potential damage to neighbouring structures in excess of Category 0 – Negligible and on this basis the predicted movements are acceptable. The northern elevation of No 10 Downside Crescent was assessed to be Category 2 – Slight and this wall will need to be underpinned as part of the proposed development. A monitoring strategy is recommended for the proposed construction and it is recommended that monitoring is carried out on all structures prior to and during the proposed basement construction.

Part 1: INVESTIGATION REPORT

This section of the report details the objectives of the investigation, the work that has been carried out to meet these objectives and the results of the investigation. Interpretation of the findings is presented in Part 2, while the Ground Movement Assessment and Basement Impact Assessment are presented in Parts 3 and 4 respectively.

1.0 INTRODUCTION

Geotechnical and Environmental Associates Limited (GEA) has been commissioned by Mr Asif Noor, to provide a supplementary basement impact assessment report for the proposed development at No 10 Downside Crescent, London NW3 2AP.

The following reports have previously been carried out in support of a planning application (ref 2016/4413/P) for the proposed development.

- *Basement Impact Assessment (ref 129 BIA, dated 9th August 2016) by Bow Tie Construction.*
- *Phase 1 Risk Assessment Report (ref 17/26538, dated April 2017) by Site Analytical Services Ltd.*
- *Basement Impact Assessment Report (ref 17/26538-2, dated April 2017) by Site Analytical Services.*
- *Basement Impact Assessment Report (ref 65914R1, July 2017) by ESI Limited.*

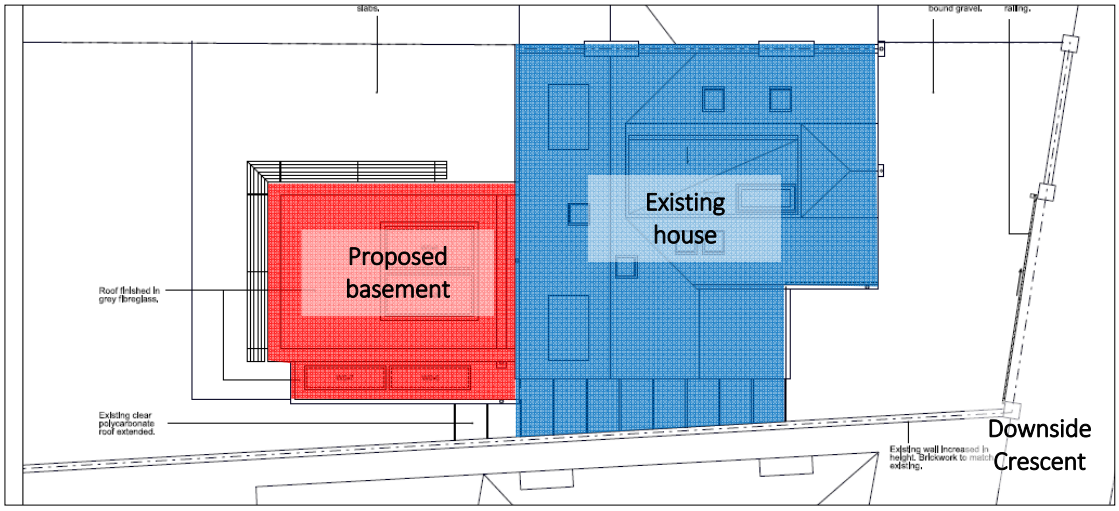
A Basement Impact Assessment (BIA) report was originally provided by Bow Tie Construction in August 2016 and included the screening and scoping elements of the BIA, including Subterranean groundwater, Stability and Surface Flow and Flooding Screening assessments. Campbell Reith Consulting Engineers was subsequently commissioned by the London Borough of Camden to carry out a BIA audit and a number of actions were raised. As a result, a Phase 1 Desk Study report and separate BIA report was provided by Site Analytical Services Ltd (SAS) in April 2017. These documents were issued to Campbell Reith to provide an update to the previous audit items and further feedback was provided from Campbell Reith via email on 21st June 2017. Following the audit feedback, a further BIA report was carried out by ESI Consulting in July 2017 to cover the surface water and groundwater aspects of the BIA only; that report was subsequently submitted to and approved by Campbell Reith.

This report addresses the sign off of the land stability section of the BIA report provided by Site Analytical Services (SAS) (ref 17/26538-2, dated April 2017) by a qualified person as required within CPG4. This report also provides a ground movement analysis and Burland damage assessment for the proposed development. A utility search of the site has also been carried out to identify the need, if any, to assess the impact of the development on nearby assets.

A contamination assessment did not form part of the project brief.

1.1 Proposed Development

It is understood that it is proposed to construct a single storey extension with a single level basement in the rear garden of No 10 Downside Crescent, as shown on the plan below.



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

1.2 Purpose of Work

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

- To carry out a review of the previous reports;
- to assess the possible impact of the proposed development on the local topography and nearby sensitive structures; and
- to carry out an assessment of the likely ground movements due to the proposed development.

1.3. Basement Impact Assessment

The work carried out includes a sign off by a suitably qualified person of the existing Land Stability Assessment by SAS (also referred to as Slope Stability Assessment), which forms part of the BIA procedure specified in the London Borough of Camden (LBC) Planning Guidance CPG4[1] and their Guidance for Subterranean Development[2] prepared by Arup. The aim of the work is to provide information on surface water, land stability and groundwater and in particular to assess whether the development will affect neighbouring properties and whether any identified impacts can be appropriately mitigated by the design of the development.

1.3.1 Qualifications

The land stability element of the Basement Impact Assessment (BIA) has been carried out by Martin Cooper, a BEng in Civil Engineering, a chartered engineer (CEng), member of the Institution of Civil Engineers (MICE), and Fellow of the Geological Society (FGS) who has over 25 years' specialist experience in ground engineering.

1 London Borough of Camden Planning Guidance CPG4 *Basements and lightwells (2015)*
2 Ove Arup & Partners (2010) *Camden geological, hydrogeological and hydrological study. Guidance for Subterranean Development.* For London Borough of Camden November 2010

The assessment has been made in conjunction with Steve Branch, a BSc in Engineering Geology and Geotechnics, MSc in Geotechnical Engineering, a chartered geologist (CGeol) and Fellow of the Geological Society (FGS) with some 30 years' experience in geotechnical engineering and engineering geology.

All assessors meet the qualification requirements of the Council guidance.

1.4 Limitations

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

2.0 THE SITE

2.1 Site Description

The site is located in the London Borough of Camden, approximately 85 m to the east of Belsize Park London Underground station. It fronts onto Downside Crescent to the west and is bounded by Nos 8 and 12 Downside Crescent, and their private front and rear gardens, to the south and north respectively and by the private rear garden of houses fronting on to Lawn Road to the east. The site may be additionally located by National Grid Reference 527483, 185093 and is shown on the map extract below.

The site is roughly rectangular in shape and is occupied in the east by a two-storey brick built semidetached house. There is a front drive area surfaced with brick in the west and a private rear garden in the east that is, in the main, laid to lawn with planted beds and borders.

A site walkover was carried out as part of the Phase 1 Risk Assessment Report (ref 17/26538, dated April 2017) by Site Analytical Services Ltd. The walkover recorded that there was no discernible slope on the site.

2.2 Site History

The site history is summarised below by reference to internet sources and historical Ordnance Survey (OS) maps obtained as part of the Phase 1 Risk Assessment Report (ref 17/26538, dated April 2017) by Site Analytical Services Ltd.

The historical maps indicate that the existing building was constructed between 1915 and 1934, with minor changes to the house thereafter. The surrounding area has been residential from 1896, with a number of industrial sites in the area, including garages, a cardboard box works, warehouses, depots and a hospital.

A review of the historical maps, appended to the aforementioned SAS report, also indicates that the site was undeveloped at the time of the first map, dated 1850. The 1871 map indicates the southeast of the site was occupied by a large house named Haverstock Lodge, which extended further towards the south. The house was surrounded by open grounds with a driveway and footpaths leading from Haverstock Hill to the southwest and Lawn Road to the east. The lodge was cleared prior to 1919 and the majority of the surrounding grounds was gradually developed with housing, with Downside Crescent to the west, between 1895 and 1919, although the site itself remained undeveloped at that time. By 1934 the site had been developed with the existing house and the site and surrounding area have since remained largely unchanged.

2.3 Other Information

A search of public registers and databases has been made via the sensitivity maps included as part of the Phase 1 Risk Assessment Report (ref 17/26538, dated April 2017) by Site Analytical Services Ltd.

The Envirocheck report has not indicated any historic landfill sites, waste management, waste transfer or Control of Major Accident Hazards (COMAH) sites are located within 250 m of the site. There are three areas of non-water potentially infilled land within 250 m of the site and located to the north and northwest. The origin of the areas is unknown, although all three areas are apparently associated with the tennis courts that are located to the northwest, that were constructed between 1915 and 1935, and which are located above the Belsize tunnel that houses the Thameslink railway line. The site is located within the Parkhill Conservation area.

Reference to records compiled by the Health Protection Agency (formerly the National Radiological Protection Board) indicates that the site falls within an area where less than 1% of homes are affected by radon emissions and therefore radon protective measures will not be necessary.

Other than the existing domestic services present on the site, which will be replaced and / or re-directed as part of the proposed redevelopment, information on buried services has been obtained from the main utility companies. This information does not indicate any potentially sensitive infrastructure, such as a Thames Water Trunk Sewer, beneath No 10 Downside

Crescent, or the adjoining sites that could be adversely affected by the proposed development. Copies of the service search information are included within the appendix.

2.4 Geology

The British Geological Survey (BGS) map of the area (Sheet 256) indicates the site is directly underlain by the London Clay. According to the geological map, the site is located roughly 550 m to the southeast of the boundary with the Claygate Member.

According to the BGS Sheet 256, the site is shown roughly 40 m south of an area of "Head Propensity", although the site itself is not indicated to be affected. Head propensity is shown on the BGS map as areas denoted as most likely to be covered by Quaternary Head Deposits as interpreted from digital slope analysis and confirmed by borehole data. These deposits are not mapped and have not been verified by fieldwork; these deposits are noted as having properties similar to that of the London Clay and are shown to occur close to the boundary with the overlying Claygate Member.

According to the BGS memoir, the London Clay is homogenous, slightly calcareous silty clay to very silty clay, with some beds of clayey silt grading to silty fine-grained sand.

GEA has previously carried out a ground investigation on Downside Crescent, roughly 120 m to the northeast of the site. The investigation encountered made ground to be directly underlain by the London Clay, which was proved to the maximum depth investigated of 6.45 m. The London Clay was found to comprise an initial horizon of soft brown and grey slightly gravelly to gravelly clay to depths of between 1.00 m and 2.00 m. Beneath this, firm becoming stiff, locally fissured, brown mottled grey clay with occasional roots, occasional selenite crystals was proved to the maximum depth investigated of 6.45 m.

A historic BGS borehole (ref TQ28/198) located roughly 320 m to the northwest of the site, indicates the London Clay extends to a depth of 69 m.

2.5 Hydrology and Hydrogeology

The hydrology and hydrogeology was assessed as part of the Phase 1 Risk Assessment Report (ref 17/26538, dated April 2017) by Site Analytical Services Ltd.

The London Clay is classified as an Unproductive Stratum, which refers to rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow, as defined by the Environment Agency (EA).

The direction of groundwater flow is likely to be with the local and wider topography towards the southeast. However, as the London Clay comprises predominantly clay soils, it cannot support groundwater flow over any significant distance, nor can it to support a "water table" such as would be found within a more porous and permeable saturated stratum. Any groundwater flow within the London Clay will also be at a very slow rate, due to its negligible permeability. The permeability will be predominantly secondary, through fissures in the clay. Published data indicates the horizontal permeability of the London Clay to generally range between 1×10^{-11} m/s and 1×10^{-9} m/s.

The nearest surface water feature in a pond on Hampstead Heath located 585 m to the north of the site. The site is not located within an area at risk from extreme flooding from rivers or the sea. The site is located outside of a groundwater source protection zone. There are no water abstraction licenses located within 1 km of the site.

Groundwater was not encountered whilst drilling during the aforementioned GEA investigation to the northeast of the site, although subsequent monitoring recorded groundwater at depths of between 0.80 m and 4.95 m.

Reference to the Lost Rivers of London[3] indicates that the site is located between a tributary of the River Fleet and the River Tyburn. The tributary of the River Fleet is located roughly 360 m to the northeast along Fleet Road and flows in a southeasterly direction. The tributary of the River Tyburn springs roughly 300 m to the west of the site on Belsize Avenue and flows in the southerly direction.

3.0 SCREENING

The London Borough of Camden guidance suggests that any development proposal that includes a subterranean basement should be screened to determine whether or not a full Basement Impact Assessment (BIA) is required.

The land stability screening element of the BIA has been provided by SAS (ref 17/26538-2, dated April 2017) and the findings are summarised below.

The subterranean groundwater, surface flow and flooding screening elements of the BIA have already been addressed by others and are not discussed in this section or later in the report.

3.1 Screening Assessment

3.1.1 Stability Screening Assessment

Question	SAS Response for the 10 Downside Crescent
1. Does the existing site include slopes, natural or manmade, greater than 7°?	No
2. Will the proposed re-profiling of landscaping at the site change slopes at the property boundary to more than 7°?	No. Reprofiling of landscaping at the site is not proposed.
3. Does the development neighbour land, including railway cuttings and the like, with a slope greater than 7°?	No. With reference to Fig 16 of Camden CPG4, the neighbouring land has an angle of less than 7°.
4. Is the site within a wider hillside setting in which the general slope is greater than 7°?	No. With reference to Fig 16 of Camden CPG4, the wider hillside setting has an angle of less than 7°.
5. Is the London Clay the shallowest stratum at the site?	*Yes. With reference to available BGS records, the London Clay Formation is expected to be encountered from ground level.*
6. Will any trees be felled as part of the proposed development and / or are any works proposed within any tree protection zones where trees are to be retained?	No. It is understood that no trees are to be felled as part of the development.
7. Is there a history of seasonal shrink-swell subsidence in the local area and / or evidence of such effects at the site?	*Yes. The site lies above the London Clay Formation, which is well known for having a high tendency to shrink and swell.*
8. Is the site within 100 m of a watercourse or potential spring line?	No. Envirocheck indicates that the closest surface water feature is located 585 m north of the site. According to publications regarding the Lost Rivers of London (Baron, 1992), (Talling, 2011) and Stanford (1868), the site is 200 m eat of tributaries to the River Tyburn (Fig 4).
9. Is the site within an area of previously worked ground?	No. According to records from the BGS the site is not in the vicinity of any recorded areas of worked ground.

[3] Nicholas Barton & Stephen Myers (2016) *The Lost Rivers of London.* Historical Publications Ltd

Question	SAS Response for the 10 Downside Crescent
10a. Is the site within an aquifer?	No. The site has been classified as being situated above an unproductive (negligibly permeable) formation (London Clay) that is generally regarded as containing insignificant quantities of groundwater.
10b. Will the proposed basement extend beneath the water table such that dewatering may be required during construction?	
11. Is the site within 50 m of Hampstead Heath ponds?	No. With reference to the Camden Geological, Hydrogeological and Hydrological Study, the site is not within the catchment of the pond chains on Hampstead, nor the Golders' Green Chain.
12. Is the site within 5 m of a highway or pedestrian right of way?	*Yes, the site lies within 5 m of Downside Crescent.*
13. Will the proposed basement significantly increase the differential depth of foundations relative to neighbouring properties?	*Yes, the development will increase the depths of foundation at the site, although the foundation depths of adjacent properties are not known.*
14. Is the site over (or within the exclusion zone of) any tunnels, eg railway lines?	No. The development is within 35 m of the Northern Line tunnels.

The above assessment has identified the following potential issues that need to be assessed:

Q5: London Clay is the shallowest stratum at the site.
Q7: There is a history of seasonal shrink-swell subsidence in the local area and / or evidence of such effects at the site.
Q12: The site is within 5 m of a highway or pedestrian right of way

4.0 SCOPING AND SITE INVESTIGATION

The purpose of scoping is to assess in more detail the factors to be investigated in the impact assessment. Potential impacts are assessed for each of the identified potential impact factors.

4.1 Potential Impacts

The following potential impacts have been identified with regard to the stability screening assessment.

Potential Impact	Consequence
London Clay is the shallowest stratum at the site.	The London Clay is prone to seasonal shrink-swell (subsidence and heave).
Seasonal shrink-swell can result in foundation movements.	Multiple potential impacts depending on the specific setting of the basement development. For example, in terraced properties, the implications of a deepened basement/foundation system on neighbouring properties should be considered.
The site is located within 5 m of a highway or pedestrian right of way	Excavation of a basement may result in structural damage to the road or footway.

These potential impacts have been investigated through the site investigation, as detailed in Part 3.0.

4.2 Summary of previous ground investigation

A ground investigation was subsequently carried out by Site Analytical Services (SAS) and comprised a single continuous flight auger borehole and a single rotary percussive borehole advanced to depths of 10 m and 15 m respectively.

SPTs were carried out at regular intervals within the boreholes to provide quantitative information about the strength of the soils, disturbed and undisturbed samples were recovered from the rotary percussive borehole and disturbed samples were recovered from the continuous flight auger borehole for subsequent laboratory examination and testing.

A groundwater monitoring standpipe was installed in each of the boreholes to a depth of 9.0 m to facilitate groundwater monitoring, which has been carried out on a single occasion approximately four weeks after installation.

4.3 Ground Conditions

The investigation encountered made ground over Head Deposits, which were in turn underlain by the London Clay, which was proved to the full depth investigated, of 15.0 m.

Below a surface covering of brick paving and concrete, the made ground comprised dark brown slightly silty slightly gravelly sand and clayey sand with brick fragments and extended to depths of 0.60 m and 1.80 m.

Below this, the Head Deposits were found to comprise firm brown silty very sandy slightly gravelly clay to depths of 2.4 m and 2.7 m.

The Head Deposits were underlain by the London Clay, comprising stiff becoming very stiff brown becoming grey silty sandy clay with gypsum crystals.

Groundwater was not encountered during the investigation. However, groundwater was measured within the standpipes at depths of 2.24 m and 1.86 m, approximately four weeks following the fieldwork.

Part 2: GROUND MOVEMENT ASSESSMENT

This section of the report comprises an analysis of the ground movements arising from the proposed basement and foundation scheme discussed in Part 2 and the information obtained from the investigation, presented in Part 1 of the report.

5.0 INTRODUCTION

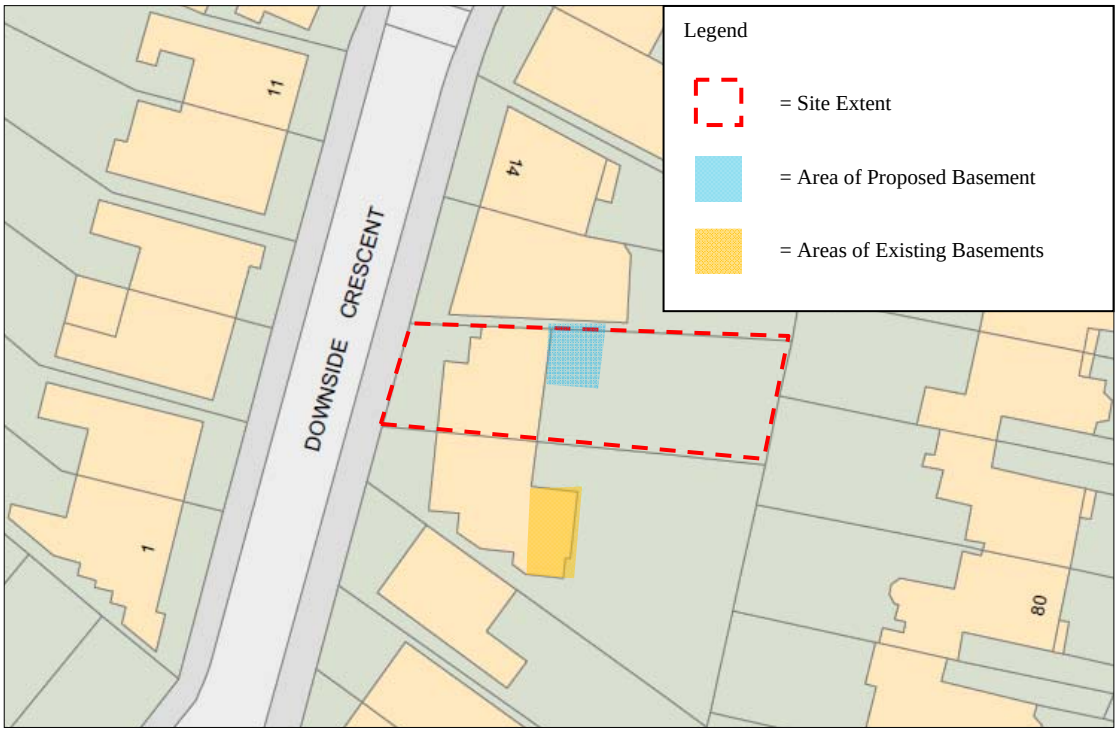
It is understood that it is proposed to construct a new single storey extension with a single level basement within the rear garden. The new basement is assumed to extend to a maximum depth of 4.0 m and the reinforced concrete retaining walls will be constructed in a 'hit and miss' sequence using a trench box excavation.

The sides of an excavation will move to some extent regardless of how they are supported. The movement will typically be both horizontal and vertical and will be influenced by the engineering properties of the ground, groundwater level and flow, the efficiency of the various support systems employed during retaining wall construction and the efficiency or stiffness of any support structures used. An analysis has been carried out of the likely movements arising from the proposed basement construction and the results of this analysis have been used to predict the effect of these movements on surrounding structures.

5.1 Basis of Ground Movement Assessment

5.1.1 Nearby Sensitive Structures

A plan showing the nearby sensitive structures is shown below.



Sensitive structures relevant to this assessment include Nos 8, 12 and 14 Downside Crescent. Garden and boundary walls have not been included in this assessment. A search of the Camden Planning Portal indicates that there is a basement beneath the single storey extension at the rear of No 8 Downside Crescent.

The heights of neighbouring houses have been estimated from observation and from drawings provided by the consulting engineers. Where the depths of foundations or the heights of buildings are not known, these dimensions have been assumed.

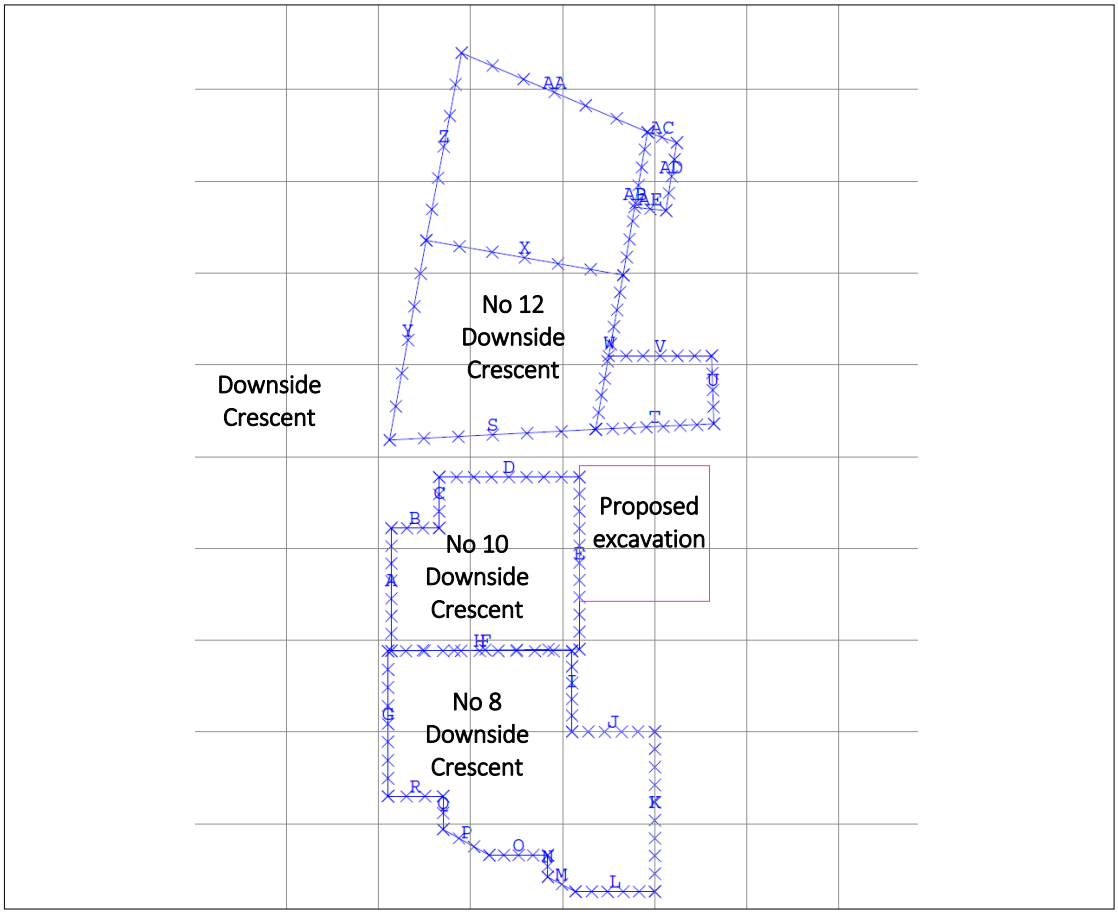
The heights and basement depths of each of the nearby sensitive structures are summarised in the table below. All building foundation depths that have not been proved are assumed to be 0.5 m deep.

Sensitive Structure	Structure Reference	Depth below existing ground level of foundations (m)	Height of building above ground level (m)
No 10 Downside Crescent	A to F	0.5	Varies between 4.8 m and 10.1 m
No 8 Downside Crescent (main house)	F to I, M to R	0.5	Varies between 5.3 m and 7.8 m
No 8 Downside Crescent (rear extension)	J to L	2.2	3.0
No 12 Downside Crescent (main house)	S, W to Y	0.5	Varies between 8.0 m and 10.0 m
No 12 Downside Crescent (rear extension)	T to V	0.5	3.0
No 14 Downside Crescent (main house)	Z to AB	0.5	Varies between 8.0 m and 10.0 m
No 14 Downside Crescent (rear extension)	AC to AD	0.5	3.0

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

Drawing Reference	Drawing Title
Print2391_1867041	Findmaps site plan
129 P 00, dated June 2016	Proposed Ground Floor and Basement Plans
129 P 21 rev a, dated June 2016	Proposed Sections C-C and X-X
Construction Method Statement by Bow Tie Construction	Drawings contained therein

The diagram below details the sensitive structures in relation to the proposed excavation.



5.1.2 Construction Sequence

It is assumed that the proposed reinforced concrete basement walls will be constructed by the same methodology as traditional underpinning, although the building will have been demolished prior to the retaining wall construction.

The following sequence of operations has been assumed to enable analysis of the ground movements around the proposed basement both during and after construction.

1. Construct reinforced concrete retaining walls to the perimeter of proposed basement. It is assumed the retaining walls will be formed in a 'hit and miss' sequence using a trench box excavation, commonly sheet lined, shored and strutted; all temporary shoring and propping to be inspected by a suitably qualified person;

2. construct the new reinforced concrete ground floor slab and excavate the new basement in a sequence that provides full restraint to the head and foot of the wall. Temporarily retain and strengthen the new retaining walls with sufficient propping and waling beams; and

3. cast basement floor slab and construct superstructure of single storey extension over basement.

The retaining walls will be adequately propped laterally and sufficiently dowelled together, and the concrete will be cast and adequately cured prior to excavation of the basement and

removal of the formwork and supports. It is assumed that the corners of the excavation will be locally stiffened by cross-bracing or similar and that the new retaining walls will not be cantilevered at any stage during the construction process. It is assumed that adequate temporary propping of the new retaining walls, particularly at the top level, will occur at all times prior to the construction of permanent structure.

The detail of the support provided to adjacent walls is beyond the scope of this report at this stage and the structural engineer will be best placed to agree a methodology with the retaining wall contractor once appointed.

When the final excavation depths have been reached, the permanent works will be formed, and will comprise reinforced concrete walls with a drained cavity lining the inside of the retaining walls. The temporary props will remain in place until the ground floor slab has been constructed.
Following this, the reinforced concrete basement floor slab will be constructed and the temporary props will be removed.

5.2 Ground Movements

An assessment of ground movements within and surrounding the excavation has been undertaken using the P-Disp Version 19.3 – Build 16 package licensed from the OASYS suite of geotechnical modelling software from Arup. This program is commonly used within the ground engineering industry and is considered to be an appropriate tool for the analysis of a reinforced concrete retained wall.

Published data for ground movements associated with underpinned retaining walls and the subsequent excavation of a new basement is limited compared to other types of retaining wall. It is possible to use the well-documented predictions and movement curves for embedded retaining walls contained within CIRIA C760[4], although this approach is considered to be unnecessarily conservative. A manual approach has therefore been adopted in conjunction with the results of a P-Disp analysis to assess the effects of construction of the proposed reinforced concrete retaining walls and the subsequent excavation of the new basement in cohesive soils.

5.2.1 P-Disp Model

At this site, unloading of the underlying London Clay will take place as a result of the demolition of the existing house, installation of the new retaining walls and excavation of the new basement, such that the reduction in vertical stress in the short term will cause heave to take place. Undrained soil parameters have been used to estimate the potential short-term movements, which include the “immediate” or elastic movements as a result of the basement excavation. The model is based on the assumption that the soils behave elastically, which provides a reasonable approximation to soil behaviour at small strains. Drained parameters have been used to provide an estimate of the total movement, which includes long term swelling that will continue for a number of years.

The elastic analysis requires values of soil stiffness at various levels to calculate displacements. Values of stiffness for the soils at this site are readily available from published data and we have used a well-established method to provide our estimates. This relates values of E_u and E', the undrained and drained stiffness respectively, to values of undrained cohesion, as described by Padfield and Sharrock[5] and Butler[6] and more recently by O’Brien and Sharp[7].

4 Gaba, A, Hardy, S, Powrie, W, Doughty, L and Selemetas, D (2017) *Embedded retaining walls – guidance for economic design* CIRIA Report C760
5 Padfield CJ and Sharrock MJ (1983) *Settlement of structures on clay soils*. CIRIA Special Publication 27
6 Butler FG (1974) *Heavily overconsolidated clays: a state of the art review*. Proc Conf Settlement of Structures, Cambridge, 531-

Relationships of $E_u = 500\ C_u$ and $E' = 300\ C_u$ for the cohesive soils have been used to obtain values of Young's modulus. More recent published data[8] indicates stiffness values of 750 x C_u for the London Clay and a ratio of E' to Eu of 0.75, and it is considered that the use of the more conservative values provides a sensible approach for this stage in the design.

The profile of the Head Deposits and underlying London Clay has been interpolated from the previous investigation by Site Analytical Services on the site and a design line of 7.5z + 40 has been adopted for this analysis.

For the purpose of this analysis, the corners have been defined by x and y coordinates, with the x-direction parallel with the orientation east-west, whilst the y-direction is parallel with the orientation of north-south. Vertical movement is in the z-direction. Wall lengths of less than 10 m have been modelled as 1 m long structural elements, while walls greater than 10 m in length have been modelled as 2 m elements to reflect their greater stiffness. The full outputs of all the analyses and P-Disp movement contour plots are included within the appendix.

At this stage, it is assumed that there will be no new loading applied at basement level. This assumption is conservative and in reality the loading of the new extension will be distributed at basement level by the new reinforced concrete retaining walls.

The soil parameters used in this assessment are tabulated below.

Stratum	Depth range (m)	Eu (MPa)	E' (MPa)
Made Ground	GL to 1.0	20.0	20.0
Head Deposits	1.0 to 2.5	20.0 to 25	12.0 to 15.0
London Clay	2.5 to 69.0	25.0 to 271.0	15.0 to 162.6

A rigid boundary for the analysis has been set at the base of the London Clay at roughly 69 m below ground level, where a nearby BGS record indicates that the base of this formation is likely to be present.

5.2.2 Ground Movements – Surrounding the Basement

Wall Installation

Following Excavation

Experience with respect to the construction of underpinned retaining walls suggests that horizontal ground movements of underpinned walls should remain typically within the range of 2 mm to 5 mm following completion of the works, provided that they are installed by a reputable and experienced contractor in accordance with the guidelines published by the Association of Specialist Underpinning Contractors[9]. While the new retaining walls are not underpins, the sequence of construction is assumed to be the same as underpins without the building above, and the parameters above are deemed reasonable for this assessment.

578, Pentech Press, Lond

7 O'Brien AS and Sharp P (2001) *Settlement and heave of overconsolidated clays - a simplified non-linear method.* Part Two, Ground Engineering, Nov 2001, 48-53

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

9 Haslam S, O'Connor L (2013) *Guidelines on safe and efficient basement construction directly below or near to existing structures* ASUC

P-Disp has been used to predict the heave movements as a result of the unloading of the underlying soils, following the proposed basement excavation. The heave movements have been used to estimate the deflection ratio of the nearby sensitive structures, the values of which are shown in the table below.

The results of the P-Disp analysis are tabulated below and have been presented to the degree of accuracy required to allow predicted variations in ground movements around the structure(s) to be illustrated, but may not reflect the anticipated accuracy of the predictions.

Building Name	Sensitive Structure Reference	Wall Length (m)	Change in Vertical Deflection, Δ (mm)	Maximum Deflection Ratio
No 10 Downside Crescent	A	6.7	< 1	0.0015
	B	2.6	< 1	0.0038
	C	2.8	< 1	0.0036
	D	7.6	4	0.0447
	E	9.4	5	0.0500
	F	10.2	< 1	0.0049
No 8 Downside Crescent	G	7.9	< 1	0.0013
	H	10.0	< 1	0.0050
	I	4.4	< 1	0.0068
	J	4.5	< 1	0.0022
	K	8.7	< 1	0.0023
	L	4.3	< 1	0.0023
	M	1.7	< 1	0.0059
	N	1.2	< 1	0.0083
	O	3.2	< 1	0.0031
	P	2.9	< 1	0.0035
	Q	1.8	< 1	0.0056
	R	3.0	< 1	0.0033
No 12 Downside Crescent	S	11.2	< 1	0.0062
	T	6.4	< 1	0.0125
	U	3.7	< 1	0.0081
	V	5.6	< 1	0.0036
	W	8.5	< 1	0.0105
	X	10.9	< 1	0.0009
	Y	11.1	< 1	0.0009
No 14 Downside Crescent	Z	10.4	< 1	0.0010
	AA	11.0	< 1	0.0009
	AB	7.9	< 1	0.0013
	AC	1.7	< 1	0.0059
	AD	3.7	< 1	0.0027

Building Name	Sensitive Structure Reference	Wall Length (m)	Change in Vertical Deflection, Δ (mm)	Maximum Deflection Ratio
	AE	1.7	< 1	0.0058

5.2.3 Movements within the Excavation (Heave)

Results

Using the same P-Disp model, the analysis indicates that, by the time the basement construction is complete, between around 5 mm and 10 mm of heave is likely to have taken place at the centre of the proposed excavation, reducing to around 5 mm at the edges. In the long term, around a further 10 mm of settlement is likely to occur within the centre of the excavation.

5.3 Building Damage Assessment

In addition to the above assessment of the likely movements that will result from the proposed development, the neighbouring buildings are considered to be sensitive structures, requiring Building Damage Assessments, on the basis of the classification given in Table 2.5 of C760.

The results above have been used to predict the building damage category for each sensitive structure and these are shown in Section 6.1 overleaf. A summary page showing the individual results for each sensitive structure is appended.

All structures are shown on the plan in Section 9.2.1.

5.3.1 Damage to Neighbouring Structures

P-Disp has been used to estimate the differential movement along the length of each sensitive structure and the results have been used in a manual assessment to predict the building damage category for each sensitive structure. The results of the building damage assessment are shown in the table below.

The plot for horizontal wall movements as a result of the excavation in front of a wall in stiff clay in CIRIA C760 (Fig 6.15a) has been adapted to reflect a trend line that assumes a movement of 5 mm immediately behind the wall. The trend line is set such that the predicted movement diminishes with distance from the top pf the wall according to the trend line set by a high stiffness wall within high stiffness clay.

The results of the preliminary conservative assessment are shown in the table below.

Sensitive Structure Reference	Category of Damage*
A	Category 0 - Negligible
B	Category 0 - Negligible
C	Category 0 - Negligible
D	Category 2 - Slight
E	Category 0 - Negligible
F	Category 0 - Negligible

Sensitive Structure Reference	Category of Damage*
G	Category 0 - Negligible
H	Category 0 - Negligible
I	Category 0 - Negligible
J	Category 0 - Negligible
K	Category 0 - Negligible
L	Category 0 - Negligible
M	Category 0 - Negligible
N	Category 0 - Negligible
O	Category 0 - Negligible
P	Category 0 - Negligible
Q	Category 0 - Negligible
R	Category 0 - Negligible
S	Category 0 - Negligible
T	Category 0 - Negligible
U	Category 0 - Negligible
W	Category 0 - Negligible
Z	Category 0 - Negligible
AA	Category 0 - Negligible
AB	Category 0 - Negligible
AC	Category 0 - Negligible
AD	Category 0 - Negligible
AE	Category 0 - Negligible

**From Table 6.4 of C760[1]: Classification of visible damage to walls.*

The above analysis has predicted that the proposed demolition of the existing house, installation of the retaining walls and excavation of the proposed basement may result in the building damage for sensitive structures of generally Category 0 (negligible), with a single wall, Wall D, classified as Category 2 (Slight).

The Camden Planning Guidance notes that '*The Council…..will expect BIAs to provide mitigation measures where any risk of damage is identified of Burland category 1 'very slight' or higher. Following inclusion of mitigation measures into the proposed scheme the*

changes in attributes are to be re-evaluated and new net consequences determined.' Additional consideration has therefore been given to the walls with damage categories of Very Slight and Slight, as discussed below.

Wall D is the northern-most elevation of the main house at No 10 Downside Crescent. This wall is located adjacent to the proposed excavation and is it likely that this will be underpinned as part of the proposed development. In any case, the wall is located within the site boundary and movements to the structure will be addressed as part of the construction process.

5.3.2 Monitoring of Ground Movements

The predictions of ground movement based on the ground movement analysis should be checked by monitoring of adjacent properties and structures. The structures to be monitored during the construction stages should include the existing house and neighbouring structures. Condition surveys of the existing structures should be carried out before and after the proposed works.

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

5.4 Ground Movement Assessment Conclusions

The analysis has concluded that the proposed development will not result in any potential damage to neighbouring structures in excess of Category 0 – Negligible and on this basis the predicted movements are considered to be acceptable.

The northern elevation of No 10 Downside Crescent, Wall D, located within the site boundary, was assessed to be Category 2 – Slight and this wall will need to be underpinned as part of the proposed development. Further analysis of Wall D has indicated that if the wall is underpinned to the full depth of the proposed basement to a distance of 1 m from the excavation, then a wall deflection of 1.9 mm may be achieved and will result in Category 1 – Very Slight.

A monitoring strategy is recommended for the proposed construction and it is recommended that movement monitoring is carried out on all structures prior to and during the proposed basement construction.

The separate phases of work, including excavation of the proposed basement, will in practice be separated by a number of weeks, during which time construction of permanent supports, basement slab and retaining wall curing will take place. This will provide an opportunity for the ground movements during and immediately after retaining wall construction to be measured and the data acquired can be fed back into the design and compared with the predicted values. Such a comparison will allow the ground model to be reviewed and the predicted wall movements to be reassessed prior to the main excavation taking place so that propping arrangements can be adjusted if required.

Part 3: BASEMENT IMPACT ASSESSMENT

This section of the report evaluates the direct and indirect implications of the proposed project, based on the findings of the previous screening and scoping, site investigation and ground movement assessment.

6.0 INTRODUCTION

The stability screening identified a number of potential impacts. The desk study and ground investigation information has been used below to review the potential impacts, to assess the likelihood of them occurring and the scope for reasonable engineering mitigation.

6.1 Potential Impacts

The table below summarises the previously identified potential impacts and the additional information that is now available from the ground investigation in consideration of each impact.

Potential Stability Impact	SAS Site Investigation Conclusions
London Clay is the shallowest stratum at the site.	There is a layer of Head Deposits located above the London Clay. The Head Deposits are a predominantly clay layer with a variable sand and gravel content.
Seasonal shrink-swell can result in foundation movements.	The London Clay was proved below the site and was recorded as having a high susceptibility to shrinkage and swelling. However, the base of the proposed basement will extend well below the potential depth of root action.
The site is located within 5 m of a highway or pedestrian right of way	The proposed basement is not to be extended below Downside Crescent and therefore it is suggested that the impact on these access roads is likely to be minimal There is nothing unusual in the proposed development that would give rise to any concerns with regard to the stability of public highways.

6.1.1 Scoping and Site Investigation

The questions in the screening stage that there were answered 'yes', were taken forward to a scoping stage and the potential impacts discussed in Section 4.0 of this report, with reference to the possible impacts outlined in the Arup report.

A ground investigation has been carried out, which has allowed an assessment of the potential impacts of the basement development on the various receptors identified from the screening and scoping stages. Principally the investigation aimed to establish the ground conditions, including the groundwater level, the engineering properties of the underlying soils to enable suitable design of the basement development and the configuration of the existing wall foundations. The findings of the investigation are discussed in Section 5.0 of this report and summarised in both Section 7.0 and the Executive Summary.

6.1.2 Impact Assessment

Section 6.0 of this report summarises whether or not, on the basis of the findings of the investigation, the potential impacts still need to be given consideration and identifies ongoing risks that will require suitable engineering mitigation. Section 5.0 makes reference to the outcomes of a ground movement analysis and building damage assessment included as an

appendix to this report, which has also been used to provide a conclusion on any potential impacts from the proposed basement development.

6.2 BIA Conclusion

A Basement Impact Assessment has been carried out following the information and guidance published by the London Borough of Camden. Information from a Site Investigation and Ground Movement Assessment has been used to assess potential impacts identified by the screening process.

It is concluded that the proposed development is unlikely to result in any specific land or slope stability issues.

APPENDIX

P-Disp Analysis Short Term Movement Contour Plots

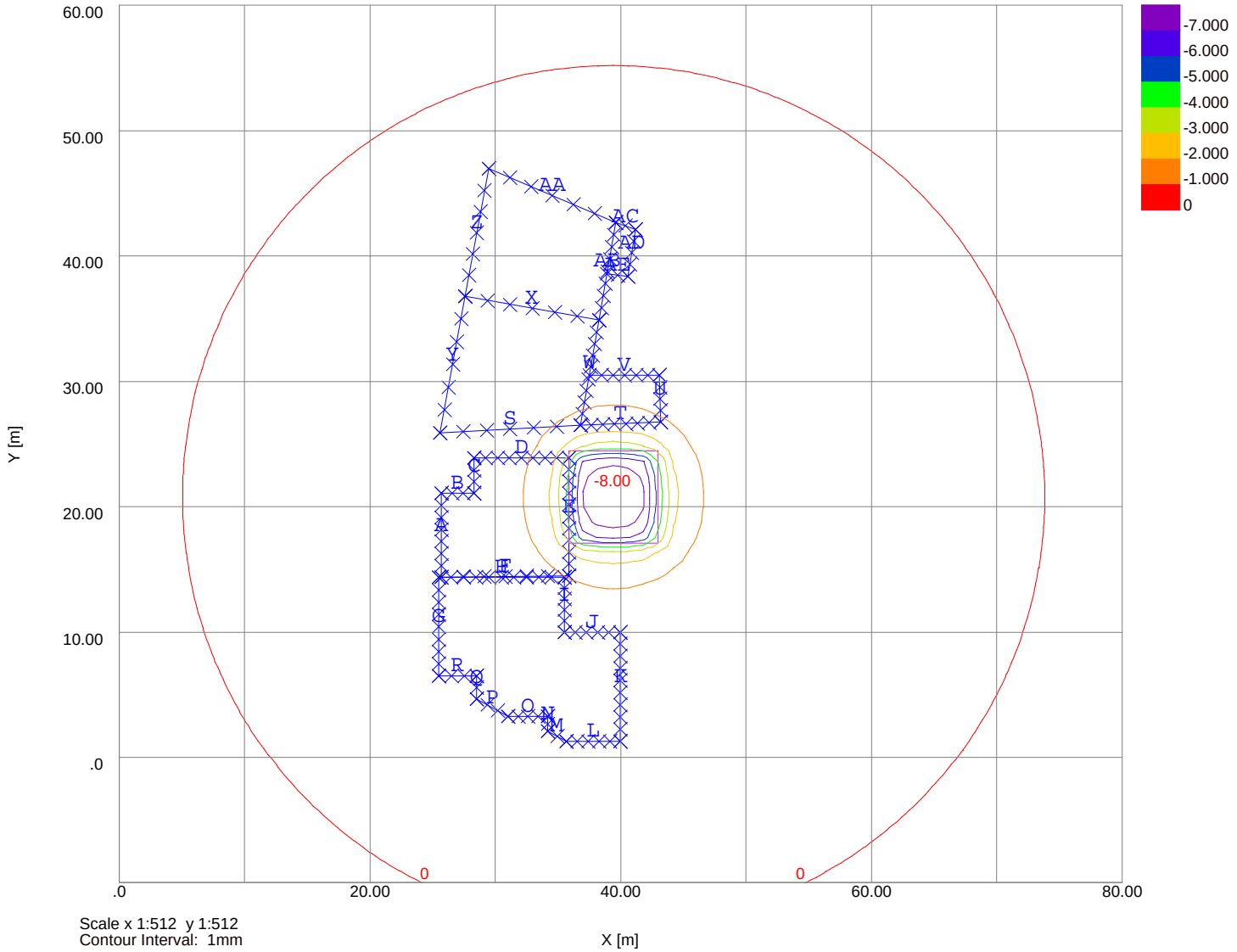
P-Disp Analysis Total Movement Contour Plots

P-Disp Analysis Vertical Displacement Plots

Damage Category Manual Calculations

Site Plan

Settlement Contours : Grid 1 at 0.0000m



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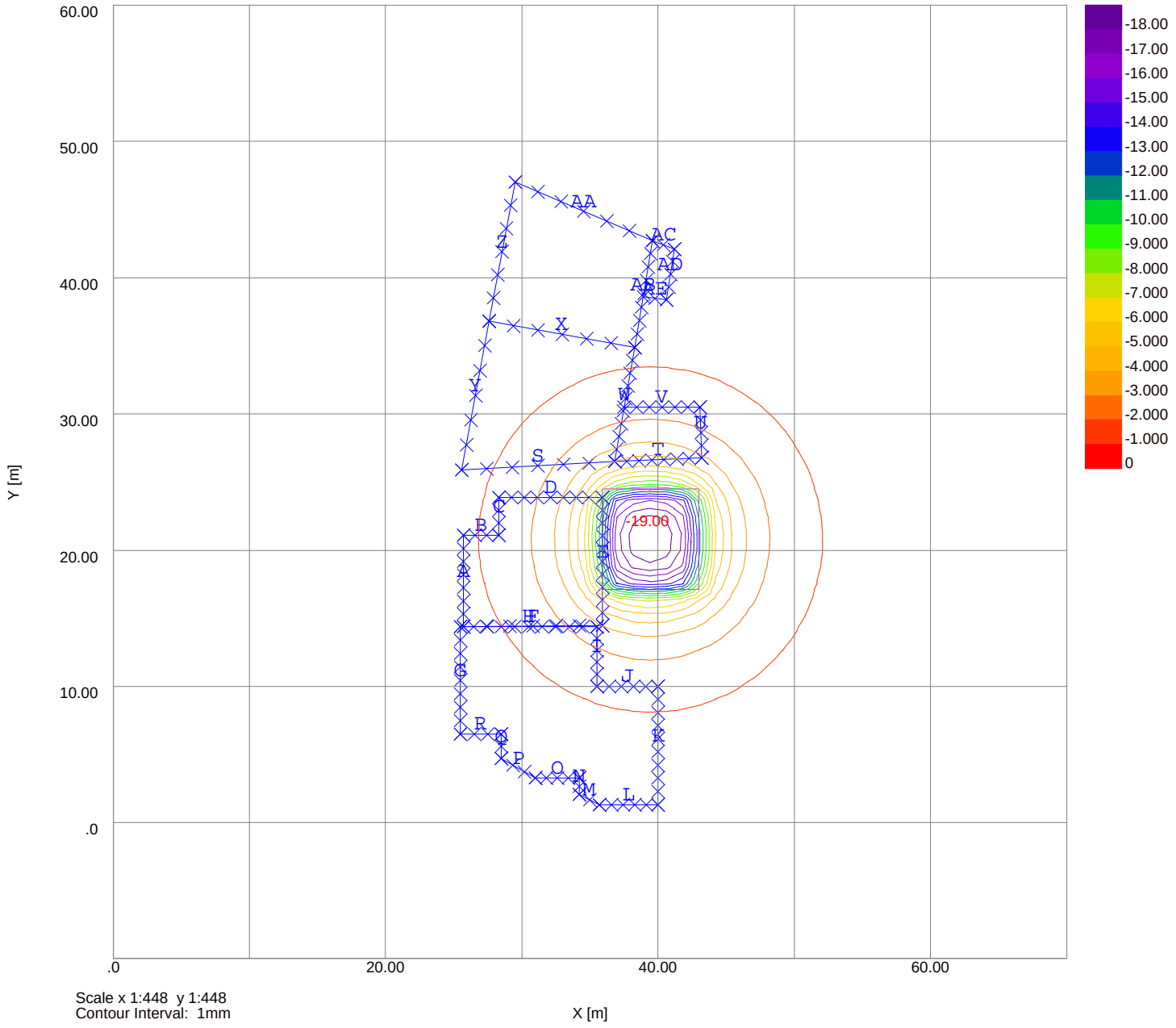
Contour Interval: 1mm

Settlement Contours : Grid 1 at 0.0000m



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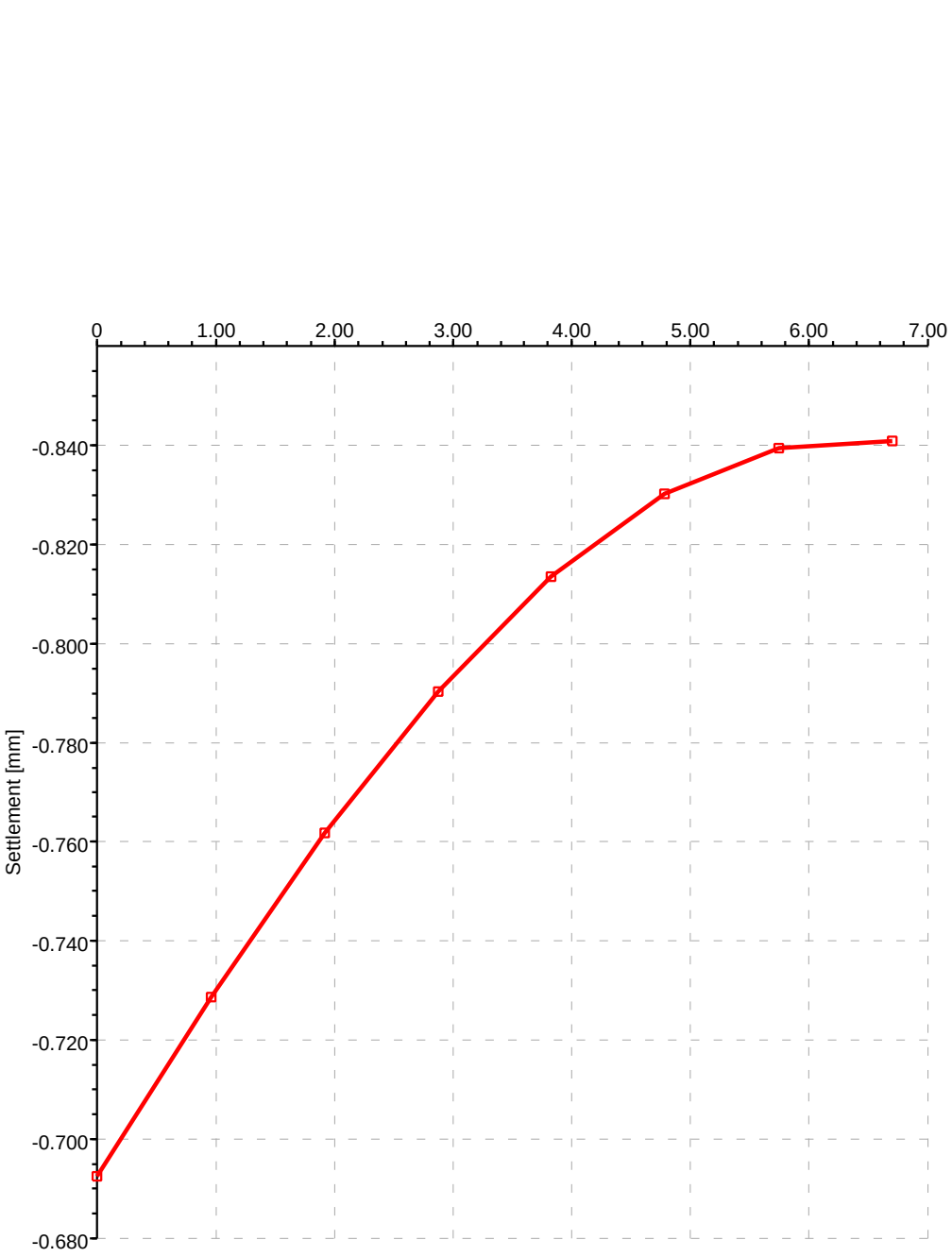
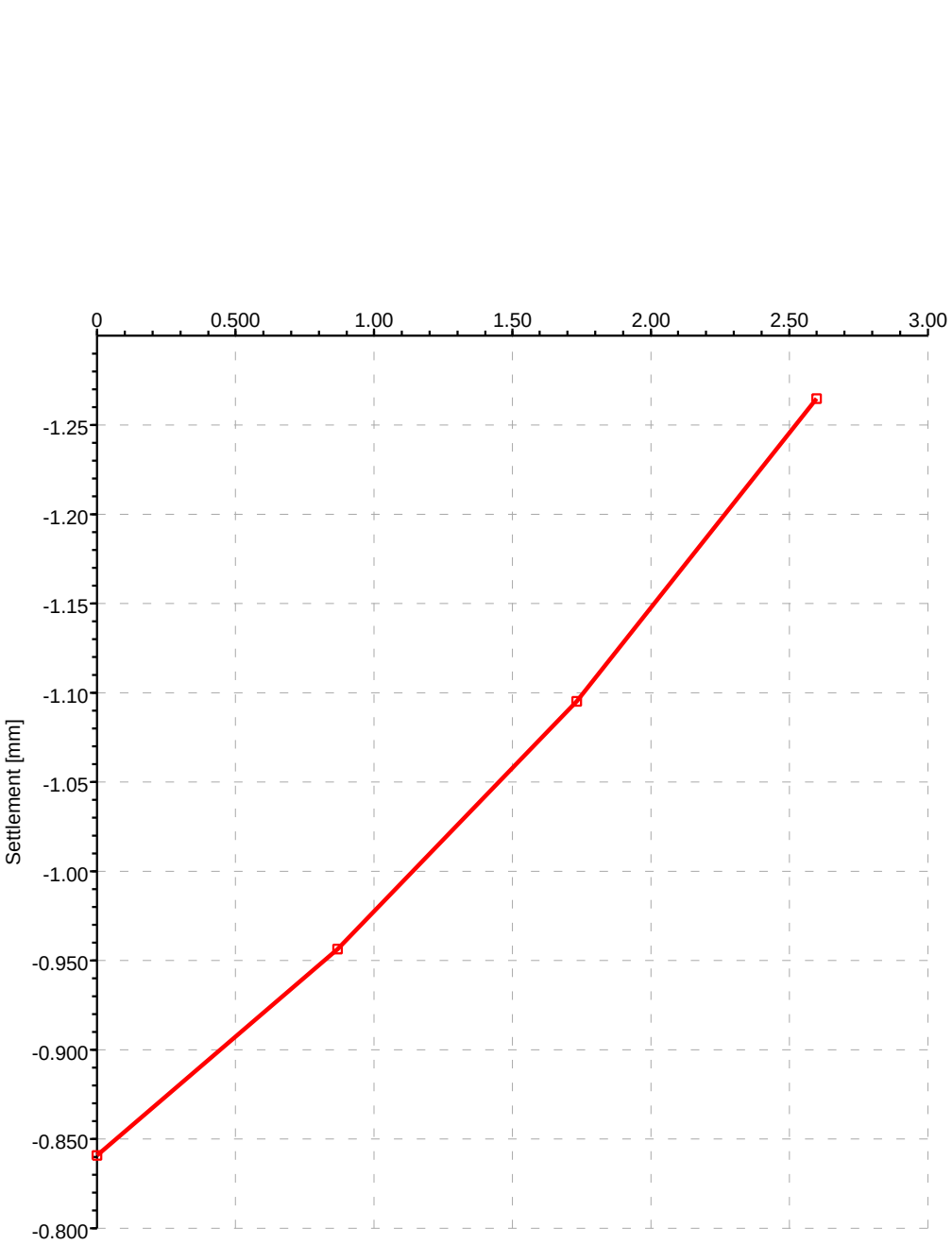
Contour Interval: 1mm

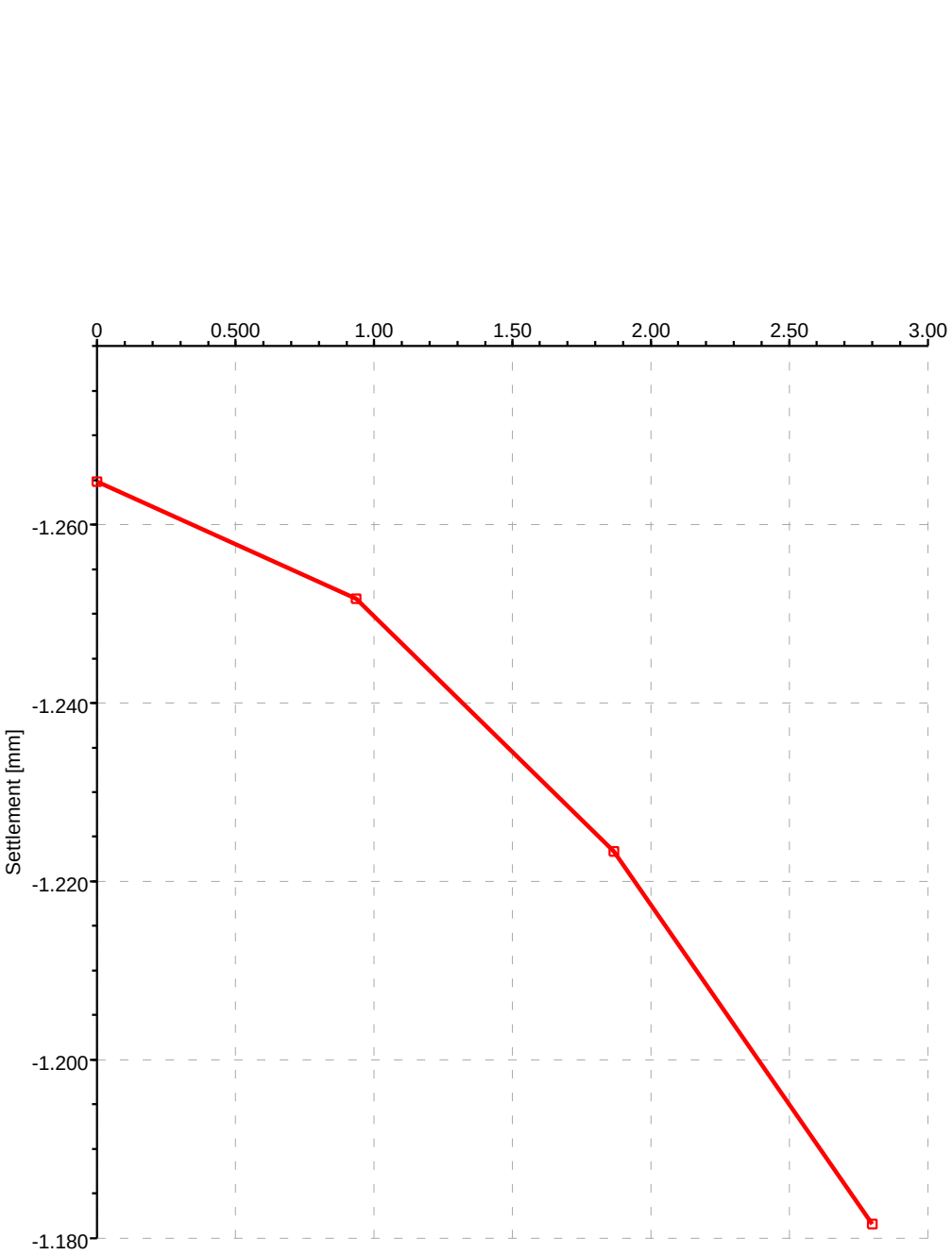
Displacement for A



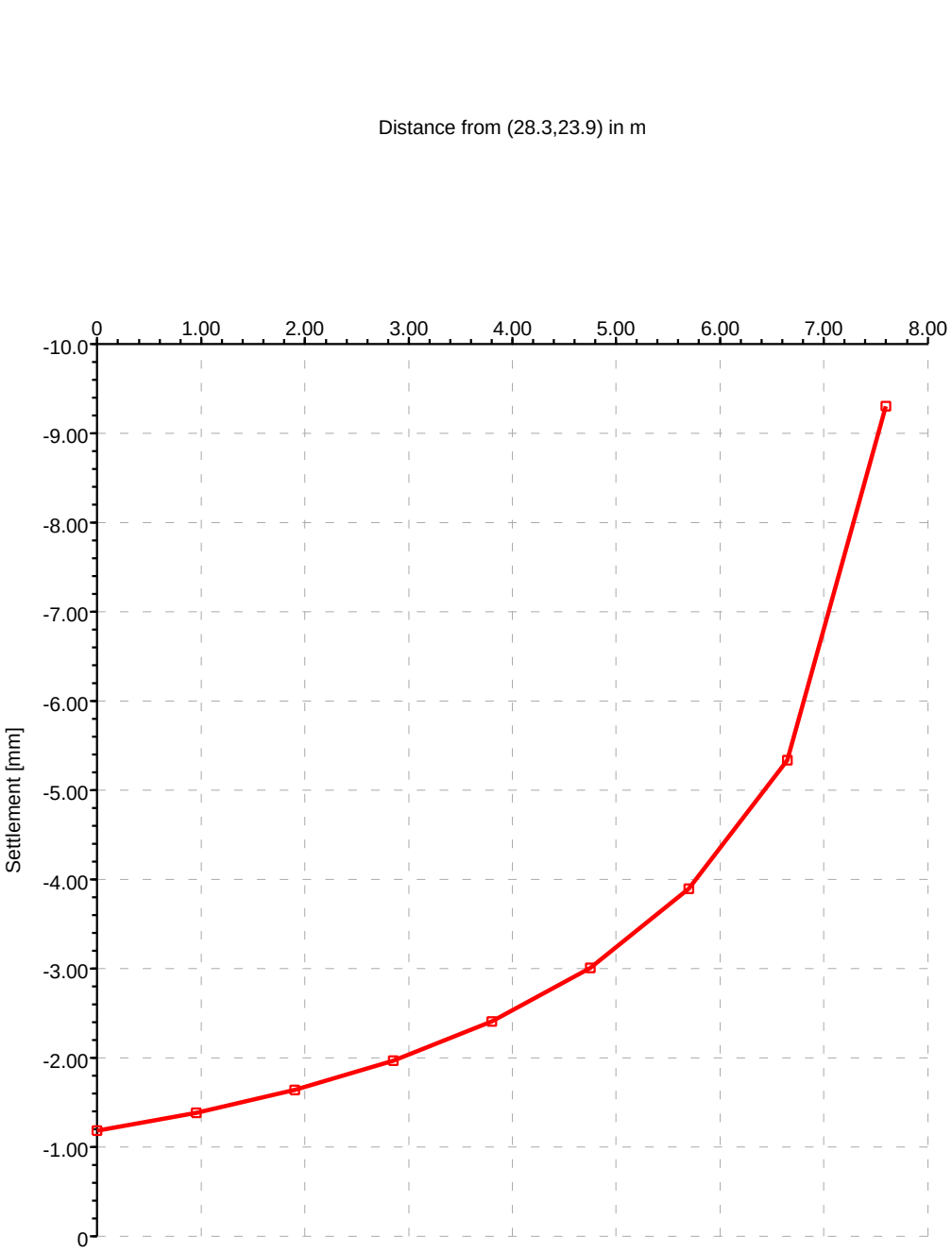
Displacement for B



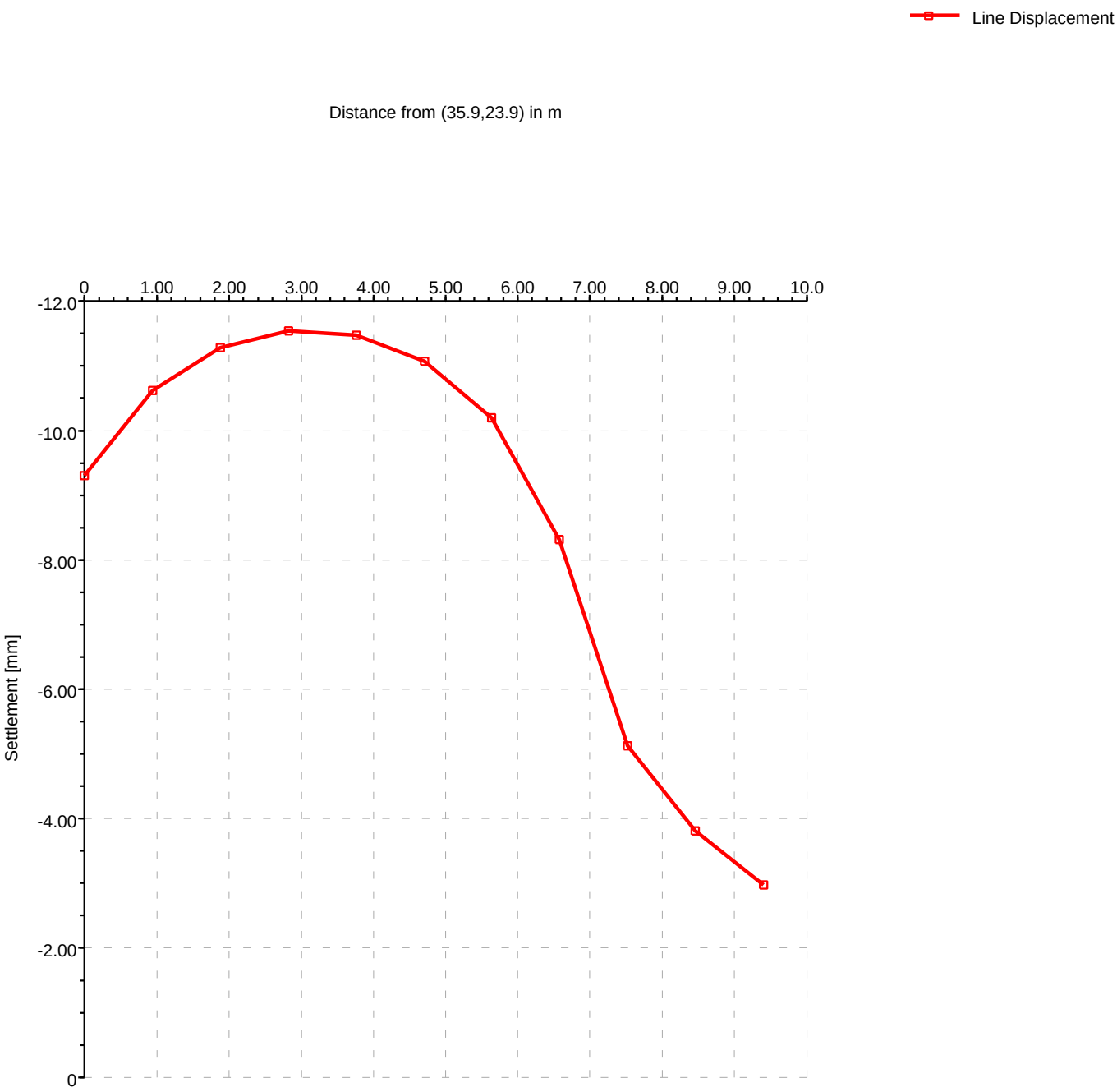
Displacement for C



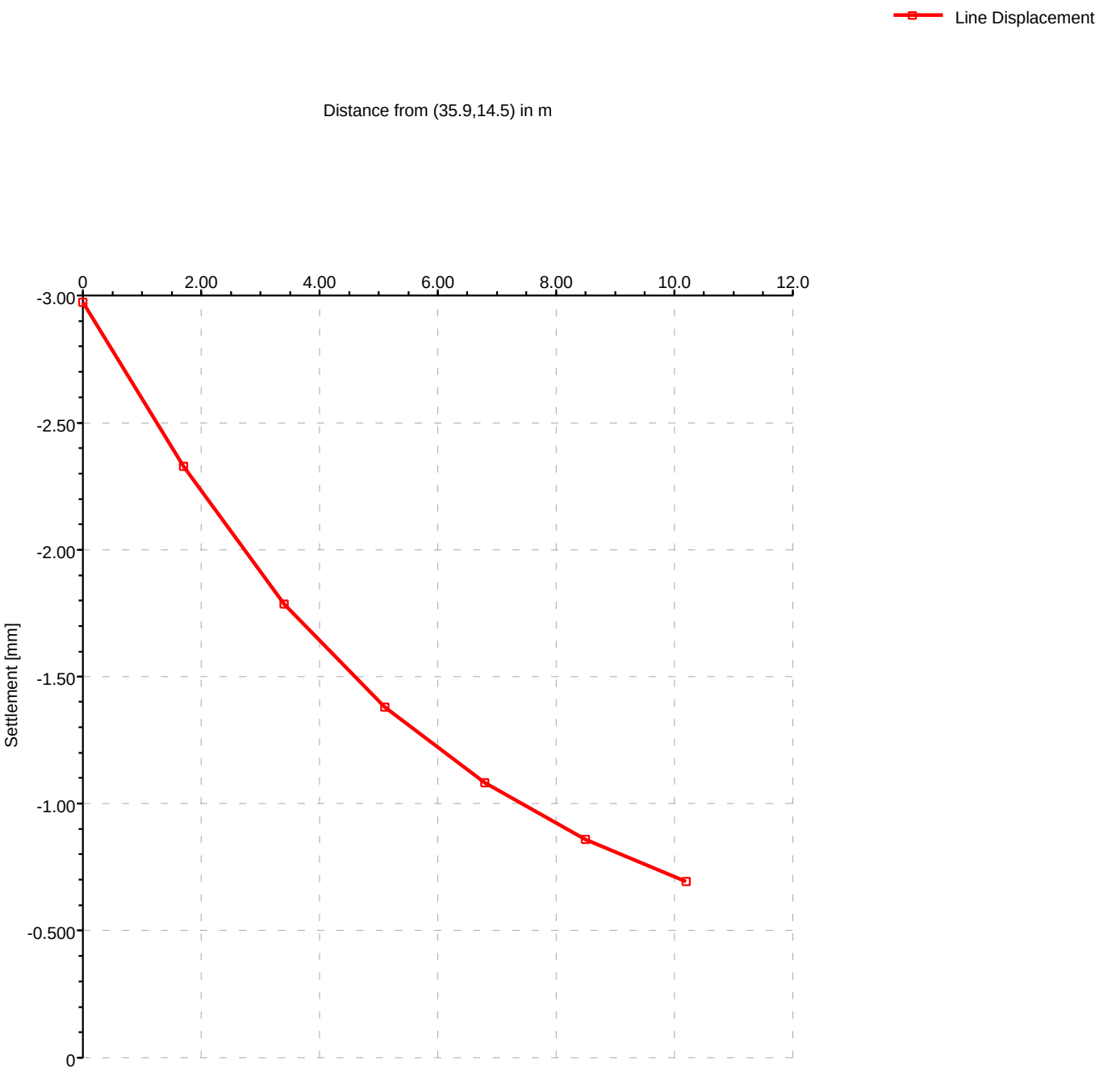
Displacement for D



Displacement for E

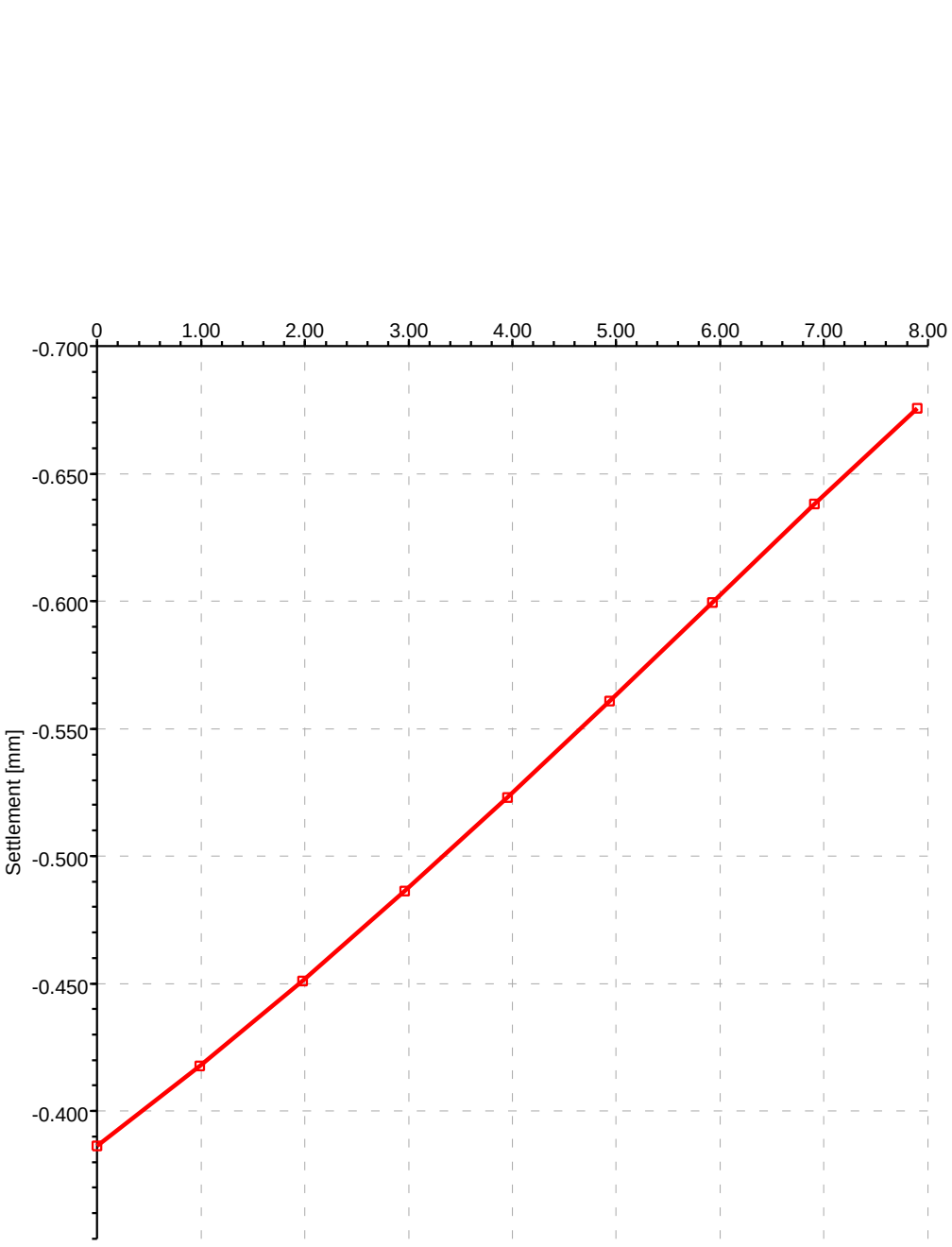


Displacement for F

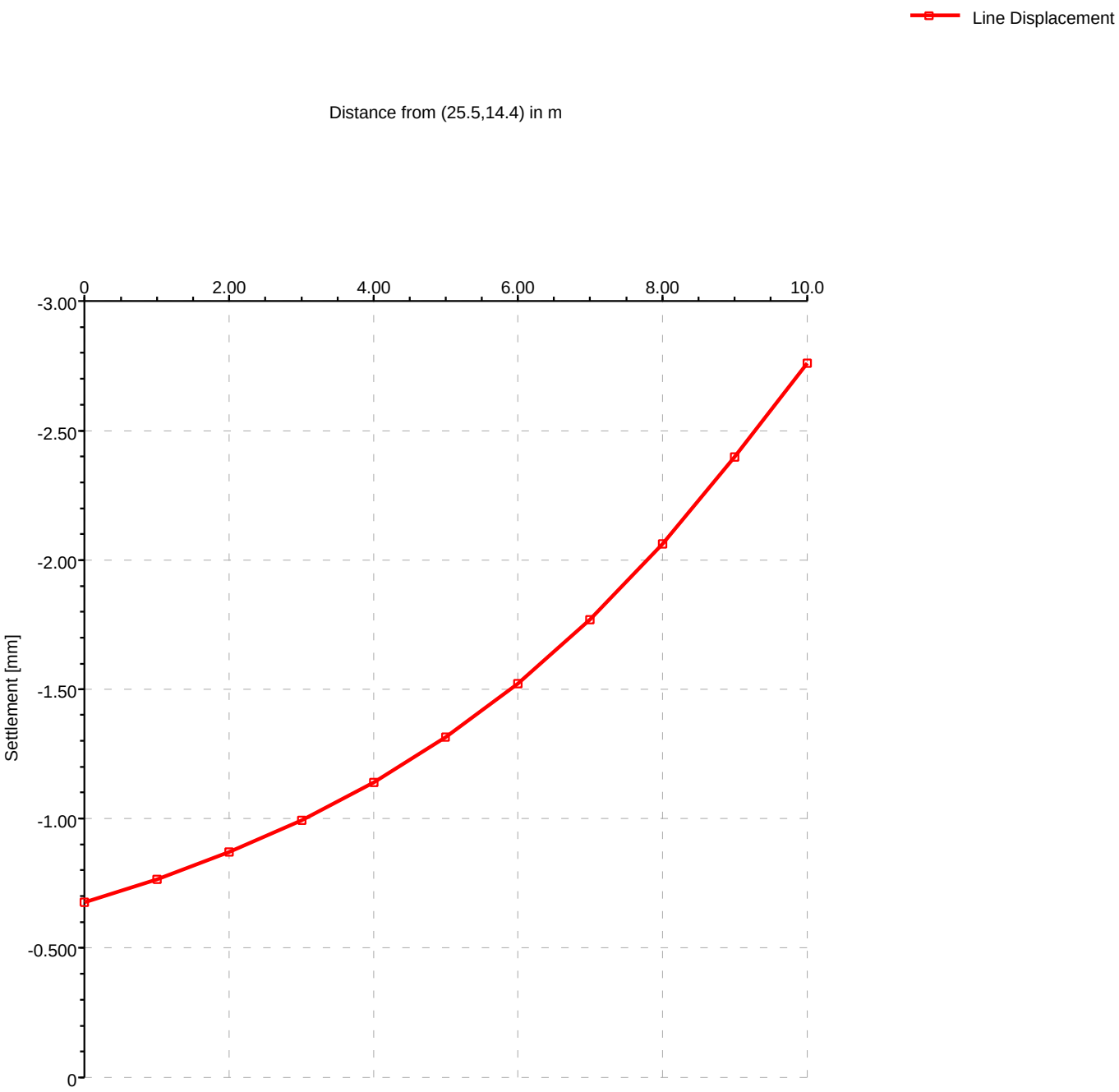


Distance from (25.5,6.5) in m

Displacement for G



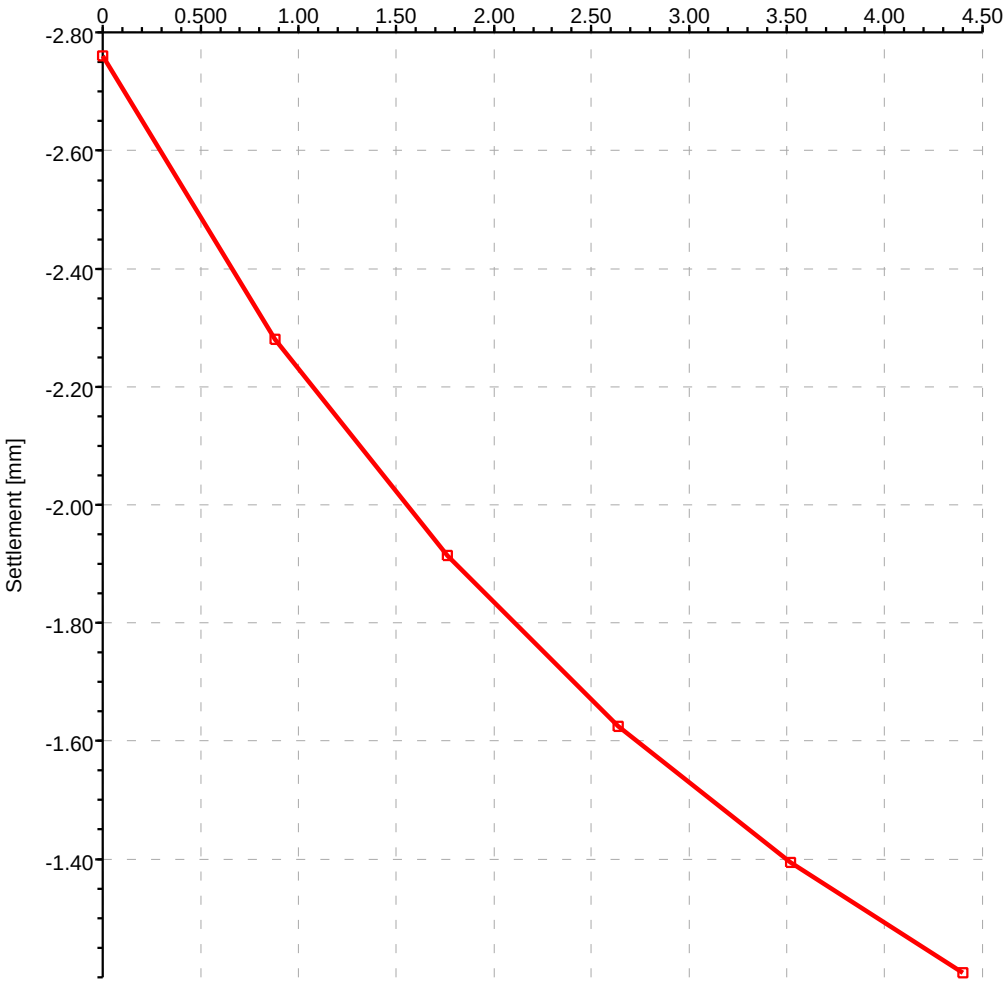
Displacement for H



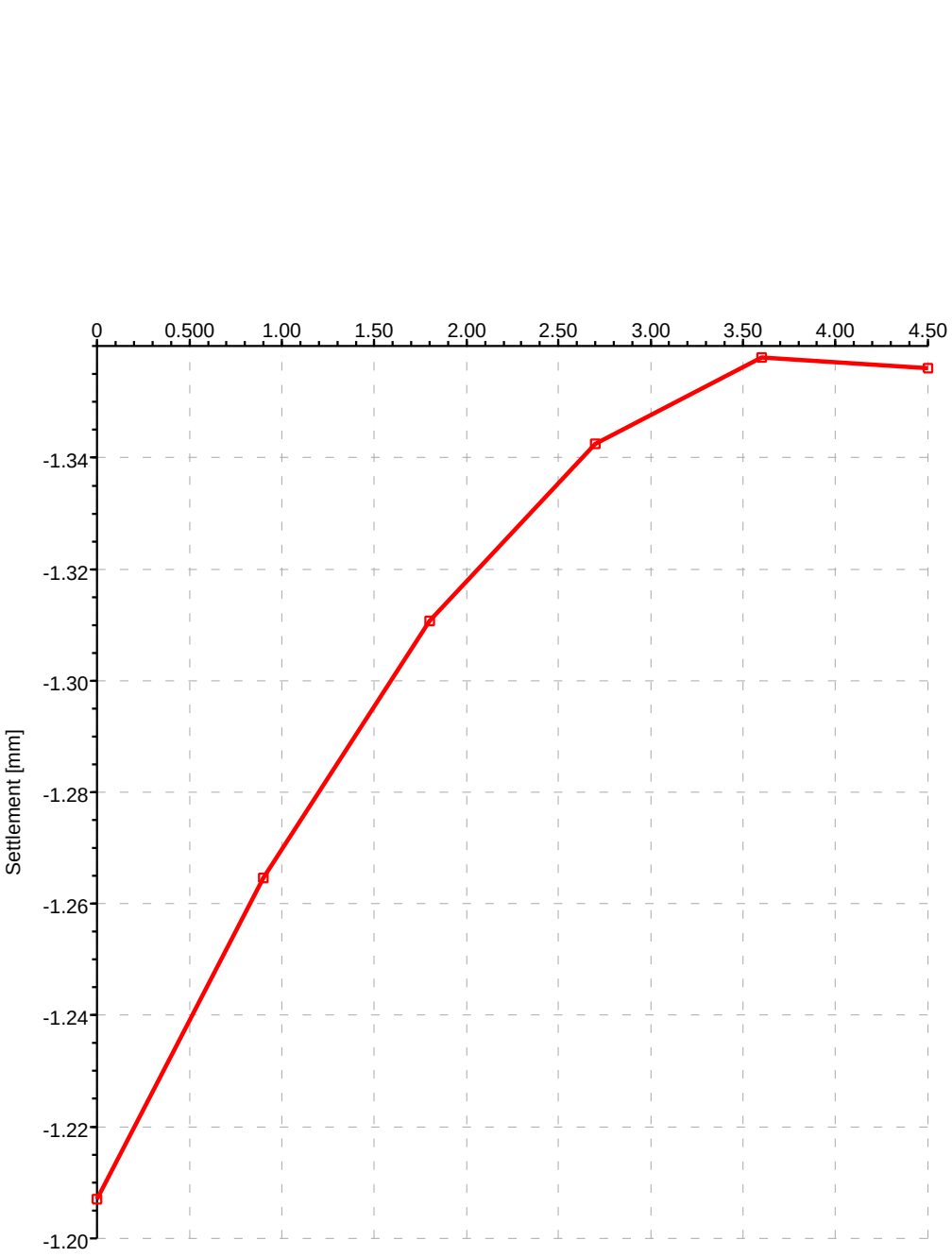
Displacement for I

Distance from (35.5,14.4) in m

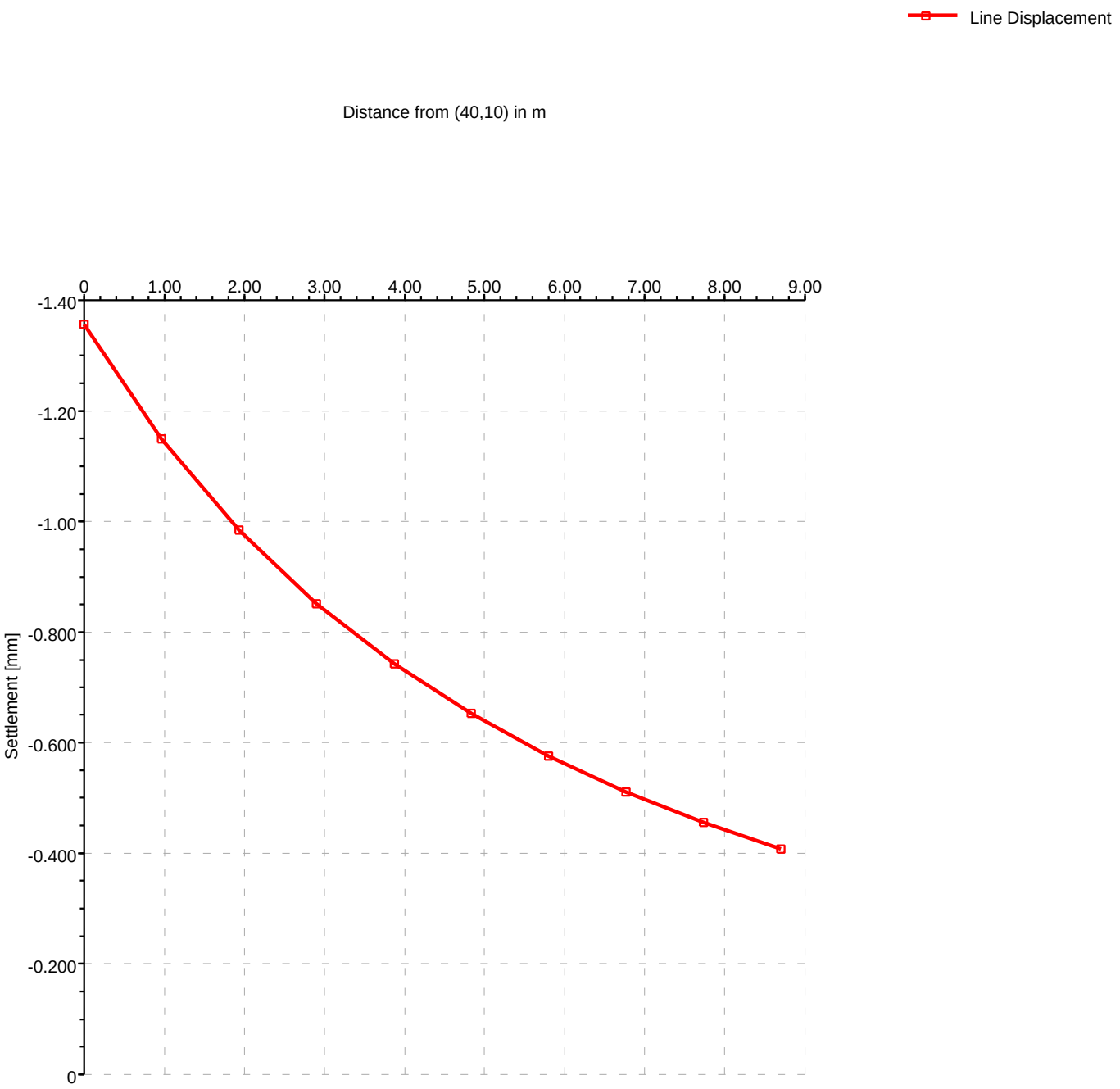
Line Displacement



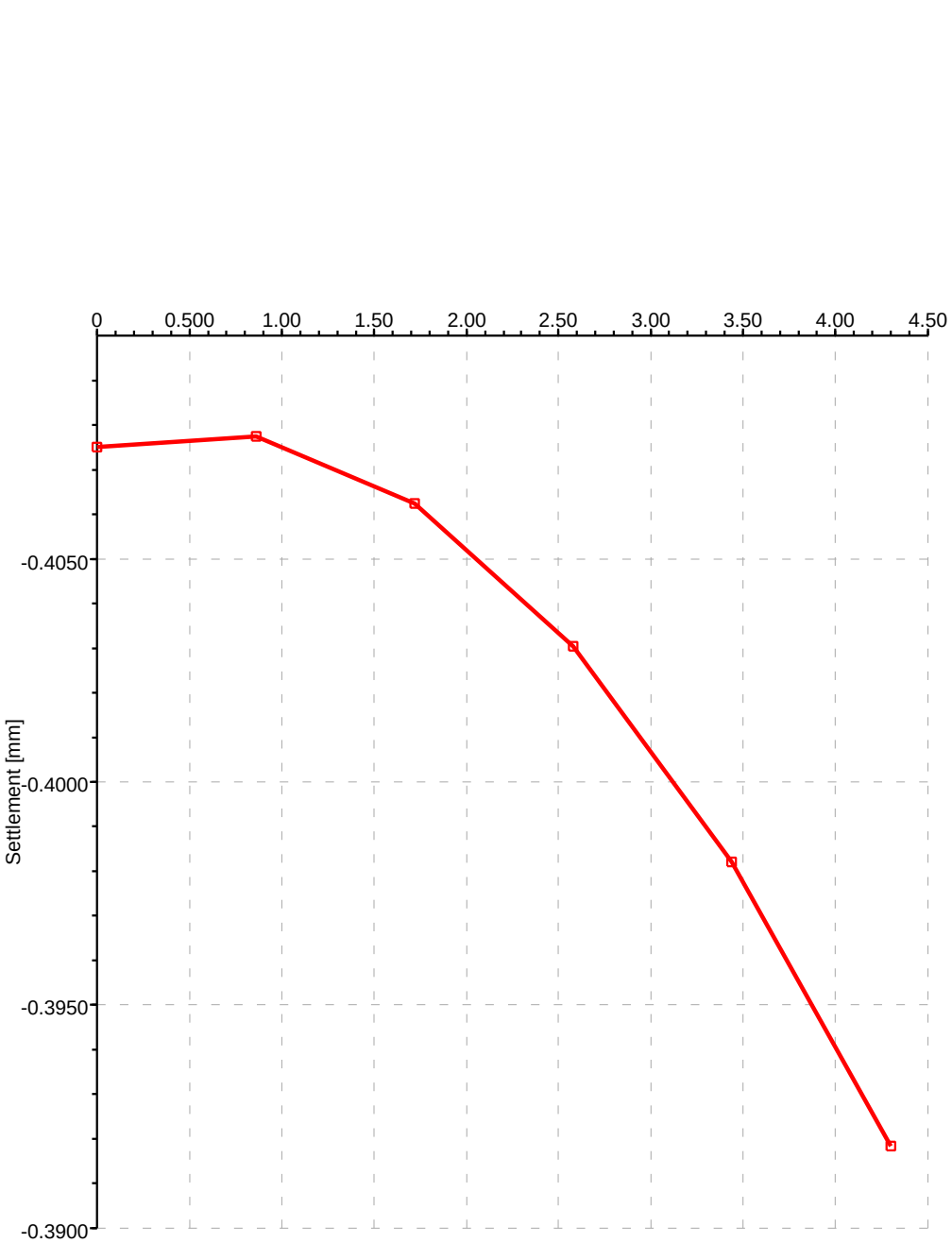
Displacement for J



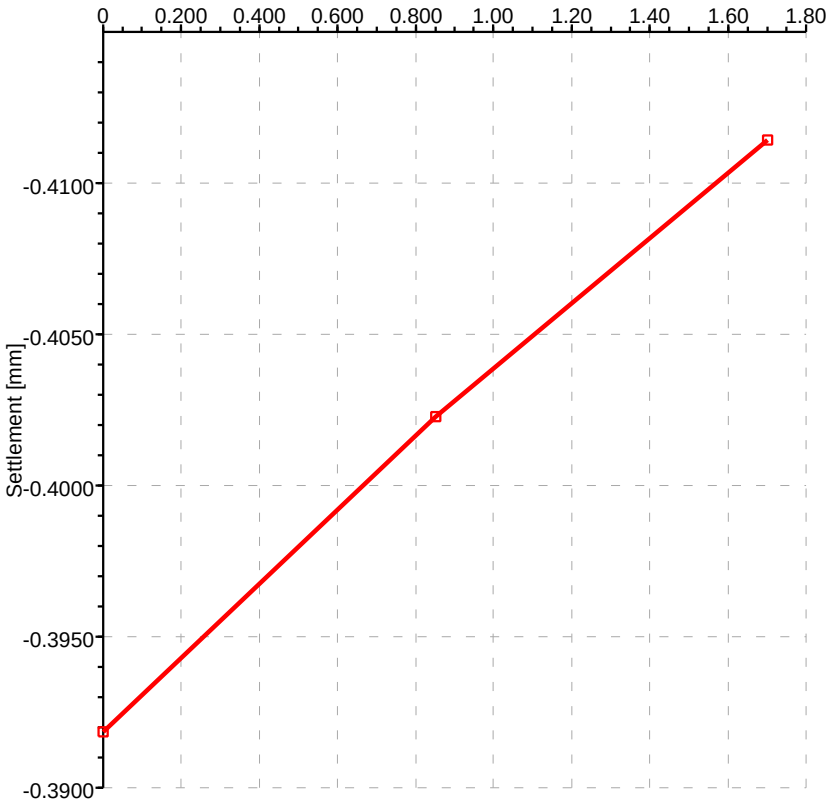
Displacement for K



Displacement for L



Displacement for M



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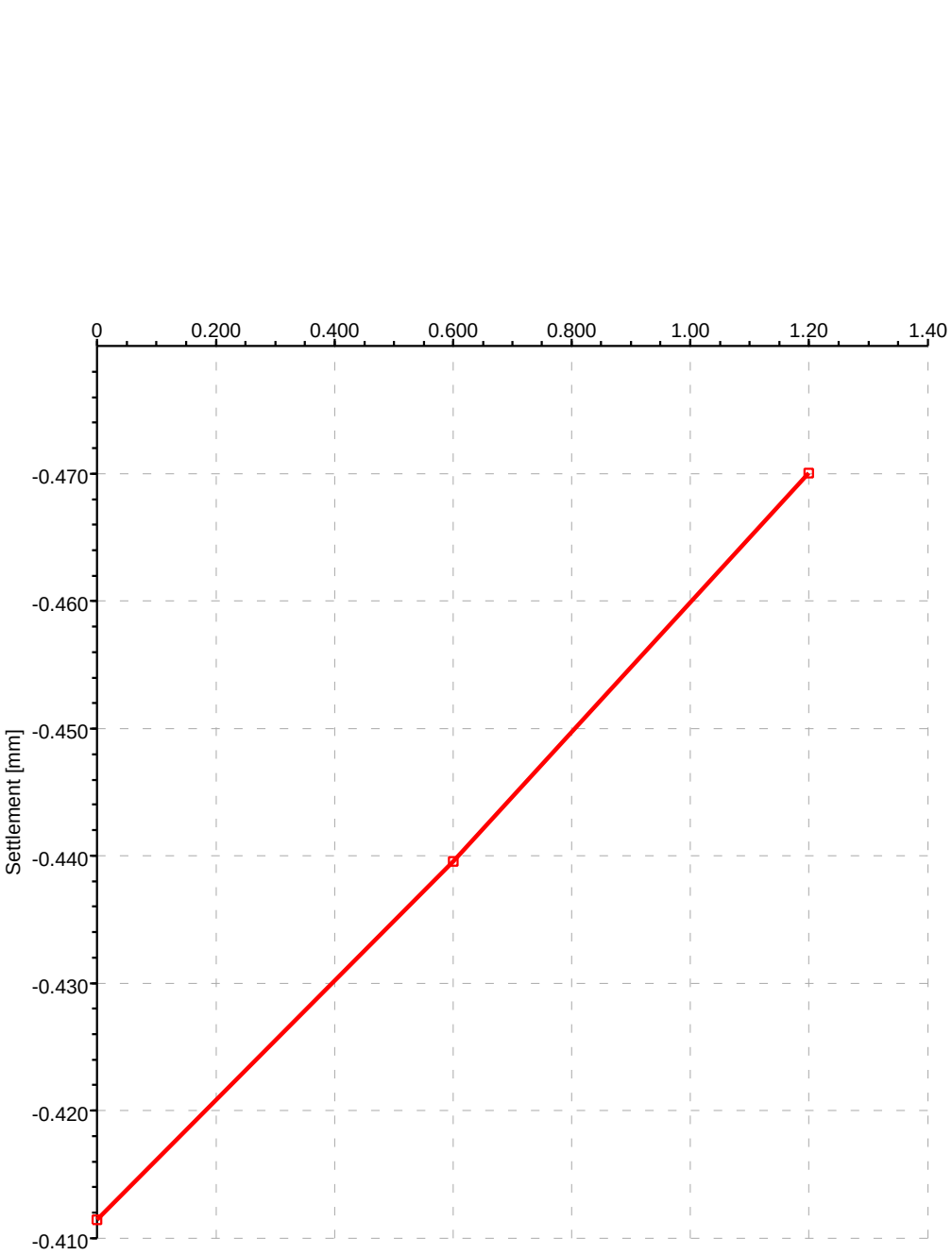

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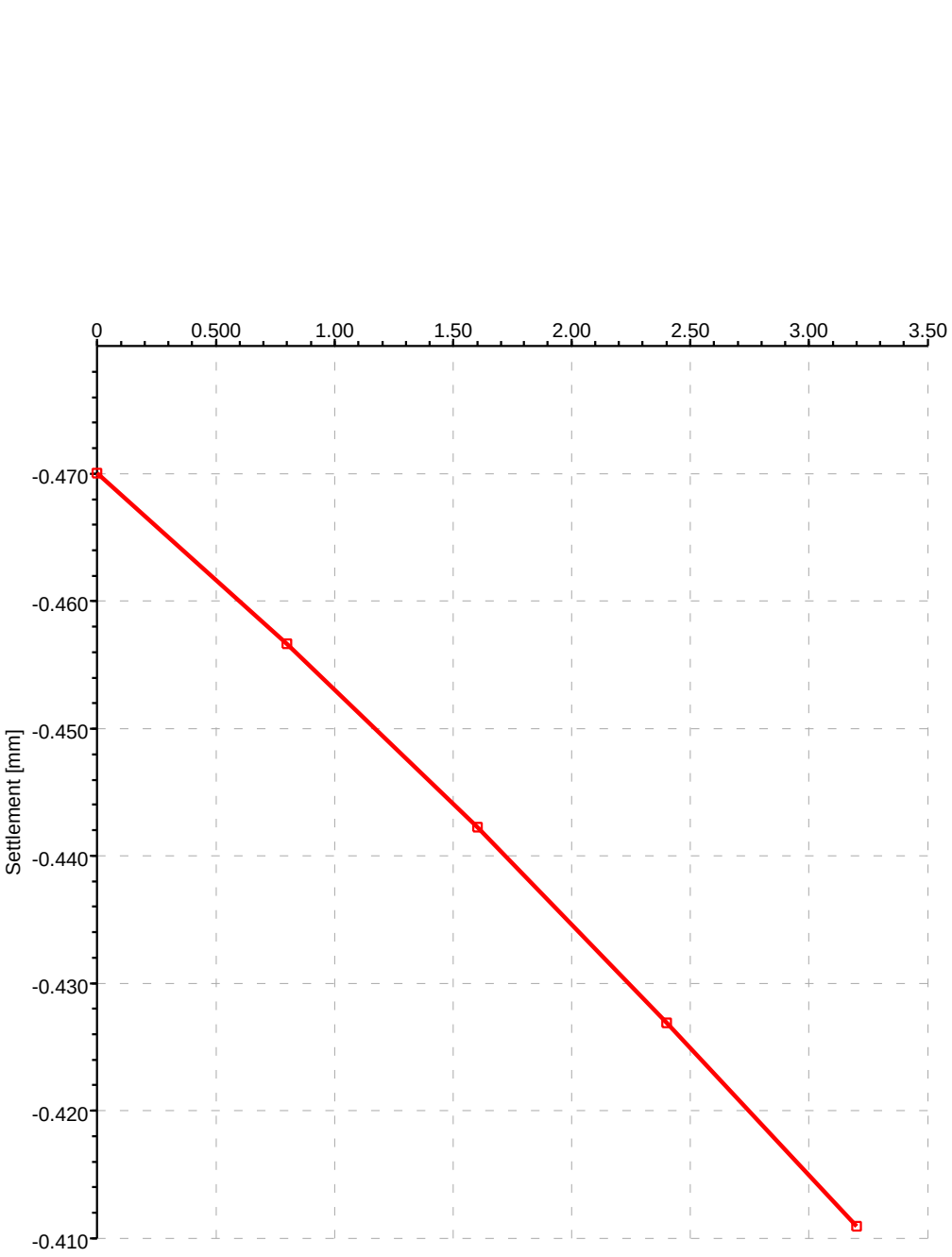
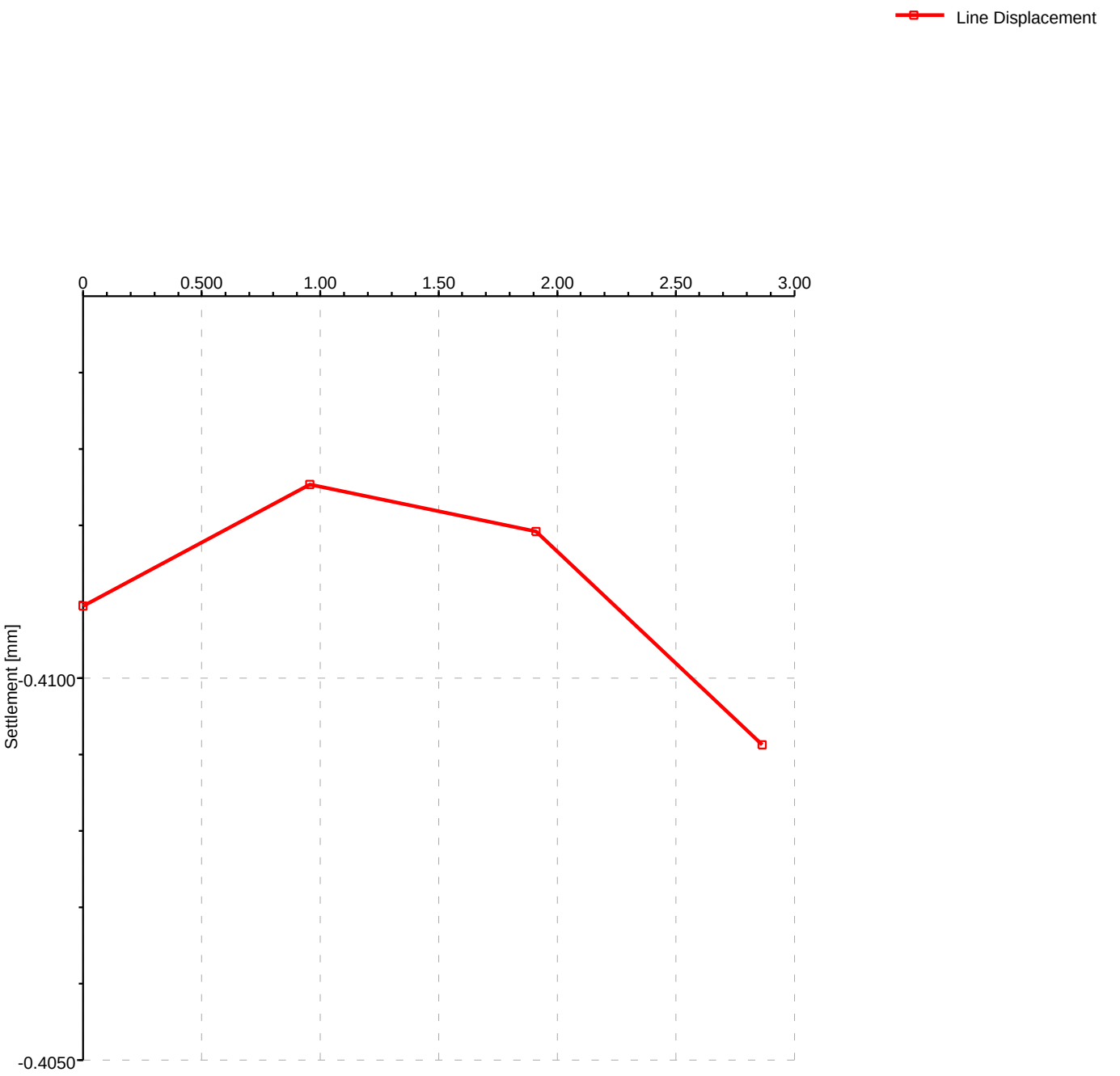
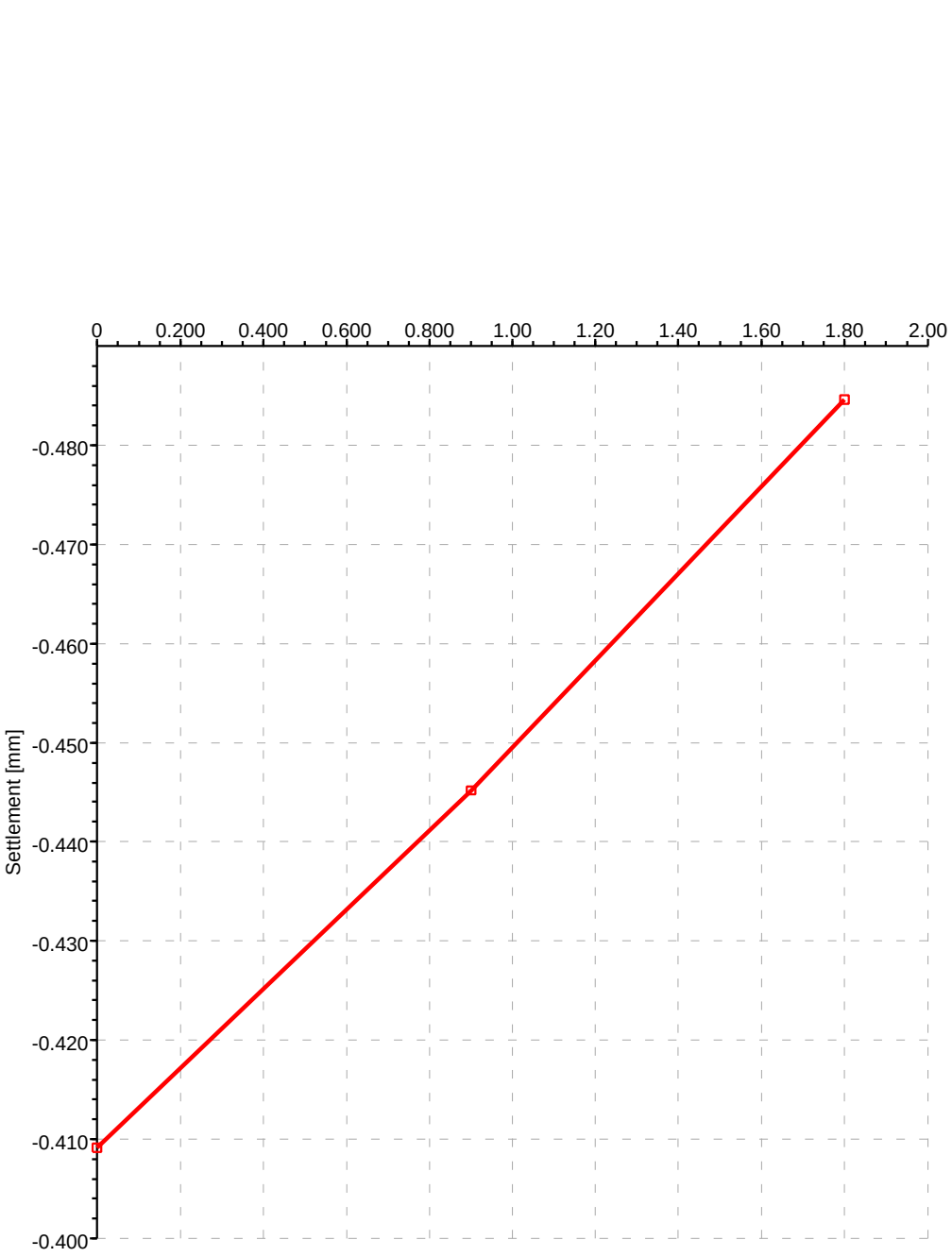


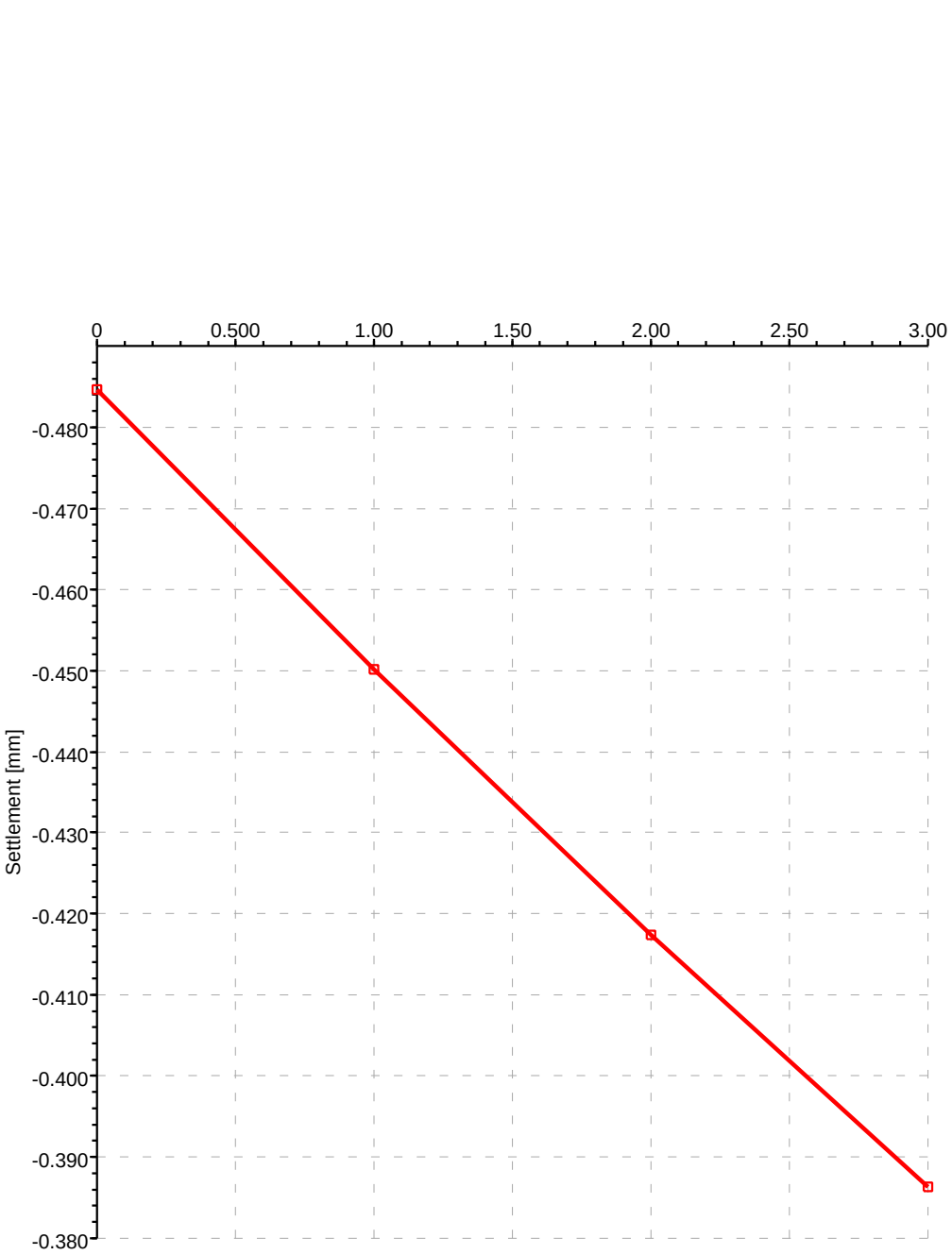
Displacement for P



Displacement for Q



Displacement for R



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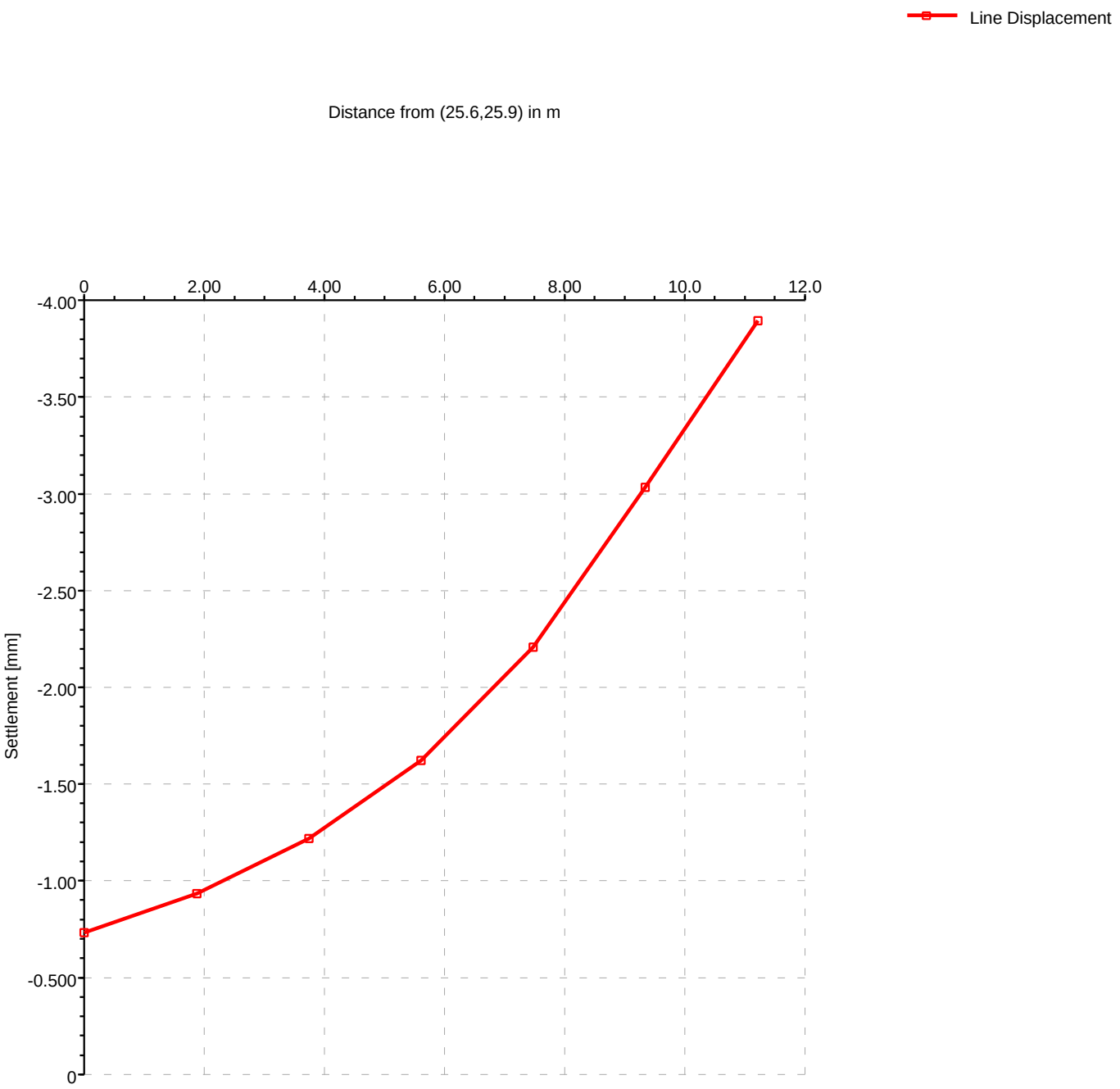
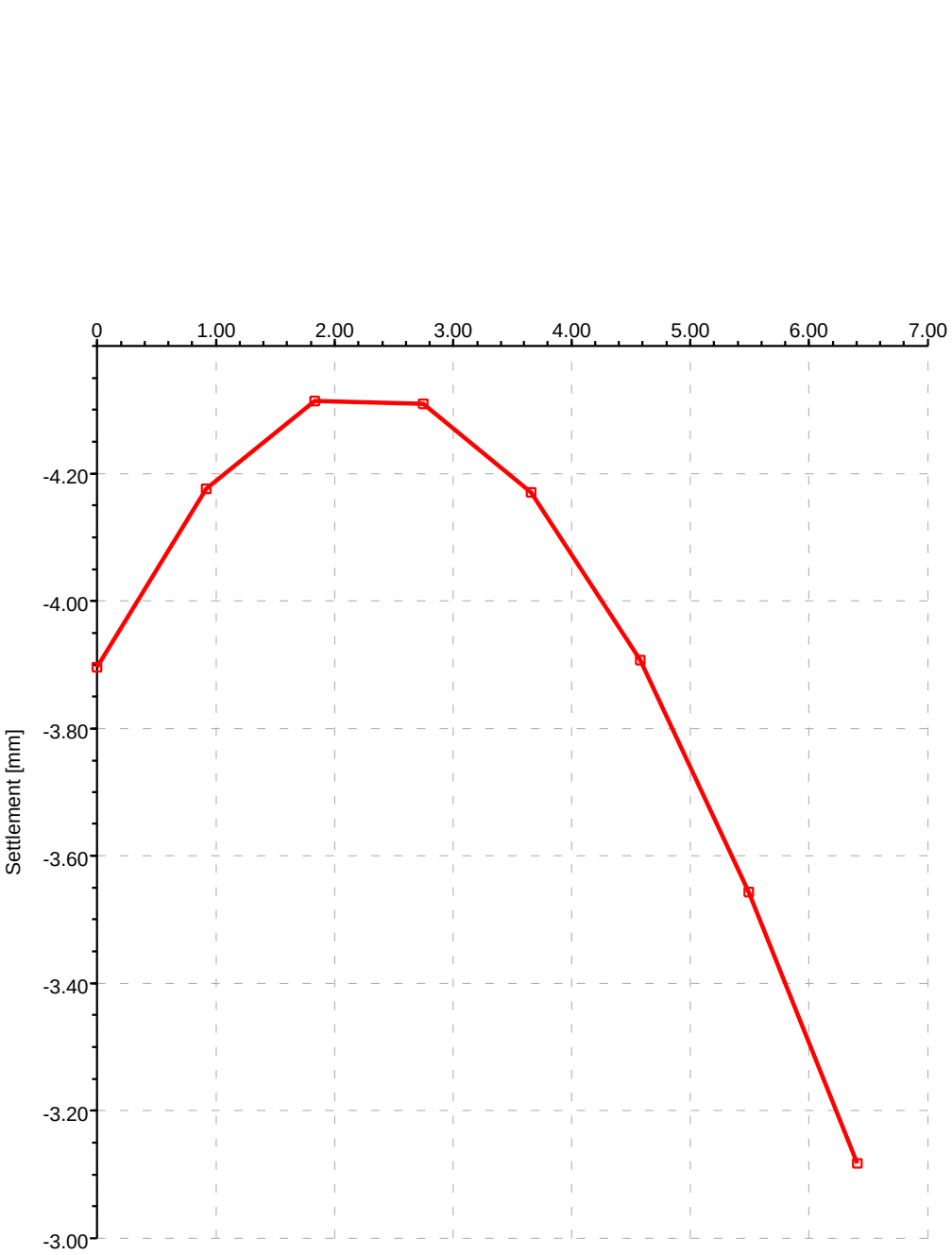
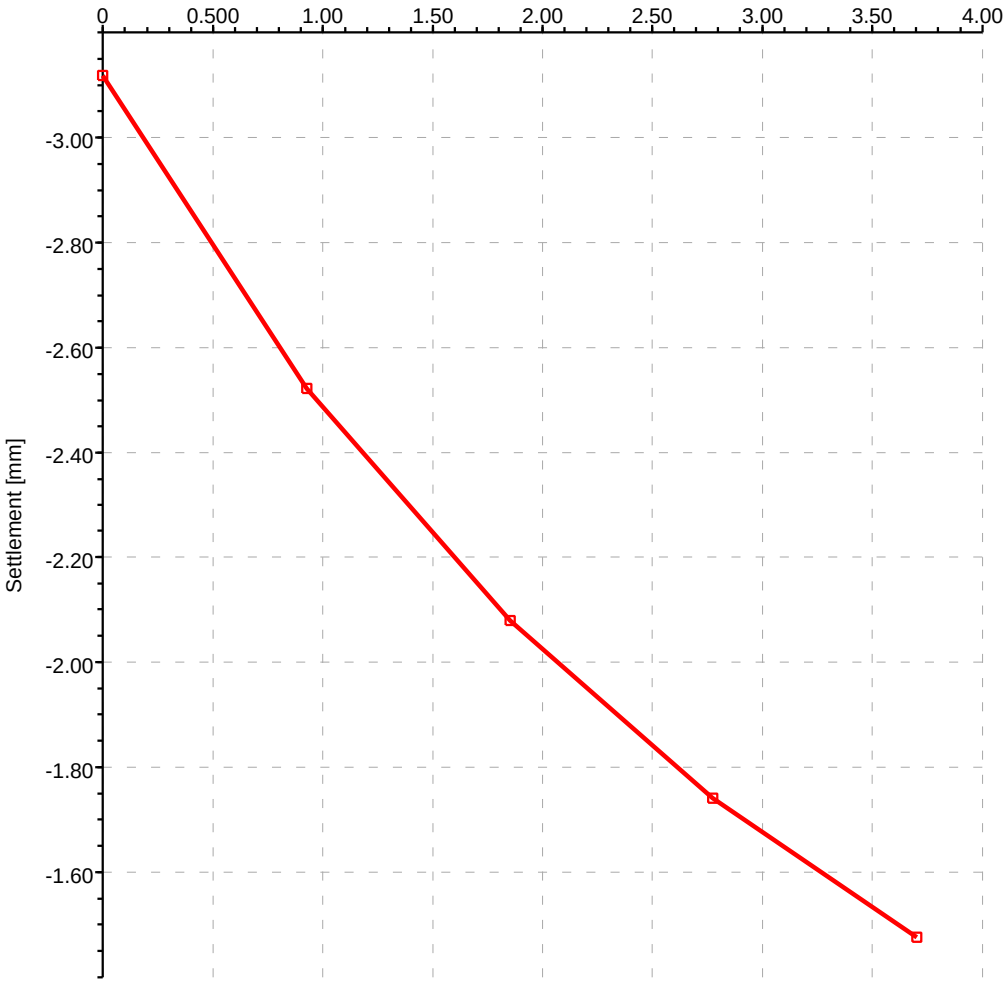


Displacement for T



Displacement for U

Distance from (43.2,26.8) in m



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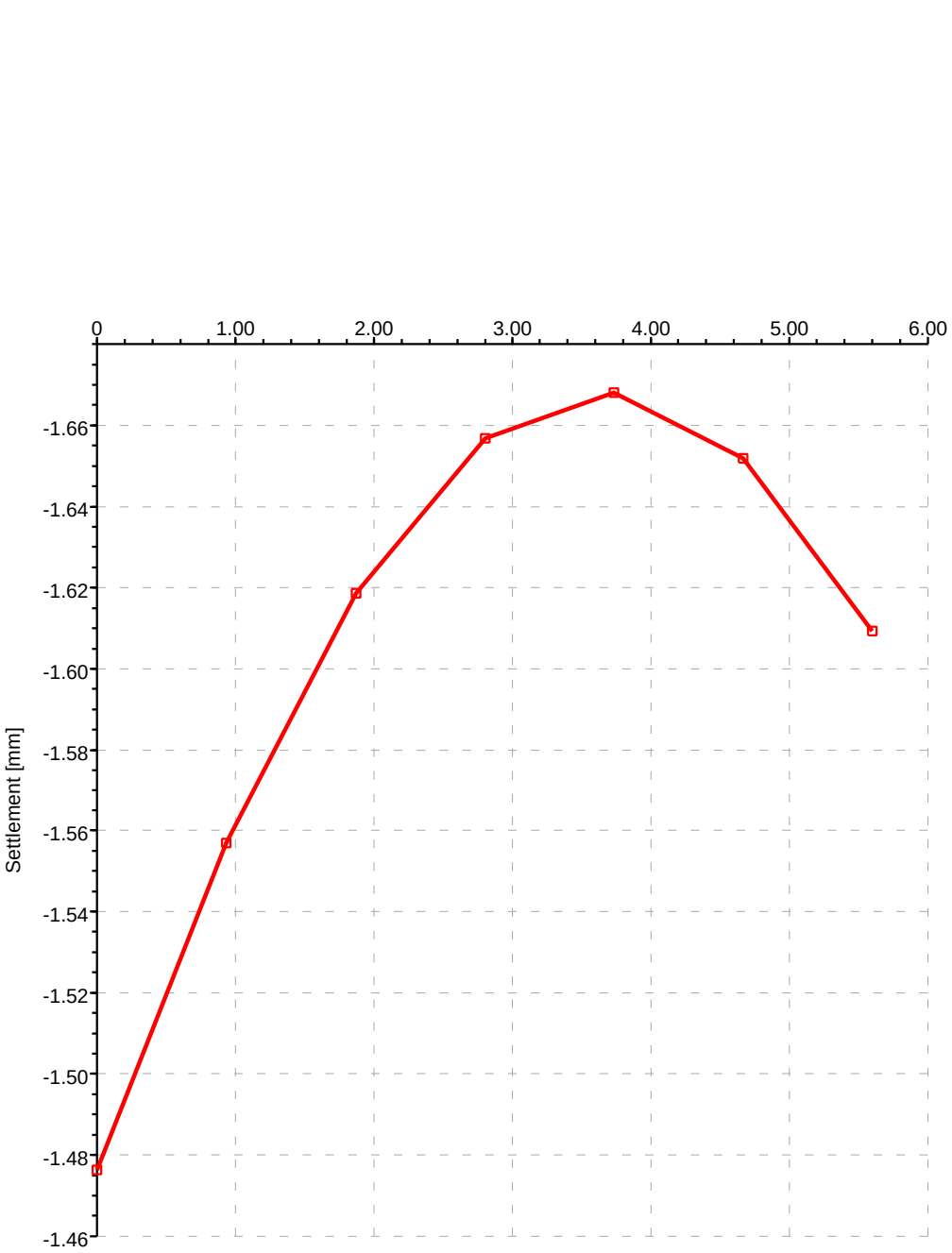

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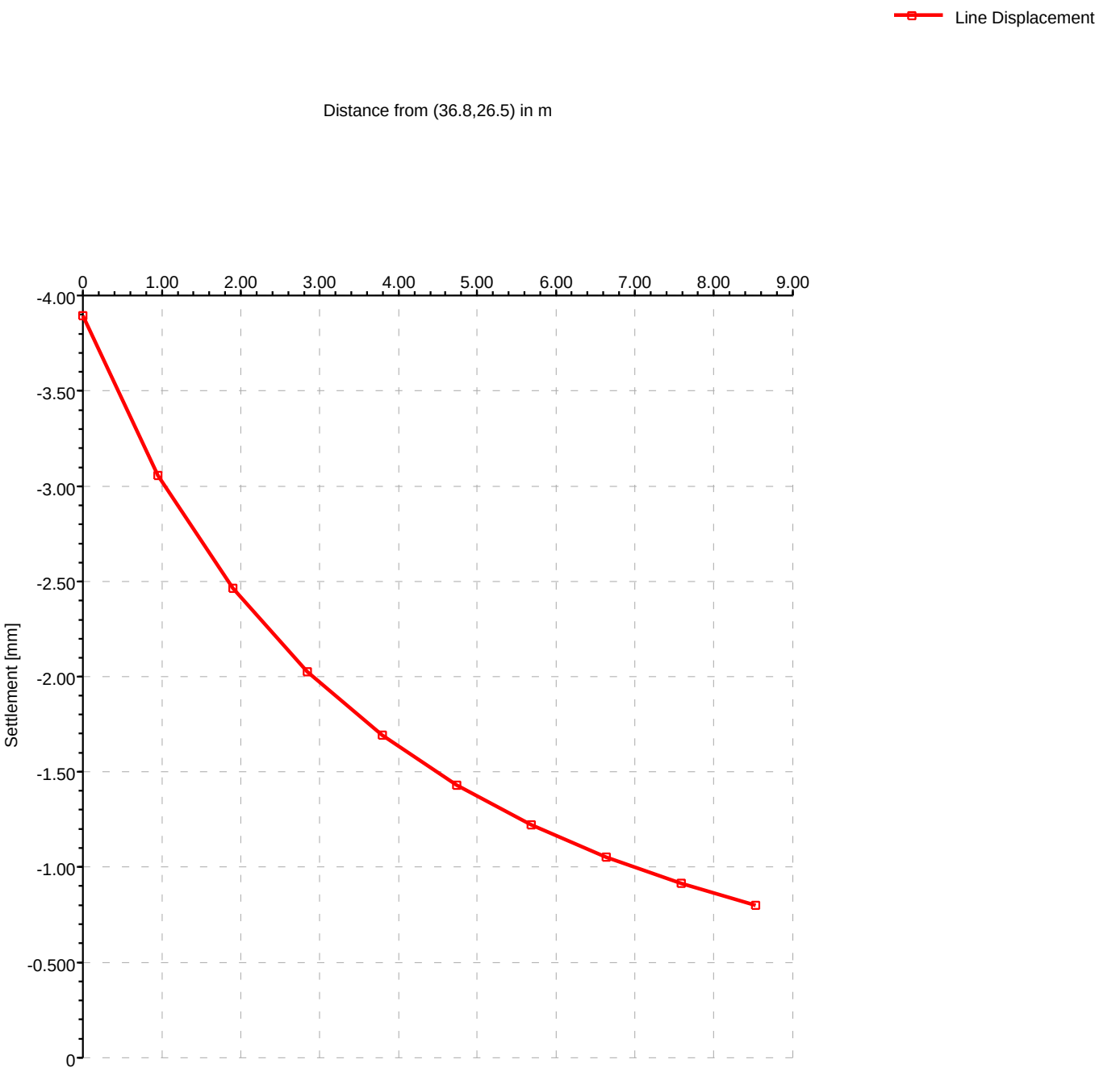
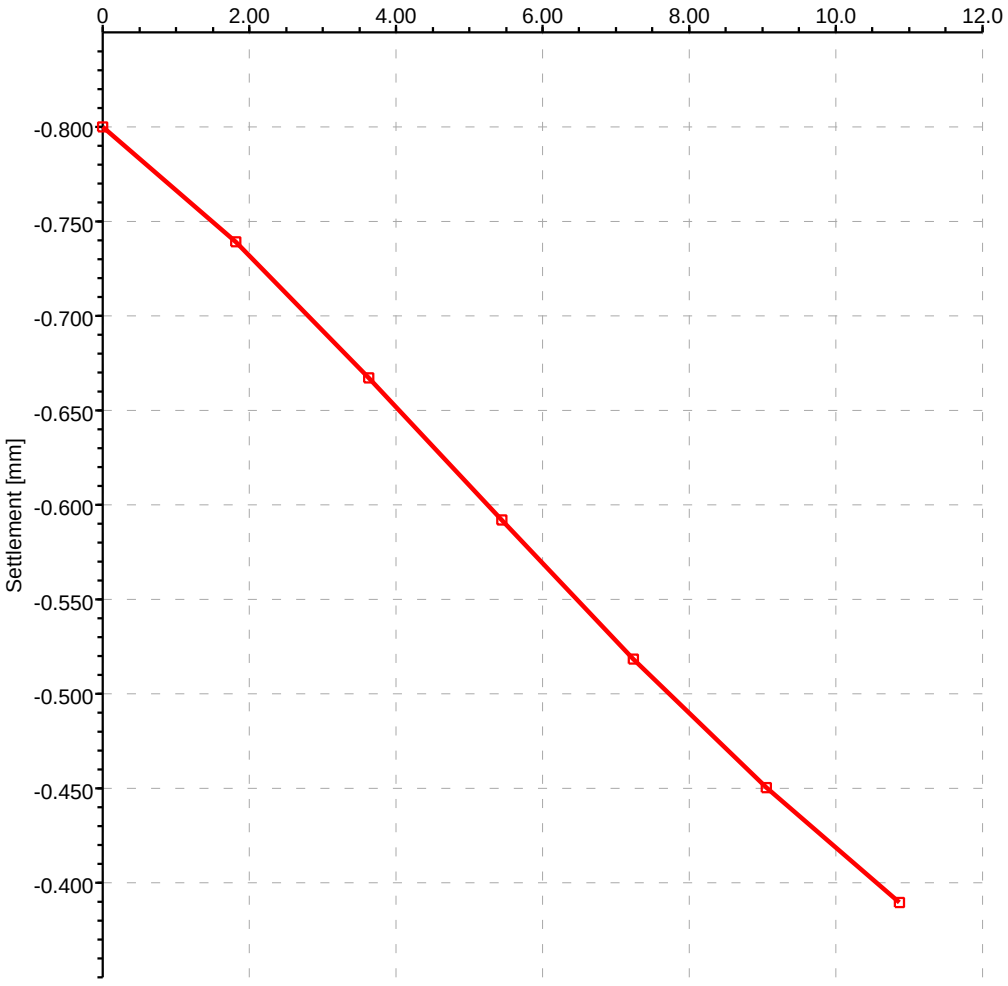


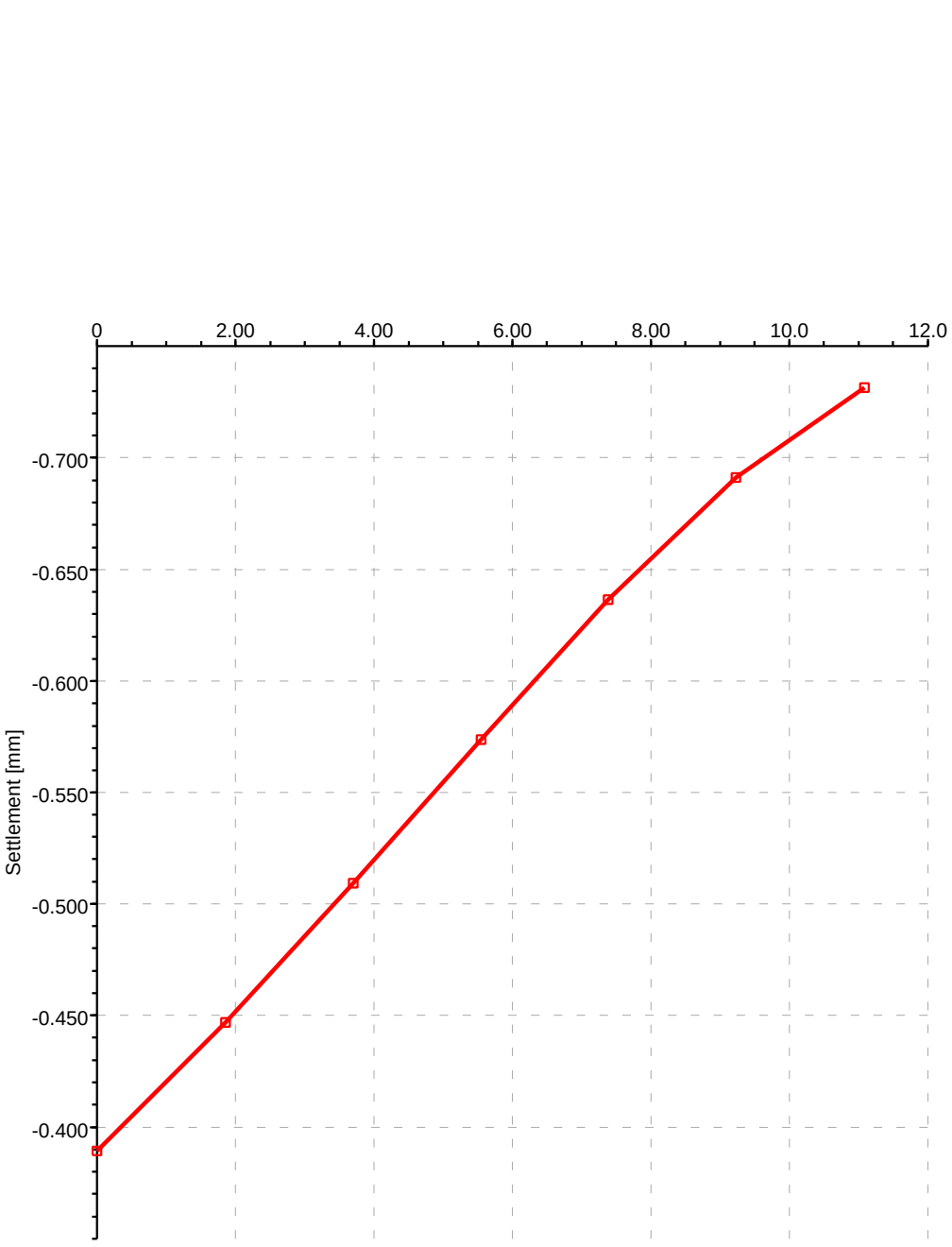
Displacement for X

Distance from (38.3,34.9) in m



Displacement for Y

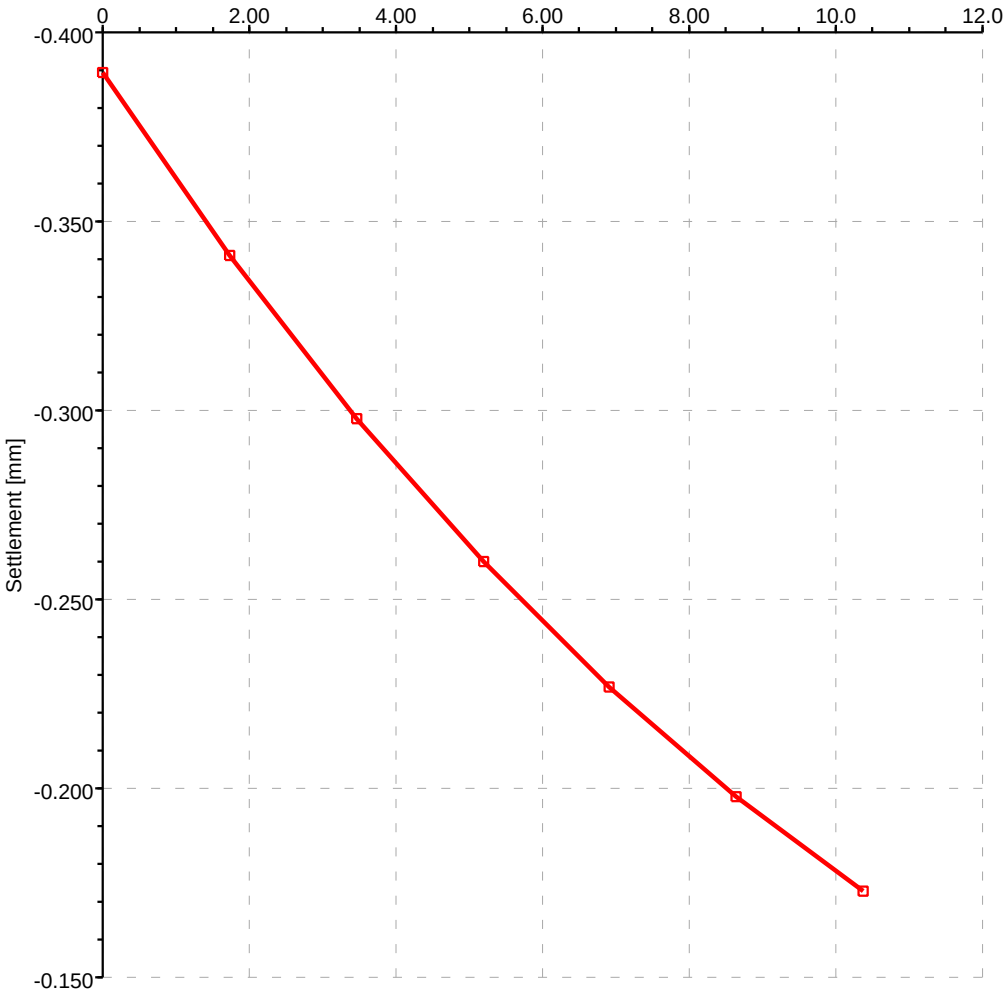
Distance from (27.6,36.8) in m



Displacement for Z

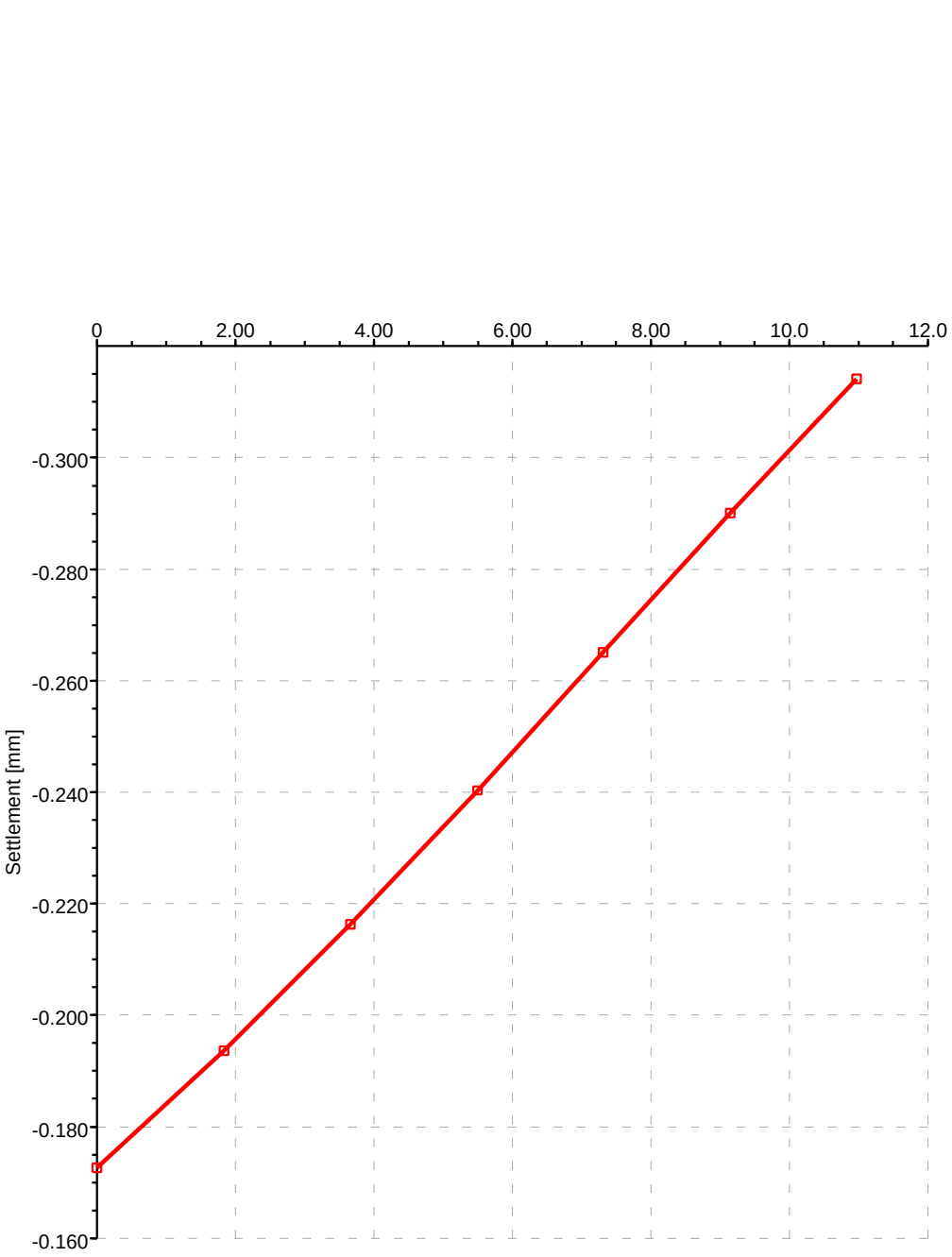
Distance from (27.6,36.8) in m

Line Displacement

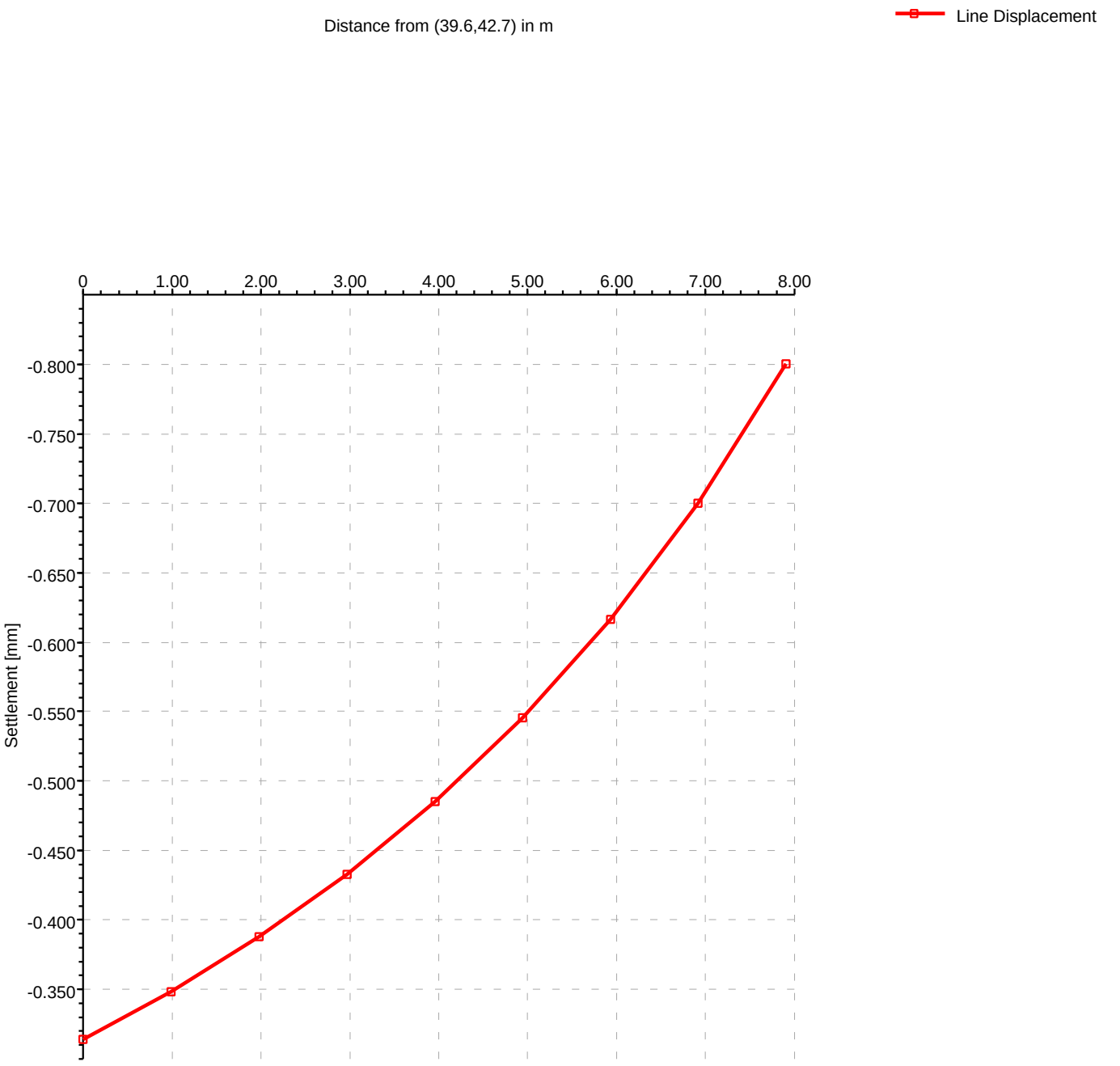


Distance from (29.5,47) in m

Displacement for AA



Displacement for AB



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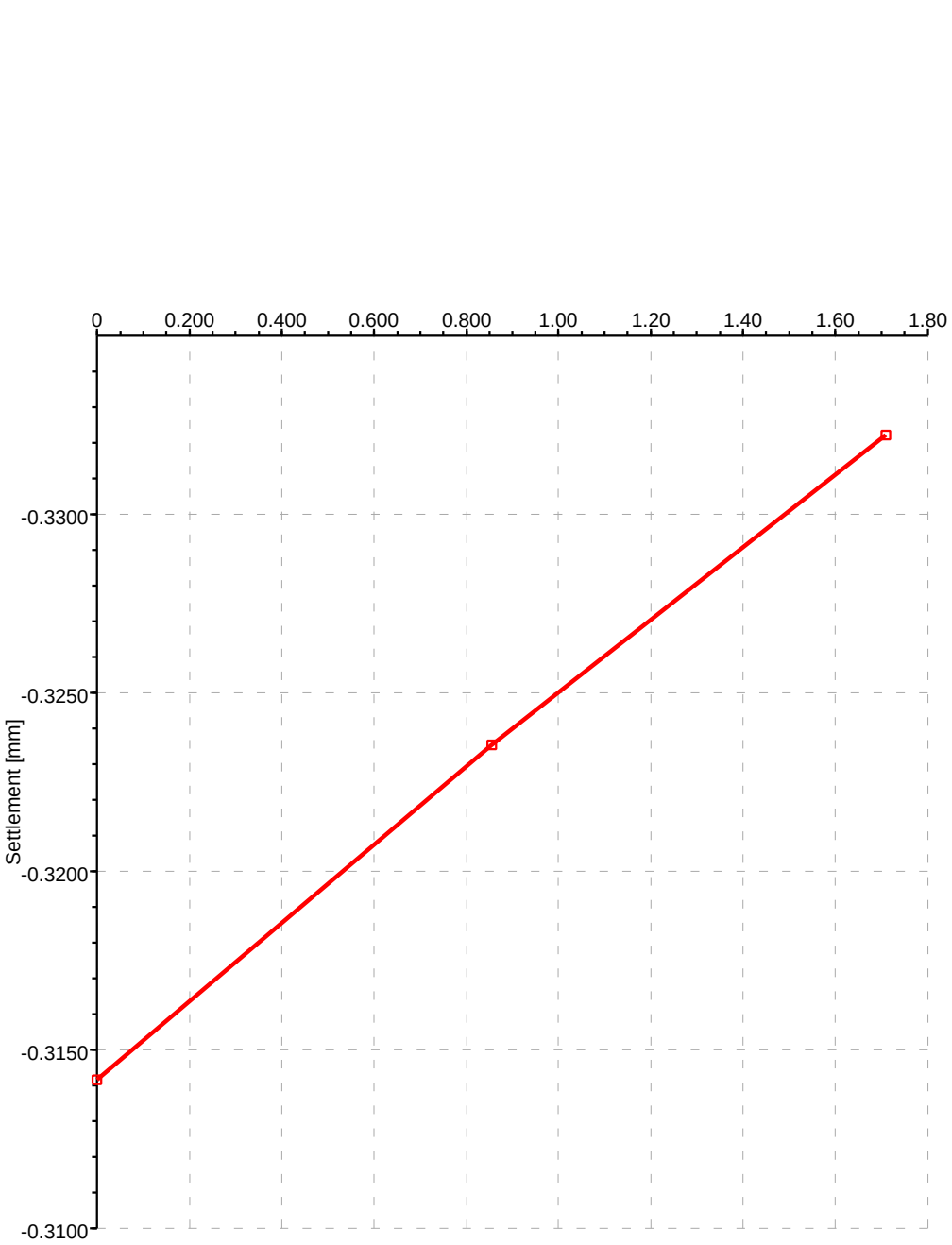

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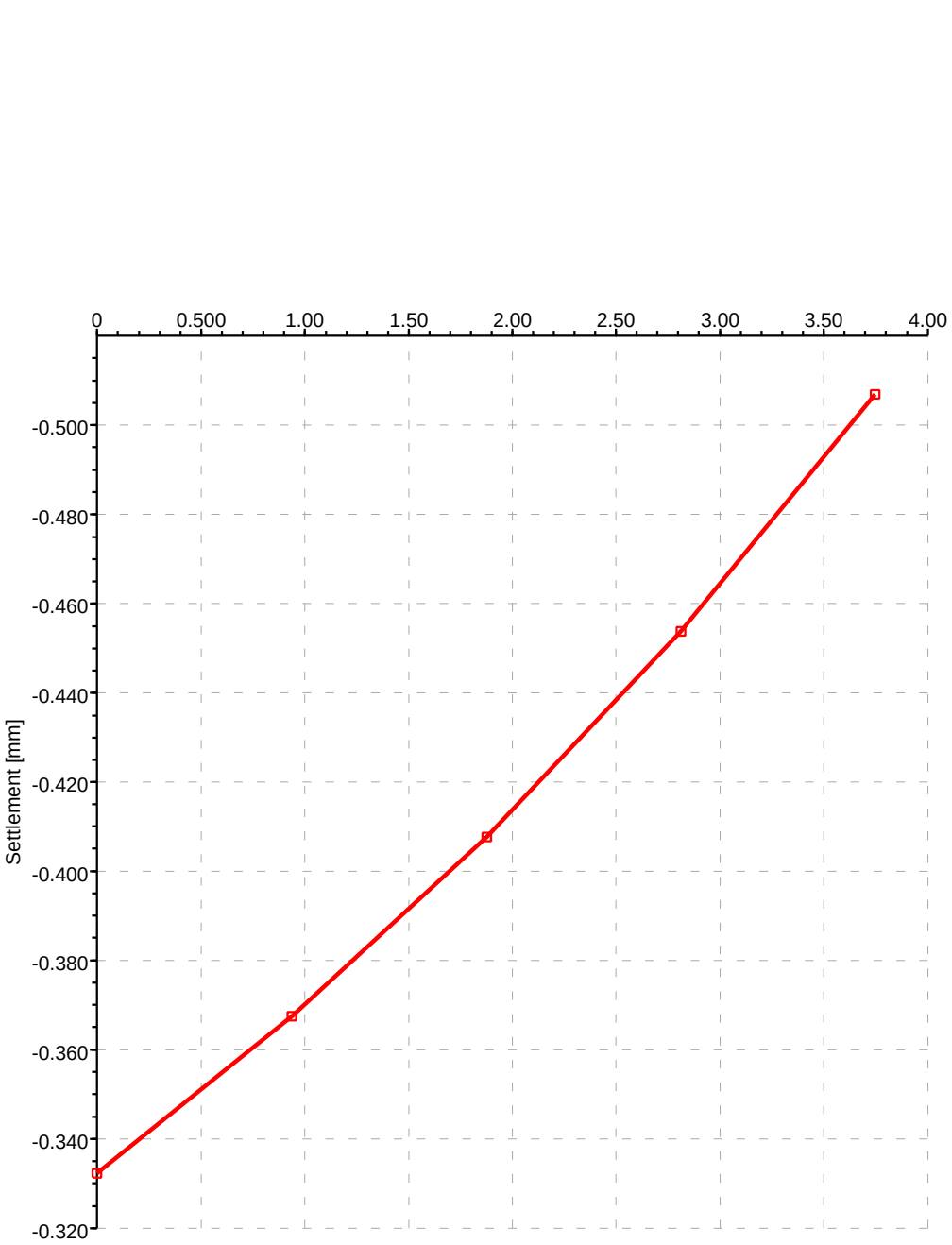
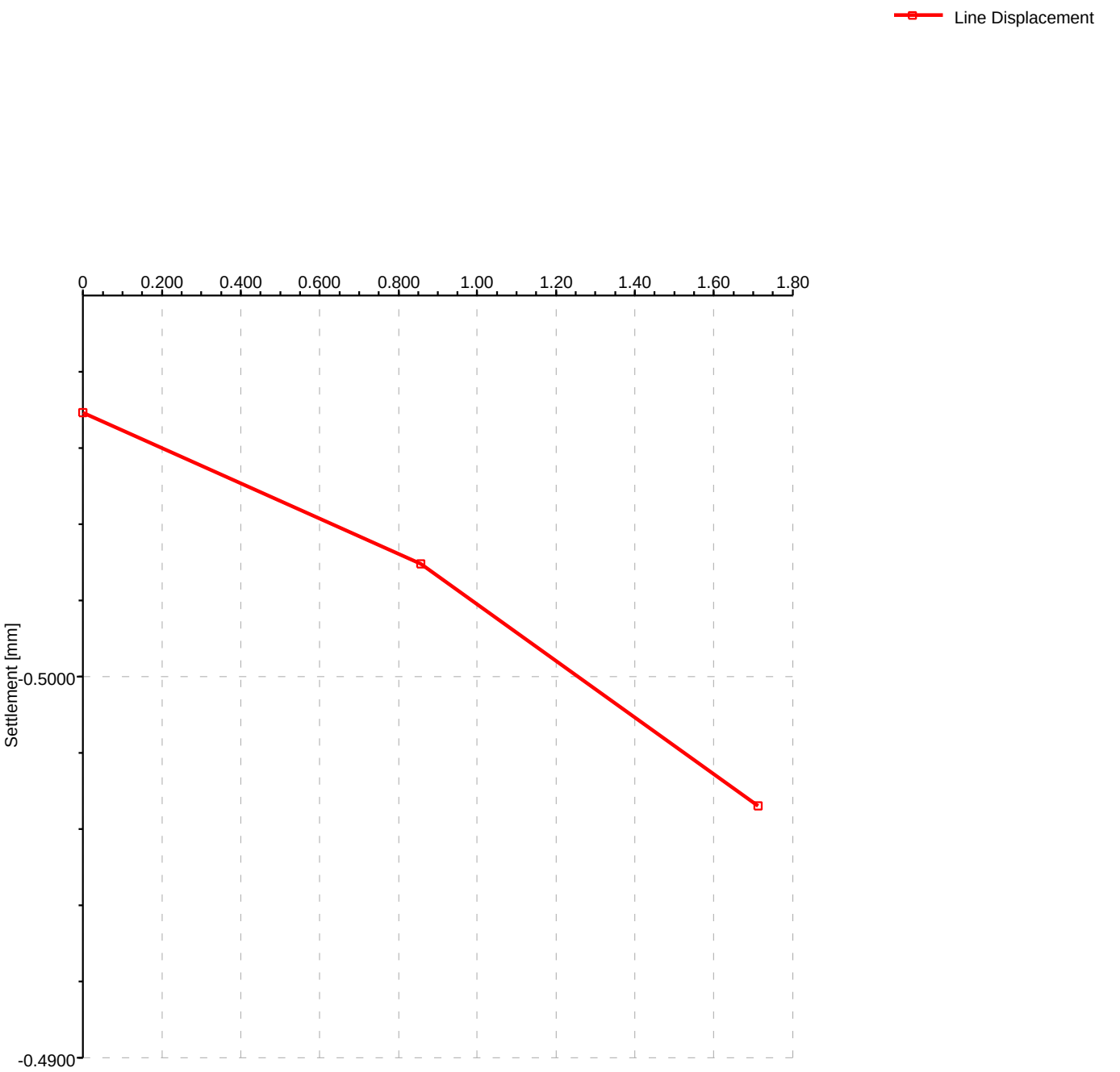
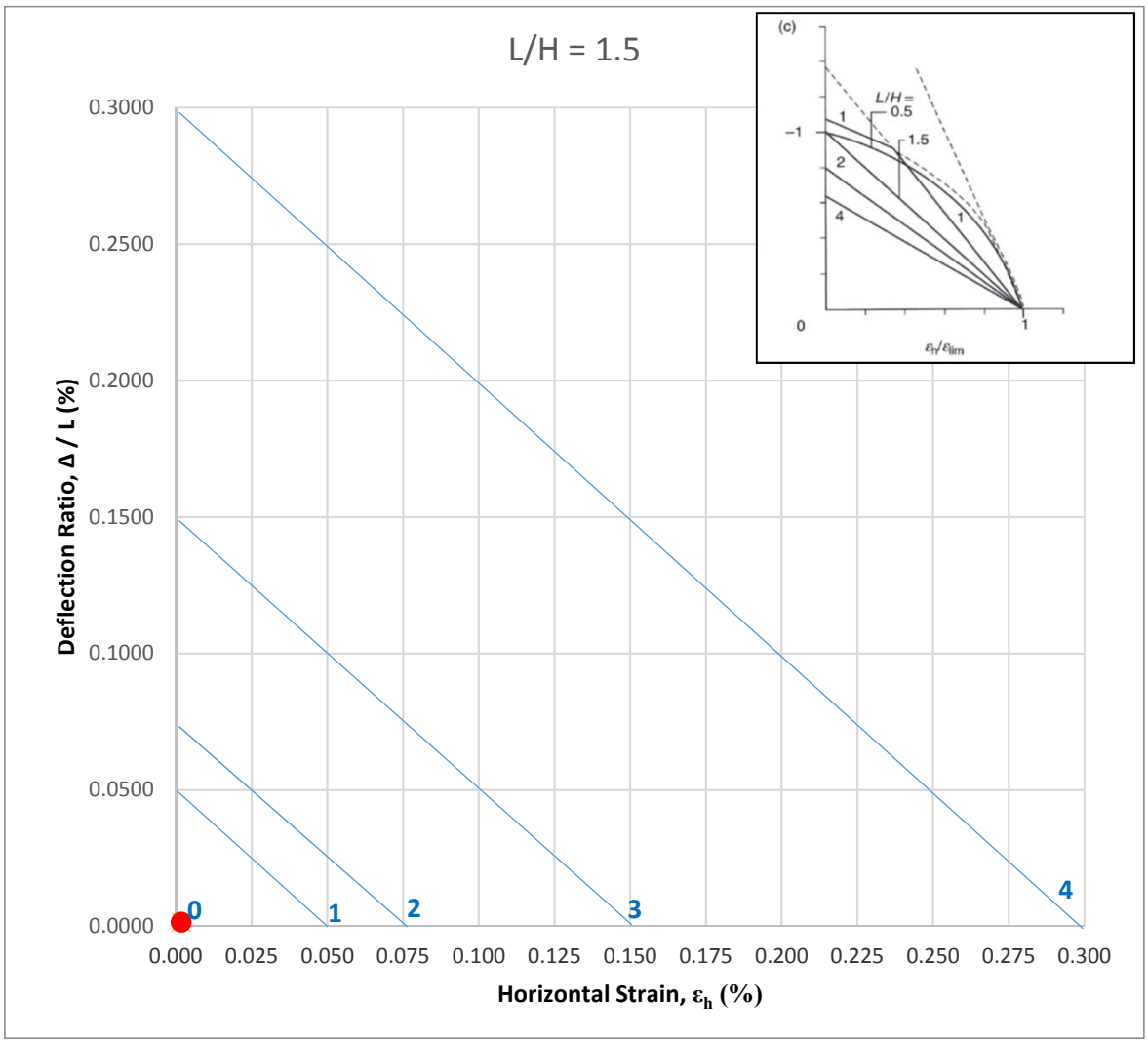


Displacement for AE



Project Number	J17190
Revision	0.0
Wall Reference	A

L / H = **1.02**



Wall Length, L =	6.7	m
Wall Height, H =	6.6	m
Change in horizontal movement, δ_h =	0.12	mm
Change in vertical movement, Δ =	0.10	mm

Horizontal Strain:

$$Horizontal\ Strain, \varepsilon_h = \frac{\delta_h \times 100}{L \times 1000}$$

ε_h = **0.0018**

Deflection Ratio:

$$Deflection\ Ratio = \frac{\Delta \times 100}{L \times 1000}$$

= **0.0015**

Ground Movement Assessment Summary

Project Number	J17190
Revision	0.0
Wall Reference	A

Input parameters:

Sensitive Structure:	Wall Length, L =	6.70	m
	Wall Height, H (including foundation depth) =	6.60	m
	Foundation depth below ground level =	0.50	m
Basement Details:	Proposed basement depth =	4.00	
	L / H =	1.02	

Vertical Displacement Behind Wall Prediction:

Change in vertical movement, Δ = 0.10 mm

Predicted from P-Disp taking worst case of short term and total movement

Horizontal Displacement Behind Wall Prediction:

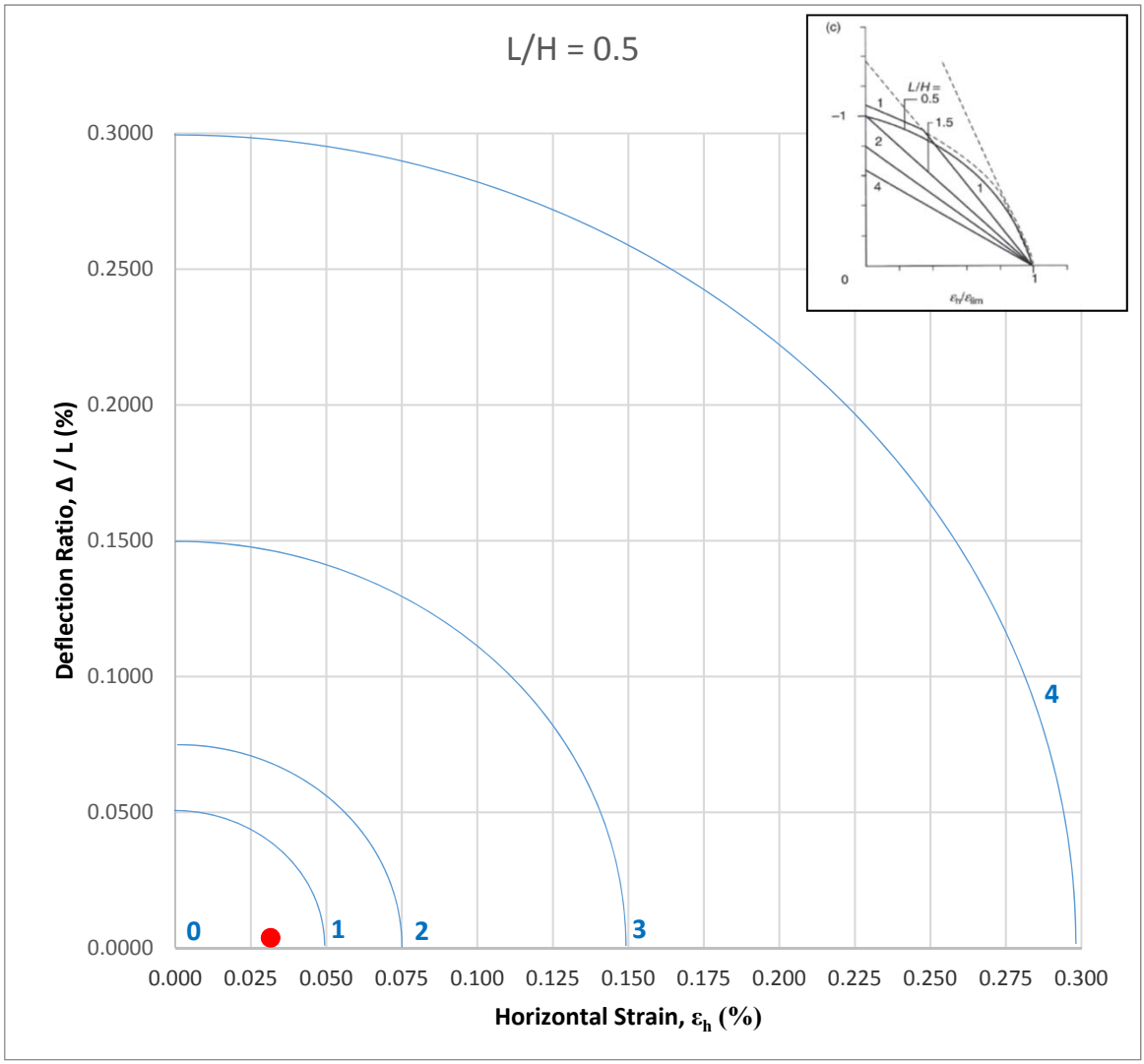
Change in horizontal movement, δ_h = 0.12 **mm**

Predicted from CIRIA C760 (Fig 6.15a) assuming excavation in front of a wall in stiff clay, based on 5 mm horizontal movement at wall with 4.0 m excavation

Building Damage Category = **CATEGORY 0 - NEGLIGIBLE**

Project Number	J17190
Revision	0.0
Wall Reference	B

L / H = **0.39**



Wall Length, L =	2.6	m
Wall Height, H =	6.6	m
Change in horizontal movement, δ_h =	0.82	mm
Change in vertical movement, Δ =	0.10	mm

Horizontal Strain:

$$Horizontal\ Strain, \varepsilon_h = \frac{\delta_h \times 100}{L \times 1000}$$

ε_h = **0.0315**

Deflection Ratio:

$$Deflection\ Ratio = \frac{\Delta \times 100}{L \times 1000}$$

= **0.0038**

Ground Movement Assessment Summary

Project Number	J17190
Revision	0.0
Wall Reference	B

Input parameters:

Sensitive Structure:	Wall Length, L =	2.60	m
	Wall Height, H (including foundation depth) =	6.60	m
	Foundation depth below ground level =	0.50	m
Basement Details:	Proposed basement depth =	4.00	
	L / H =	0.39	

Vertical Displacement Behind Wall Prediction:

Change in vertical movement, Δ =	0.10	mm

Predicted from P-Disp taking worst case of short term and total movement

Horizontal Displacement Behind Wall Prediction:

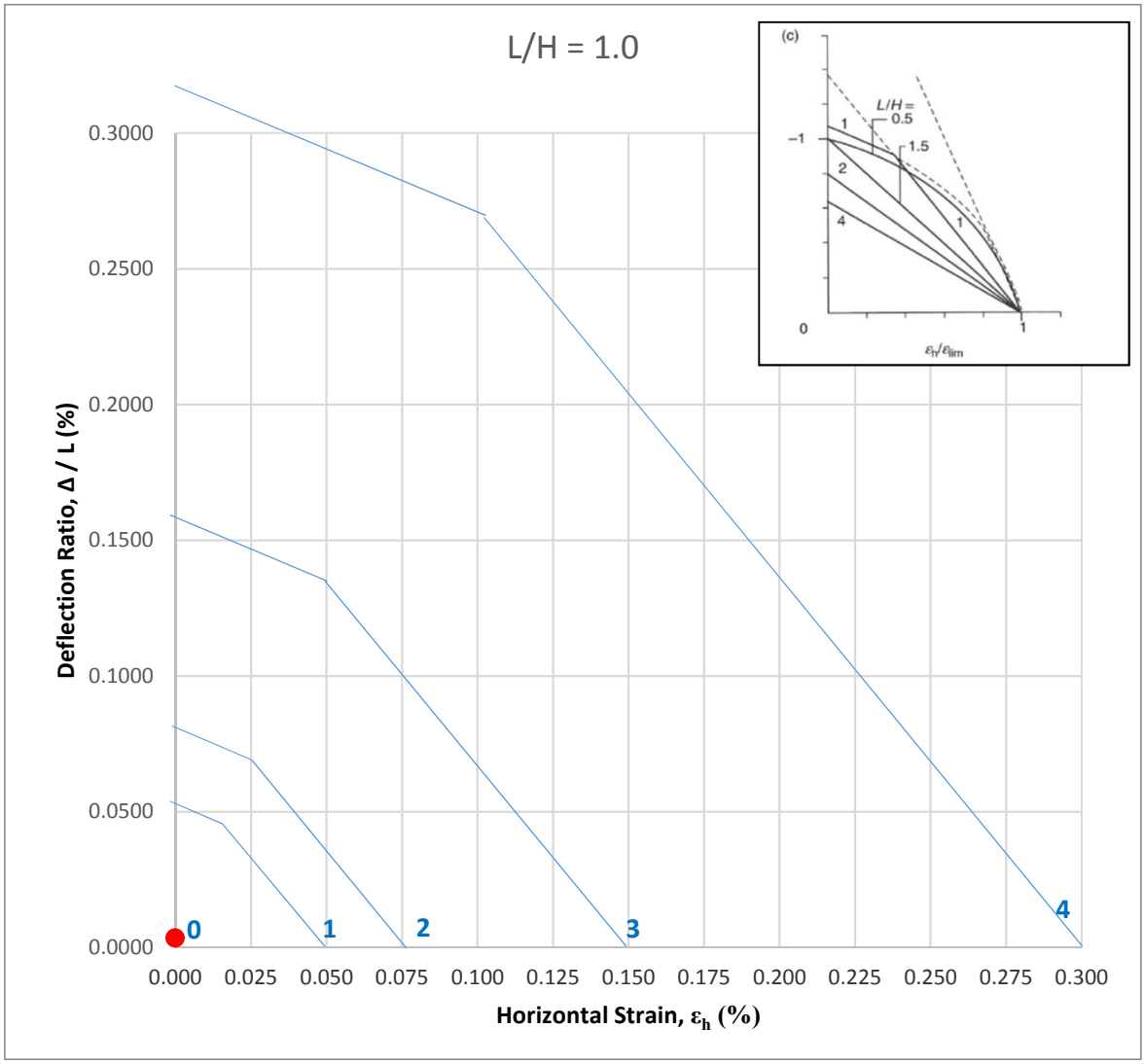
Change in horizontal movement, δ_h =	0.82	**mm**

Predicted from CIRIA C760 (Fig 6.15a) assuming excavation in front of a wall in stiff clay, based on 5 mm horizontal movement at wall with 4.0 m excavation

Building Damage Category = **CATEGORY 0 - NEGLIGIBLE**

Project Number	J17190
Revision	0.0
Wall Reference	C

L / H = **0.58**



Wall Length, L =	2.8	m
Wall Height, H =	4.8	m
Change in horizontal movement, δ_h =	0.00	mm
Change in vertical movement, Δ =	0.10	mm

Horizontal Strain:

$$Horizontal\ Strain, \varepsilon_h = \frac{\delta_{h\ \times 100}}{L\ \times 1000}$$

ε_h = **0.0000**

Deflection Ratio:

$$Deflection\ Ratio = \frac{\Delta \times 100}{L \times 1000}$$

= **0.0036**

Ground Movement Assessment Summary

Project Number	J17190
Revision	0.0
Wall Reference	C

Input parameters:

Sensitive Structure:	Wall Length, L =	2.80	m
	Wall Height, H (including foundation depth) =	4.80	m
	Foundation depth below ground level =	0.50	m
Basement Details:	Proposed basement depth =	4.00	
	L / H =	0.58	

Vertical Displacement Behind Wall Prediction:

Change in vertical movement, Δ =	0.10	mm

Predicted from P-Disp taking worst case of short term and total movement

Horizontal Displacement Behind Wall Prediction:

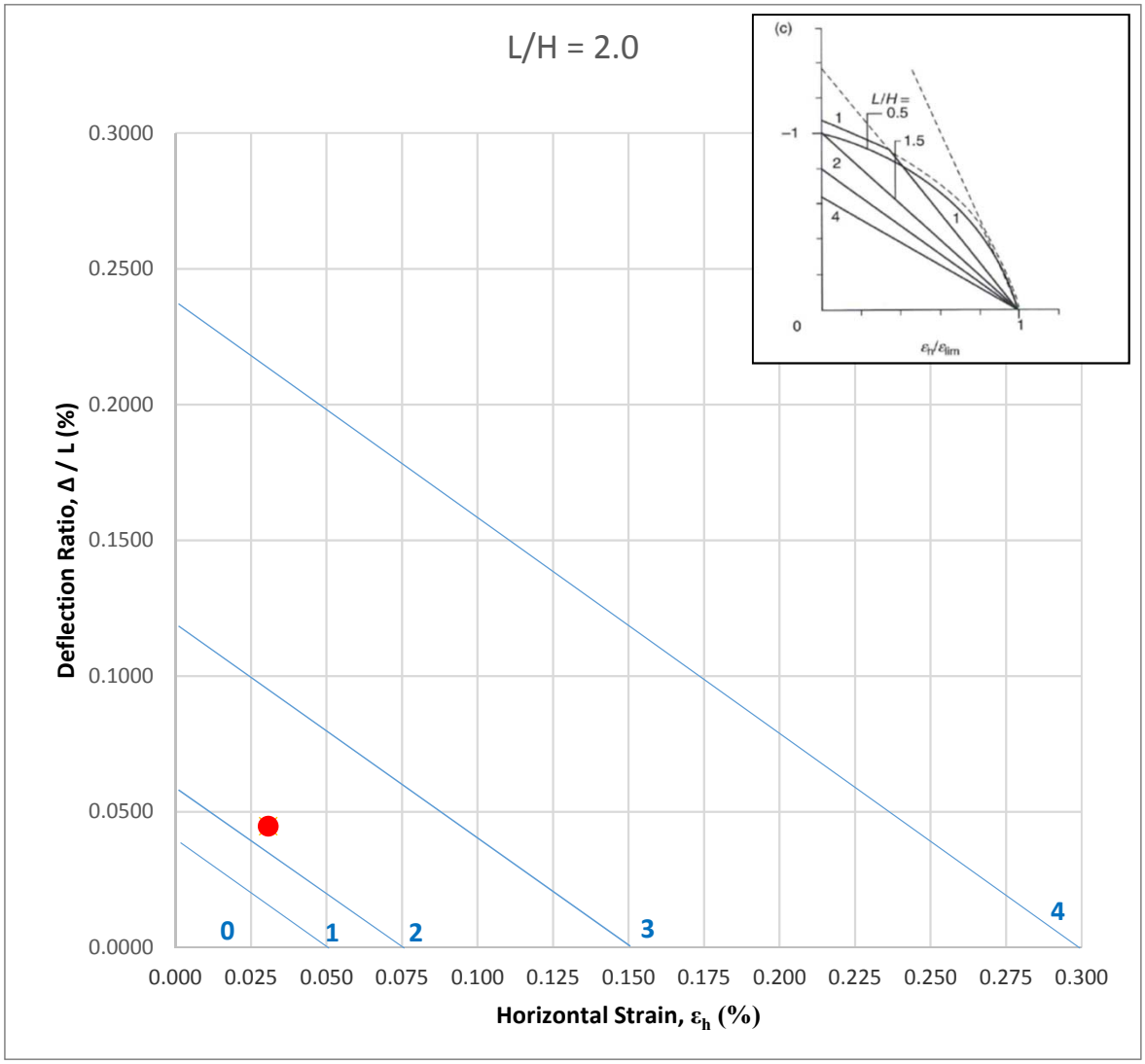
Change in horizontal movement, δ_h =	0.00	**mm**

Predicted from CIRIA C760 (Fig 6.15a) assuming excavation in front of a wall in stiff clay, based on 5 mm horizontal movement at wall with 4.0 m excavation

Building Damage Category = **CATEGORY 0 - NEGLIGIBLE**

Project Number	J17190
Revision	0.0
Wall Reference	D

L / H = **1.58**



Wall Length, L =	7.6	m
Wall Height, H =	4.8	m
Change in horizontal movement, δ_h =	2.34	mm
Change in vertical movement, Δ =	3.40	mm

Horizontal Strain:

$$Horizontal\ Strain, \varepsilon_h = \frac{\delta_{h\ \times 100}}{L\ \times 1000}$$

ε_h = **0.0308**

Deflection Ratio:

$$Deflection\ Ratio = \frac{\Delta \times 100}{L \times 1000}$$

= **0.0447**

Ground Movement Assessment Summary

Project Number	J17190
Revision	0.0
Wall Reference	D

Input parameters:

Sensitive Structure:	Wall Length, L =	7.60	m
	Wall Height, H (including foundation depth) =	4.80	m
	Foundation depth below ground level =	0.50	m
Basement Details:	Proposed basement depth =	4.00	
	L / H =	1.58	

Vertical Displacement Behind Wall Prediction:

Change in vertical movement, Δ =	3.40	mm

Predicted from P-Disp taking worst case of short term and total movement

Horizontal Displacement Behind Wall Prediction:

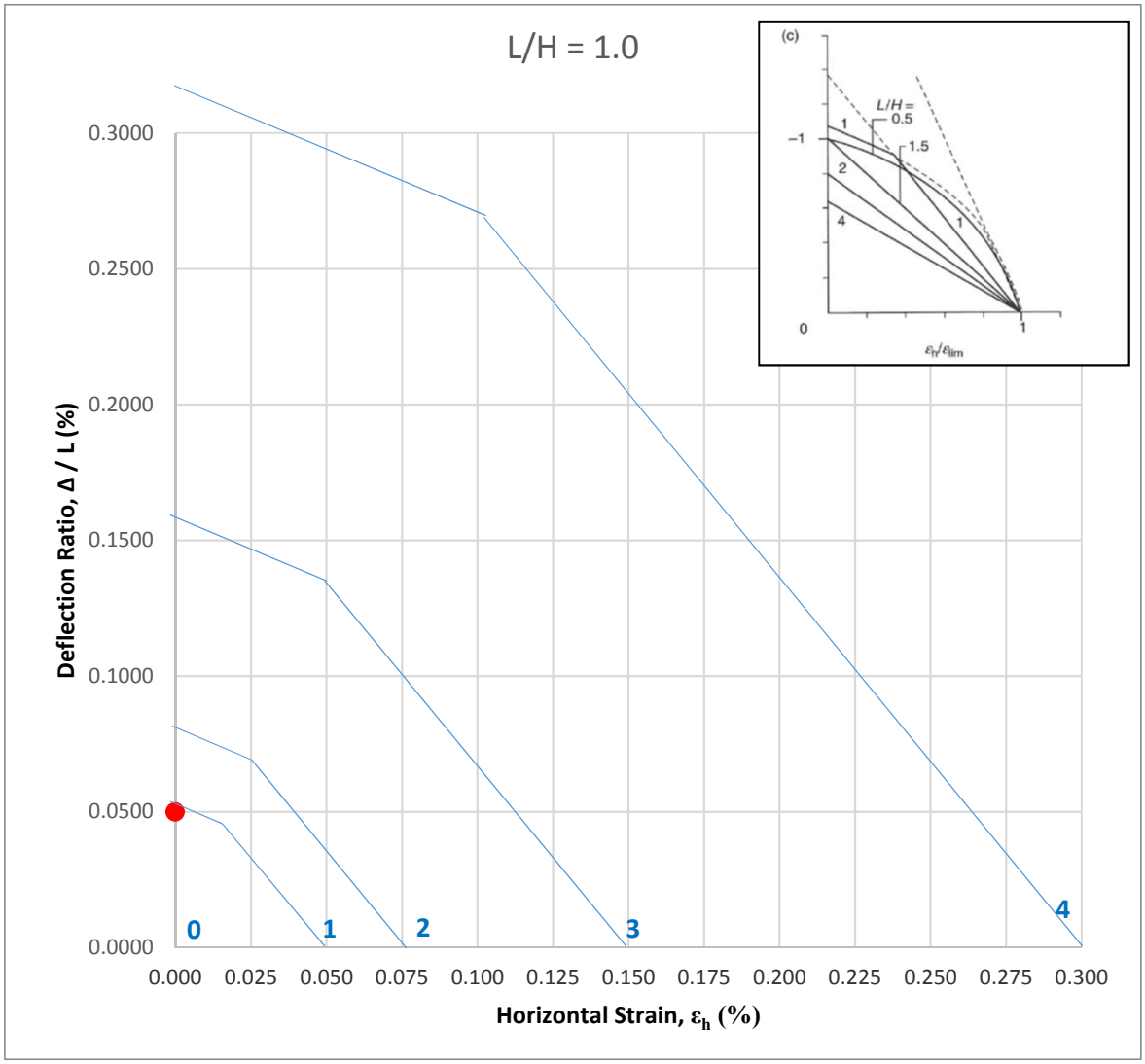
Change in horizontal movement, δ_h =	2.34	**mm**

Predicted from CIRIA C760 (Fig 6.15a) assuming excavation in front of a wall in stiff clay, based on 5 mm horizontal movement at wall with 4.0 m excavation

Building Damage Category = **CATEGORY 2 - SLIGHT**

Project Number	J17190
Revision	0.0
Wall Reference	E

L / H = **0.93**



Wall Length, L =	9.4	m
Wall Height, H =	10.1	m
Change in horizontal movement, δ_h =	0.00	mm
Change in vertical movement, Δ =	4.70	mm

Horizontal Strain:

$$Horizontal\ Strain, \varepsilon_h = \frac{\delta_{h\ \times 100}}{L\ \times 1000}$$

ε_h = **0.0000**

Deflection Ratio:

$$Deflection\ Ratio = \frac{\Delta \times 100}{L \times 1000}$$

= **0.0500**

Ground Movement Assessment Summary

Project Number	J17190
Revision	0.0
Wall Reference	E

Input parameters:

Sensitive Structure:	Wall Length, L =	9.40	m
	Wall Height, H (including foundation depth) =	10.10	m
	Foundation depth below ground level =	4.00	m
Basement Details:	Proposed effective basement depth =	0.00	
	L / H =	0.93	

Vertical Displacement Behind Wall Prediction:

Change in vertical movement, Δ = 4.70 mm

Predicted from P-Disp taking worst case of short term and total movement

Horizontal Displacement Behind Wall Prediction:

Change in horizontal movement, δ_h = 0.00 **mm**

Predicted from CIRIA C760 (Fig 6.15a) assuming excavation in front of a wall in stiff clay, based on 5 mm horizontal movement at wall with 4.0 m excavation

Building Damage Category = **CATEGORY 0 - NEGLIBILE**

Project Number	J17190
Revision	0.0
Wall Reference	F

L / H = **1.55**

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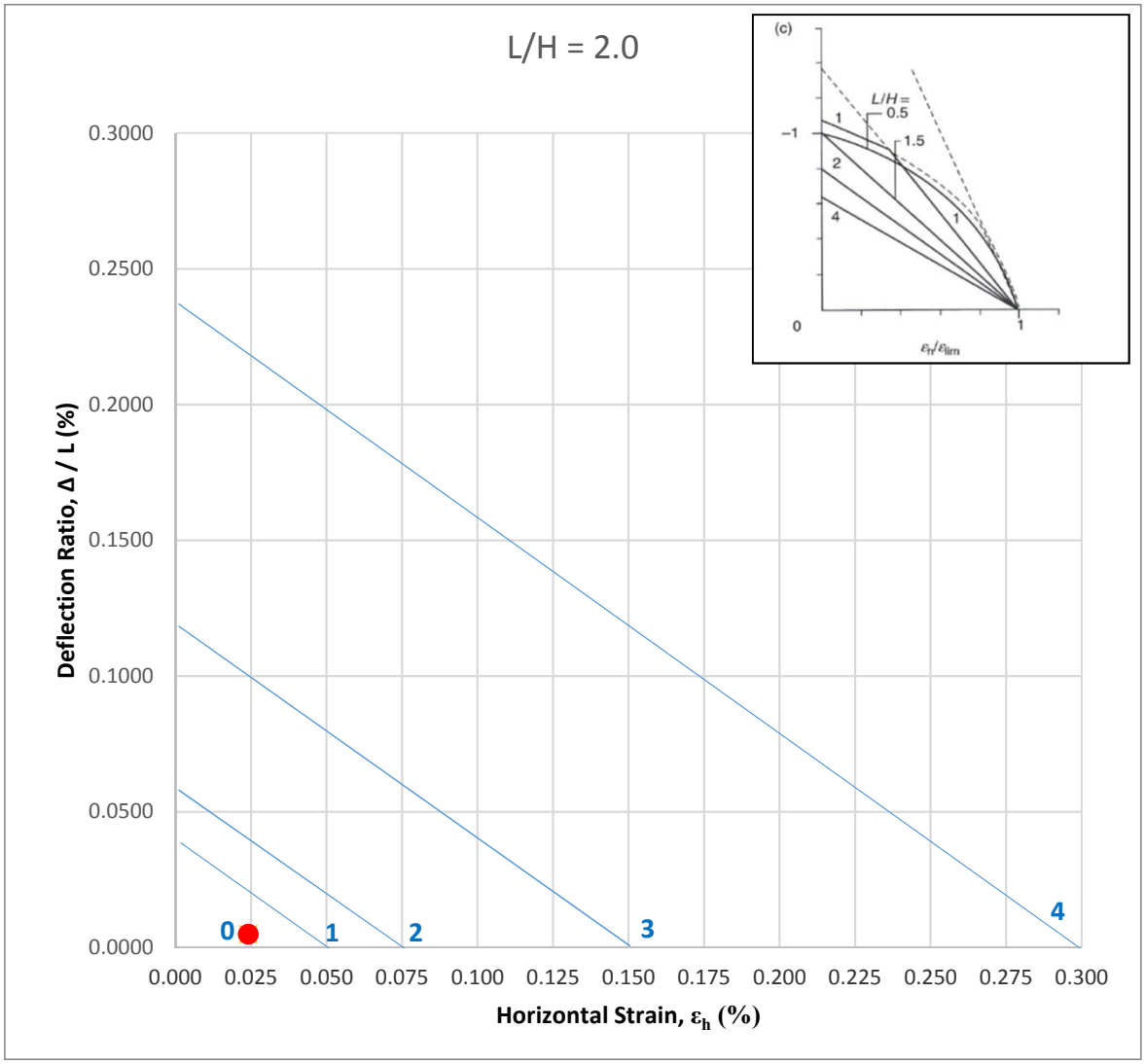


Wall Length, L =	10.2	m
Wall Height, H =	6.6	m
Change in horizontal movement, δ_h =	2.47	mm
Change in vertical movement, Δ =	0.50	mm

Horizontal Strain:

$$Horizontal\ Strain, \varepsilon_h = \frac{\delta_h \times 100}{L \times 1000}$$

ε_h = **0.0242**

Deflection Ratio:

$$Deflection\ Ratio = \frac{\Delta \times 100}{L \times 1000}$$

= **0.0049**

Ground Movement Assessment Summary

Project Number	J17190
Revision	0.0
Wall Reference	F

Input parameters:

Sensitive Structure:	Wall Length, L =	10.20	m
	Wall Height, H (including foundation depth) =	6.60	m
	Foundation depth below ground level =	0.50	m
Basement Details:	Proposed basement depth =	4.00	
	L / H =	1.55	

Vertical Displacement Behind Wall Prediction:

Change in vertical movement, Δ =	0.50	mm

Predicted from P-Disp taking worst case of short term and total movement

Horizontal Displacement Behind Wall Prediction:

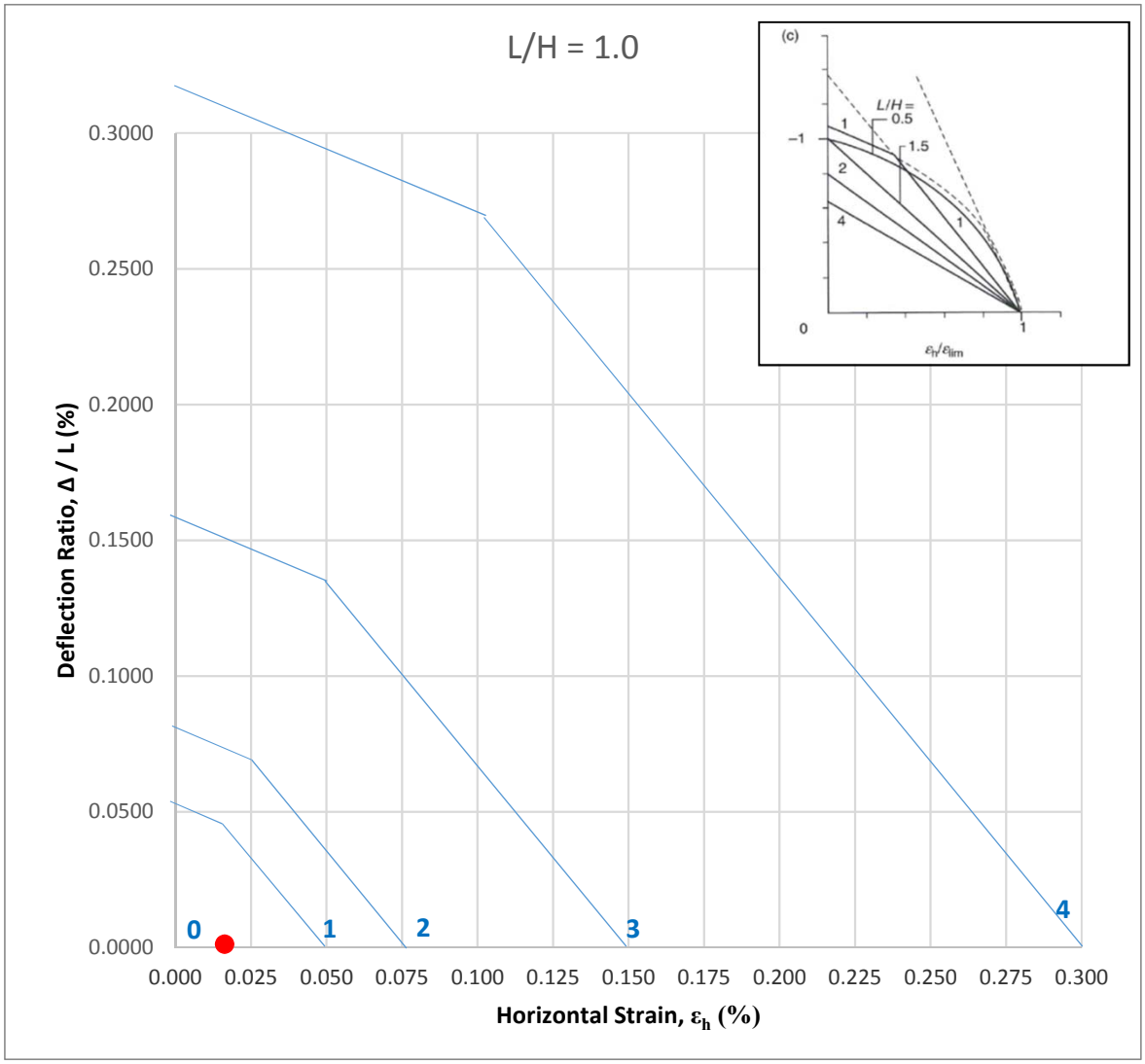
Change in horizontal movement, δ_h =	2.47	**mm**

Predicted from CIRIA C760 (Fig 6.15a) assuming excavation in front of a wall in stiff clay, based on 5 mm horizontal movement at wall with 4.0 m excavation

Building Damage Category = **CATEGORY 0 - NEGLIGIBLE**

Project Number	J17190
Revision	0.0
Wall Reference	G

L / H = **0.95**



Wall Length, L =	7.9	m
Wall Height, H =	8.3	m
Change in horizontal movement, δ_h =	1.29	mm
Change in vertical movement, Δ =	0.10	mm

Horizontal Strain:

$$Horizontal\ Strain, \varepsilon_h = \frac{\delta_{h\ \times 100}}{L\ \times 1000}$$

ε_h = **0.0163**

Deflection Ratio:

$$Deflection\ Ratio = \frac{\Delta \times 100}{L \times 1000}$$

= **0.0013**

Ground Movement Assessment Summary

Project Number	J17190
Revision	0.0
Wall Reference	G

Input parameters:

Sensitive Structure:	Wall Length, L =	7.90	m
	Wall Height, H (including foundation depth) =	8.30	m
	Foundation depth below ground level =	0.50	m
Basement Details:	Proposed basement depth =	4.00	
	L / H =	0.95	

Vertical Displacement Behind Wall Prediction:

Change in vertical movement, Δ =	0.10	mm

Predicted from P-Disp taking worst case of short term and total movement

Horizontal Displacement Behind Wall Prediction:

Change in horizontal movement, δ_h =	1.29	**mm**

Predicted from CIRIA C760 (Fig 6.15a) assuming excavation in front of a wall in stiff clay, based on 5 mm horizontal movement at wall with 4.0 m excavation

Building Damage Category = **CATEGORY 0 - NEGLIGIBLE**

Project Number	J17190
Revision	0.0
Wall Reference	H

L / H = **1.72**

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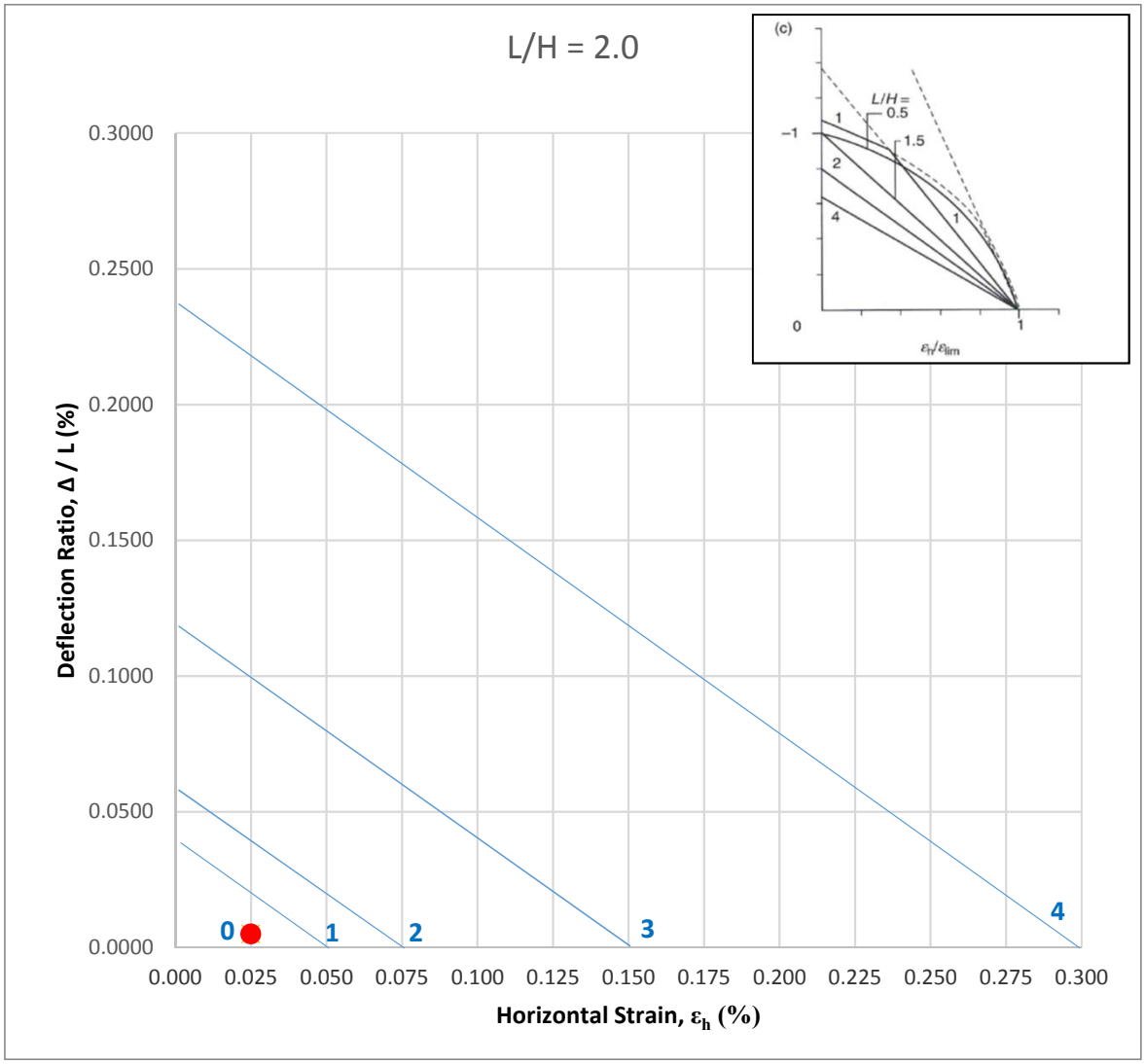

Wall Length, L =	10.0	m
Wall Height, H =	5.8	m
Change in horizontal movement, δ_h =	2.50	mm
Change in vertical movement, Δ =	0.50	mm

Horizontal Strain:

$$Horizontal\ Strain, \varepsilon_h = \frac{\delta_h \times 100}{L \times 1000}$$

ε_h = **0.0250**

Deflection Ratio:

$$Deflection\ Ratio = \frac{\Delta \times 100}{L \times 1000}$$

= **0.0050**

Ground Movement Assessment Summary

Project Number	J17190
Revision	0.0
Wall Reference	H

Input parameters:

Sensitive Structure:	Wall Length, L =	10.00	m
	Wall Height, H (including foundation depth) =	5.80	m
	Foundation depth below ground level =	0.50	m
Basement Details:	Proposed basement depth =	4.00	
	L / H =	1.72	

Vertical Displacement Behind Wall Prediction:

Change in vertical movement, Δ = 0.50 mm

Predicted from P-Disp taking worst case of short term and total movement

Horizontal Displacement Behind Wall Prediction:

Change in horizontal movement, δ_h = 2.50 **mm**

Predicted from CIRIA C760 (Fig 6.15a) assuming excavation in front of a wall in stiff clay, based on 5 mm horizontal movement at wall with 4.0 m excavation

Building Damage Category = **CATEGORY 0 - NEGLIGIBLE**

Project Number	J17190
Revision	0.0
Wall Reference	I

L / H = **0.76**

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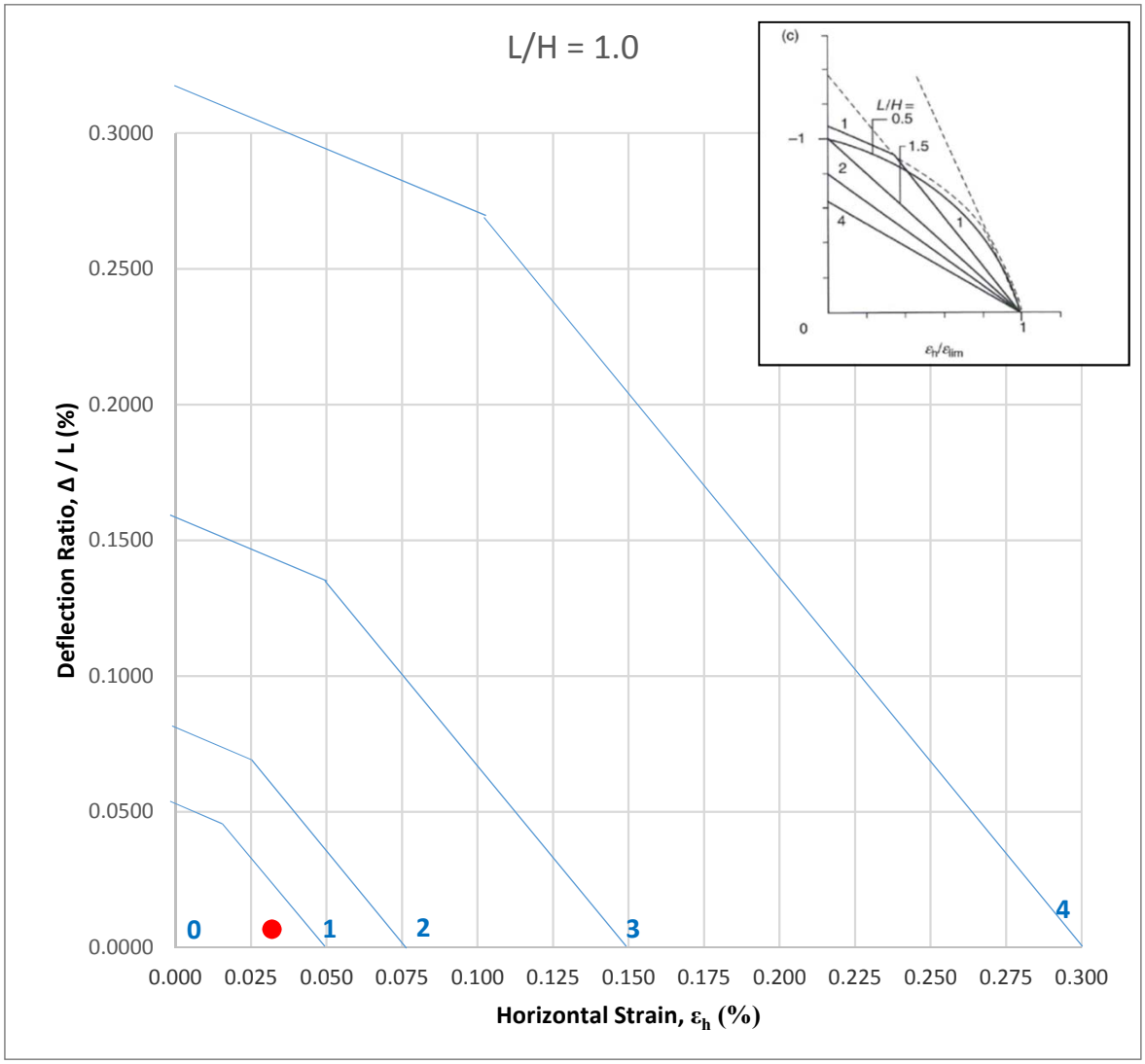


Wall Length, L =	4.4	m
Wall Height, H =	5.8	m
Change in horizontal movement, δ_h =	1.41	mm
Change in vertical movement, Δ =	0.30	mm

Horizontal Strain:

$$Horizontal\ Strain, \varepsilon_h = \frac{\delta_{h\ \times 100}}{L\ \times 1000}$$

ε_h = **0.0320**

Deflection Ratio:

$$Deflection\ Ratio = \frac{\Delta \times 100}{L \times 1000}$$

= **0.0068**

Ground Movement Assessment Summary

Project Number	J17190
Revision	0.0
Wall Reference	I

Input parameters:

Sensitive Structure:	Wall Length, L =	4.40	m
	Wall Height, H (including foundation depth) =	5.80	m
	Foundation depth below ground level =	0.50	m
Basement Details:	Proposed basement depth =	4.00	
	L / H =	0.76	

Vertical Displacement Behind Wall Prediction:

Change in vertical movement, Δ =	0.30	mm

Predicted from P-Disp taking worst case of short term and total movement

Horizontal Displacement Behind Wall Prediction:

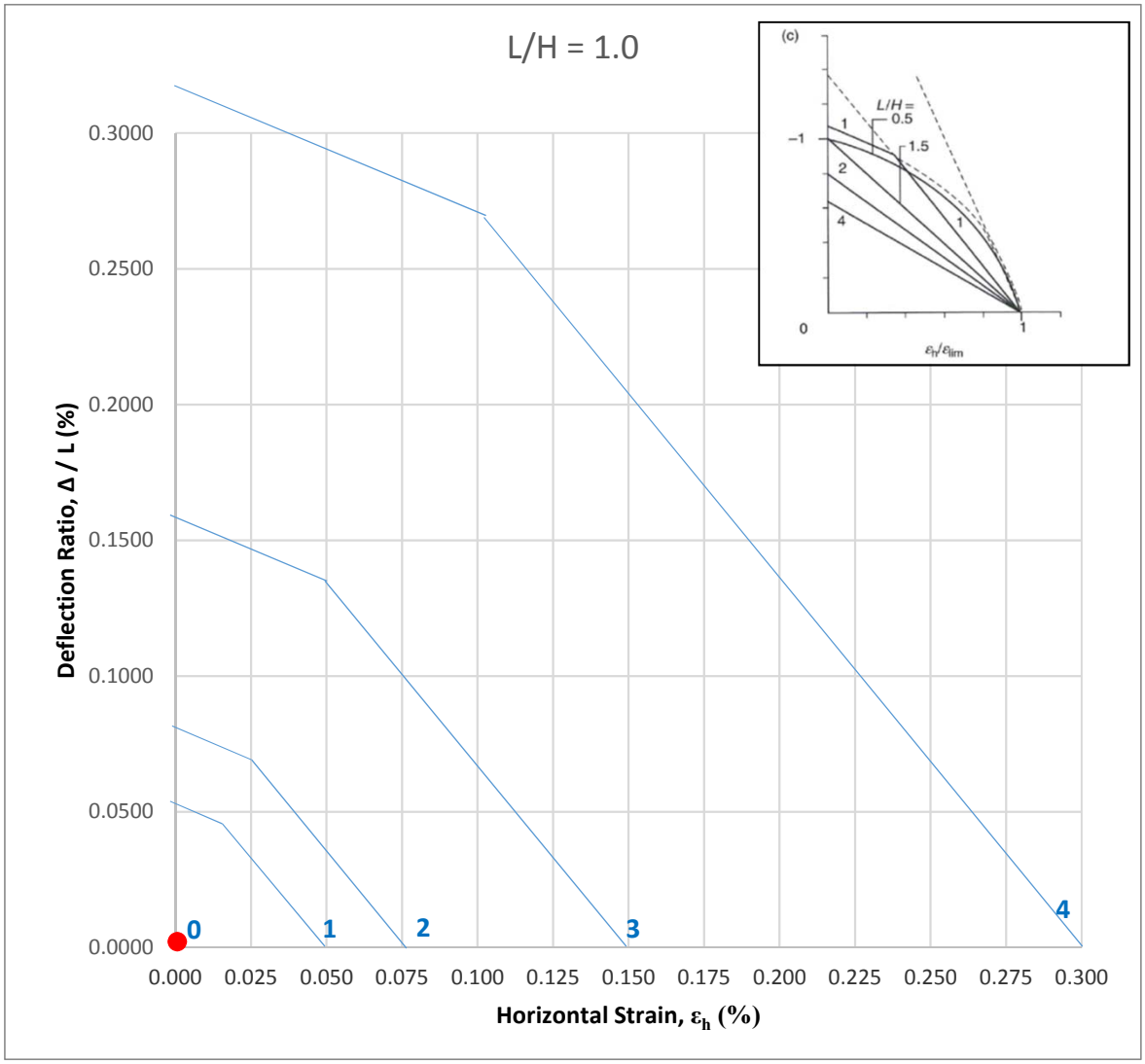
Change in horizontal movement, δ_h =	1.41	**mm**

Predicted from CIRIA C760 (Fig 6.15a) assuming excavation in front of a wall in stiff clay, based on 5 mm horizontal movement at wall with 4.0 m excavation

Building Damage Category = **CATEGORY 0 - NEGLIGIBLE**

Project Number	J17190
Revision	0.0
Wall Reference	J

L / H = **0.87**



Wall Length, L =	4.5	m
Wall Height, H =	5.2	m
Change in horizontal movement, δ_h =	0.03	mm
Change in vertical movement, Δ =	0.10	mm

Horizontal Strain:

$$Horizontal\ Strain, \varepsilon_h = \frac{\delta_{h\ \times 100}}{L\ \times 1000}$$

ε_h = **0.0007**

Deflection Ratio:

$$Deflection\ Ratio = \frac{\Delta \times 100}{L \times 1000}$$

= **0.0022**

Ground Movement Assessment Summary

Project Number	J17190
Revision	0.0
Wall Reference	J

Input parameters:

Sensitive Structure:	Wall Length, L =	4.50	m
	Wall Height, H (including foundation depth) =	5.20	m
	Foundation depth below ground level =	2.20	m
Basement Details:	Proposed basement depth =	4.00	
	L / H =	0.87	

Vertical Displacement Behind Wall Prediction:

Change in vertical movement, Δ =	0.10	mm

Predicted from P-Disp taking worst case of short term and total movement

Horizontal Displacement Behind Wall Prediction:

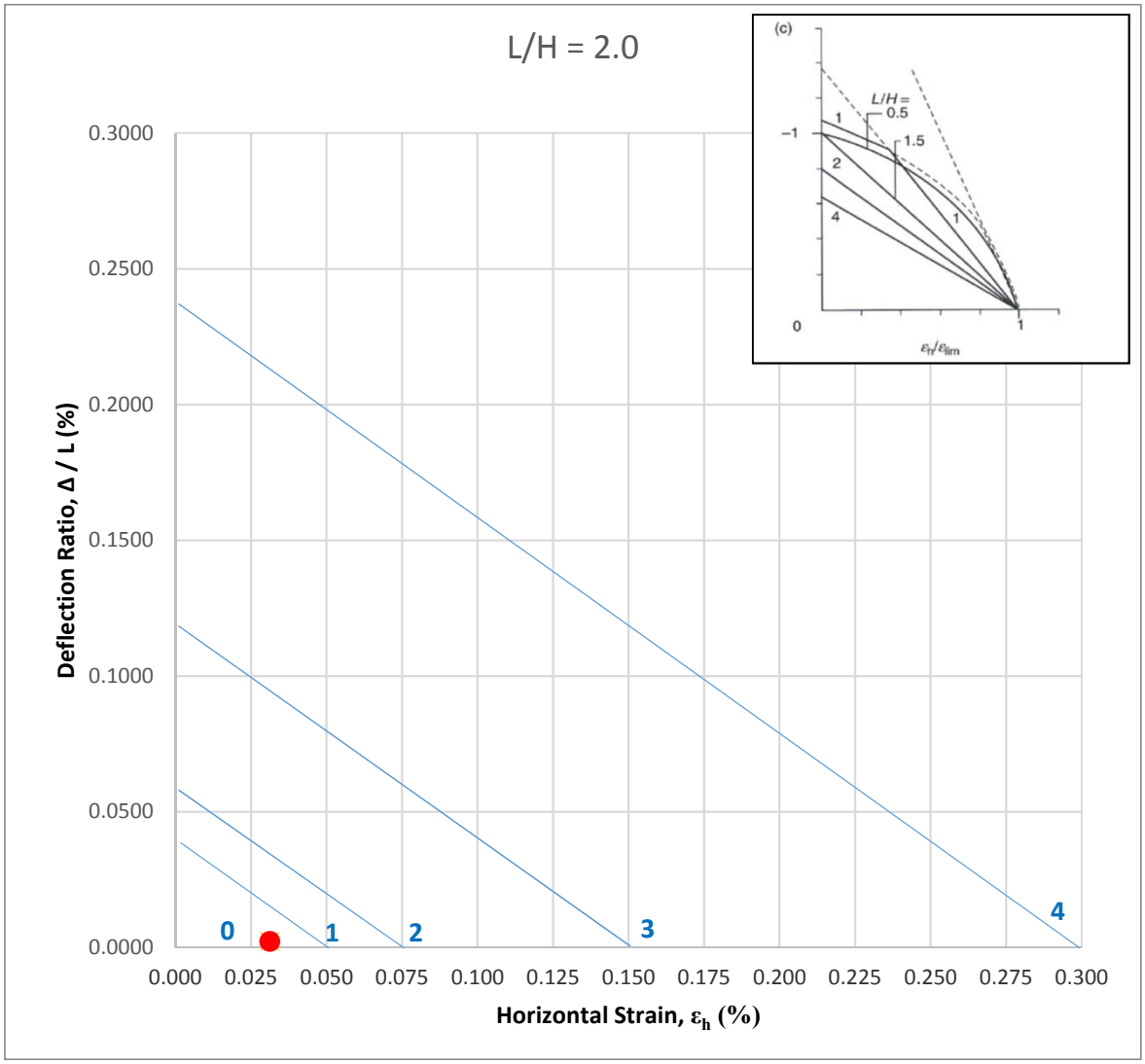
Change in horizontal movement, δ_h =	0.03	**mm**

Predicted from CIRIA C760 (Fig 6.15a) assuming excavation in front of a wall in stiff clay, based on 5 mm horizontal movement at wall with 4.0 m excavation

Building Damage Category = **CATEGORY 0 - NEGLIGIBLE**

Project Number	J17190
Revision	0.0
Wall Reference	K

L / H = **1.67**



Wall Length, L =	8.7	m
Wall Height, H =	5.2	m
Change in horizontal movement, δ_h =	2.72	mm
Change in vertical movement, Δ =	0.20	mm

Horizontal Strain:

$$Horizontal\ Strain, \varepsilon_h = \frac{\delta_{h\ \times 100}}{L\ \times 1000}$$

ε_h = **0.0313**

Deflection Ratio:

$$Deflection\ Ratio = \frac{\Delta \times 100}{L \times 1000}$$

= **0.0023**

Ground Movement Assessment Summary

Project Number	J17190
Revision	0.0
Wall Reference	K

Input parameters:

Sensitive Structure:	Wall Length, L =	8.70	m
	Wall Height, H (including foundation depth) =	5.20	m
	Foundation depth below ground level =	2.20	m
Basement Details:	Proposed basement depth =	4.00	
	L / H =	1.67	

Vertical Displacement Behind Wall Prediction:

Change in vertical movement, Δ = 0.20 mm

Predicted from P-Disp taking worst case of short term and total movement

Horizontal Displacement Behind Wall Prediction:

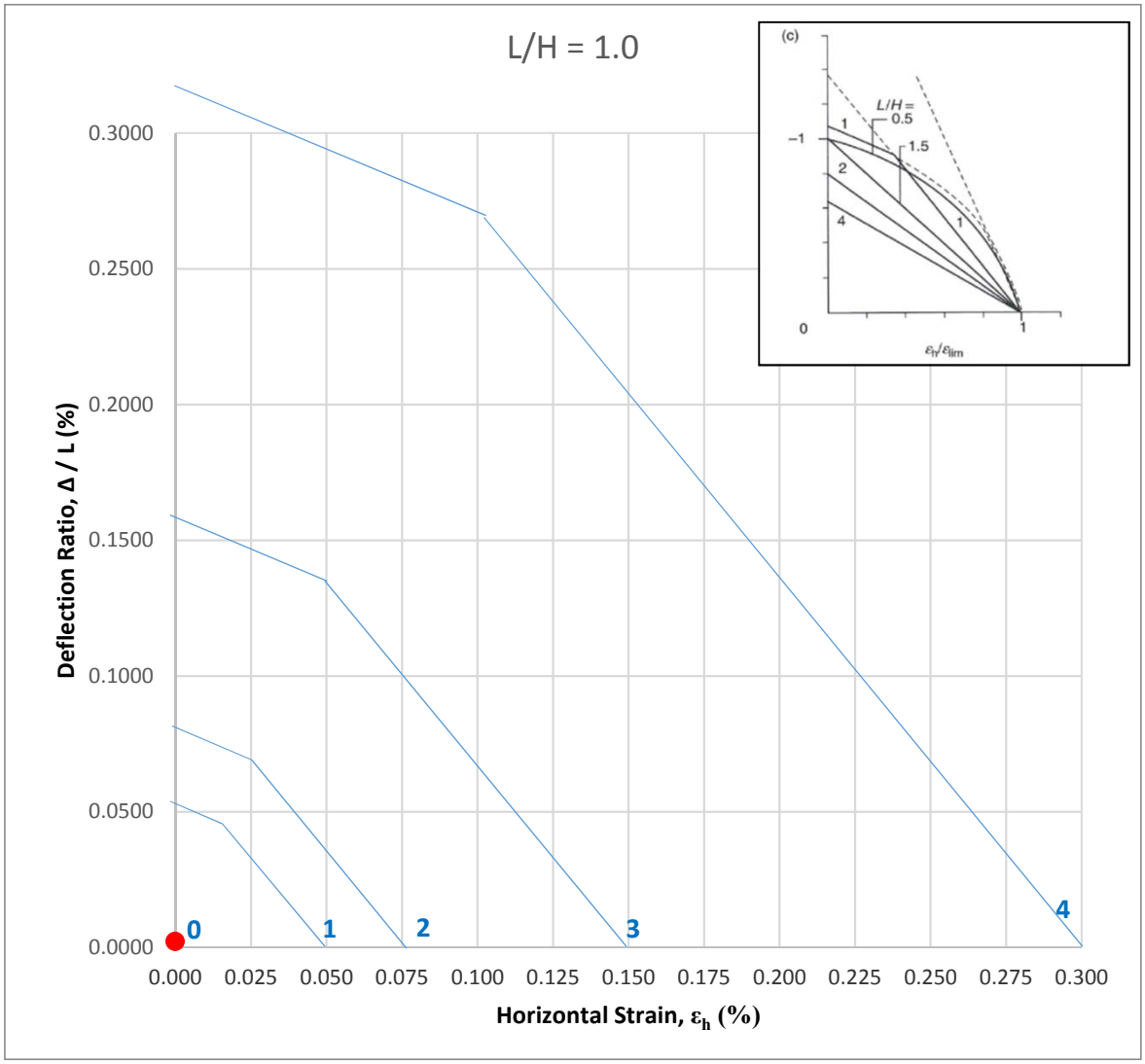
Change in horizontal movement, δ_h = 2.72 **mm**

Predicted from CIRIA C760 (Fig 6.15a) assuming excavation in front of a wall in stiff clay, based on 5 mm horizontal movement at wall with 4.0 m excavation

Building Damage Category = **CATEGORY 0 - NEGLIGIBLE**

Project Number	J17190
Revision	0.0
Wall Reference	L

L / H = **0.83**



Wall Length, L =	4.3	m
Wall Height, H =	5.2	m
Change in horizontal movement, δ_h =	0.00	mm
Change in vertical movement, Δ =	0.10	mm

Horizontal Strain:

$$Horizontal\ Strain, \varepsilon_h = \frac{\delta_{h\ \times 100}}{L\ \times 1000}$$

ε_h = **0.0000**

Deflection Ratio:

$$Deflection\ Ratio = \frac{\Delta \times 100}{L \times 1000}$$

= **0.0023**

Ground Movement Assessment Summary

Project Number	J17190
Revision	0.0
Wall Reference	L

Input parameters:

Sensitive Structure:	Wall Length, L =	4.30	m
	Wall Height, H (including foundation depth) =	5.20	m
	Foundation depth below ground level =	2.20	m
Basement Details:	Proposed basement depth =	4.00	
	L / H =	0.83	

Vertical Displacement Behind Wall Prediction:

Change in vertical movement, Δ = 0.10 mm

Predicted from P-Disp taking worst case of short term and total movement

Horizontal Displacement Behind Wall Prediction:

Change in horizontal movement, δ_h = 0.00 **mm**

Predicted from CIRIA C760 (Fig 6.15a) assuming excavation in front of a wall in stiff clay, based on 5 mm horizontal movement at wall with 4.0 m excavation

Building Damage Category = **CATEGORY 0 - NEGLIGIBLE**

Project Number	J17190
Revision	0.0
Wall Reference	M

L / H = **0.29**

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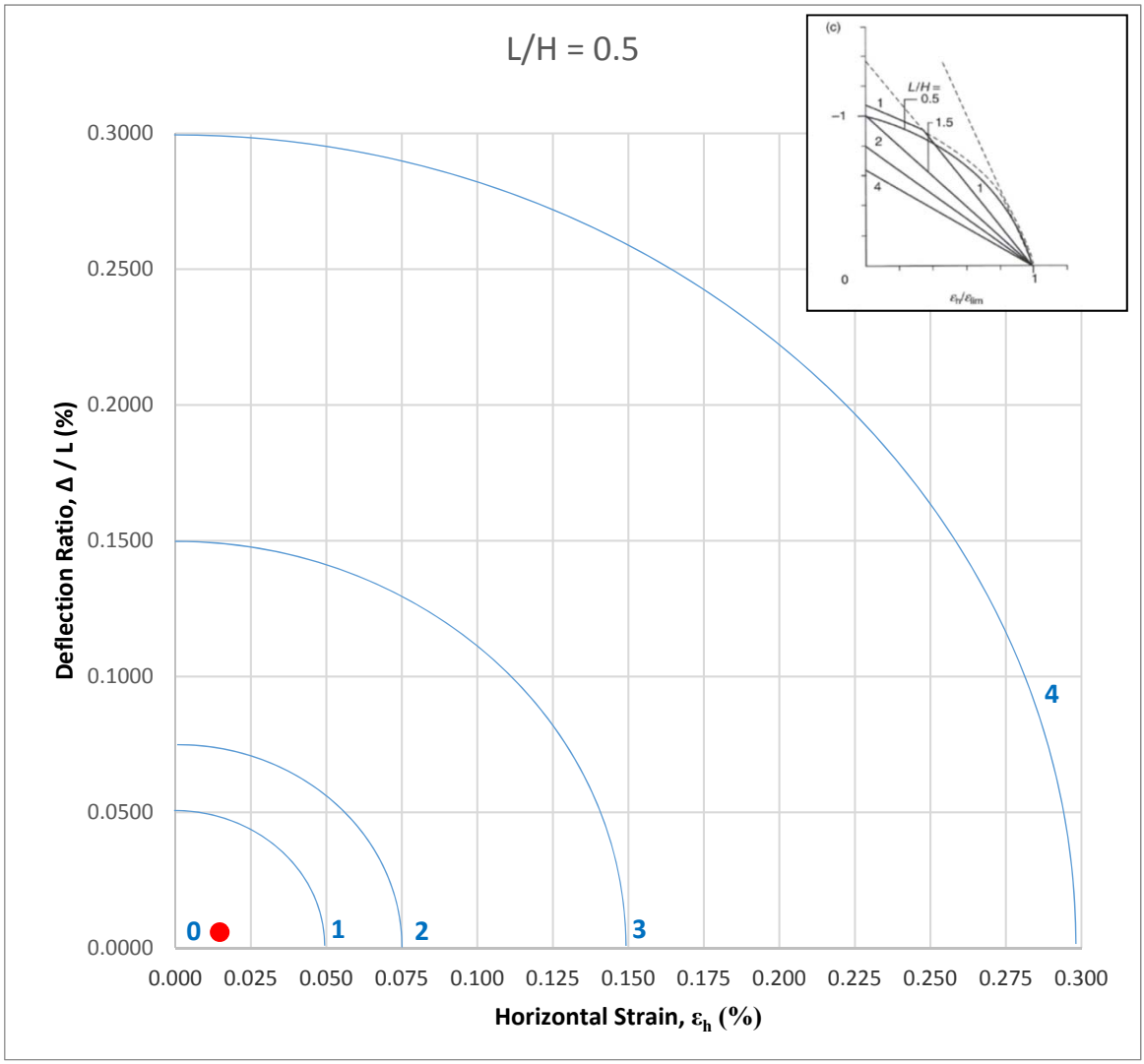

Wall Length, L =	1.7	m
Wall Height, H =	5.8	m
Change in horizontal movement, δ_h =	0.25	mm
Change in vertical movement, Δ =	0.10	mm

Horizontal Strain:

$$Horizontal\ Strain, \varepsilon_h = \frac{\delta_h \times 100}{L \times 1000}$$

ε_h = **0.0147**

Deflection Ratio:

$$Deflection\ Ratio = \frac{\Delta \times 100}{L \times 1000}$$

= **0.0059**

Ground Movement Assessment Summary

Project Number	J17190
Revision	0.0
Wall Reference	M

Input parameters:

Sensitive Structure:	Wall Length, L =	1.70	m
	Wall Height, H (including foundation depth) =	5.80	m
	Foundation depth below ground level =	0.50	m
Basement Details:	Proposed basement depth =	4.00	
	L / H =	0.29	

Vertical Displacement Behind Wall Prediction:

Change in vertical movement, Δ =	0.10	mm

Predicted from P-Disp taking worst case of short term and total movement

Horizontal Displacement Behind Wall Prediction:

Change in horizontal movement, δ_h =	0.25	**mm**

Predicted from CIRIA C760 (Fig 6.15a) assuming excavation in front of a wall in stiff clay, based on 5 mm horizontal movement at wall with 4.0 m excavation

Building Damage Category = **CATEGORY 0 - NEGLIGIBLE**

Project Number	J17190
Revision	0.0
Wall Reference	N

L / H = **0.21**

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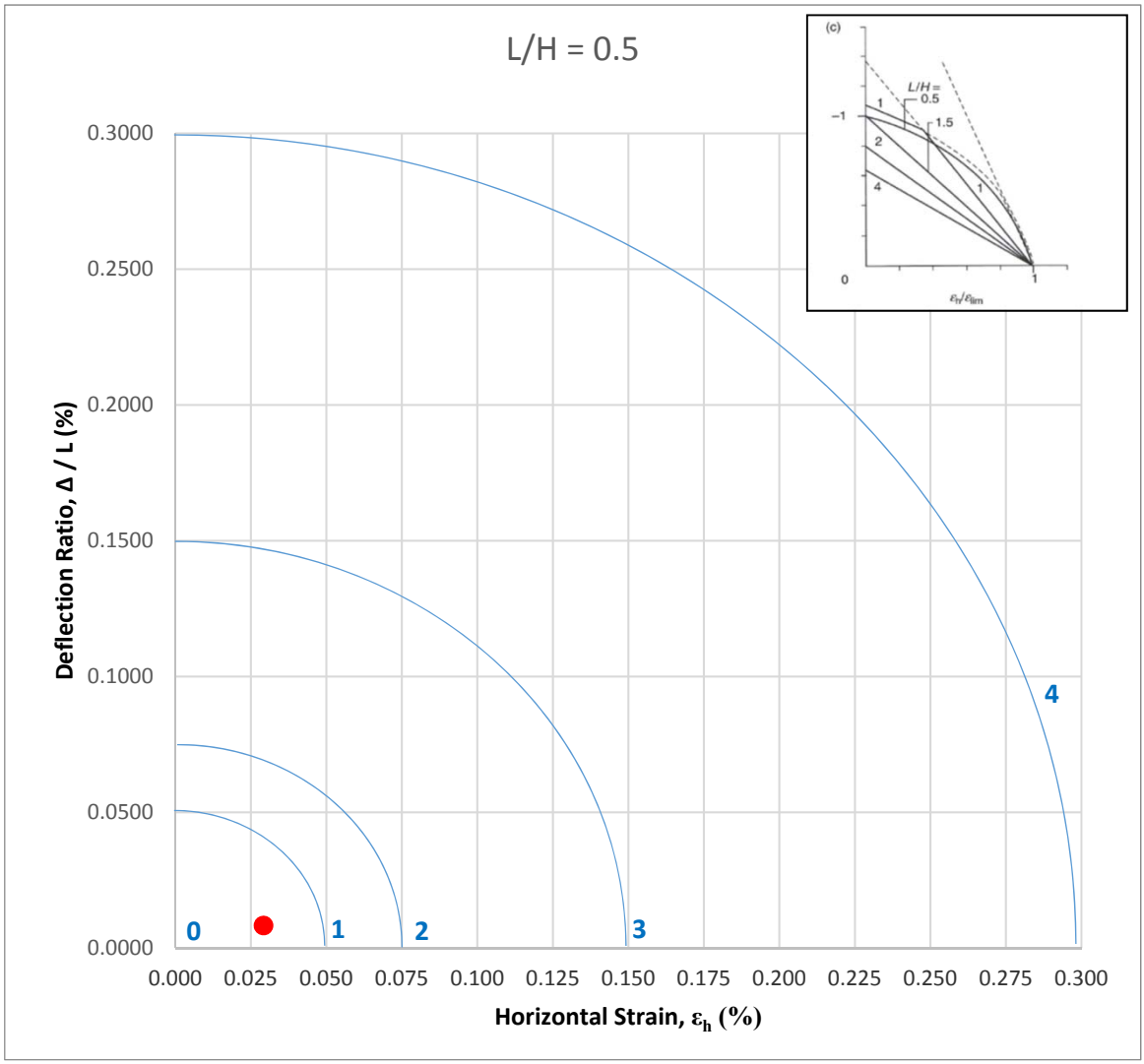


Wall Length, L =	1.2	m
Wall Height, H =	5.8	m
Change in horizontal movement, δ_h =	0.35	mm
Change in vertical movement, Δ =	0.10	mm

Horizontal Strain:

$$Horizontal\ Strain, \varepsilon_h = \frac{\delta_h \times 100}{L \times 1000}$$

ε_h = **0.0292**

Deflection Ratio:

$$Deflection\ Ratio = \frac{\Delta \times 100}{L \times 1000}$$

= **0.0083**

Ground Movement Assessment Summary

Project Number	J17190
Revision	0.0
Wall Reference	N

Input parameters:

Sensitive Structure:	Wall Length, L =	1.20	m
	Wall Height, H (including foundation depth) =	5.80	m
	Foundation depth below ground level =	0.50	m
Basement Details:	Proposed basement depth =	4.00	
	L / H =	0.21	

Vertical Displacement Behind Wall Prediction:

Change in vertical movement, Δ =	0.10	mm

Predicted from P-Disp taking worst case of short term and total movement

Horizontal Displacement Behind Wall Prediction:

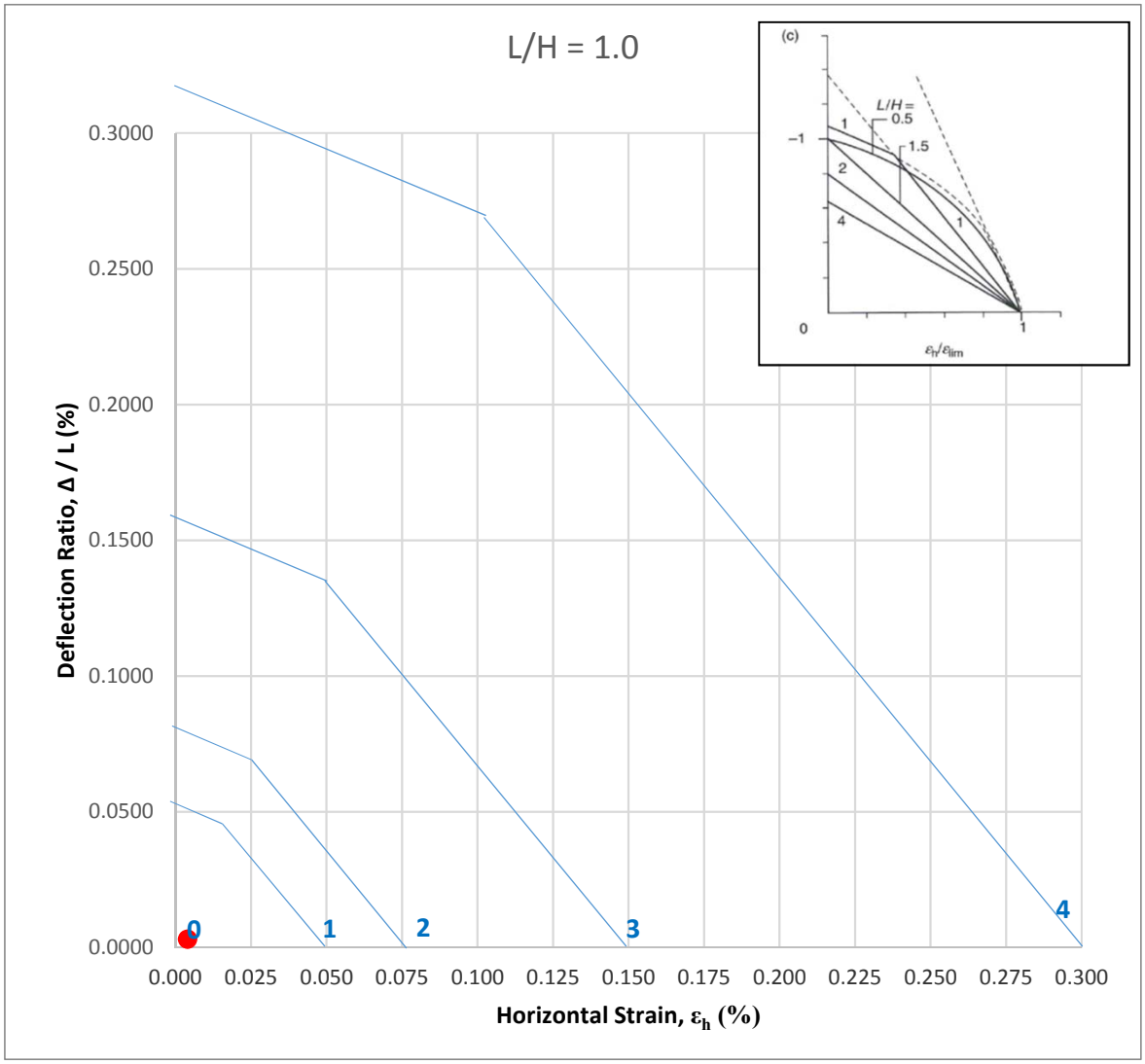
Change in horizontal movement, δ_h =	0.35	**mm**

Predicted from CIRIA C760 (Fig 6.15a) assuming excavation in front of a wall in stiff clay, based on 5 mm horizontal movement at wall with 4.0 m excavation

Building Damage Category = **CATEGORY 0 - NEGLIGIBLE**

Project Number	J17190
Revision	0.0
Wall Reference	O

L / H = **0.55**



Wall Length, L =	3.2	m
Wall Height, H =	5.8	m
Change in horizontal movement, δ_h =	0.13	mm
Change in vertical movement, Δ =	0.10	mm

Horizontal Strain:

$$Horizontal\ Strain, \varepsilon_h = \frac{\delta_{h\ \times 100}}{L\ \times 1000}$$

ε_h = **0.0041**

Deflection Ratio:

$$Deflection\ Ratio = \frac{\Delta \times 100}{L \times 1000}$$

= **0.0031**

Ground Movement Assessment Summary

Project Number	J17190
Revision	0.0
Wall Reference	O

Input parameters:

Sensitive Structure:	Wall Length, L =	3.20	m
	Wall Height, H (including foundation depth) =	5.80	m
	Foundation depth below ground level =	0.50	m
Basement Details:	Proposed basement depth =	4.00	
	L / H =	0.55	

Vertical Displacement Behind Wall Prediction:

Change in vertical movement, Δ =	0.10	mm

Predicted from P-Disp taking worst case of short term and total movement

Horizontal Displacement Behind Wall Prediction:

Change in horizontal movement, δ_h =	0.13	**mm**

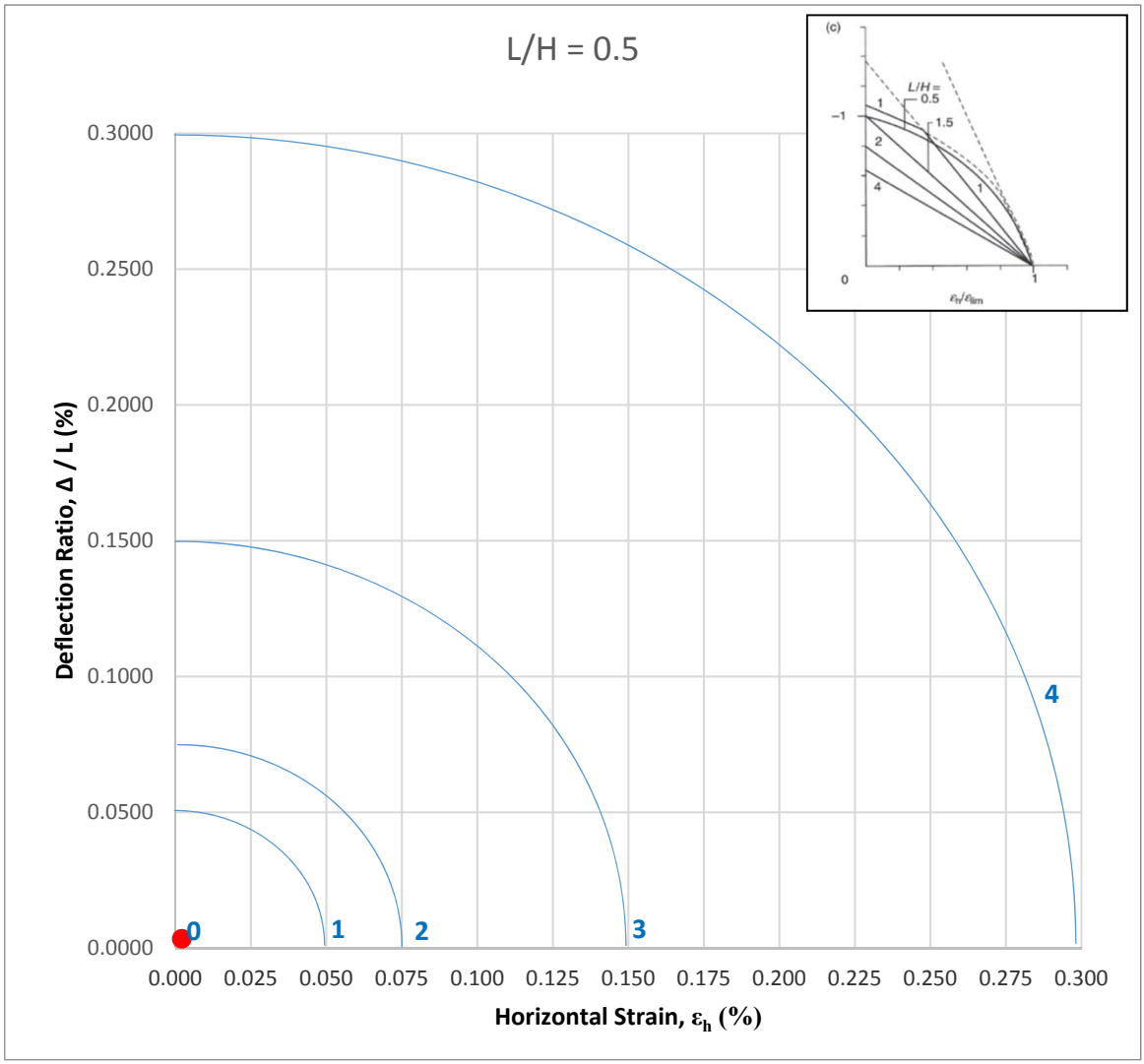
Predicted from CIRIA C760 (Fig 6.15a) assuming excavation in front of a wall in stiff clay, based on 5 mm horizontal movement at wall with 4.0 m excavation

Building Damage Category = **CATEGORY 0 - NEGLIGIBLE**

Project Number	J17190
Revision	0.0
Wall Reference	P

L / H = **0.49**

Geotechnical & Environmental Associates



Wall Length, L =	2.9	m
Wall Height, H =	5.8	m
Change in horizontal movement, δ_h =	0.06	mm
Change in vertical movement, Δ =	0.10	mm

Horizontal Strain:

$$Horizontal\ Strain, \varepsilon_h = \frac{\delta_h \times 100}{L \times 1000}$$

ε_h = **0.0021**

Deflection Ratio:

$$Deflection\ Ratio = \frac{\Delta \times 100}{L \times 1000}$$

= **0.0035**

Ground Movement Assessment Summary

Project Number	J17190
Revision	0.0
Wall Reference	P

Input parameters:

Sensitive Structure:	Wall Length, L =	2.87	m
	Wall Height, H (including foundation depth) =	5.80	m
	Foundation depth below ground level =	0.50	m
Basement Details:	Proposed basement depth =	4.00	
	L / H =	0.49	

Vertical Displacement Behind Wall Prediction:

Change in vertical movement, Δ =	0.10	mm

Predicted from P-Disp taking worst case of short term and total movement

Horizontal Displacement Behind Wall Prediction:

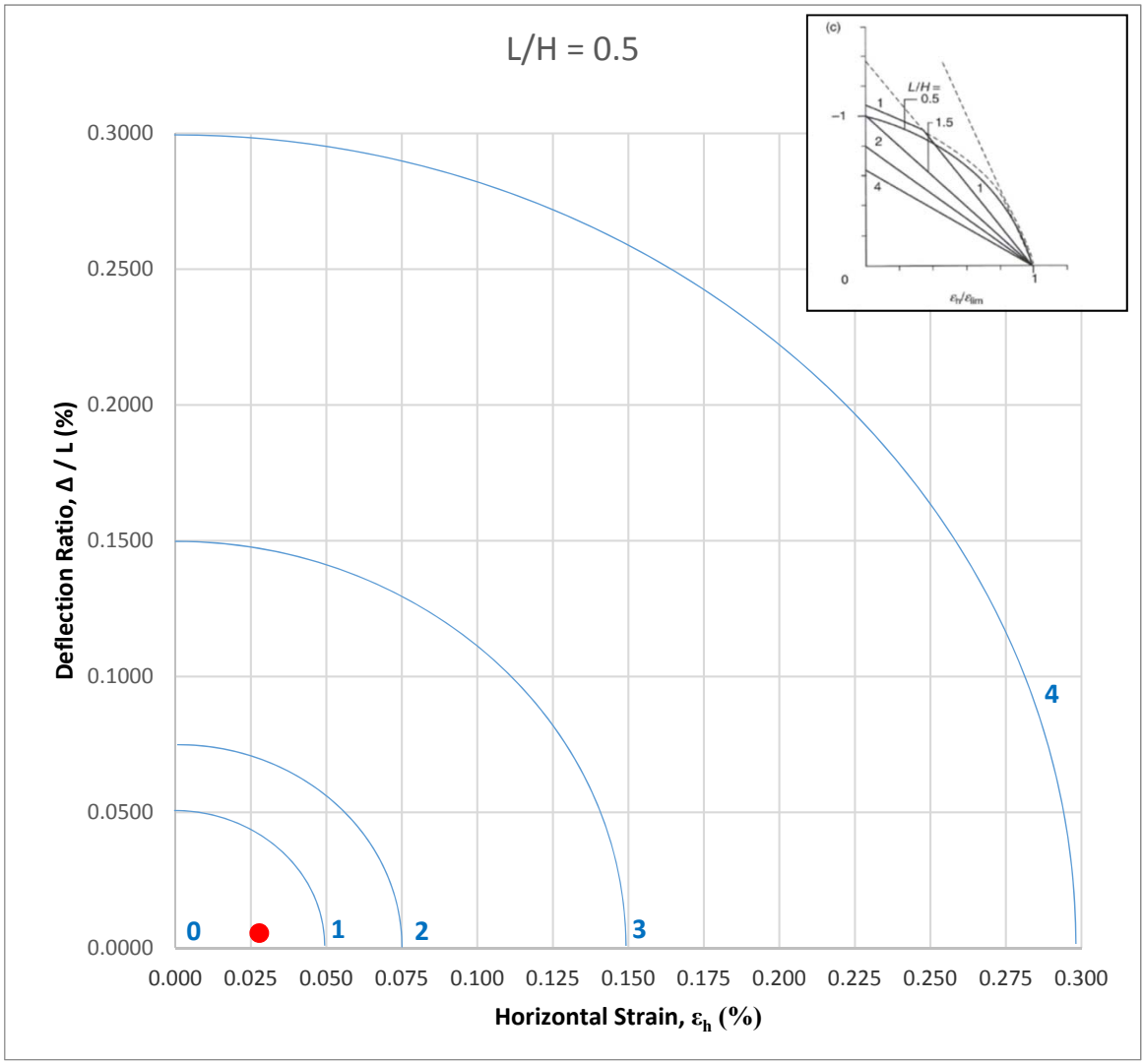
Change in horizontal movement, δ_h =	0.06	**mm**

Predicted from CIRIA C760 (Fig 6.15a) assuming excavation in front of a wall in stiff clay, based on 5 mm horizontal movement at wall with 4.0 m excavation

Building Damage Category = **CATEGORY 0 - NEGLIGIBLE**

Project Number	J17190
Revision	0.0
Wall Reference	Q

L / H = **0.31**



Wall Length, L =	1.8	m
Wall Height, H =	5.8	m
Change in horizontal movement, δ_h =	0.50	mm
Change in vertical movement, Δ =	0.10	mm

Horizontal Strain:

$$Horizontal\ Strain, \varepsilon_h = \frac{\delta_h \times 100}{L \times 1000}$$

ε_h = **0.0278**

Deflection Ratio:

$$Deflection\ Ratio = \frac{\Delta \times 100}{L \times 1000}$$

= **0.0056**

Ground Movement Assessment Summary

Project Number	J17190
Revision	0.0
Wall Reference	Q

Input parameters:

Sensitive Structure:	Wall Length, L =	1.80	m
	Wall Height, H (including foundation depth) =	5.80	m
	Foundation depth below ground level =	0.50	m
Basement Details:	Proposed basement depth =	4.00	
	L / H =	0.31	

Vertical Displacement Behind Wall Prediction:

Change in vertical movement, Δ =	0.10	mm

Predicted from P-Disp taking worst case of short term and total movement

Horizontal Displacement Behind Wall Prediction:

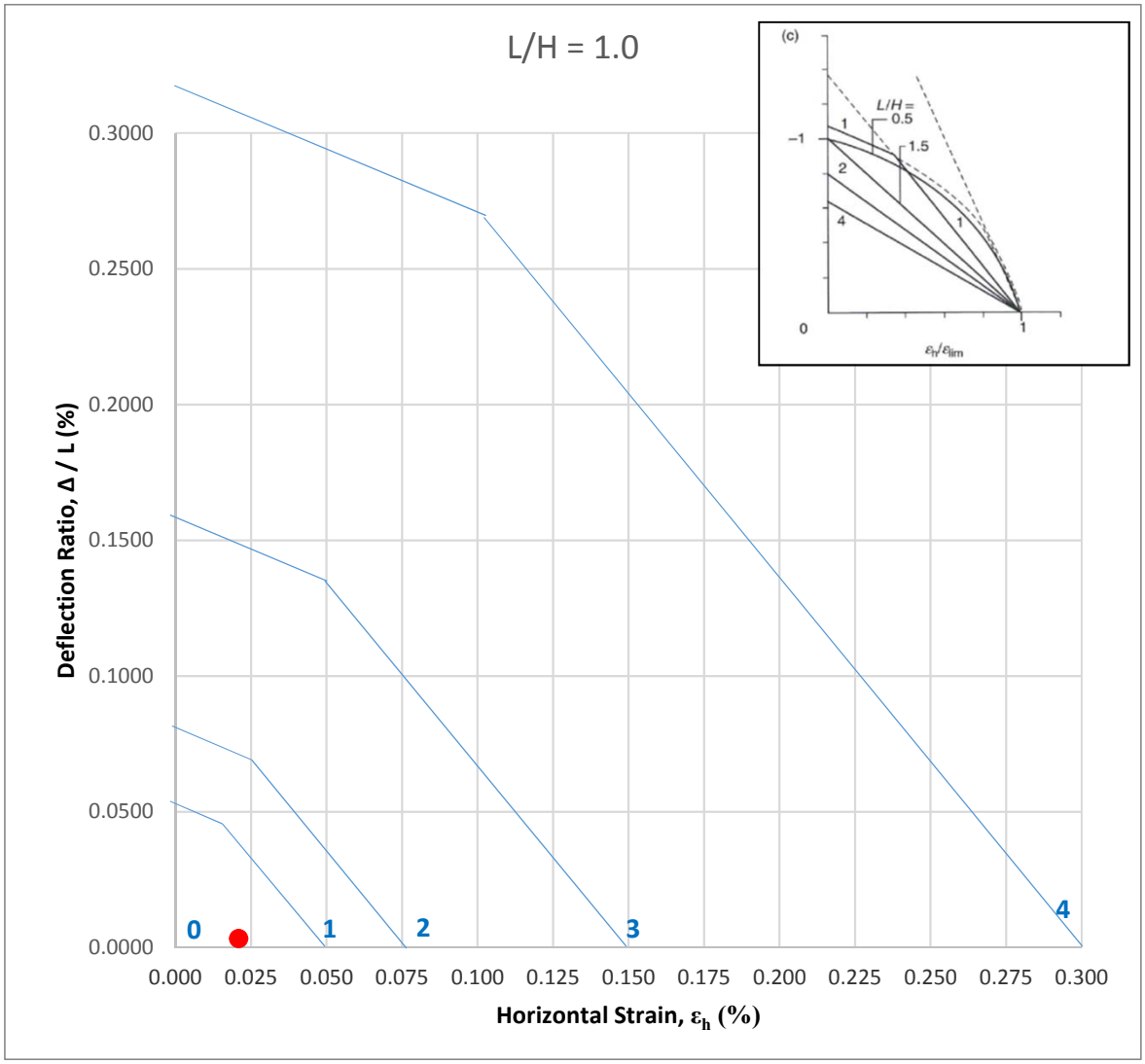
Change in horizontal movement, δ_h =	0.50	**mm**

Predicted from CIRIA C760 (Fig 6.15a) assuming excavation in front of a wall in stiff clay, based on 5 mm horizontal movement at wall with 4.0 m excavation

Building Damage Category = **CATEGORY 0 - NEGLIGIBLE**

Project Number	J17190
Revision	0.0
Wall Reference	R

L / H = **0.52**



Wall Length, L =	3.0	m
Wall Height, H =	5.8	m
Change in horizontal movement, δ_h =	0.63	mm
Change in vertical movement, Δ =	0.10	mm

Horizontal Strain:

$$Horizontal\ Strain, \varepsilon_h = \frac{\delta_{h\ \times 100}}{L\ \times 1000}$$

ε_h = **0.0210**

Deflection Ratio:

$$Deflection\ Ratio = \frac{\Delta \times 100}{L \times 1000}$$

= **0.0033**

Ground Movement Assessment Summary

Project Number	J17190
Revision	0.0
Wall Reference	R

Input parameters:

Sensitive Structure:	Wall Length, L =	3.00	m
	Wall Height, H (including foundation depth) =	5.80	m
	Foundation depth below ground level =	0.50	m
Basement Details:	Proposed basement depth =	4.00	
	L / H =	0.52	

Vertical Displacement Behind Wall Prediction:

Change in vertical movement, Δ = 0.10 mm

Predicted from P-Disp taking worst case of short term and total movement

Horizontal Displacement Behind Wall Prediction:

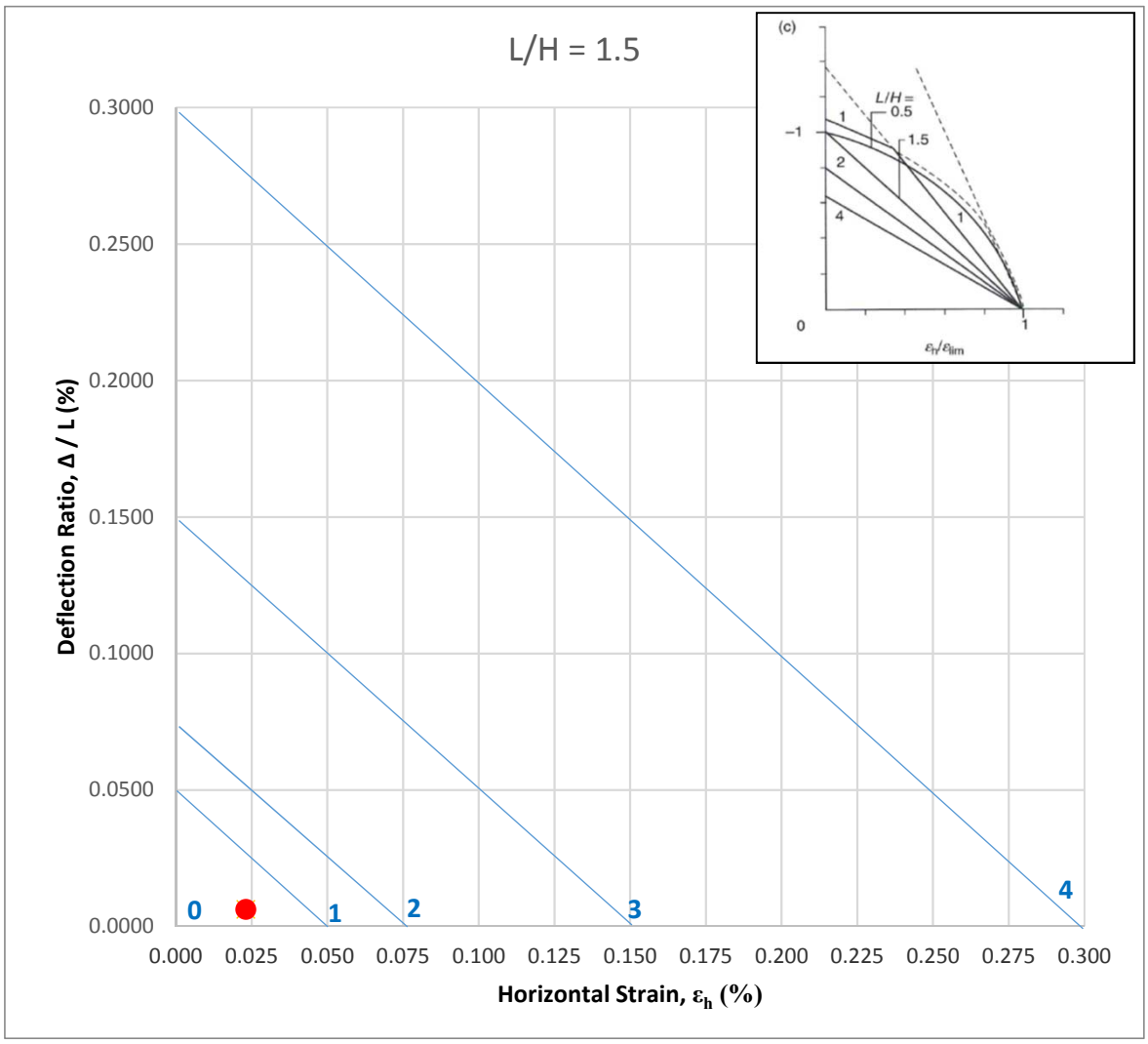
Change in horizontal movement, δ_h = 0.63 **mm**

Predicted from CIRIA C760 (Fig 6.15a) assuming excavation in front of a wall in stiff clay, based on 5 mm horizontal movement at wall with 4.0 m excavation

Building Damage Category = **CATEGORY 0 - NEGLIGIBLE**

Project Number	J17190
Revision	0.0
Wall Reference	S

L / H = **1.07**



Wall Length, L =	11.2	m
Wall Height, H =	10.5	m
Change in horizontal movement, δ_h =	2.60	mm
Change in vertical movement, Δ =	0.70	mm

Horizontal Strain:

$$Horizontal\ Strain, \varepsilon_h = \frac{\delta_h \times 100}{L \times 1000}$$

ε_h = **0.0232**

Deflection Ratio:

$$Deflection\ Ratio = \frac{\Delta \times 100}{L \times 1000}$$

= **0.0062**

Ground Movement Assessment Summary

Project Number	J17190
Revision	0.0
Wall Reference	S

Input parameters:

Sensitive Structure:	Wall Length, L =	11.22	m
	Wall Height, H (including foundation depth) =	10.50	m
	Foundation depth below ground level =	0.50	m
Basement Details:	Proposed basement depth =	4.00	
	L / H =	1.07	

Vertical Displacement Behind Wall Prediction:

Change in vertical movement, Δ = 0.70 mm

Predicted from P-Disp taking worst case of short term and total movement

Horizontal Displacement Behind Wall Prediction:

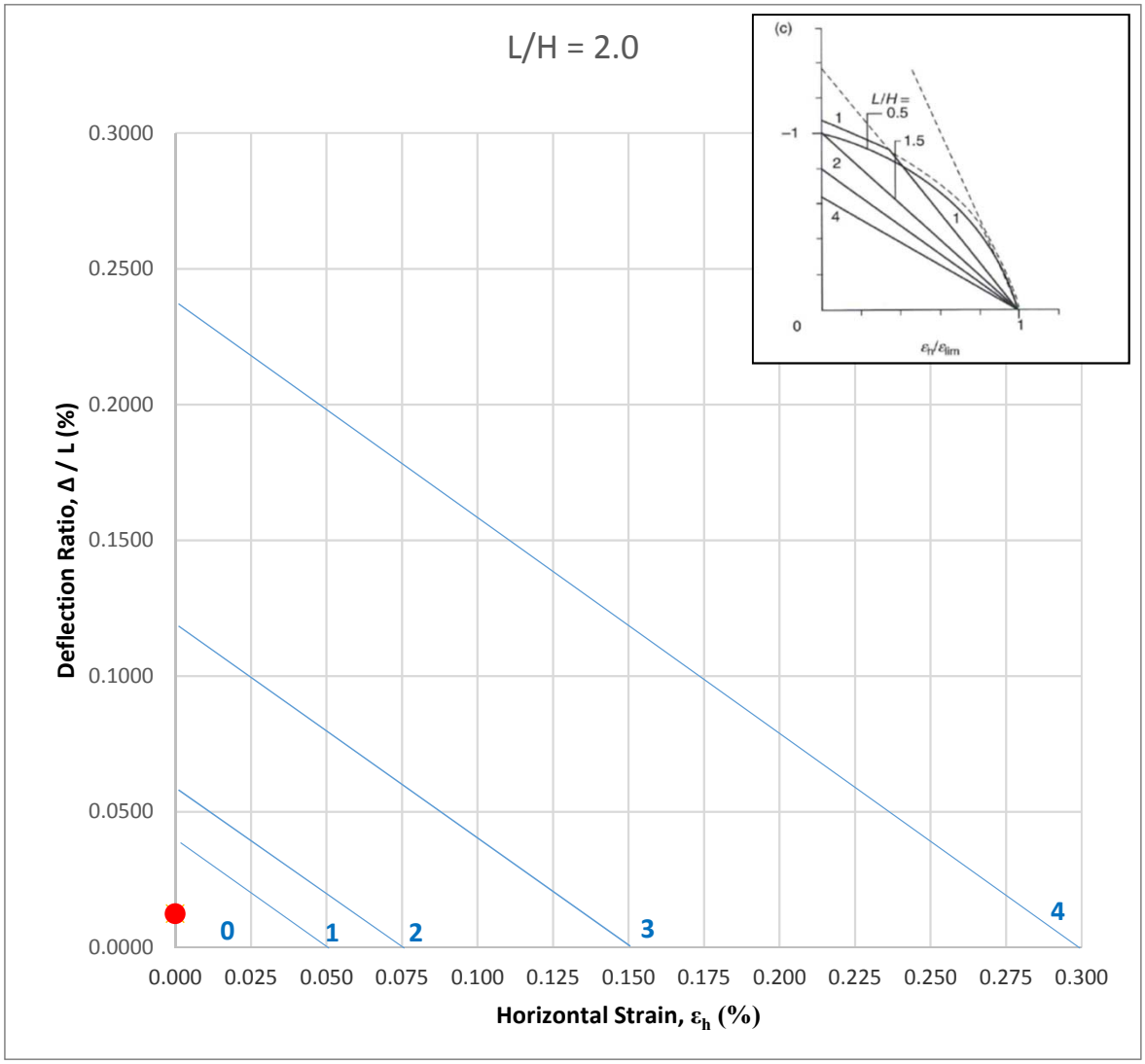
Change in horizontal movement, δ_h = 2.60 **mm**

Predicted from CIRIA C760 (Fig 6.15a) assuming excavation in front of a wall in stiff clay, based on 5 mm horizontal movement at wall with 4.0 m excavation

Building Damage Category = **CATEGORY 0 - NEGLIGIBLE**

Project Number	J17190
Revision	0.0
Wall Reference	T

L / H = **1.83**



Wall Length, L =	6.4	m
Wall Height, H =	3.5	m
Change in horizontal movement, δ_h =	0.00	mm
Change in vertical movement, Δ =	0.80	mm

Horizontal Strain:

$$Horizontal\ Strain, \varepsilon_h = \frac{\delta_{h\ \times 100}}{L\ \times 1000}$$

ε_h = **0.0000**

Deflection Ratio:

$$Deflection\ Ratio = \frac{\Delta \times 100}{L \times 1000}$$

= **0.0125**

Ground Movement Assessment Summary

Project Number	J17190
Revision	0.0
Wall Reference	T

Input parameters:

Sensitive Structure:	Wall Length, L =	6.41	m
	Wall Height, H (including foundation depth) =	3.50	m
	Foundation depth below ground level =	0.50	m
Basement Details:	Proposed basement depth =	4.00	
	L / H =	1.83	

Vertical Displacement Behind Wall Prediction:

Change in vertical movement, Δ =	0.80	mm

Predicted from P-Disp taking worst case of short term and total movement

Horizontal Displacement Behind Wall Prediction:

Change in horizontal movement, δ_h =	0.00	**mm**

Predicted from CIRIA C760 (Fig 6.15a) assuming excavation in front of a wall in stiff clay, based on 5 mm horizontal movement at wall with 4.0 m excavation

Building Damage Category = **CATEGORY 0 - NEGLIGIBLE**

Project Number	J17190
Revision	0.0
Wall Reference	U

L / H = **1.06**

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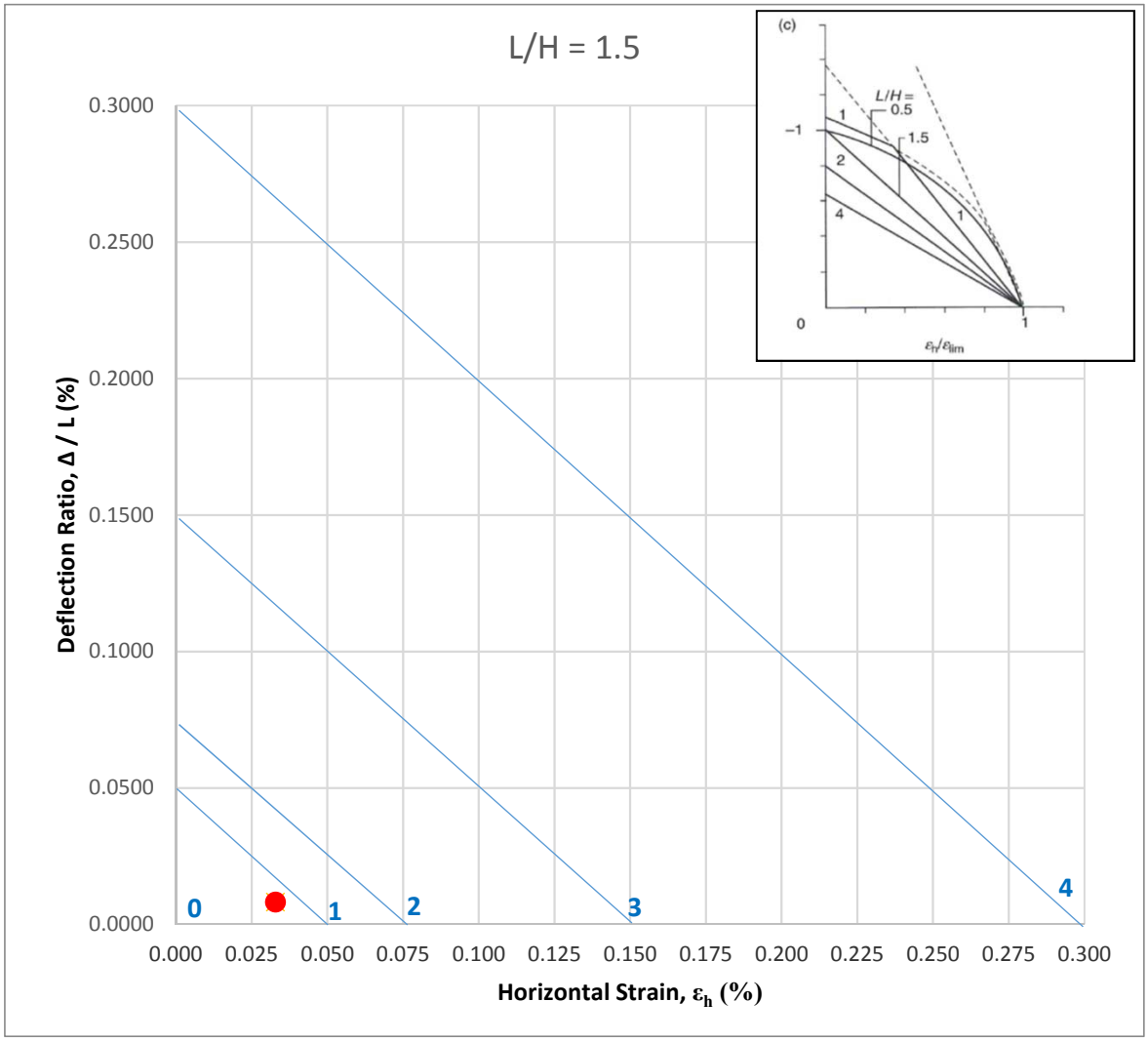


Wall Length, L =	3.7	m
Wall Height, H =	3.5	m
Change in horizontal movement, δ_h =	1.22	mm
Change in vertical movement, Δ =	0.30	mm

Horizontal Strain:

$$Horizontal\ Strain, \varepsilon_h = \frac{\delta_h \times 100}{L \times 1000}$$

ε_h = **0.0330**

Deflection Ratio:

$$Deflection\ Ratio = \frac{\Delta \times 100}{L \times 1000}$$

= **0.0081**

Ground Movement Assessment Summary

Project Number	J17190
Revision	0.0
Wall Reference	U

Input parameters:

Sensitive Structure:	Wall Length, L =	3.70	m
	Wall Height, H (including foundation depth) =	3.50	m
	Foundation depth below ground level =	0.50	m
Basement Details:	Proposed basement depth =	4.00	
	L / H =	1.06	

Vertical Displacement Behind Wall Prediction:

Change in vertical movement, Δ =	0.30	mm

Predicted from P-Disp taking worst case of short term and total movement

Horizontal Displacement Behind Wall Prediction:

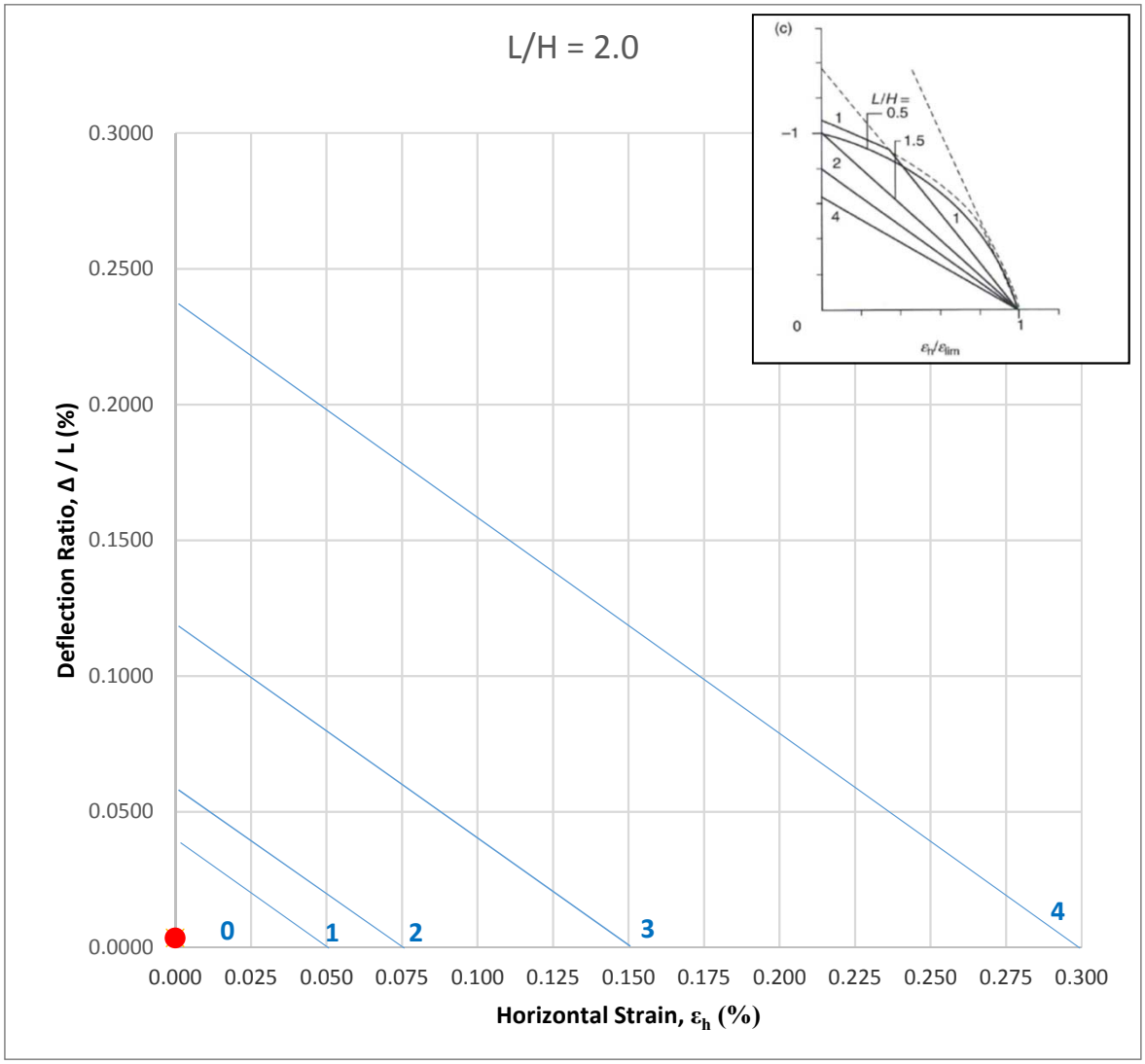
Change in horizontal movement, δ_h =	1.22	**mm**

Predicted from CIRIA C760 (Fig 6.15a) assuming excavation in front of a wall in stiff clay, based on 5 mm horizontal movement at wall with 4.0 m excavation

Building Damage Category = **CATEGORY 0 - NEGLIGIBLE**

Project Number	J17190
Revision	0.0
Wall Reference	V

L / H = **1.60**



Wall Length, L =	5.6	m
Wall Height, H =	3.5	m
Change in horizontal movement, δ_h =	0.00	mm
Change in vertical movement, Δ =	0.20	mm

Horizontal Strain:

$$Horizontal\ Strain, \varepsilon_h = \frac{\delta_{h\ \times 100}}{L\ \times 1000}$$

ε_h = **0.0000**

Deflection Ratio:

$$Deflection\ Ratio = \frac{\Delta \times 100}{L \times 1000}$$

= **0.0036**

Ground Movement Assessment Summary

Project Number	J17190
Revision	0.0
Wall Reference	V

Input parameters:

Sensitive Structure:	Wall Length, L =	5.60	m
	Wall Height, H (including foundation depth) =	3.50	m
	Foundation depth below ground level =	0.50	m
Basement Details:	Proposed basement depth =	4.00	
	L / H =	1.60	

Vertical Displacement Behind Wall Prediction:

Change in vertical movement, Δ = 0.20 mm

Predicted from P-Disp taking worst case of short term and total movement

Horizontal Displacement Behind Wall Prediction:

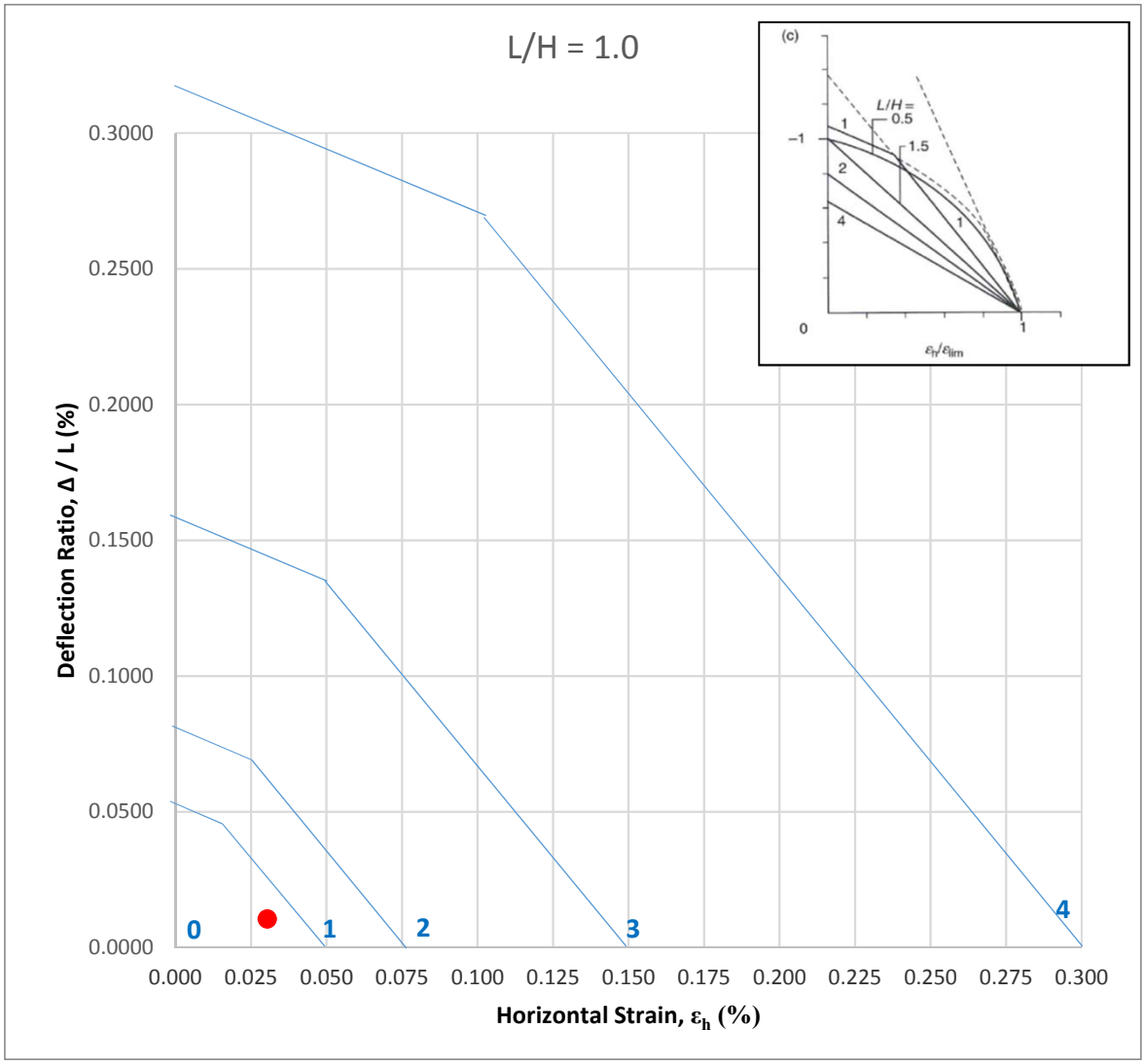
Change in horizontal movement, δ_h = 0.00 **mm**

Predicted from CIRIA C760 (Fig 6.15a) assuming excavation in front of a wall in stiff clay, based on 5 mm horizontal movement at wall with 4.0 m excavation

Building Damage Category = **CATEGORY 0 - NEGLIGIBLE**

Project Number	J17190
Revision	0.0
Wall Reference	W

L / H = **0.81**



Wall Length, L =	8.5	m
Wall Height, H =	10.5	m
Change in horizontal movement, δ_h =	2.60	mm
Change in vertical movement, Δ =	0.90	mm

Horizontal Strain:

$$Horizontal\ Strain, \varepsilon_h = \frac{\delta_h \times 100}{L \times 1000}$$

ε_h = **0.0305**

Deflection Ratio:

$$Deflection\ Ratio = \frac{\Delta \times 100}{L \times 1000}$$

= **0.0105**

Ground Movement Assessment Summary

Project Number	J17190
Revision	0.0
Wall Reference	W

Input parameters:

Sensitive Structure:	Wall Length, L =	8.53	m
	Wall Height, H (including foundation depth) =	10.50	m
	Foundation depth below ground level =	0.50	m
Basement Details:	Proposed basement depth =	4.00	
	L / H =	0.81	

Vertical Displacement Behind Wall Prediction:

Change in vertical movement, Δ =	0.90	mm

Predicted from P-Disp taking worst case of short term and total movement

Horizontal Displacement Behind Wall Prediction:

Change in horizontal movement, δ_h =	2.60	**mm**

Predicted from CIRIA C760 (Fig 6.15a) assuming excavation in front of a wall in stiff clay, based on 5 mm horizontal movement at wall with 4.0 m excavation

Building Damage Category = **CATEGORY 0 - NEGLIGIBLE**

Project Number	J17190
Revision	0.0
Wall Reference	X

L / H = **1.03**

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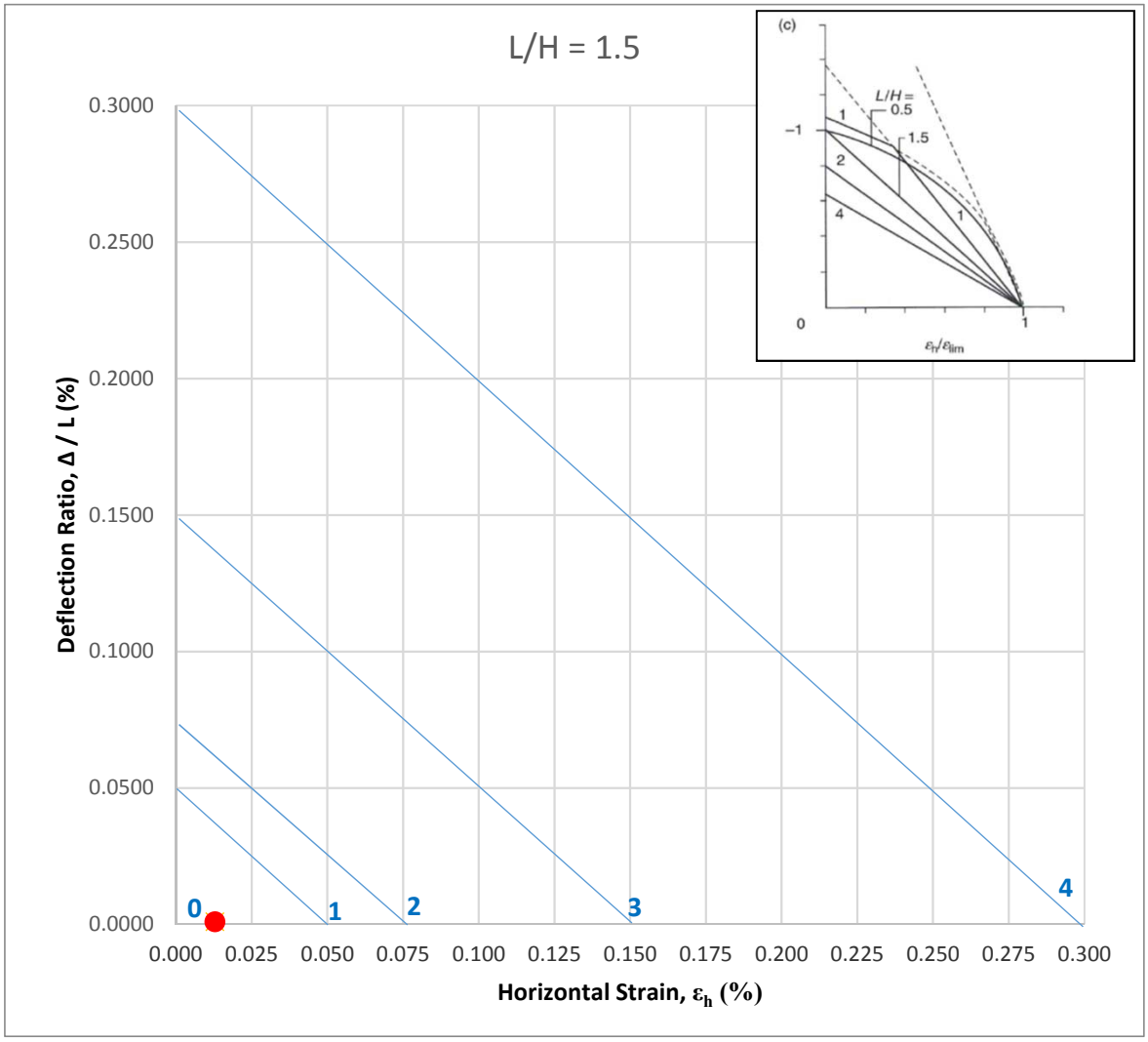


Wall Length, L =	10.9	m
Wall Height, H =	10.5	m
Change in horizontal movement, δ_h =	1.41	mm
Change in vertical movement, Δ =	0.10	mm

Horizontal Strain:

$$Horizontal\ Strain, \varepsilon_h = \frac{\delta_h \times 100}{L \times 1000}$$

ε_h = **0.0130**

Deflection Ratio:

$$Deflection\ Ratio = \frac{\Delta \times 100}{L \times 1000}$$

= **0.0009**

Ground Movement Assessment Summary

Project Number	J17190
Revision	0.0
Wall Reference	X

Input parameters:

Sensitive Structure:	Wall Length, L =	10.87	m
	Wall Height, H (including foundation depth) =	10.50	m
	Foundation depth below ground level =	0.50	m
Basement Details:	Proposed basement depth =	4.00	
	L / H =	1.03	

Vertical Displacement Behind Wall Prediction:

Change in vertical movement, Δ =	0.10	mm

Predicted from P-Disp taking worst case of short term and total movement

Horizontal Displacement Behind Wall Prediction:

Change in horizontal movement, δ_h =	1.41	**mm**

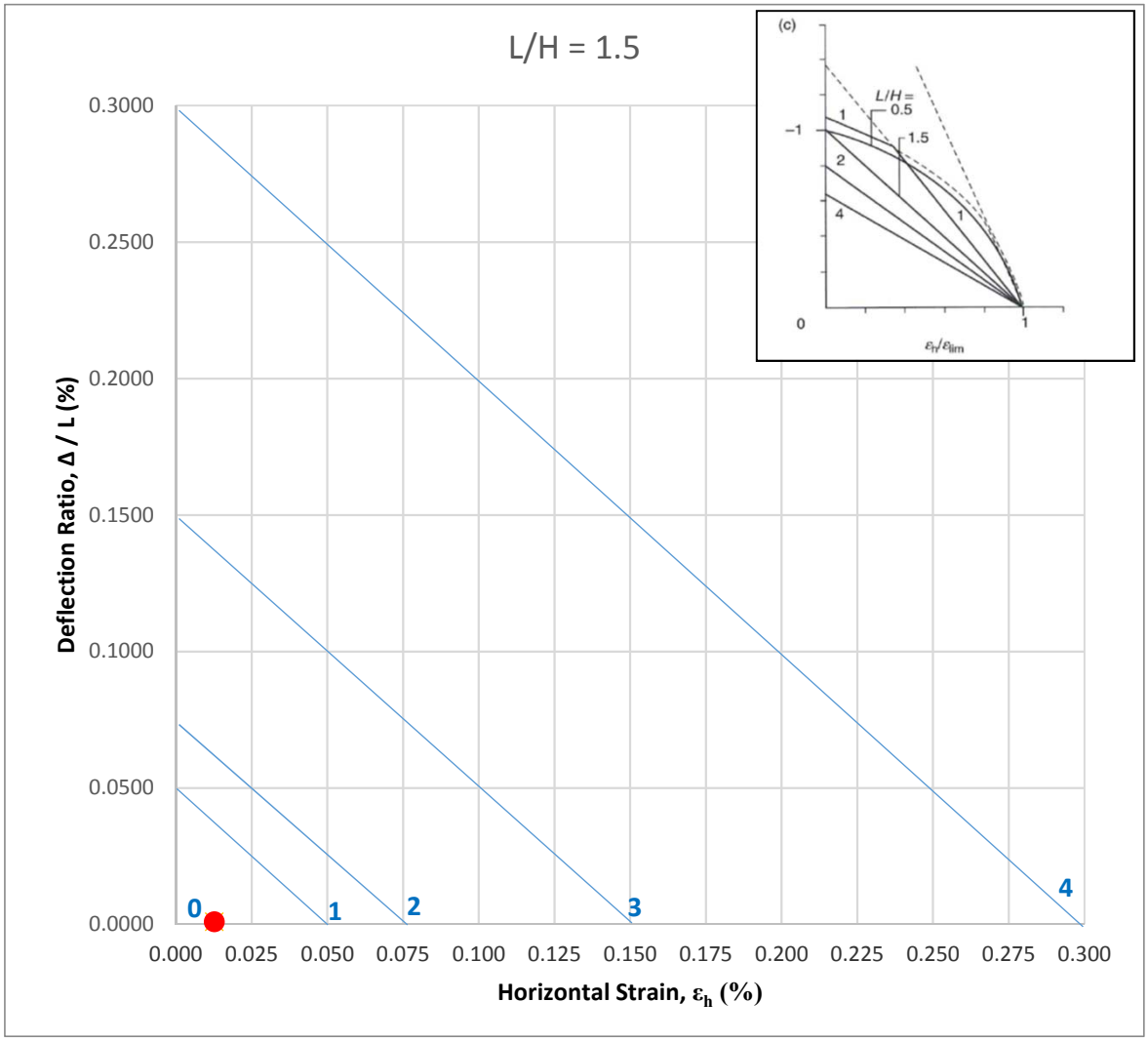
Predicted from CIRIA C760 (Fig 6.15a) assuming excavation in front of a wall in stiff clay, based on 5 mm horizontal movement at wall with 4.0 m excavation

Building Damage Category = **CATEGORY 0 - NEGLIGIBLE**

Project Number	J17190
Revision	0.0
Wall Reference	Y

L / H = **1.30**

Geotechnical & Environmental Associates



Wall Length, L =	11.1	m
Wall Height, H =	8.5	m
Change in horizontal movement, δ_h =	1.41	mm
Change in vertical movement, Δ =	0.10	mm

Horizontal Strain:

$$Horizontal\ Strain, \varepsilon_h = \frac{\delta_h \times 100}{L \times 1000}$$

ε_h = **0.0127**

Deflection Ratio:

$$Deflection\ Ratio = \frac{\Delta \times 100}{L \times 1000}$$

= **0.0009**

Ground Movement Assessment Summary

Project Number	J17190
Revision	0.0
Wall Reference	Y

Input parameters:

Sensitive Structure:	Wall Length, L =	11.08	m
	Wall Height, H (including foundation depth) =	8.50	m
	Foundation depth below ground level =	0.50	m
Basement Details:	Proposed basement depth =	4.00	
	L / H =	1.30	

Vertical Displacement Behind Wall Prediction:

Change in vertical movement, Δ =	0.10	mm

Predicted from P-Disp taking worst case of short term and total movement

Horizontal Displacement Behind Wall Prediction:

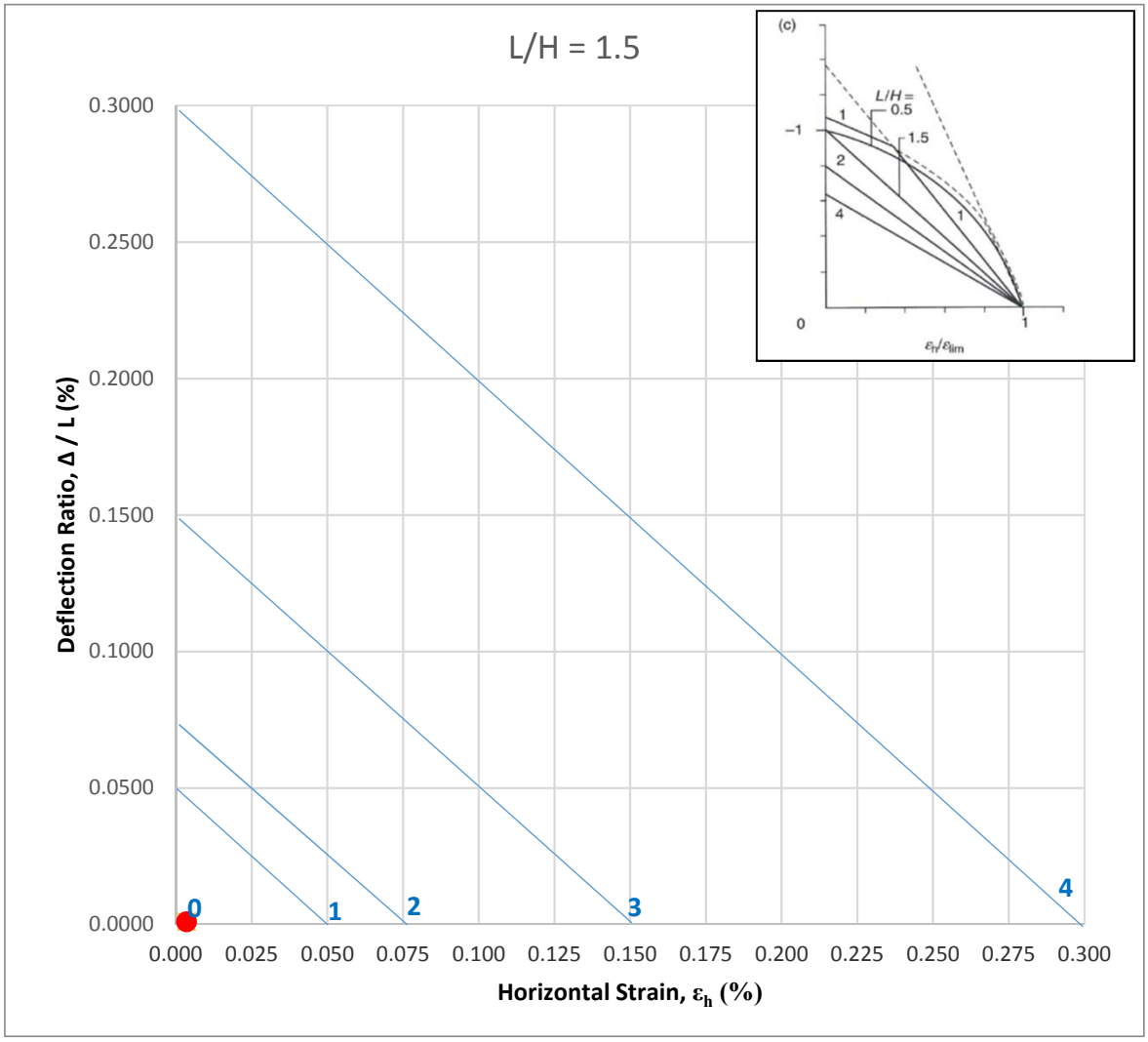
Change in horizontal movement, δ_h =	1.41	**mm**

Predicted from CIRIA C760 (Fig 6.15a) assuming excavation in front of a wall in stiff clay, based on 5 mm horizontal movement at wall with 4.0 m excavation

Building Damage Category = **CATEGORY 0 - NEGLIGIBLE**

Project Number	J17190
Revision	0.0
Wall Reference	Z

L / H = **1.22**



Wall Length, L =	10.4	m
Wall Height, H =	8.5	m
Change in horizontal movement, δ_h =	0.37	mm
Change in vertical movement, Δ =	0.10	mm

Horizontal Strain:

$$Horizontal\ Strain, \varepsilon_h = \frac{\delta_{h\ \times 100}}{L\ \times 1000}$$

ε_h = **0.0036**

Deflection Ratio:

$$Deflection\ Ratio = \frac{\Delta \times 100}{L \times 1000}$$

= **0.0010**

Ground Movement Assessment Summary

Project Number	J17190
Revision	0.0
Wall Reference	Z

Input parameters:

Sensitive Structure:	Wall Length, L =	10.38	m
	Wall Height, H (including foundation depth) =	8.50	m
	Foundation depth below ground level =	0.50	m
Basement Details:	Proposed basement depth =	4.00	
	L / H =	1.22	

Vertical Displacement Behind Wall Prediction:

Change in vertical movement, Δ =	0.10	mm

Predicted from P-Disp taking worst case of short term and total movement

Horizontal Displacement Behind Wall Prediction:

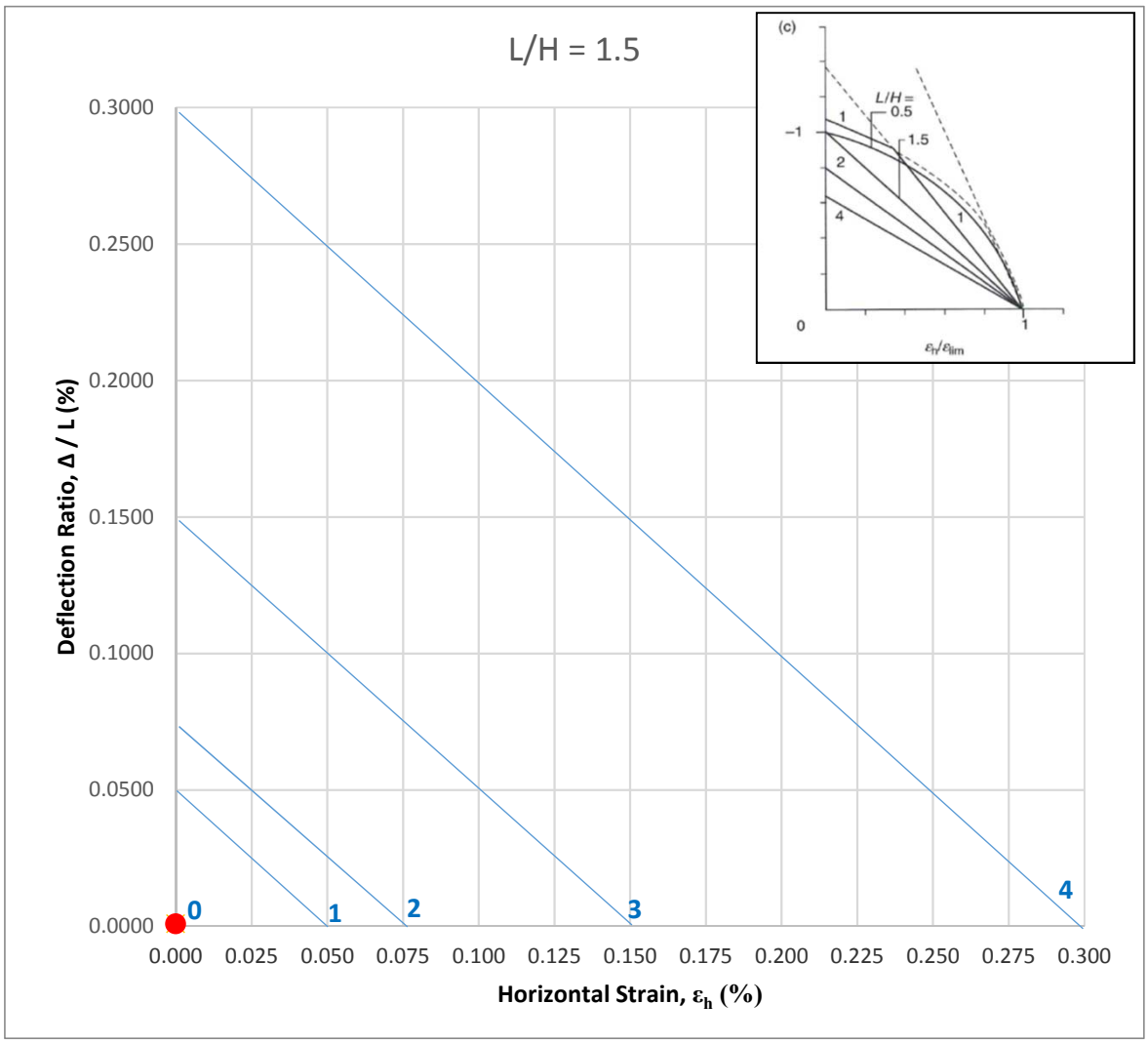
Change in horizontal movement, δ_h =	0.37	**mm**

Predicted from CIRIA C760 (Fig 6.15a) assuming excavation in front of a wall in stiff clay, based on 5 mm horizontal movement at wall with 4.0 m excavation

Building Damage Category = **CATEGORY 0 - NEGLIGIBLE**

Project Number	J17190
Revision	0.0
Wall Reference	AA

L / H = **1.05**



Wall Length, L =	11.0	m
Wall Height, H =	10.5	m
Change in horizontal movement, δ_h =	0.00	mm
Change in vertical movement, Δ =	0.10	mm

Horizontal Strain:

$$Horizontal\ Strain, \varepsilon_h = \frac{\delta_h \times 100}{L \times 1000}$$

ε_h = **0.0000**

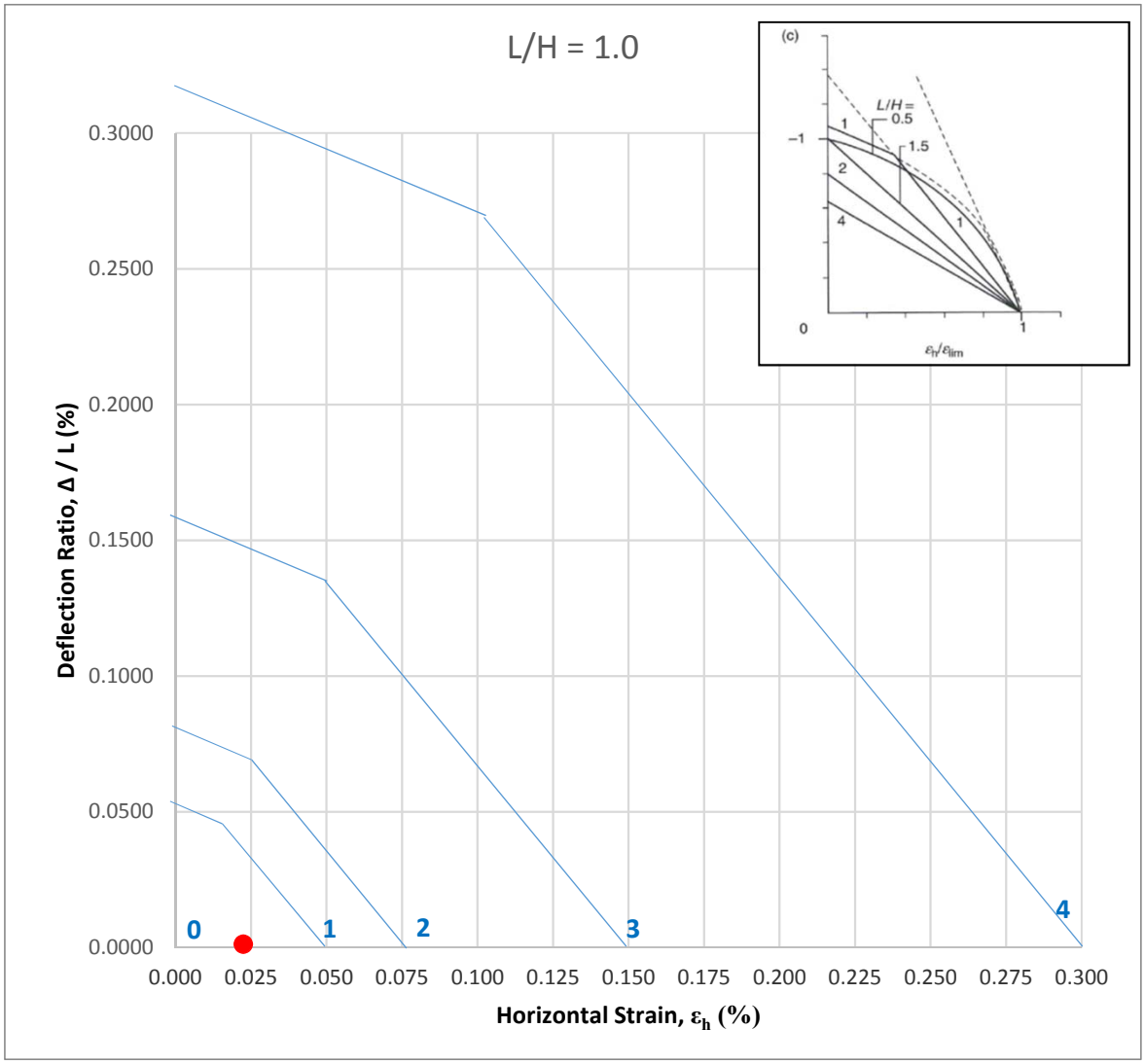
Deflection Ratio:

$$Deflection\ Ratio = \frac{\Delta \times 100}{L \times 1000}$$

= **0.0009**

Project Number	J17190
Revision	0.0
Wall Reference	AB

L / H = **0.75**



Wall Length, L =	7.9	m
Wall Height, H =	10.5	m
Change in horizontal movement, δ_h =	1.78	mm
Change in vertical movement, Δ =	0.10	mm

Horizontal Strain:

$$Horizontal\ Strain, \varepsilon_h = \frac{\delta_{h\ \times 100}}{L\ \times 1000}$$

ε_h = **0.0225**

Deflection Ratio:

$$Deflection\ Ratio = \frac{\Delta \times 100}{L \times 1000}$$

= **0.0013**

Project Number	J17190
Revision	0.0
Wall Reference	AC

L / H = **0.49**

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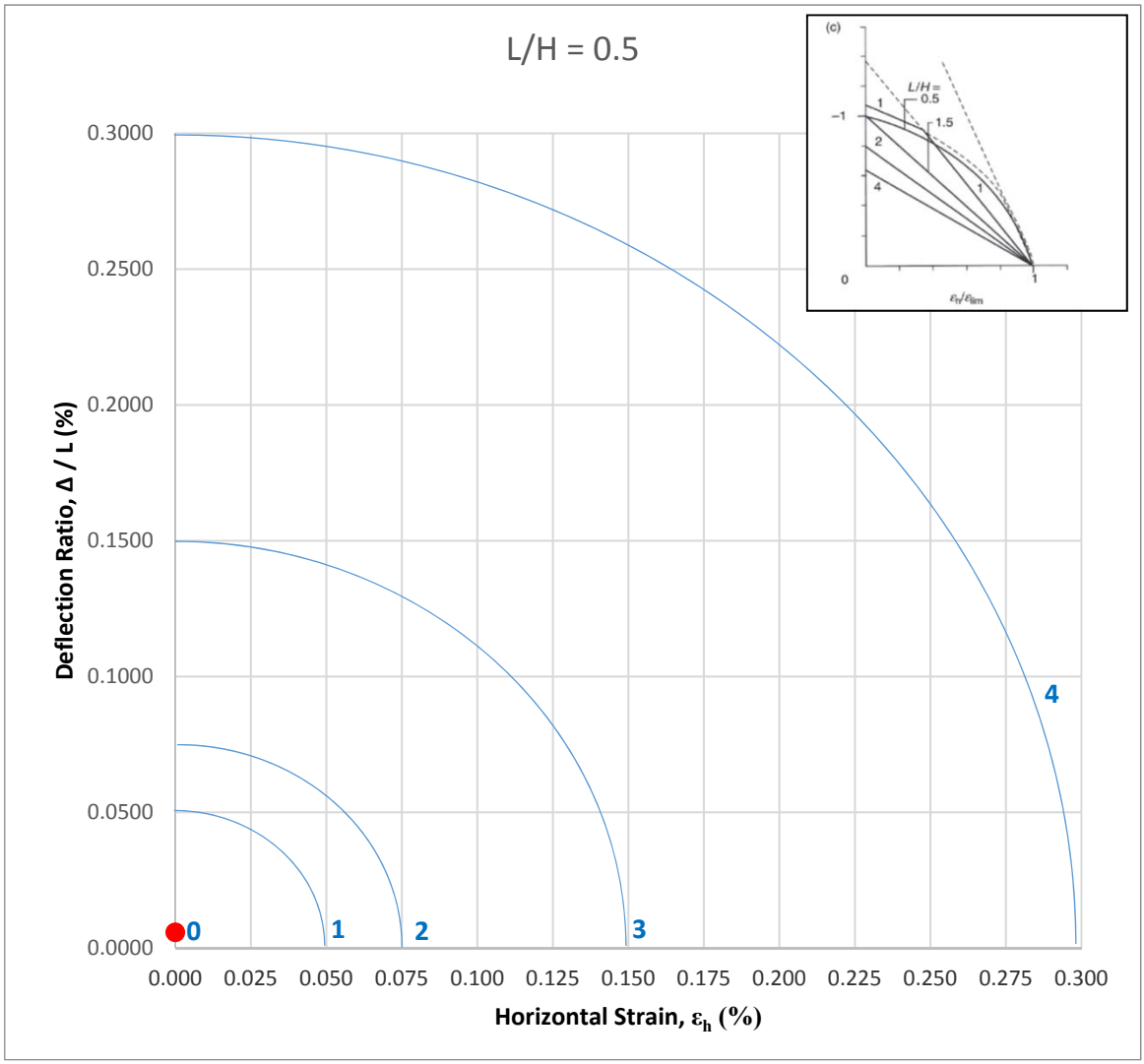

Wall Length, L =	1.7	m
Wall Height, H =	3.5	m
Change in horizontal movement, δ_h =	0.00	mm
Change in vertical movement, Δ =	0.10	mm

Horizontal Strain:

$$Horizontal\ Strain, \varepsilon_h = \frac{\delta_h \times 100}{L \times 1000}$$

ε_h = **0.0000**

Deflection Ratio:

$$Deflection\ Ratio = \frac{\Delta \times 100}{L \times 1000}$$

= **0.0059**

Project Number	J17190
Revision	0.0
Wall Reference	AD

L / H = **1.07**

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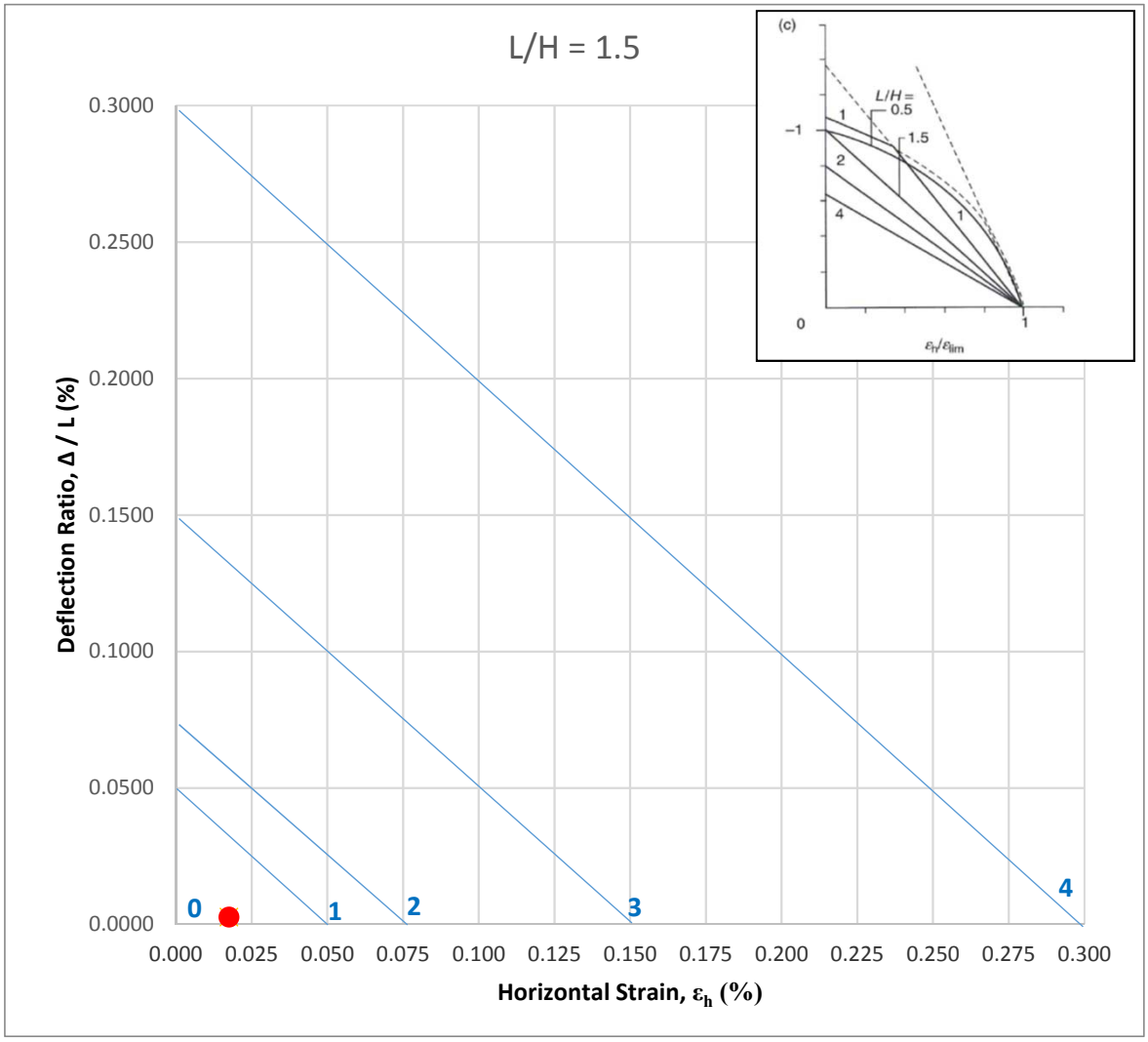


Wall Length, L =	3.7	m
Wall Height, H =	3.5	m
Change in horizontal movement, δ_h =	0.66	mm
Change in vertical movement, Δ =	0.10	mm

Horizontal Strain:

$$Horizontal\ Strain, \varepsilon_h = \frac{\delta_h \times 100}{L \times 1000}$$

ε_h = **0.0176**

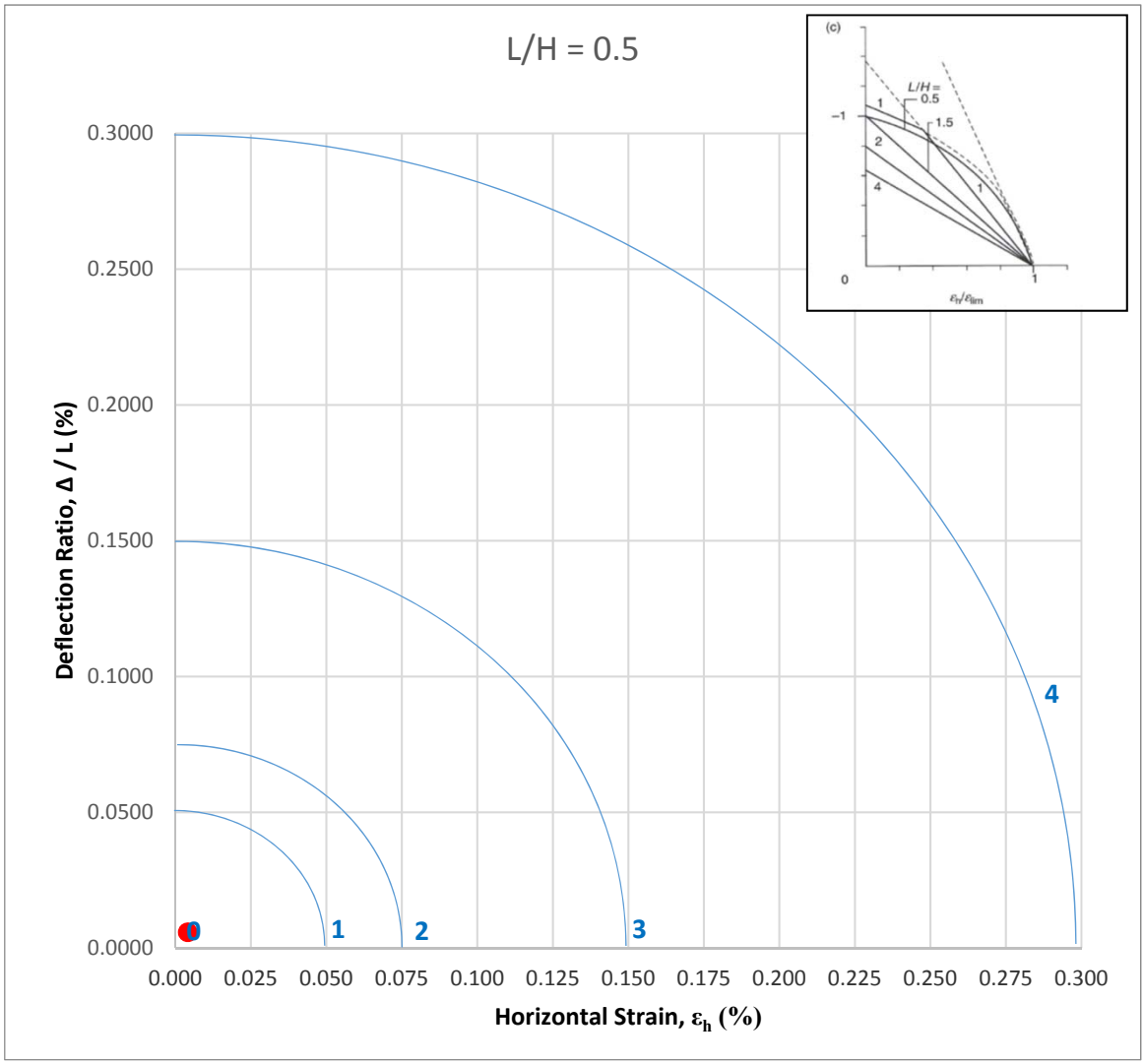
Deflection Ratio:

$$Deflection\ Ratio = \frac{\Delta \times 100}{L \times 1000}$$

= **0.0027**

Project Number	J17190
Revision	0.0
Wall Reference	AE

L / H = **0.49**



Wall Length, L =	1.7	m
Wall Height, H =	3.5	m
Change in horizontal movement, δ_h =	0.07	mm
Change in vertical movement, Δ =	0.10	mm

Horizontal Strain:

$$Horizontal\ Strain, \varepsilon_h = \frac{\delta_h \times 100}{L \times 1000}$$

ε_h = **0.0041**

Deflection Ratio:

$$Deflection\ Ratio = \frac{\Delta \times 100}{L \times 1000}$$

= **0.0058**

Asset location search

Property Searches

Geotechnical & Environmental Associates
Widbury Hill
WARE
SG12 7QE

Search address supplied

10
Downside Crescent
London
NW3 2AP

Your reference J17190

Our reference ALS/ALS Standard/2017_3617210

Search date 24 July 2017

Keeping you up-to-date

Knowledge of features below the surface is essential in every development. The benefits of this not only include ensuring due diligence and avoiding risk, but also being able to ascertain the feasibility for any commercial or residential project.

An asset location search provides information on the location of known Thames Water clean and/or wastewater assets, including details of pipe sizes, direction of flow and depth. Please note that information on cover and invert levels will only be provided where the data is available.

Thames Water Utilities Ltd
Property Searches, PO Box 3189, Slough SL1 4WW
DX 151280 Slough 13

searches@thameswater.co.uk
www.thameswater-propertysearches.co.uk

0845 070 9148

searchcode

Asset location search

Search address supplied: 10, Downside Crescent, London, NW3 2AP

Dear Sir / Madam

An Asset Location Search is recommended when undertaking a site development. It is essential to obtain information on the size and location of clean water and sewerage assets to safeguard against expensive damage and allow cost-effective service design.

The following records were searched in compiling this report: - the map of public sewers & the map of waterworks. Thames Water Utilities Ltd (TWUL) holds all of these.

This searchprovides maps showing the position, size of Thames Water assets close to the proposed development and also manhole cover and invert levels, where available.

Please note that none of the charges made for this report relate to the provision of Ordnance Survey mapping information. The replies contained in this letter are given following inspection of the public service records available to this company. No responsibility can be accepted for any error or omission in the replies.

You should be aware that the information contained on these plans is current only on the day that the plans are issued. The plans should only be used for the duration of the work that is being carried out at the present time. Under no circumstances should this data be copied or transmitted to parties other than those for whom the current work is being carried out.

Thames Water do update these service plans on a regular basis and failure to observe the above conditions could lead to damage arising to new or diverted services at a later date.

Contact Us

If you have any further queries regarding this enquiry please feel free to contact a member of the team on 0845 070 9148, or use the address below:

Thames Water Utilities Ltd
Property Searches
PO Box 3189
Slough
SL1 4WW

Email: searches@thameswater.co.uk
Web: www.thameswater-propertysearches.co.uk

Waste Water Services

Asset location search

Thames Water Property Searches

Please provide a copy extract from the public sewer map.

Enclosed is a map showing the approximate lines of our sewers. Our plans do not show sewer connections from individual properties or any sewers not owned by Thames Water unless specifically annotated otherwise. Records such as "private" pipework are in some cases available from the Building Control Department of the relevant Local Authority.

Where the Local Authority does not hold such plans it might be advisable to consult the property deeds for the site or contact neighbouring landowners.

This report relates only to sewerage apparatus of Thames Water Utilities Ltd, it does not disclose details of cables and or communications equipment that may be running through or around such apparatus.

The sewer level information contained in this response represents all of the level data available in our existing records. Should you require any further Information, please refer to the relevant section within the 'Further Contacts' page found later in this document.

For your guidance:

- The Company is not generally responsible for rivers, watercourses, ponds, culverts or highway drains. If any of these are shown on the copy extract they are shown for information only.
- Any private sewers or lateral drains which are indicated on the extract of the public sewer map as being subject to an agreement under Section 104 of the Water Industry Act 1991 are not an ‘as constructed’ record. It is recommended these details be checked with the developer.

Clean Water Services

Please provide a copy extract from the public water main map.

Enclosed is a map showing the approximate positions of our water mains and associated apparatus. Please note that records are not kept of the positions of individual domestic supplies.

For your information, there will be a pressure of at least 10m head at the outside stop valve. If you would like to know the static pressure, please contact our Customer Centre on 0800 316 9800. The Customer Centre can also arrange for a full flow and pressure test to be carried out for a fee.

Asset location search

Property Searches

For your guidance:

- Assets other than vested water mains may be shown on the plan, for information only.
- If an extract of the public water main record is enclosed, this will show known public water mains in the vicinity of the property. It should be possible to estimate the likely length and route of any private water supply pipe connecting the property to the public water network.

Payment for this Search

A charge will be added to your suppliers account.

Asset location search

Property Searches

Further contacts:

Waste Water queries

Should you require verification of the invert levels of public sewers, by site measurement, you will need to approach the relevant Thames Water Area Network Office for permission to lift the appropriate covers. This permission will usually involve you completing a TWOSA form. For further information please contact our Customer Centre on Tel: 0845 920 0800. Alternatively, a survey can be arranged, for a fee, through our Customer Centre on the above number.

If you have any questions regarding sewer connections, budget estimates, diversions, building over issues or any other questions regarding operational issues please direct them to our service desk. Which can be contacted by writing to:

Developer Services (Waste Water)
Thames Water
Clearwater Court
Vastern Road
Reading
RG1 8DB

Tel: 0845 850 2777
Email: developer.services@thameswater.co.uk

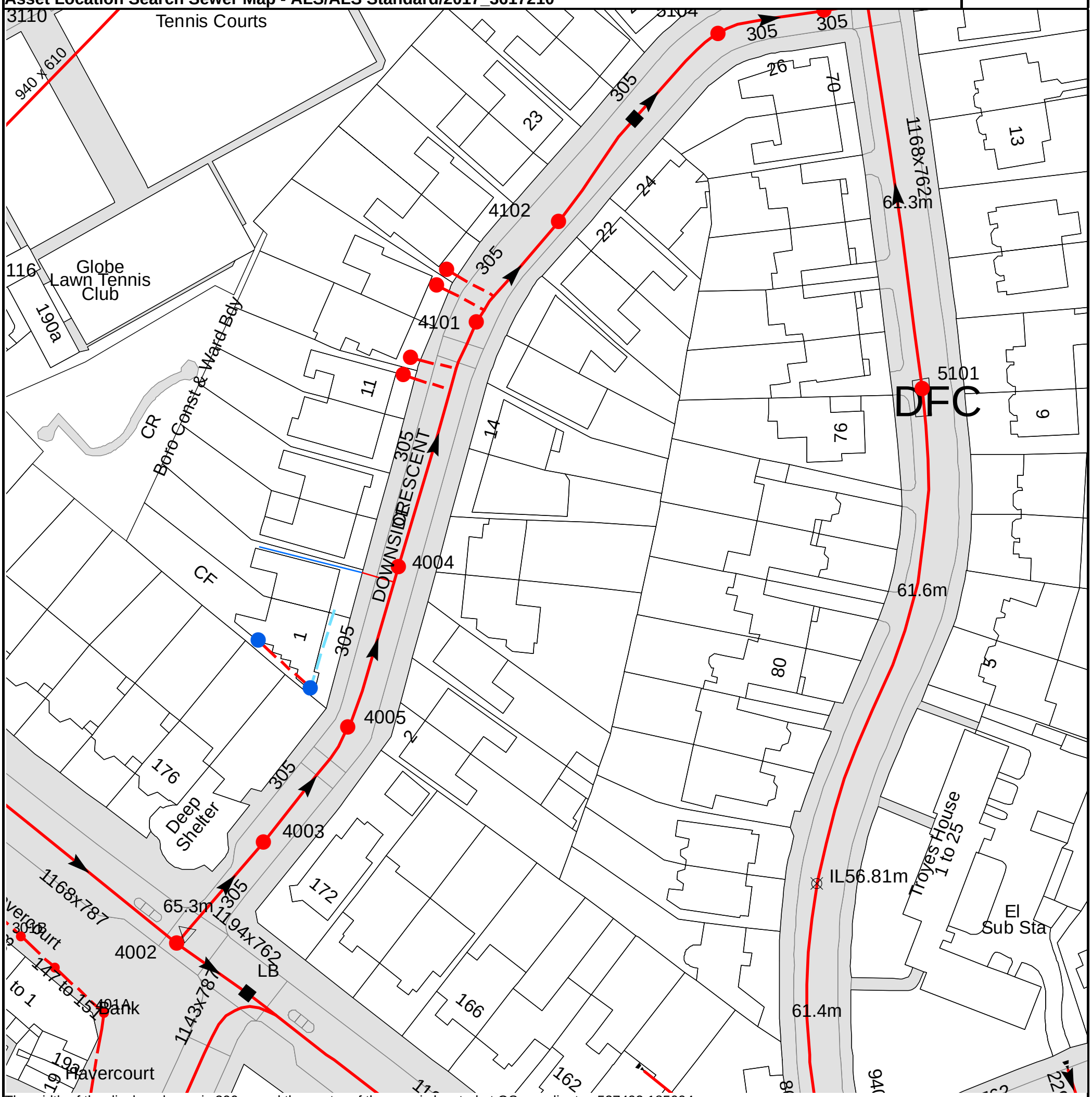
Clean Water queries

Should you require any advice concerning clean water operational issues or clean water connections, please contact:

Developer Services (Clean Water)
Thames Water
Clearwater Court
Vastern Road
Reading
RG1 8DB

Tel: 0845 850 2777
Email: developer.services@thameswater.co.uk

Asset Location Search Sewer Map - ALS/ALS Standard/2017_3617210



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 527492,185094

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

Manhole Reference	Manhole Cover Level	Manhole Invert Level
5101	61.5	57.66
5105	n/a	55.97
401A	n/a	n/a
401B	n/a	n/a
4002	64.6	59.54
301B	n/a	n/a
4003	64.6	59.28
4005	n/a	n/a
40BB	n/a	n/a
40BA	n/a	n/a
4004	64.53	58.25
4106	n/a	n/a
4105	n/a	n/a
4101	64.04	57.4
4104	n/a	n/a
4103	n/a	n/a
4102	n/a	n/a
5104	n/a	n/a

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

ALS Sewer Map Key

Public Sewer Types (Operated & Maintained by Thames Water)

Foul: A sewer designed to convey waste water from domestic and industrial sources to a treatment works.

Surface Water: A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.

Combined: A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.

Trunk Surface Water

Trunk Foul

Storm Relief

Trunk Combined

Vent Pipe

Bio-solids (Sludge)

Proposed Thames Surface Water Sewer

Proposed Thames Water Foul Sewer

Gallery

Foul Rising Main

Surface Water Rising Main

Combined Rising Main

Sludge Rising Main

Proposed Thames Water Rising Main

Vacuum

Sewer Fittings

A feature in a sewer that does not affect the flow in the pipe. Example: a vent is a fitting as the function of a vent is to release excess gas.

Air Valve

Dam Chase

Fitting

Meter

Vent Column

Operational Controls

A feature in a sewer that changes or diverts the flow in the sewer. Example: A hydrobrake limits the flow passing downstream.

Control Valve

Drop Pipe

Ancillary

Weir

End Items

End symbols appear at the start or end of a sewer pipe. Examples: an Undefined End at the start of a sewer indicates that Thames Water has no knowledge of the position of the sewer upstream of that symbol, Outfall on a surface water sewer indicates that the pipe discharges into a stream or river.

Outfall

Undefined End

Inlet

Other Symbols

Symbols used on maps which do not fall under other general categories

Public/Private Pumping Station

Change of characteristic indicator (C.O.C.I.)

Invert Level

Summit

Areas

Lines denoting areas of underground surveys, etc.

Agreement

Operational Site

Chamber

Tunnel

Conduit Bridge

Other Sewer Types (Not Operated or Maintained by Thames Water)

Foul Sewer

Surface Water Sewer

Combined Sewer

Gulley

Culverted Watercourse

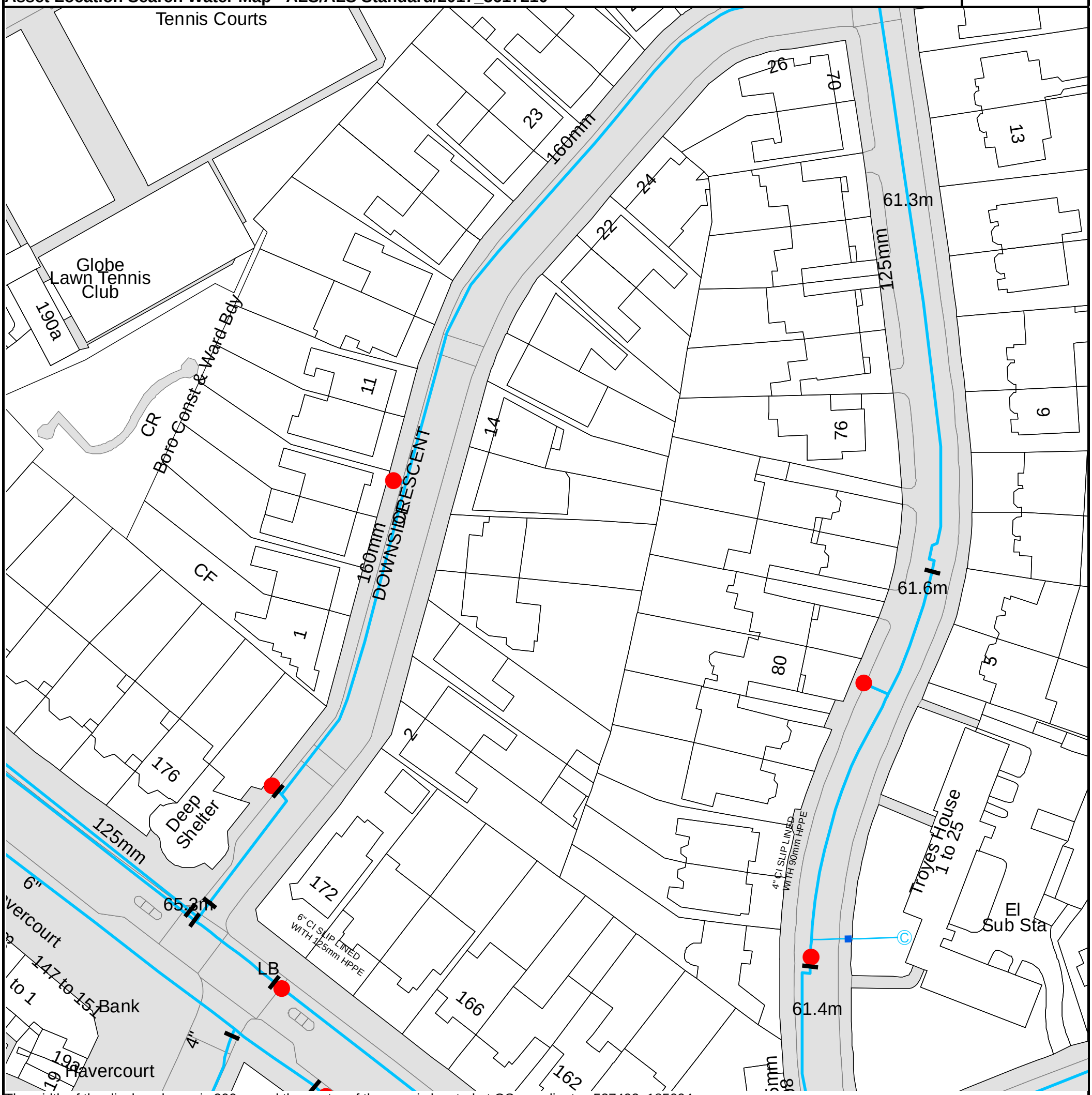
Proposed

Abandoned Sewer

Notes:

1) All levels associated with the plans are to Ordnance Datum Newlyn.
2) All measurements on the plans are metric.
3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate direction of flow.
4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.
5) 'na' or '0' on a manhole level indicates that data is unavailable.
6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in milimetres. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology present on the plan, please contact a member of Property Insight on 0845 070 9148.

Asset Location Search Water Map - ALS/ALS Standard/2017_3617210



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 527492, 185094.

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

ALS Water Map Key

Water Pipes (Operated & Maintained by Thames Water)

4"

Distribution Main: The most common pipe shown on water maps. With few exceptions, domestic connections are only made to distribution mains.

16"

Trunk Main: A main carrying water from a source of supply to a treatment plant or reservoir, or from one treatment plant or reservoir to another. Also a main transferring water in bulk to smaller water mains used for supplying individual customers.

3" SUPPLY

Supply Main: A supply main indicates that the water main is used as a supply for a single property or group of properties.

3" FIRE

Fire Main: Where a pipe is used as a fire supply, the word FIRE will be displayed along the pipe.

3" METERED

Metered Pipe: A metered main indicates that the pipe in question supplies water for a single property or group of properties and that quantity of water passing through the pipe is metered even though there may be no meter symbol shown.

Transmission Tunnel: A very large diameter water pipe. Most tunnels are buried very deep underground. These pipes are not expected to affect the structural integrity of buildings shown on the map provided.

Proposed Main: A main that is still in the planning stages or in the process of being laid. More details of the proposed main and its reference number are generally included near the main.

Valves

- General Purpose Valve
- Air Valve
- Pressure Control Valve
- Customer Valve

Hydrants

- Single Hydrant

Meters

- Meter

End Items

Symbol indicating what happens at the end of a water main.

- Blank Flange
- Capped End
- Emptying Pit
- Undefined End
- Manifold
- Customer Supply
- Fire Supply

Operational Sites

- Booster Station
- Other
- Other (Proposed)
- Pumping Station
- Service Reservoir
- Shaft Inspection
- Treatment Works
- Unknown
- Water Tower

Other Symbols

- Data Logger

PIPE DIAMETER	DEPTH BELOW GROUND
Up to 300mm (12")	900mm (3')
300mm - 600mm (12" - 24")	1100mm (3' 8")
600mm and bigger (24" plus)	1200mm (4')

Other Water Pipes (Not Operated or Maintained by Thames Water)

Other Water Company Main: Occasionally other water company water pipes may overlap the border of our clean water coverage area. These mains are denoted in purple and in most cases have the owner of the pipe displayed along them.

Private Main: Indiates that the water main in question is not owned by Thames Water. These mains normally have text associated with them indicating the diameter and owner of the pipe.

Terms and Conditions

All sales are made in accordance with Thames Water Utilities Limited (TWUL) standard terms and conditions unless previously agreed in writing.

1. All goods remain in the property of Thames Water Utilities Ltd until full payment is received.
2. Provision of service will be in accordance with all legal requirements and published TWUL policies.
3. All invoices are strictly due for payment 14 days from due date of the invoice. Any other terms must be accepted/agreed in writing prior to provision of goods or service, or will be held to be invalid.
4. Thames Water does not accept post-dated cheques-any cheques received will be processed for payment on date of receipt.
5. In case of dispute TWUL`s terms and conditions shall apply.
6. Penalty interest may be invoked by TWUL in the event of unjustifiable payment delay. Interest charges will be in line with UK Statute Law 'The Late Payment of Commercial Debts (Interest) Act 1998'.
7. Interest will be charged in line with current Court Interest Charges, if legal action is taken.
8. A charge may be made at the discretion of the company for increased administration costs.

A copy of Thames Water's standard terms and conditions are available from the Commercial Billing Team (cashoperations@thameswater.co.uk).

We publish several Codes of Practice including a guaranteed standards scheme. You can obtain copies of these leaflets by calling us on 0800 316 9800

If you are unhappy with our service you can speak to your original goods or customer service provider. If you are not satisfied with the response, your complaint will be reviewed by the Customer Services Director. You can write to her at: Thames Water Utilities Ltd. PO Box 492, Swindon, SN38 8TU.

If the Goods or Services covered by this invoice falls under the regulation of the 1991 Water Industry Act, and you remain dissatisfied you can refer your complaint to Consumer Council for Water on 0121 345 1000 or write to them at Consumer Council for Water, 1st Floor, Victoria Square House, Victoria Square, Birmingham, B2 4AJ.

Ways to pay your bill

Credit Card	**BACS Payment**	**Telephone Banking**	**Cheque**
Call **0845 070 9148** quoting your invoice number starting CBA or ADS / OSS	Account number **90478703** Sort code **60-00-01** A remittance advice must be sent to: **Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW.** or email **ps.billing@thameswater.co.uk**	By calling your bank and quoting: Account number **90478703** Sort code **60-00-01** and your invoice number	Made payable to '**Thames Water Utilities Ltd**' Write your Thames Water account number on the back. Send to: **Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW** or by DX to **151280 Slough 13**

Search Code

IMPORTANT CONSUMER PROTECTION INFORMATION

This search has been produced by Thames Water Property Searches, Clearwater Court, Vastern Road, Reading RG1 8DB, which is registered with the Property Codes Compliance Board (PCCB) as a subscriber to the Search Code. The PCCB independently monitors how registered search firms maintain compliance with the Code.

The Search Code:

- provides protection for homebuyers, sellers, estate agents, conveyancers and mortgage lenders who rely on the information included in property search reports undertaken by subscribers on residential and commercial property within the United Kingdom
- sets out minimum standards which firms compiling and selling search reports have to meet
- promotes the best practise and quality standards within the industry for the benefit of consumers and property professionals
- enables consumers and property professionals to have confidence in firms which subscribe to the code, their products and services.

By giving you this information, the search firm is confirming that they keep to the principles of the Code. This provides important protection for you.

The Code's core principles

Firms which subscribe to the Search Code will:

- display the Search Code logo prominently on their search reports
- act with integrity and carry out work with due skill, care and diligence
- at all times maintain adequate and appropriate insurance to protect consumers
- conduct business in an honest, fair and professional manner
- handle complaints speedily and fairly
- ensure that products and services comply with industry registration rules and standards and relevant laws
- monitor their compliance with the Code

Complaints

If you have a query or complaint about your search, you should raise it directly with the search firm, and if appropriate ask for any complaint to be considered under their formal internal complaints procedure. If you remain dissatisfied with the firm's final response, after your complaint has been formally considered, or if the firm has exceeded the response timescales, you may refer your complaint for consideration under The Property Ombudsman scheme (TPOs). The Ombudsman can award compensation of up to £5,000 to you if he finds that you have suffered actual loss as a result of your search provider failing to keep to the Code.

Please note that all queries or complaints regarding your search should be directed to your search provider in the first instance, not to TPOs or to the PCCB.

TPOs Contact Details

The Property Ombudsman scheme
Milford House
43-55 Milford Street
Salisbury
Wiltshire SP1 2BP
Tel: 01722 333306
Fax: 01722 332296
Email: admin@tpos.co.uk

You can get more information about the PCCB from www.propertycodes.org.uk

PLEASE ASK YOUR SEARCH PROVIDER IF YOU WOULD LIKE A COPY OF THE SEARCH CODE

Plant Protection
Cadent
Block 1; Floor 1
Brick Kiln Street
Hinckley
LE10 0NA
E-mail: plantprotection@cadentgas.com
Telephone: +44 (0)800 688588

National Gas Emergency Number:
0800 111 999*

National Grid Electricity Emergency Number:
0800 40 40 90*
* Available 24 hours, 7 days/week.
Calls may be recorded and monitored.

www.cadentgas.com

Su Connor
Geotechnical & Environmental Associates
Widbury Barn
Widbury Hill
Ware
Herts
SG12 7QE

Date: 25/07/2017
Our Ref: NL_TE_Z5_3WWX_539283
Your Ref: J17190
RE: Scheduled Works, 10 Downside Crescent

Thank you for your enquiry which was received on 24/07/2017.
Please note this response and any attached map(s) are valid for 28 days.

An assessment has been carried out with respect to Cadent Gas Ltd, National Grid Electricity Transmission plc's and National Grid Gas plc's apparatus. Please note it does not cover the items listed in the section "Your Responsibilities and Obligations", including gas service pipes and related apparatus.
For details of Network areas please see the Cadent website (http://cadentgas.com/Digging-safely/Dial-before-you-dig) or the enclosed documentation.

Are My Works Affected?

Following further consultation and re-assessment of your enquiry, Cadent and/or National Grid has identified that it has apparatus in the vicinity of your enquiry, but if your works are undertaken in the appropriate manner this apparatus should not be affected by your activities as specified.

Please note that there may also be gas service(s) or recently installed apparatus present. Further detail can be found in the "Essential Guidance" document (http://www2.nationalgrid.com/WorkArea/DownloadAsset.aspx?id=8589934982).

Please proceed with extreme caution, and with reference to the guidance and plans attached in this response.

The details contained within this enquiry are valid for 28 days. If the scheduled work is not completed within this time, or should the location, date or nature of your activities change, you must submit another enquiry.

Your Responsibilities and Obligations

It is your responsibility to ensure that the information you have submitted is accurate and that all relevant documents including links are provided to all persons (either direct labour or contractors) working for you near Cadent and/or National Grid's apparatus, e.g. as contained within the Construction (Design and Management) Regulations.

This assessment solely relates to Cadent Gas Ltd, National Grid Electricity Transmission plc (NGET) and National Grid Gas plc (NGG) and apparatus. This assessment does **NOT** include:

- Cadent and/or National Grid's legal interest (easements or wayleaves) in the land which restricts activity in proximity to Cadent and/or National Grid's assets in private land. You must obtain details of any such restrictions from the landowner in the first instance and if in doubt contact Plant Protection.
- Gas service pipes and related apparatus
- Recently installed apparatus
- Apparatus owned by other organisations, e.g. other gas distribution operators, local electricity companies, other utilities, etc.

It is **YOUR** responsibility to take into account whether the items listed above may be present and if they could be affected by your proposed activities. Further "Essential Guidance" in respect of these items can be found on the National Grid Website (http://www2.nationalgrid.com/WorkArea/DownloadAsset.aspx?id=8589934982).

This communication does not constitute any formal agreement or consent for any proposed development work; either generally or with regard to Cadent and/or National Grid's easements or wayleaves nor any planning or building regulations applications.

Cadent Gas Ltd, NGG and NGET or their agents, servants or contractors do not accept any liability for any losses arising under or in connection with this information. This limit on liability applies to all and any claims in contract, tort (including negligence), misrepresentation (excluding fraudulent misrepresentation), breach of statutory duty or otherwise. This limit on liability does not exclude or restrict liability where prohibited by the law nor does it supersede the express terms of any related agreements.

If you require further assistance please contact the Plant Protection team via e-mail (click here) or via the contact details at the top of this response.

Yours faithfully

Plant Protection Team

ASSESSMENT

Affected Apparatus
The apparatus that has been identified as being in the vicinity of your proposed works is:

- Low or Medium pressure (below 2 bar) gas pipes and associated equipment. (As a result it is highly likely that there are gas services and associated apparatus in the vicinity)

Requirements

BEFORE carrying out any work you must:

- Carefully read these requirements including the attached guidance documents and maps showing the location of apparatus.
- Contact the landowner and ensure any proposed works in private land do not infringe Cadent and/or National Grid's legal rights (i.e. easements or wayleaves). If the works are in the road or footpath the relevant local authority should be contacted.
- Ensure that all persons, including direct labour and contractors, working for you on or near Cadent and/or National Grid's apparatus follow the requirements of the HSE Guidance Notes HSG47 - 'Avoiding Danger from Underground Services' and GS6 – 'Avoidance of danger from overhead electric power lines'. This guidance can be downloaded free of charge at http://www.hse.gov.uk
- In line with the above guidance, verify and establish the actual position of mains, pipes, cables, services and other apparatus on site before any activities are undertaken.

DURING any work you must:

- Ensure that no mechanical excavation takes place above or within 0.5m of the Cadent buried medium and low pressure gas pipes and associated equipment.
- Comply with all guidance relating to general activities and any specific guidance for each asset type as specified in the Guidance Section below.
- Ensure that access to Cadent and/or National Grid apparatus is maintained at all times.
- Prevent the placing of heavy construction plant, equipment, materials or the passage of heavy vehicles over Cadent and/or National Grid apparatus unless specifically agreed with Cadent and/or National Grid in advance.
- Exercise extreme caution if slab (mass) concrete is encountered during excavation works as this may be protecting or supporting Cadent and/or National Grid apparatus.
- Maintain appropriate clearances between gas apparatus and the position of other buried plant.

Please refer to the "General Guidance" or contact the Plant Protection Team for further information regarding the above.

GUIDANCE

Excavating Safely - Avoiding injury when working near gas pipes:
http://www.nationalgrid.com/NR/rdonlyres/2D2EEA97-B213-459C-9A26-18361C6E0B0D/25249/Digsafe_leaflet3e2finalamends061207.pdf

Standard Guidance

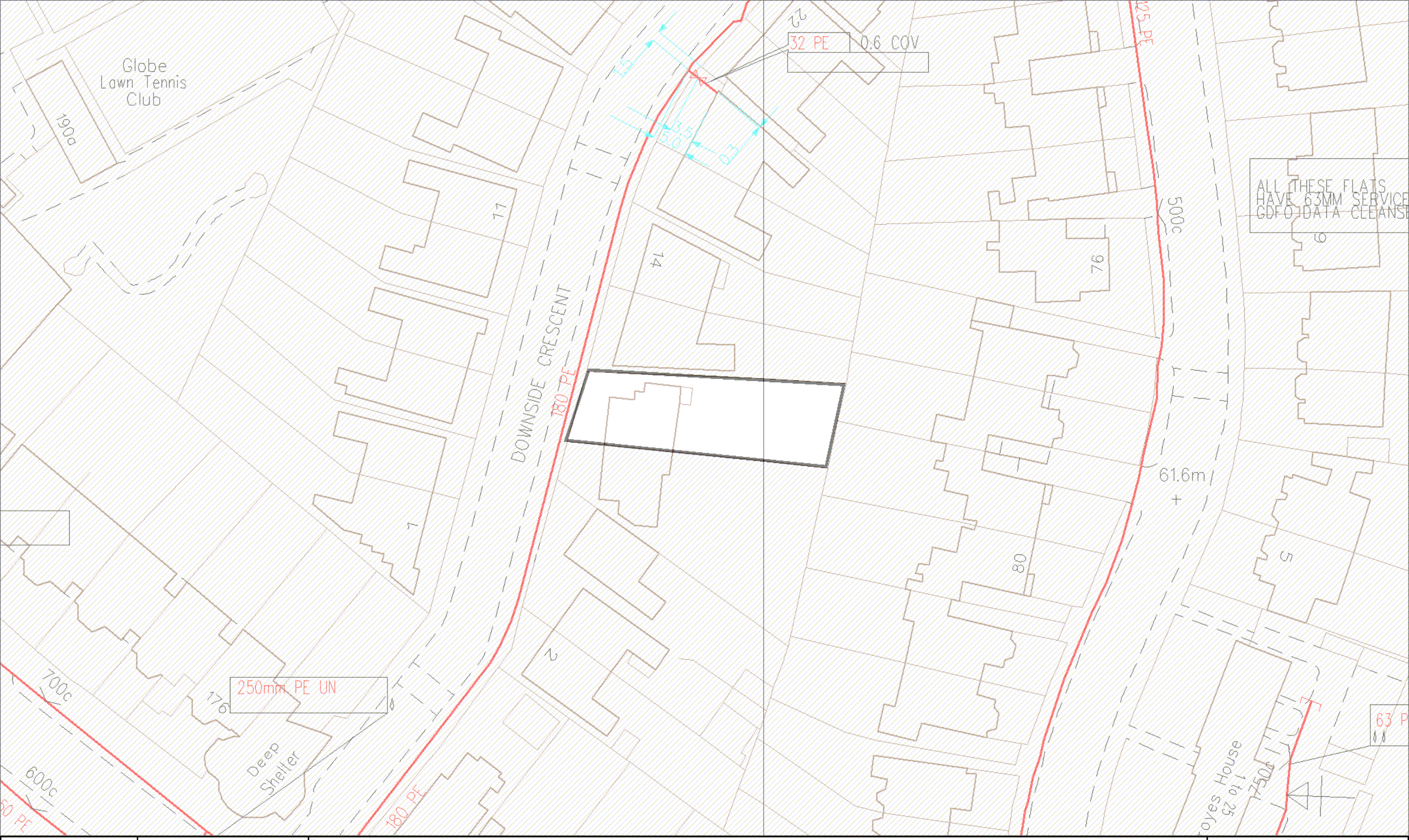
Essential Guidance document:
http://www2.nationalgrid.com/WorkArea/DownloadAsset.aspx?id=8589934982

General Guidance document:
http://www2.nationalgrid.com/WorkArea/DownloadAsset.aspx?id=35103

Excavating Safely in the vicinity of gas pipes guidance (Credit card):
http://www.nationalgrid.com/NR/rdonlyres/A3D37677-6641-476C-9DDA-E89949052829/44257/ExcavatingSafelyCreditCard.pdf

Excavating Safely in the vicinity of electricity cables guidance (Credit card):
http://www.nationalgrid.com/NR/rdonlyres/35DDEC6D-D754-4BA5-AF3C-D607D05A25C2/44858/ExcavatingSafelyCreditCardelectricitycables.pdf

Copies of all the Guidance Documents can also be downloaded from the National Grid Website:
http://www.nationalgrid.com/uk/Gas/Safety/work/downloads/



ID: NL_TE_Z5_3WWX_539283	View extent: 206m, 122m	Proceed with caution. Always dig safely
USER: GEA-Ltd	LP MAINS MP MAINS IP MAINS LHP MAINS NHP MAINS	This plan shows those pipes owned by National Grid Gas plc in its role as a Licensed Gas Transporter (GT). Gas pipes owned by other GTs, or otherwise privately owned, may be present in this area. Information with regard to such pipes should be obtained from the relevant owners. The information shown on this plan is given without warranty, the accuracy thereof cannot be guaranteed. Service pipes, valves, syphons, stub connections, etc., are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by National Grid Gas plc or their agents, servants or contractors for any error or omission. Safe digging practices, in accordance with HS(G)47, must be used to verify and establish the actual position of mains, pipes, services and other apparatus on site before any mechanical plant is used. It is your responsibility to ensure that this information is provided to all persons (either direct labour or contractors) working for you on or near gas apparatus. The information included on this plan should not be referred to beyond a period of 28 days from the date of issue.
DATE: 25/07/2017	0m 10m Approximate scale 1:500 on A3 Colour Landscape	
DATA DATE: 24/07/2017		
REF: J17190		
MAP REF: TQ2785 CENTRE: 527491, 185094		

Some examples of Plant Items: Valve, Depth of Cover, Syphon, Diameter Change, Material Change, Out of Standard Service

Map 1 of 1 (GAS)

MAPS Plot Server Version 1.9.0

Cadent
Your Gas Network

Requested by: Geotechnical & Environmental Associates

ENQUIRY SUMMARY

Received Date
24/07/2017

Your Reference
J17190

Location
Centre Point: 527491, 185094
X Extent: 41
Y Extent: 15
Postcode: NW3 2AP
Location Description: 10 Downside Crescent

Map Options
Paper Size: A3
Orientation: LANDSCAPE
Requested Scale: 500
Actual Scale: 1:500 (GAS)
Real World Extents: 206m x 122m (GAS)

Start Date
01/08/2017

Recipients
tacita@gea-ltd.co.uk

Enquirer Details
Organisation Name: Geotechnical & Environmental Associates
Contact Name: Su Connor
Email Address: tacita@gea-ltd.co.uk
Telephone: 1727824666 (441727824666)
Address: Widbury Barn, Widbury Hill, Ware, Herts, SG12 7QE

Description of Works
A number of boreholes to depths of 20 m and some trial pits

Enquiry Type
Scheduled Works

Activity Type
General Excavation

Work Types
Work Type: Boring/Moling/Horizontal Drilling greater than 300mm

Tacita Wallace
Geotechnical & Environmental Associates
Widbury Barn
Widbury Hill
Ware
Herts
SG12 7QE

Our Ref: 2017/2261649
Your Ref: J17190
01/08/2017

Dear Sir/Madam

10, DOWNSIDE CRESCENT, LONDON, NW3 2AP

Thank you for your letter of 24/07/2017 in which you asked if there are any electric lines and/or electrical plant belonging to UK Power Networks (LPN) plc ("UK Power Networks") within the land identified by your enquiry.

I enclose a copy of UK Power Networks record of its electric lines and/or electrical plant at the site identified by your enquiry. If the records provided do not relate to the land to which you had intended to refer please resubmit your enquiry.

Should your excavation affect any of our Extra High Voltage equipment (6.6 KV, 22 KV, 33 KV or 132 KV), please contact us to obtain a copy of the primary route drawings and associated cross sections.

This information is made available to you on the terms set out below.

1. **UK Power Networks does not warrant that the information provided to you is correct. You rely upon it at your own risk.**

2. UK Power Networks does not exclude or limit its liability if it causes the death of any person or causes personal injury to a person where such death or personal injury is caused by its negligence.

3. **Subject to paragraph 2 UK Power Networks has no liability to you in contract, in tort (including negligence), for breach of statutory duty or otherwise how for any loss, damage, costs, claims, demands, or expenses that you or any third party may suffer or incur as a result of using the information provided whether for physical damage to property or for any economic loss (including without limitation loss of profit, loss of opportunity, loss of savings, loss of goodwill, loss of business, loss of use) or any special or consequential loss or damage whatsoever.**

4. The information about UK Power Networks electrical plant and/or electric lines provided to you belongs to and remains the property of UK Power Networks. You must not alter it in any respect.

5. **The information provided to you about the electrical plant and/or electric lines depicted on the plans may NOT be a complete record of such apparatus belonging to UK Power Networks. The information provided relates to electric lines and/or electrical plant belonging to UK Power Networks that it believes to be present but the**

plans are NOT definitive: other electric lines and/or electrical plant may be present and that may or may not belong to UK Power Networks.

6. **Other apparatus not belonging to UK Power Networks is not shown on the plan. It is your responsibility to make your own enquiries elsewhere to discover whether apparatus belonging to others is present. It would be prudent to assume that other apparatus is present.**

7. You are responsible for ensuring that the information made available to you is passed to those acting on your behalf and that all such persons are made aware of the contents of this letter.

8. Because the information provided to you may **NOT** be accurate, you are recommended to ascertain the presence of UK Power Networks electric lines and/or electrical plant by the digging of trial holes. **Trial holes should be dug by hand only**.

Excavations must be carried out in line with the Health and Safety Executive guidance document HSG 47. We will not undertake this work. A copy of HSG 47 can be obtained from the Health an Safety Executives website.

All electric lines discovered must be considered LIVE and DANGEROUS at all times and must not be cut, resited, suspended, bent or interfered with unless specially authorised by UK Power Networks.

The electric line and electrical plant belonging to UK Power Networks remains so even when made dead and abandoned and any such electric line and/or electrical plant exposed shall be reported to UK Power Networks.

Where your works are likely to affect our electric lines and/or electrical plant an estimate of the price of any protective /diversionary works can be prepared by UK Power Networks Branch at Metropolitan House, Darkes Lane, Potters Bar, Herts. , EN6 1AG, telephone no. 0845 2340040

9 **Any work near to any overhead electric lines must be carried out by you in accordance with the Health and Safety Executive guidance document GS6 and the Electricity at Work Regulations**.

The GS6 Recommendations may be purchased from HSE Books or downloaded from the Energy Networks Association's website.

If given a reasonable period of prior notice UK Power Networks will attend on site without charge to advise how and where "goal posts" should be erected. If you wish to avail yourself of this service, in the first instance please telephone: 0845 6014516 between 08:30 and 17:00 Monday to Friday, Public and bank holidays excepted.

10. You are responsible for the security of the information provided to you. It must not be given, sold or made available upon payment of a fee to a third party.

11. If in carrying out work on land in, on, under or over which is installed an electric line and/or electrical plant that belongs to UK Power Networks you and/or anyone working on your behalf damages (however slightly) that apparatus you must inform immediately UK Power Networks by telephone at the number below providing:

- your name, address and telephone number; and
- the date, time and place at which such damage was caused; and
- a description of the electric line and/or electrical plant to which damage was caused; and
- the name of the person whom it appears to you is responsible for that damage; and
- the nature of the damage

In the East of England or London 0800 780078 (24 Hours).

12. The expression "UK Power Networks" includes UK Power Networks (EPN) plc, UK Power Networks (LPN) plc, UK Power Networks (SEPN) plc, UK Power Networks and any of their successors and predecessors in title.

    IF YOU DO **NOT** ACCEPT AND/OR **DO NOT** UNDERSTAND THE TERMS OF USE SET OUT IN PARAGRAPHS 1 TO 12 INCLUSIVE ABOVE YOU MUST NOT USE THE PLANS AND RETURN THEM TO ME.

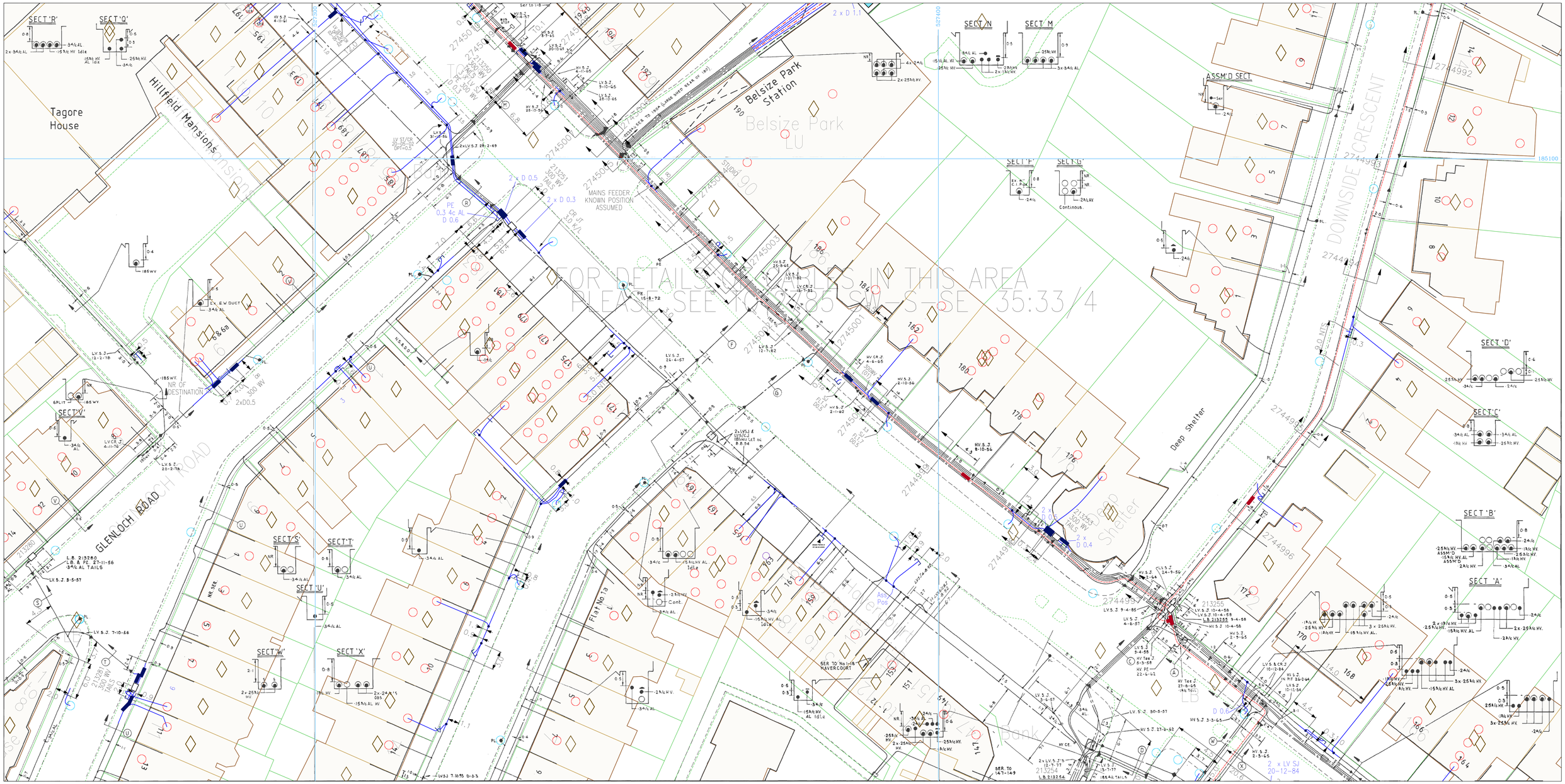
I would remind you that work adjacent to electric lines and/or electrical plant represents a serious risk to health and safety and as such should feature amongst the items you have assessed in your workplace risk assessment and method statement.

I shall be pleased to supply you with further assistance if you require it.

Yours sincerely

M. Ellis

Mark Ellis - Telephone: 0800 0565 866
Plan Provision



0m 10m 20m 30m 40m 50m 60m 70m

Plotted On : 01/08/2017

Plotted By : Mark Ellis

Plot Description: 10, DOWNSIDE CRESCENT, LONDON, NW3 2AP

2017/2261649/comp

Map Centre : TQ2785SW

UK Power Networks
Plan Provision
Fore Hamlet
IPSWICH
Suffolk
IP3 8AA
Tel 0800 0565 866
Fax 08701 963782

For details of the symbology please refer to
http://www.ukpowernetworks.co.uk/safety-emergencies/in-the-workplace/understanding-safety-symbols.shtml

PRIMARY CABLES
EXTRA HIGH VOLTAGE CABLES (EHV) 22,000 TO 132,000 Volts

Depth normally 750mm cover in carriageway & 600mm cover in footway.

Before digging within one metre of these cable routes
Telephone 0800 056 5866 in order that the Company's apparatus may be located on site and any necessary protection works agreed.

N.B. THRUST BORERS OR MOLES MUST NOT BE USED WITHIN THE VICINITY OF ANY CABLES BELONGING TO UK POWER NETWORKS WITHOUT FIRST CONTACTING THIS COMPANY.

1. The position of the apparatus shown on this drawing is believed to be correct but the original landmarks may have been altered since the apparatus was installed.
2. The exact position of the apparatus should be verified – use approved cable avoidance tools prior to excavation using suitable hand tools.
3. It is essential that trial holes are carefully made avoiding the use of mechanical tools or picks until the exact location of all cables have been determined.
4. It must be assumed that each property and item of street furniture has an electricity supply. A separate record is kept for each service cable but its route is not necessarily shown on this record.
5. All cables must be treated as being live unless proved otherwise by UK Power Networks.
6. The information provided must be given to all people working near UK Power Networks' plant & equipment. Do not use plans more than 3 months after the issue date for excavation purposes.
7. Please be aware that electric cables/lines belonging to other owners of licensed electricity distribution systems may be present and it is your responsibility to identify their location.

ADVICE TO CONTRACTORS ON AVOIDING DANGER
FROM BURIED ELECTRICITY CABLES.

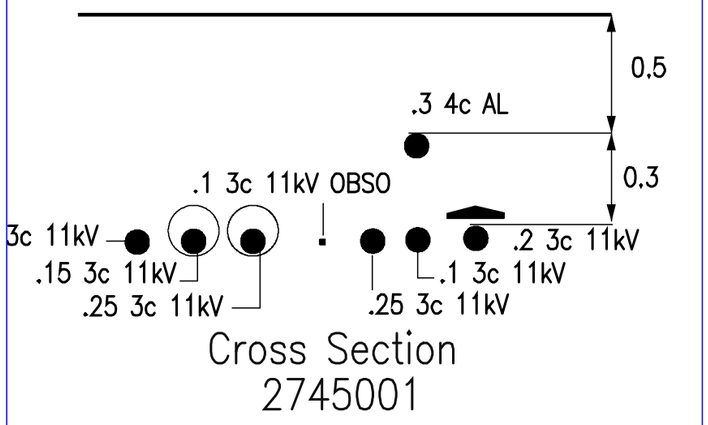
1) Do have cable drawings with you on site and check them before you start the excavation.
2) Do have a cable locator tool on site and use it to help you.
3) Mark out the location of electricity cables.
4) Do not use a mechanical excavator within 0.5m of electricity cables.
5) Use spades and shovels in preference to other tools.
6) Never disturb electricity cables and joints or their protective covers.

IF IN DOUBT – ASK! PHONE 0800 056 5866
EMERGENCY – If you damage a cable or line Phone
0800 780 0780 (24hrs) URGENTLY

These basic safety precautions are explained in detail in the HSE booklet. HS(G)47 – Avoiding Danger from Underground Services, a copy of which may be obtained from your supervisor or HMSO.

Please be aware that electric lines belonging to other owners of licensed electricity distribution systems may be present and it is your responsibility to identify their location.

Cross Section (2745001)



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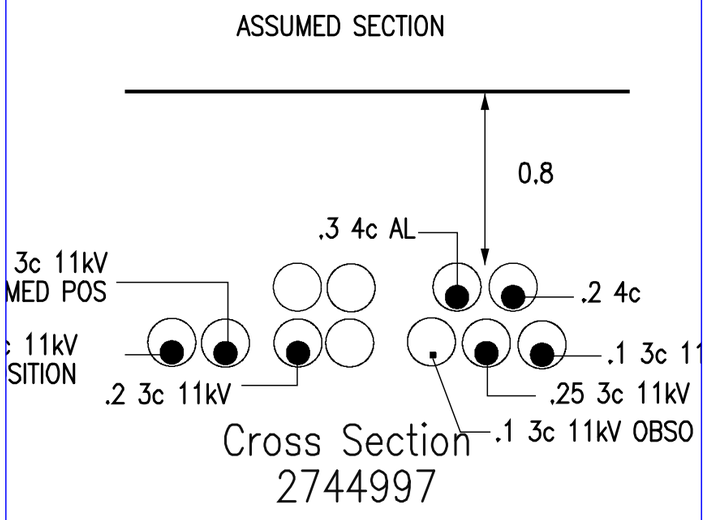

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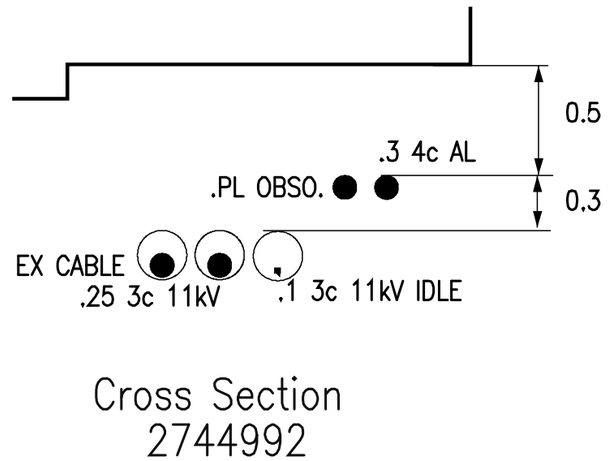

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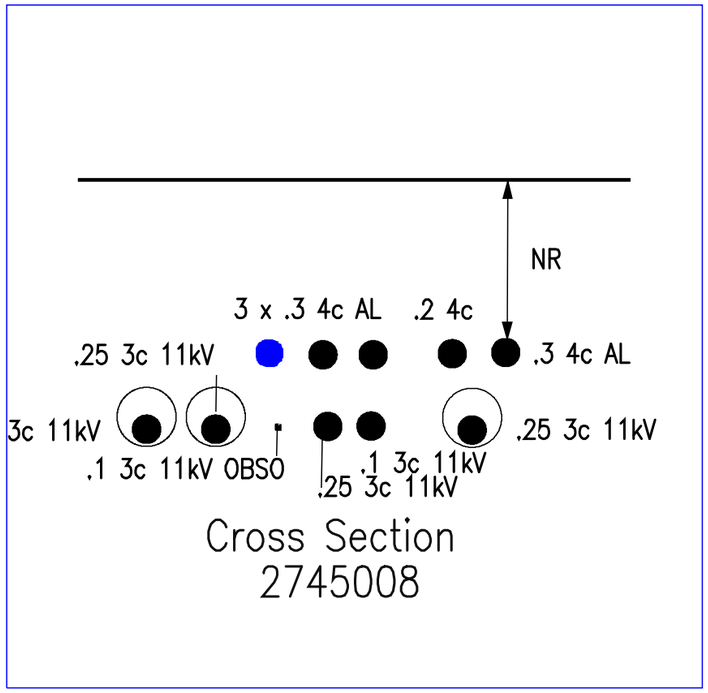

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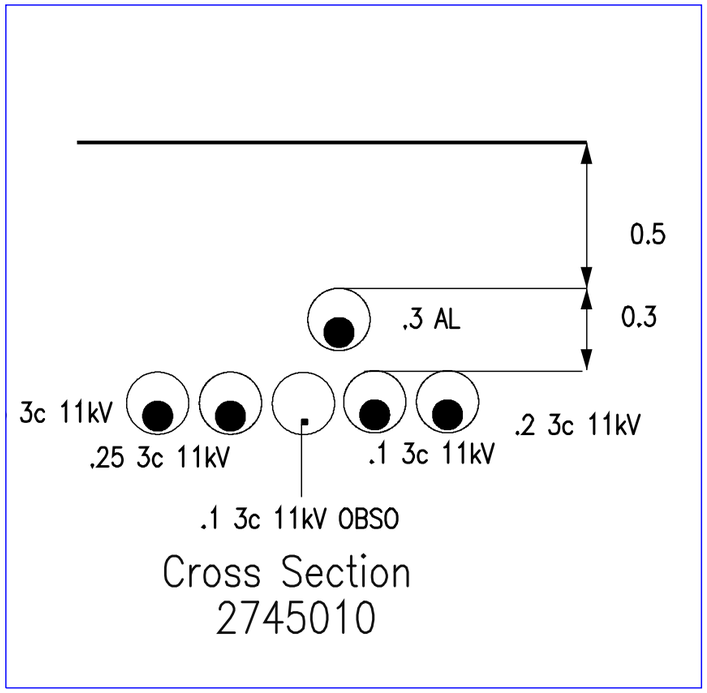

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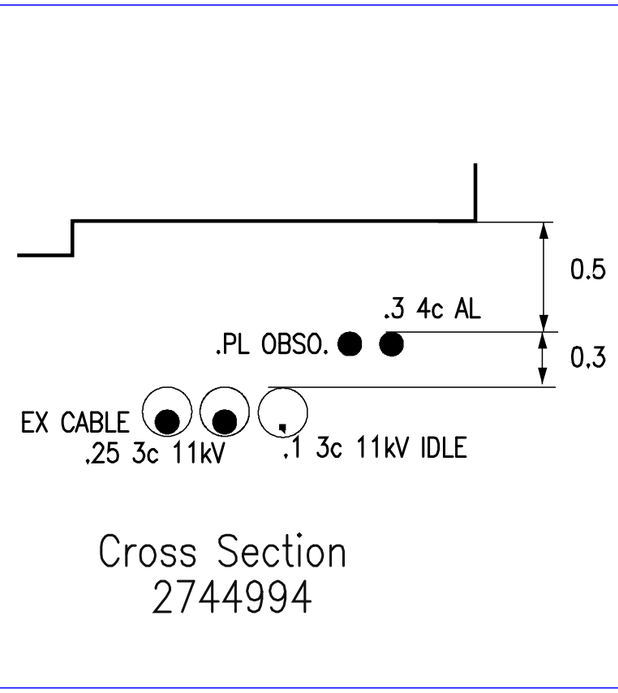

Plotted By: Mark Ellis

Plotted On 01/08/2017

2017/2261649

TQ2785SWBSE

UK Power Networks

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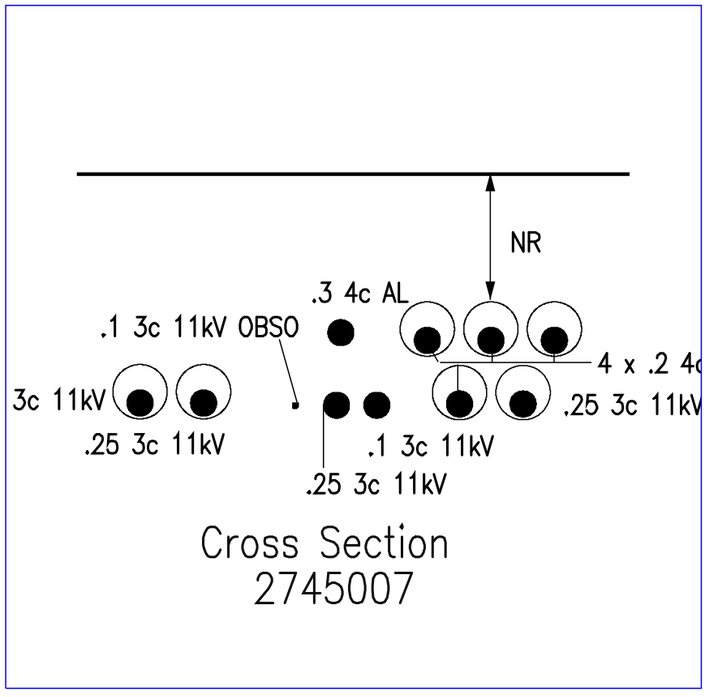

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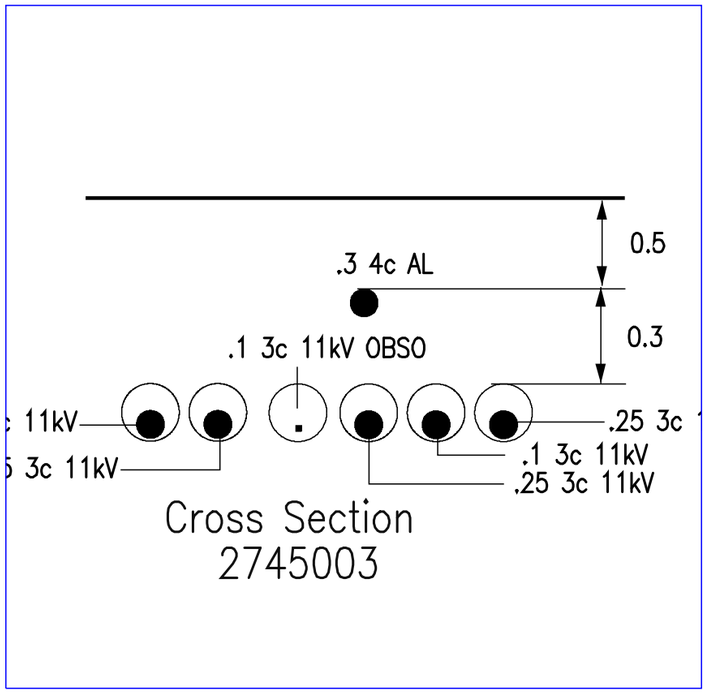

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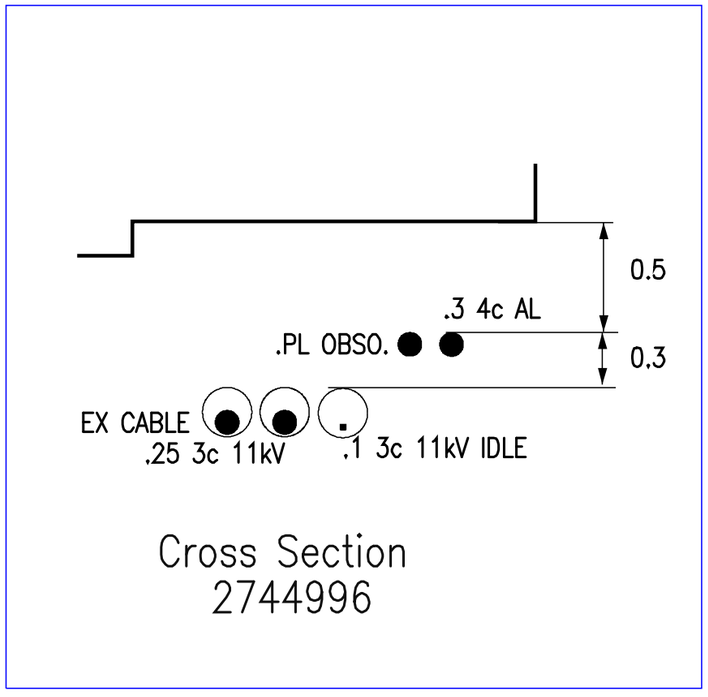

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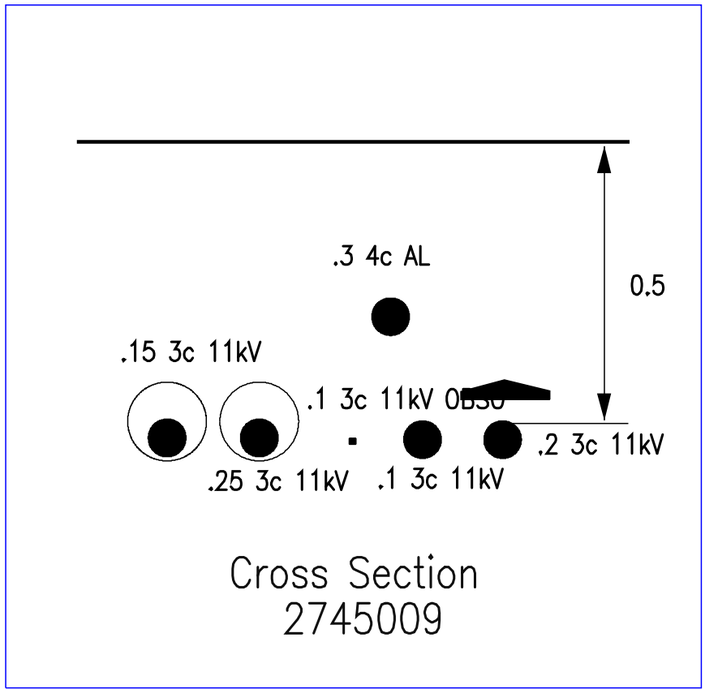

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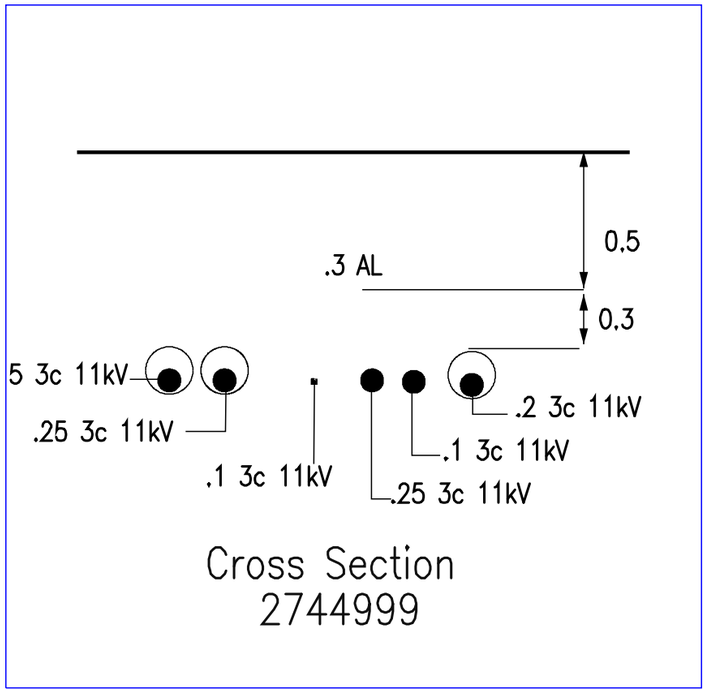

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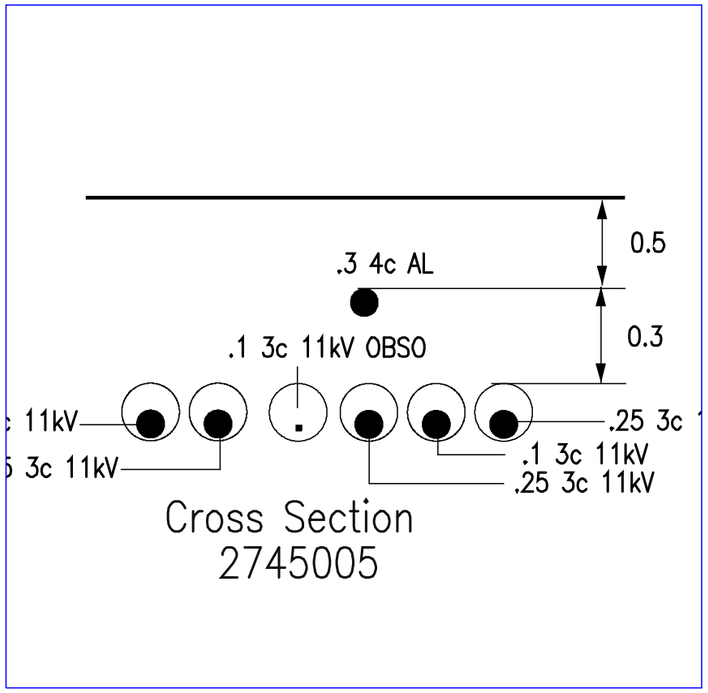

Plotted By: Mark Ellis

Plotted On 01/08/2017

2017/2261649

TQ2785SWBSE

UK Power Networks

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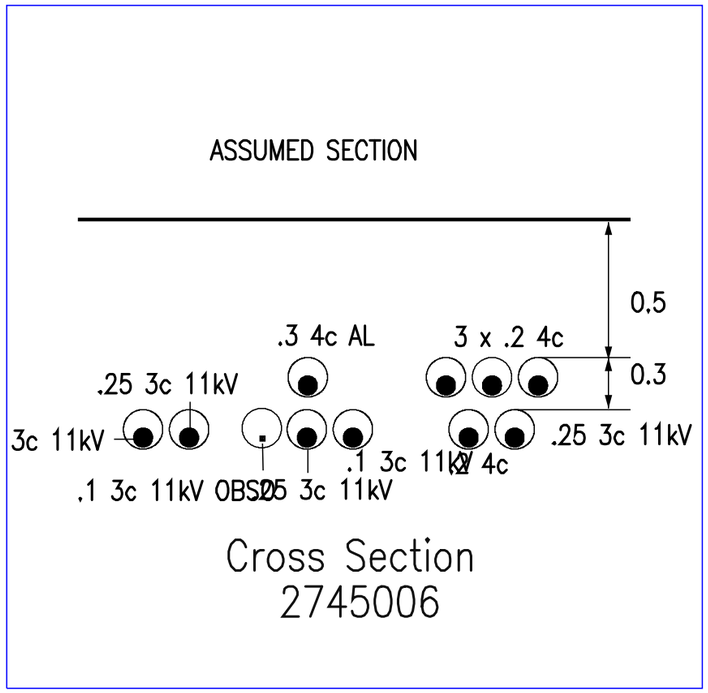

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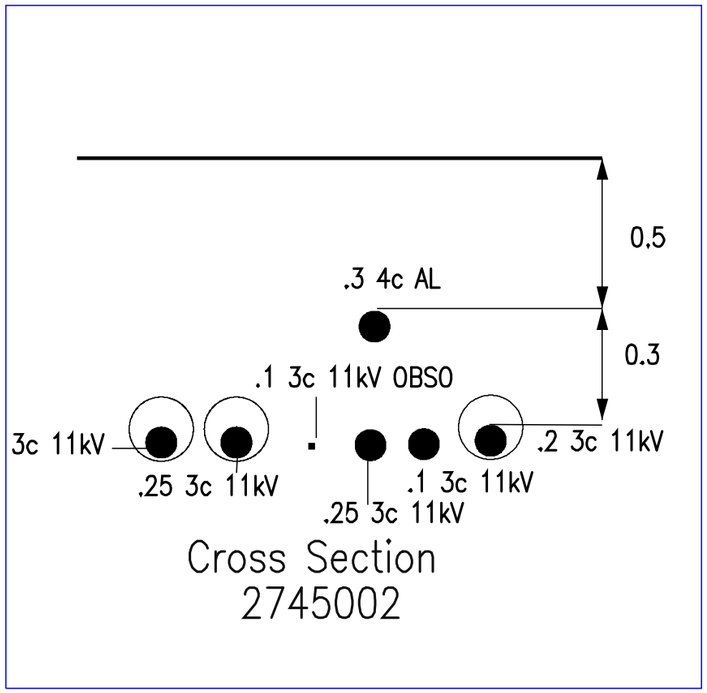

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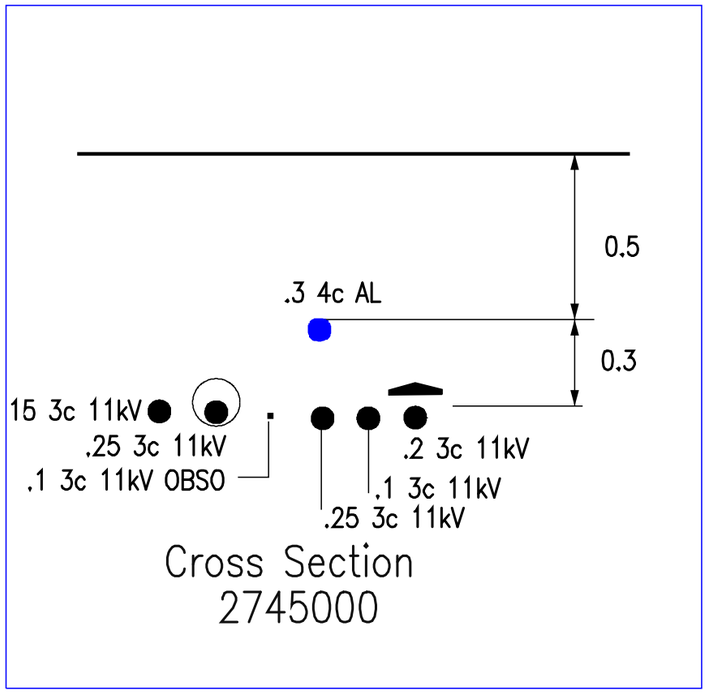

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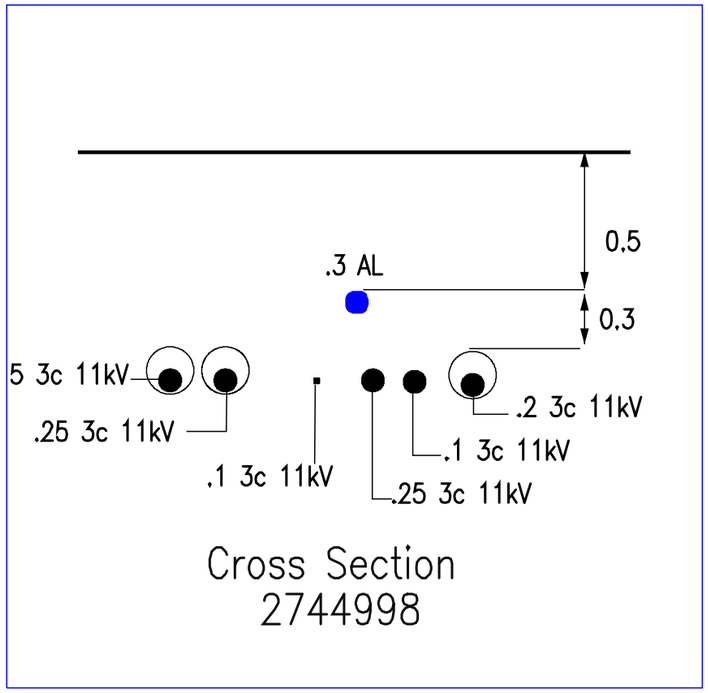

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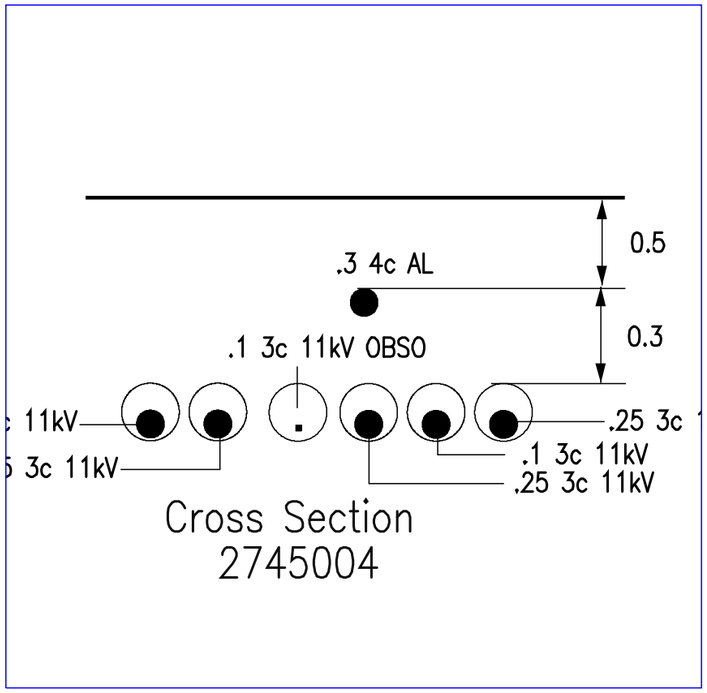

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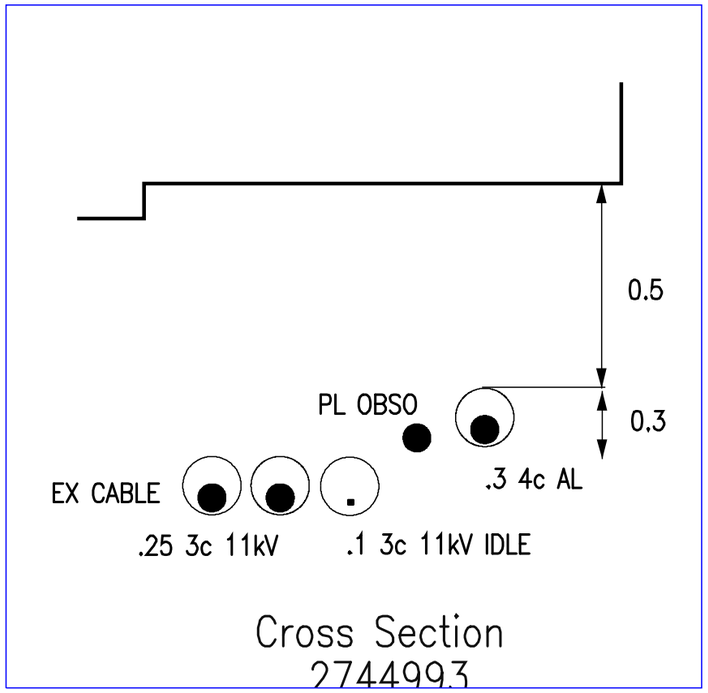

Plotted By: Mark Ellis

Plotted On 01/08/2017

2017/2261649

TQ2785SWBSE

UK Power Networks

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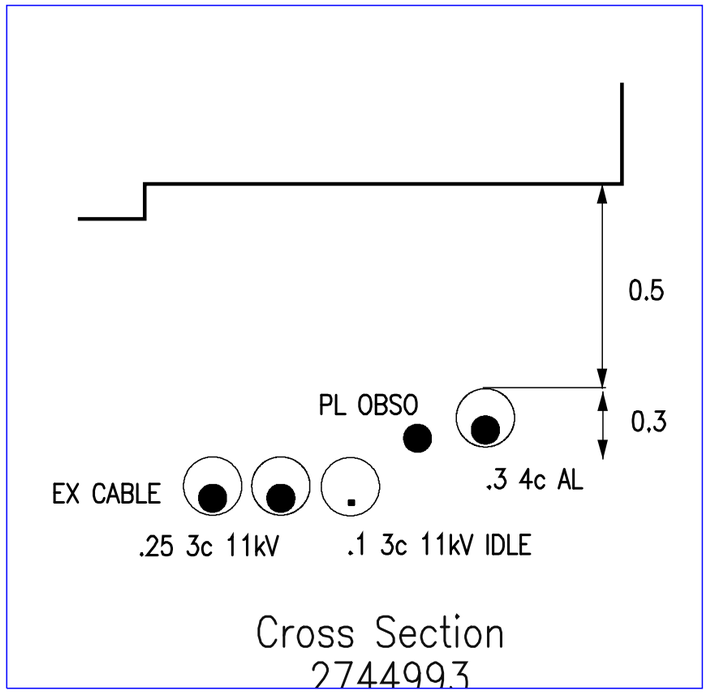


Plotted By: Mark Ellis

Plotted On 01/08/2017

2017/2261649

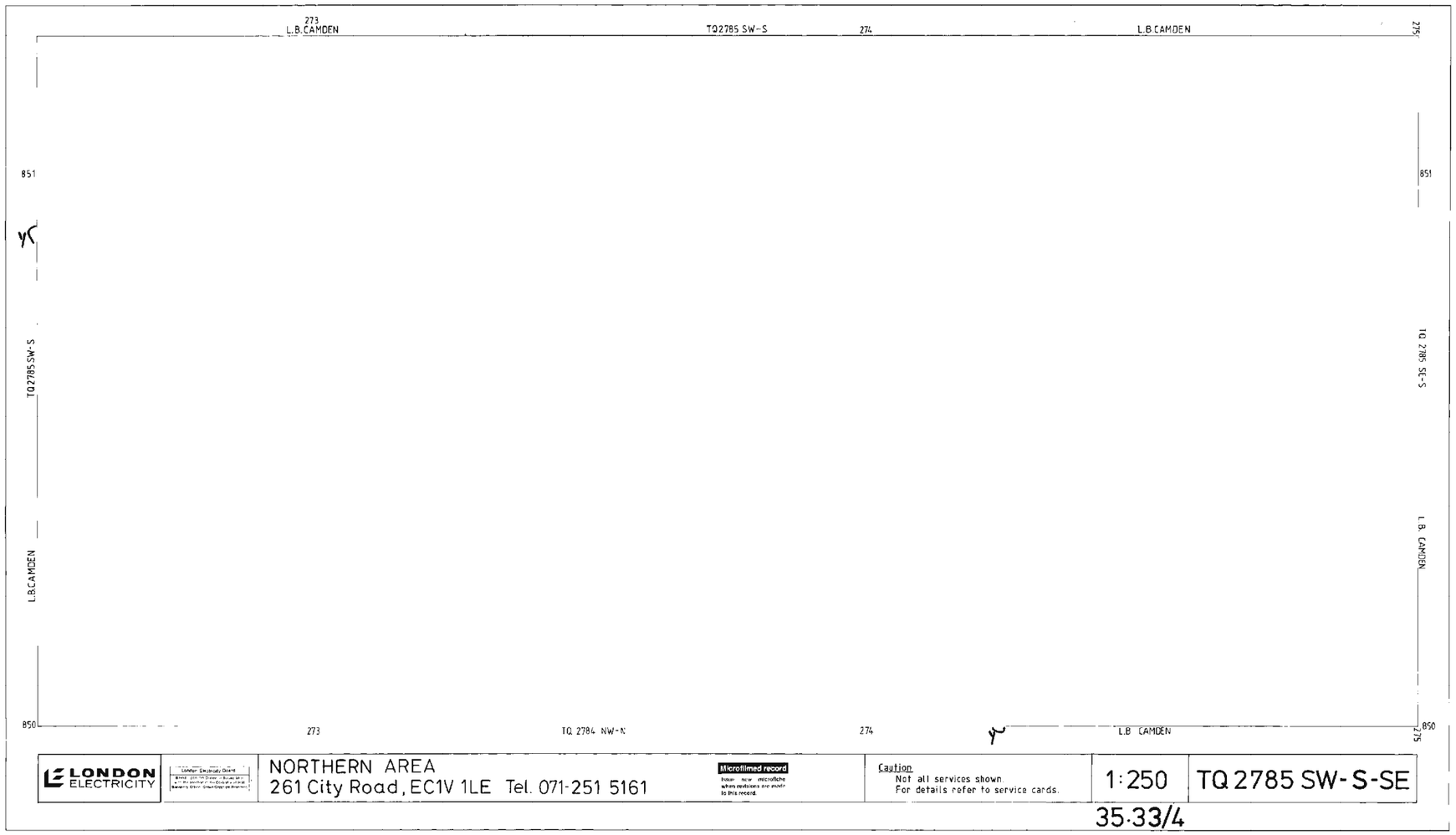
TQ2785SWBSE

UK Power Networks

Microfilmed record
Item: new microfiche when revisions are made to this record

TQ 2785
SW-S-SE
35·33/4

NOT CHECKED



LONDON ELECTRICITY

London Electricity Board

NORTHERN AREA
261 City Road, EC1V 1LE Tel. 071-251 5161

Microfilmed record
Item: new microfiche when revisions are made to this record

Caution
Not all services shown.
For details refer to service cards.

1:250

TQ 2785 SW-S-SE

35.33/4

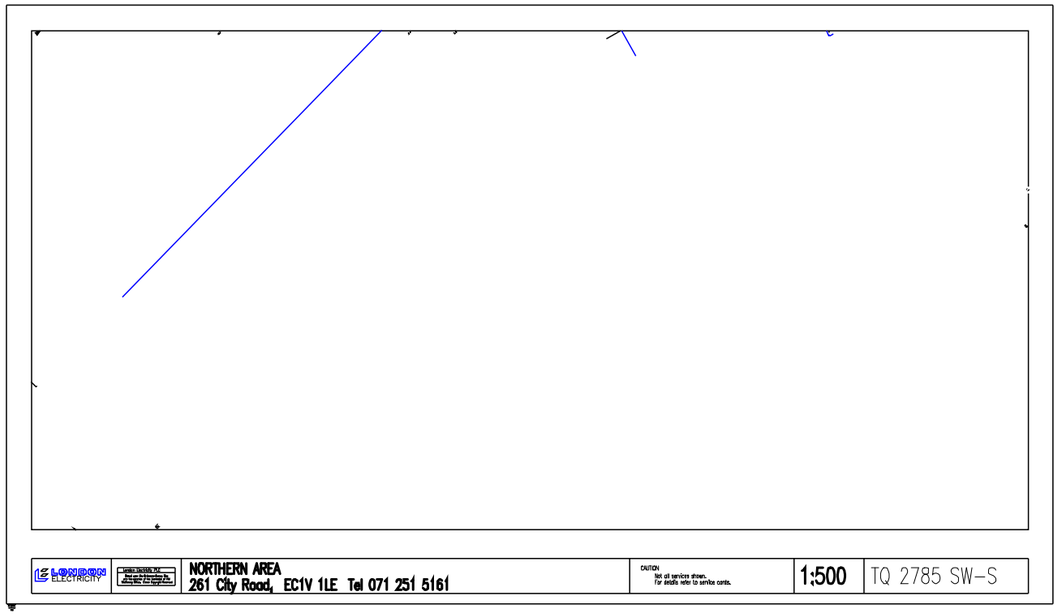
Plotted By: Mark Ellis

Plotted On 01/08/2017

2017/2261649

TQ2785SWBSE

UK Power Networks



Plotted By: Mark Ellis

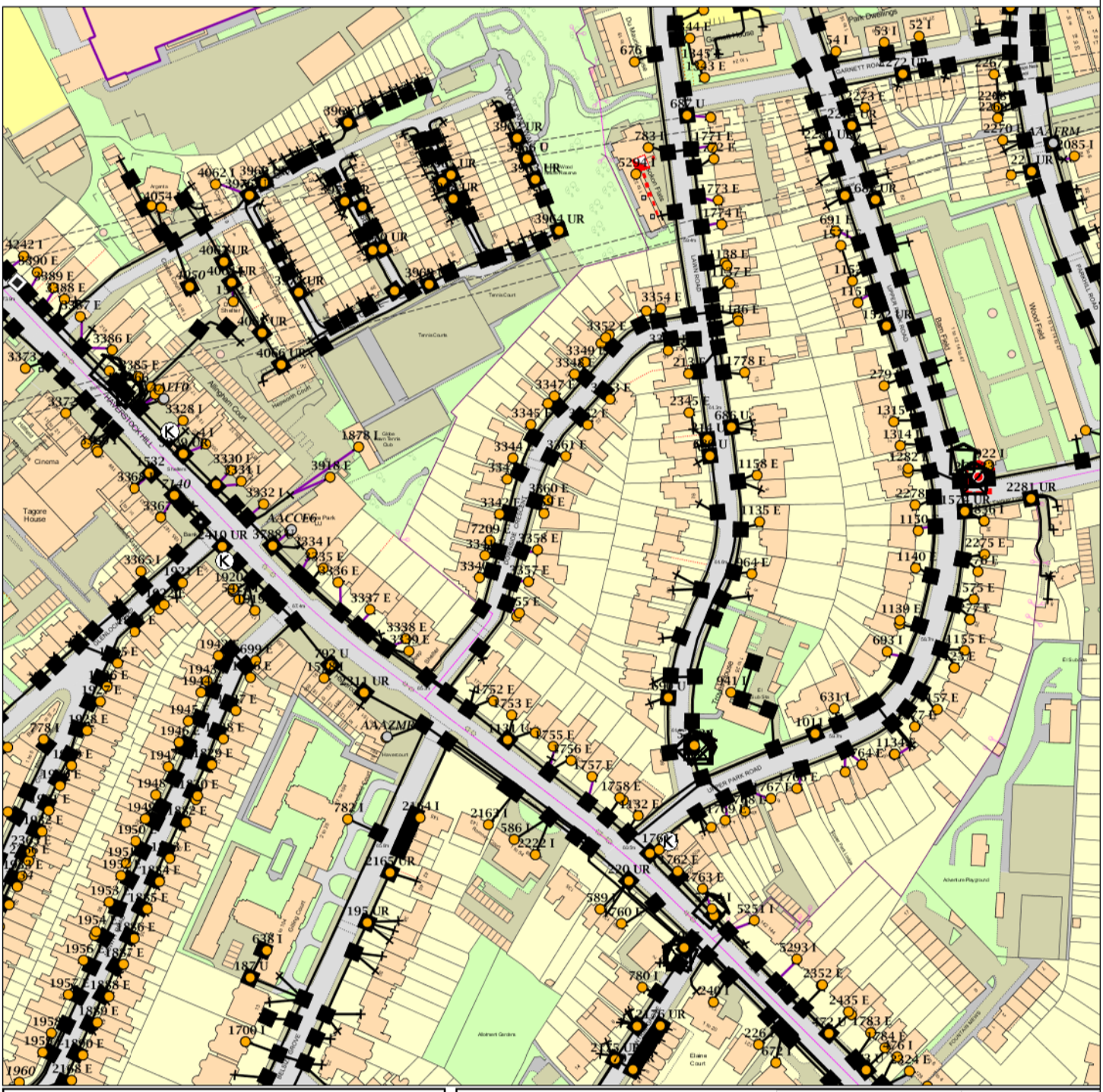
Plotted On 01/08/2017

2017/2261649

TQ2785SWBSE

UK Power Networks

Maps by email Plant Information Reply



IMPORTANT WARNING

Information regarding the location of BT apparatus is given for your assistance and is intended for general guidance only.
No guarantee is given of its accuracy.
It should not be relied upon in the event of excavations or other works being made near to BT apparatus which may exist at various depths and may deviate from the marked route.

openreach BT

CLICK BEFORE YOU DIG

FOR PROFESSIONAL FREE ON SITE ASSISTANCE PRIOR TO COMMENCEMENT OF EXCAVATION WORKS INCLUDING LOCATE AND MARKING SERVICE

email cbyd@openreach.co.uk

ADVANCE NOTICE REQUIRED
(Office hours: Monday - Friday 08.00 to 17.00)
www.openreach.co.uk/cbyd

KEY TO BT SYMBOLS

DP		Pole	
Planned DP		Planned Pole	
PCP		Joint Box	
Planned PCP		Change Of State	+
Built		Split Coupling	×
Planned		Duct Tee	▲
Inferred		Planned Box	
Building		Manhole	
Kiosk	K	Planned Manhole	
Hatchings		Cabinet	
		Planned Cabinet	

Other proposed plant is shown using dashed lines.
BT Symbols not listed above maybe disregarded.
Existing BT Plant may not be recorded.
Information valid at time of preparation

openreach
a BT Group business

BT Ref : ANO10263E
Map Reference : (centre) TQ2748385093
Easting/Northing : (centre) 527483,185
Issued : 24/07/2017 10:26:35

WARNING: IF PLANNED WORKS FALL INSIDE HATCHED AREA IT IS ESSENTIAL BEFORE PROCEEDING THAT YOU CONTACT THE NATIONAL NOTICE HANDLING CENTRE. PLEASE SEND E-MAIL TO: nnhc@openreach.co.uk

Transport for London
London Underground

London Underground
Infrastructure Protection

3rd Floor
Albany House
55 Broadway
London SW1H 0BD

www.tfl.gov.uk/tube

Your ref:
Our ref: 20403-SI-N045

Caroline Anderson
Geotechnical and Environmental Associates
Caroline@gea-ltd.co.uk

19 July 2017

Dear Caroline,

10 Downside Crescent London NW3 2AP

Thank you for your communication of 29th July 2017.

Attached is a 1:1,250 plan @A4 showing the location of Belsize Park London Underground Station which is served by the Northern line:

Please note:

- shaded areas represent sub-surface structures which can be as shallow as 0.2 metres below surface level
- the positions of the tunnels on this plan are indicative only and must not be used for design purposes
- due to varying levels within underground stations it is not possible to show tunnel crown depths in the shaded area
- for more accurate tunnel location information a survey will need to be undertaken
- this letter must be distributed with the drawing which it refers to

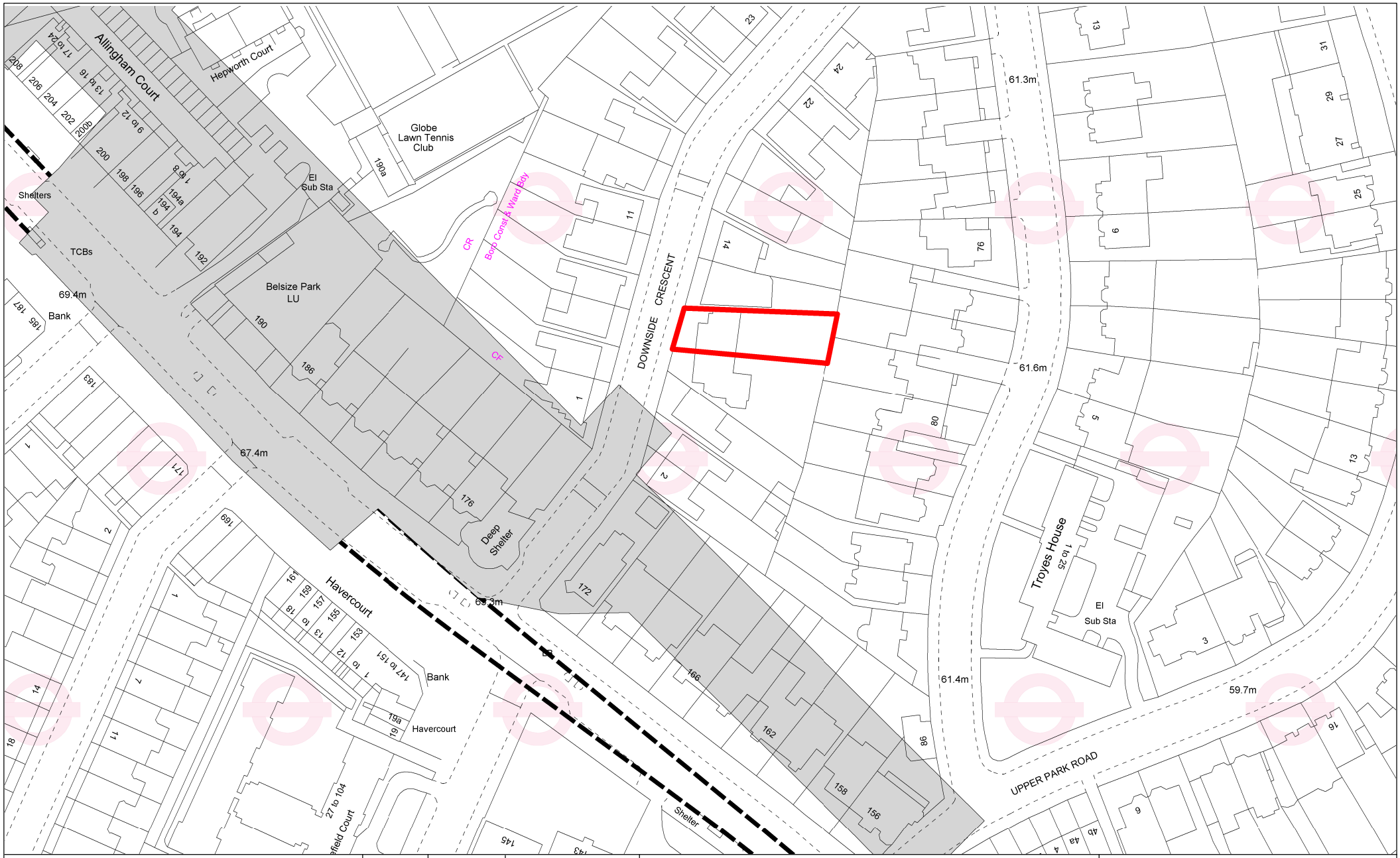
If you or any other intends undertaking the following at the above location London Underground Infrastructure Protection must be provided with details of the proposals so that the safety of our railway can be assured:

- demolition
- structural works
- excavation
- boreholes or piling
- highway works above shaded areas

If I can be of further assistance, please contact me.

Yours sincerely

Shahina Inayathusein
Information Manager
Email: locationenquiries@tube.tfl.gov.uk
Direct line: 020 3054 1365



Date	19 July 2017
LCS Code	N045
Drawn by	S. Inayathusein
Scale	1:1250 at A4

1. All dimensions and LUL asset locations are approximate
2. This drawing must be read in conjunction with the accompanying letter sent by LUL
3. This drawing is for planning purposes only
4. For more accurate tunnel location information a survey will need to be undertaken.

London Underground Limited
Infrastructure Protection
3rd Floor Albany House, 55 Broadway,
London, SW1H 0BD
Tel: 0207 027 8903
lulcedip@tube.tfl.gov.uk

10 Downside Crescent
London
NW3 2AP

Geotechnical & Environmental Associates (GEA)
is an engineer-led and client-focused independent specialist providing a complete range of geotechnical and contaminated land investigation, analytical and consultancy services to the property and construction industries.

We have offices at

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Gotham Road
Kingston on Soar
Notts
NG11 0DE
tel 01509 674888
midlands@gea-ltd.co.uk

Enquiries can also be made on-line at

www.gea-ltd.co.uk

where information can be found on all of the services that we offer.

GEA Geotechnical & Environmental Associates