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The Coach House, 50A Belsize Square, London, NW3 4HN

Basement Movement Monitoring Specification

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1.0 SCOPE OF WORKS

The works comprise:

The installation of instruments as detailed in Section 3 at the locations shown in Appendix C of this document.

The monitoring of the above instrumentation is in accordance with Appendix A. The number and precise locations of instruments specified may change during the works; this shall be subject to agreement with the Client, Party Wall Surveyor and Engineer.

All instruments are to be adequately protected against any damage from construction plant or private vehicles using clearly visible markings and suitable head protection e.g. manhole rings or similar. Any damaged instruments are to be immediately replaced or repaired at the Contractors own cost.

The Main Contractor shall be responsible for the following:-

- Reporting of all data in a manner easily understood by all interested parties.

- Co-ordination of these monitoring works with other site operations to ensure that all instruments can be read and can be reviewed against specified trigger values both during and post construction.

- Regular site meetings between with the Clients Design Team and Party Wall surveyors to review the data and their implications.

In addition, the Main Contractor will have responsibility for the following:

- Review of methods of working/operations to limit movements, and

- Implementation of any emergency remedial measures if deemed necessary by the results of the monitoring.

For all precise levelling and remote horizontal monitoring, the base reading measurements are to be tied back to a bench mark which is to be substantially outside the zone of influence of the ground movements induced by the proposed development or other nearby works by others.

Table I summarises the instrument types and uses proposed at the properties to be monitored.

The Main Contractor shall allow for locations as outlined in Appendix C on each of the neighbouring structures described in Table 1. These locations are to be agreed with the Main Contractor and relevant Party Wall Surveyors.

Table I Instrumentation

Item	Instrumentation Type
sheet piled walls	Cast-in inclinometers
Adjacent Buildings: Ground settlement monitoring	Levelling points or reflectors building Party Wall

Base reading measurements for the levelling must be tied back to at least two Ordnance Survey permanent bench marks outside the zone of influence of the development or other nearby construction activities.

2.0 INTRODUCTION

2.1 General

The excavation of the semi-basement at 50a Belsize Square will lead to ground movements, in the vicinity of the excavation due to the following:

- Installation of the sheet pile & retaining wall;
- Excavation within the retaining wall;
- Potential dewatering of the basement excavation;

Estimated lateral deflections of the Retaining Wall during the various stages of construction will be undertaken by a Specialist Sub Consultant appointed by the Main Contractor. Detailed calculations will follow to demonstrate these estimated deflections. This Specification is aimed at providing a strategy for the monitoring of potential ground and building movements at the site. The monitoring is a check to confirm predicted building movements are not exceeded.

2.2 This Specification

This Specification is intended to define a background level of monitoring. The Main Contractor may choose to carry out additional monitoring during critical operations. Monitoring that is to be carried out is as follows:

- Horizontal movements of the perimeter wall in the vicinity of immediately adjacent structures.
- Movements both vertical and horizontal of the facades of the adjacent buildings.

- Monitoring of any existing cracks in the adjacent buildings.

All instruments are to be protected from interference and damage as part of these works.

Access to all instrumentation for reading shall be the responsibility of the Main Contractor and they shall be in sole charge for ensuring that all instruments can be read at each visit. The Main Contractor will be responsible for ensuring that all the instruments specified are fully operational at all times and any defective or damaged instruments are immediately identified and replaced.

The Main Contractor shall be fully responsible for reviewing the monitoring data with the Instrumentation Engineer before passing onto Conisbee, determining its accuracy and assessing whether immediate action is to be taken by him and/or other contractors on site to prevent damage to instrumentation or to ensure safety of the site and personnel. All work shall comply with the relevant legislation, regulations and manufacturer's instructions for installation and monitoring of instrumentation.

2.3 Applicable Standards and References

The following British Standards and civil engineering industry references are applicable to the monitoring of ground movements related to activities on construction works sites:

CIRIA SP 201 – Response of buildings to excavation-induced ground movements,

SPERW – Specification for Embedded Retaining Walls.

3.0 GENERAL ITEMS

3.1 Site Description

The site is located at The Coach House, 50A Belsize Square, London, NW3 4HN. It is proposed to construct a single storey basement with 3 storeys above.

The previous building occupying the site is to be demolished. The existing building had a semi-basement on the site with solid masonry retaining walls around the perimeter of the site.

To form the new basement, it is proposed to use sheet piles along the front elevation with the pavement, and to traditional underpin the boundary walls in a two stage sequence to form a new rc retaining wall. Once the underpin wall has been constructed, the original boundary wall will be demolished.

3.2 Definitions

In this Specification the following works and expressions shall have the meanings assigned to them:

"Works" mean the permanent works in the installation of all instruments specified and their protection from damage, including all temporary works required for the completion of the permanent works.

3.3 Adjacent features

The following buildings are adjacent to the proposed excavation and may be affected by proposed construction activities:

Structure (Address)	Comment
50 Belsize Square	This property is to the side of the development. The property is load bearing masonry, with [assumed] timber floors. A semi-basement runs the length of the building.
Gardens Boundary Wall – to perimeter	A brick boundary wall is located in the rear garden at perimeter of the site. This is found on (shallow) strip footings.

3.4 Services

Below ground drainage information will be provided by Conisbee.

All other service information will be available from the Architect.

3.5 Health and Safety

The Monitoring Contractor shall produce health and safety method statements for the installation and survey monitoring system for these works. The Health and Safety plan shall include the trigger values for movements presented in Appendix B of this specification

4.0 SPECIFICATION FOR INSTRUMENTATION

4.1 General

The Monitoring Contractor is required to monitor, protect and reinstall instruments as detailed in Appendix C. The readings are to be reported as specified in Section 4 of this Specification.

The following instruments are defined:

Inclinometer: A device that allows for the measurement of horizontal deflection in a vertical plane on 2 diametrically opposed axes.

Levelling Points: A Hilti nail (or similar) placed into the ground or cast below ground for protection in concrete slab on which the staff is held. The head of the nail or similar should be protected when not in use.

Horizontal and vertical position monitoring targets: A device to be monitored by EDM, Distomat or similar to measure precise 3D horizontal and vertical movement. Targets or reflectors can be removable.

Tell-tales and 3 stud sets: A device which allows measurement of movement in cracks to be made in two axes perpendicular to each other.

4.2 Levelling Datums

All levels shall be reported relative to Ordnance Datum. The Main Contractor shall establish remote permanent datums (with reference to OS datums) outside the zone of influence of the works. The remote datums shall be carefully chosen to avoid ground movements from any other construction works or developments in the vicinity of the site. The location of these datums shall be agreed with the Clients Consultants and Party Wall Surveyor before the start of any works. All level monitoring surveys are to be tied back to the permanent datums after each round of surveying.

4.3 Monitoring of Sheet pile Wall Deflection

The deflection of the sheet pile wall shall be monitored using 6 inclinometers. Should this not be possible due to the construction method of the piles, inclinometers should be installed immediately outside of the pile wall at the scheduled locations.

4.4 Levelling points

Reflectors or targets to be fixed to all the buildings for the recording of 3D vertical and horizontal movements as may arise during dewatering, excavation and construction. These reflectors must be protected against damage and disturbance.

Three lines of surface survey points are required to the existing boundary wall to be retained at approximate floor levels and eaves level. These points could be prone to damage and should be protected as in Section 3.10

4.5 Monitoring of existing cracks

The locations of tell-tales or Demec studs to monitor existing cracks shall be agreed with the CM and appropriate Party Wall Surveyor.

4.6 Instrument Installation Records and Reports

Where instrumentation is to be installed or reinstalled the Monitoring Contractor shall make a complete record of the work, including the position and level of each instrument. The records shall include base readings and measurements taken during each monitoring visit. Both tables and graphical outputs of these measurements shall be presented in a format to be agreed with the Main Contractor and Clients Consultants. The report shall include photographs of each type of instrumentation installed and clear scaled sections and plans of each instrument installed. This report shall also include the supplier's technical fact sheet on the type of instrument used and instructions on monitoring.

Two signed copies of the report shall be supplied to the Clients Consultants within one week of completion of site measurements for approval.

4.7 Installation

All instruments shall be installed to the satisfaction of the Main Contractor. No loosening or disturbance of the instrument with use or time shall be acceptable. All instruments are to be clearly marked to avoid damage.

All setting out shall be undertaken by the Main Contractor. The precise locations will be agreed by the Main Contractor prior to installation of the instrument.

The installations are to be managed and supervised by the Main Contractor.

4.8 Monitoring

Ambient temperatures shall be recorded during monitoring. The frequencies of monitoring for each Section of the Works are given in Appendix A.

The following accuracies shall be achieved:

Surface Survey / Retaining Walls

Precise Level (vertical/horizontal)	+/- 1.0mm
Positional survey of instrumentation locations	+/- 10.0mm
Crack monitoring	+/- 0.5mm
3D reflectors Triangulation / traverse Survey of Instruments	+/- 0.1mm
Triangulation / traverse survey of instruments	+/- 1.0mm

4.9 Protection of Instruments

The Main Contractor is required to protect all instruments over the period of the works.

If any instruments are damaged during the works the Main Contractor shall notify the Client and provide details of additional instruments to replace or repair those damaged.

5.0 REPORT OF RESULTS AND TRIGGER LEVELS

5.1 General

Within 24 hours of taking the readings, the Main Contractor will submit a single page summary of the recorded movements. All readings shall be immediately reviewed at site level by the Main Contractor and appropriate contractors.

Within five working days of taking the readings the Main Contractor shall produce a full report (see below).

The following system of control shall be employed by the Main Contractor and appropriate contractors for each section of the works. The Trigger value, at which the appropriate action shall be taken, for each section, is given in Appendix B.

CATEGORY	**ACTION**
AMBER	Increase monitoring and undertake a detailed review of construction methods. Prepare a revised method of working
RED	Stop any further excavation. Review monitoring and implement revised plan

Any movements which exceed the amber trigger levels given in Appendix B shall be immediately reported to the Client and appropriate remedial measures be implemented to arrest further movements, and hence prevent damage.

5.2 Standard Reporting

In addition to any copies requested by the CM, 1 no. bound colour copies of the report shall be submitted to the Main Contractor for forwarding to the Clients Design Team.

The Main Contractor shall report whether the movements are within (or otherwise) the Trigger Levels indicated in Appendix B. A summary of the extent of any demolition, excavation, temporary works, new construction etc. and any other significant events shall be given. These works shall be shown in the form of annotated plans (and sections) for each survey visit both local to the instrumentation and over a wider area. The associated changes to readings at each survey or monitoring point shall be then regulated to the construction activity so that the cause of any change, if it occurs, can be determined.

The Main Contractor shall also give details of any events on site which in his opinion could affect the validity of the results of any of the surveys.

The report shall contain as a minimum, for each survey visit the following information:

- The date and time of each reading;
- The weather on the day;
- The name of the person recording the data on site and the person analysing the readings together with their company affiliations;
- Any damage to the instrumentation or difficulties in reading;
- The calibration constraints or equations that are being applied;
- Changes to read out boxes or equipment etc. used in the works;
- Tables comparing the latest reading with the last reading and the base reading and the changes between these recorded data;
- Graphs showing variations in vertical and horizontal movements and opening of the crack width with time for the crack measuring gauges;
- Variation of water levels against time and with depth below ground; and

Construction activity as described. It is very important that each set of readings is associated with the extent of excavation and construction at that time. Readings shall be accompanied by information describing the extent of works at the time of readings.

Spreadsheet columns of numbers should be clearly labelled together with units. Numbers should not be reported to a greater accuracy than is appropriate. Graph axis should be linear and clearly labelled together with units. The axis scales are to be agreed with the Main Contractor before the start of monitoring and are to remain constant for the duration of the job unless agreed otherwise. The specified trigger values are also to be plotted on all graphs.

The results are to be presented on a spreadsheet using the latest version of Excel. All computer data files and calculation sheets used in processing the data, including graphs, shall be preserved until the end of the contract.

The reports are to include progress photographs of the works both general to the area of each instrument and globally to the main Works. In particular, these are to supplement annotated plans/sections described above. Wherever possible the global photographs are to be taken from approximately the same spot on each occasion. The locations of these points on site are to be provisionally agreed with the Main Contractor at the start of the Works.

5.3 Erroneous Data

All data shall be checked for errors by the Main Contractor prior to submission. If a reading that appears to be erroneous (i.e. it shows a trend which is not supported by the surrounding instrumentation), he shall notify the Client immediately, resurvey the point in question and the neighbouring points and if the error is repeated, he shall attempt to identify the cause of the error. Both sets of readings shall be processed and submitted, together with the reasons for the errors and details of remedial works. If the error persists at subsequent survey visits, the Main Contractor shall propose how the data should be corrected. Correction could be achieved by correcting the readings subsequent to the error first being identified to a new base reading.

The Main Contractor shall rectify any faults found in or damage caused to the instrumentation system for the duration of the specified monitoring period, irrespective of cause, at his own cost.

5.4 Trigger Values

Trigger values for maximum movements as listed in Appendix B. If the movement exceeds these values then action may be required to limit further movement.

It is important that all neighbouring points (not necessarily a single survey point) should be used in assessing the impact of any movements which exceed the trigger values, and that rechecks are carried out to ensure the data is not erroneous. A detailed record of all activities in the area of the survey point will also be required as specified elsewhere.

5.5 Responsibility for Instrumentation

The Main Contractor shall appoint a qualified person [Instrumentation Engineer [IE] to be responsible for managing the installation of the instruments and reporting to the Main Contractor of the results in a format which is user friendly to all parties; and immediately reporting to all parties any damage, complaints or compensation claims for damage. This person shall be responsible for informing the Main Contractor of any movements which exceed the specified trigger values listed in Appendix B so that the Main Contractor can implement appropriate procedures. He shall immediately inform the Main Contractor of any decisions taken.

The Main Contractor shall regularly review the survey data before the data is passed on to Conisbee in respect to : ensuring that all instruments specified can be read at the specified monitoring periods; checking accuracy and validity of readings with respect to local construction activity and trigger values listed in Appendix B; instructing further reading where there is doubt; reporting and implementing previously agreed emergency procedures where required; ensuring all processed data and reporting is clear and in a manner easily understood.

The CV of the Instrumentation Engineer shall be submitted to Conisbee for approval. The Instrumentation Engineer shall have at least 10 years suitable experience. He shall not be replaced without the approval of the Main Contractor. Should the Main Contractor consider during the monitoring works that the Instrumentation Engineer is unsuitable for the tasks, a suitable replacement agreeable to the Main Contractor and Client shall be found at no additional cost to the project.

6.0 DRAWINGS AND METHOD STATEMENTS

The Monitoring Contractor shall submit the following information:

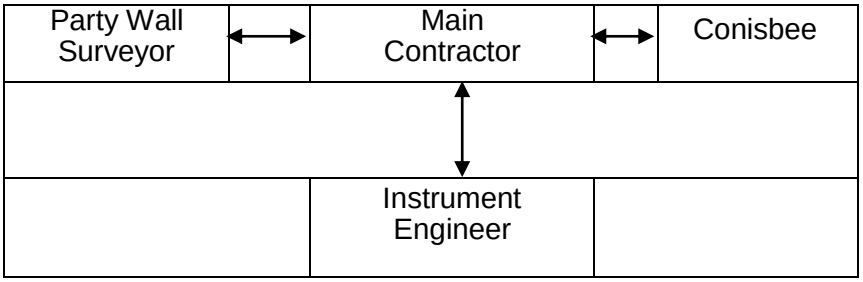
- Details of the types of instruments to be used;
- CV of Instrumentation Engineer and his company affiliation;
- Details of specialist Sub-contractors to be used for approval of the Main Contractor.
- Typical format (tables and graphs) for presenting movement and water monitoring data and any software used;
- Details of the protection works to all instruments; and
- Information requested in clause 4.5

The Main Contractor shall provide the following:

- Contingency measures to be taken should movements exceed permitted trigger levels. Also, what allowance is made in the programme for these measures to be put in place should it be required.

7.0 SITE MANAGEMENT STRUCTURE

The site management structure and responsibilities shall be as defined below:



APPENDIX A

MONITORING FREQUENCY

INSTRUMENT	FREQUENCY OF READING
Wall deflection inclinometers	Pre-construction None – installed with piles or immediately thereafter. Installation of pile walls 3 No. Base line measurements,during excavation, and basement construction Monitored once a week during excavation unless directed by the Main Contractor who may require more frequent readings. Post construction works To be agreed with Main Contractor but typically once a month for up to six months.
Survey of reflectors on buildings	Pre-construction Monitored on three occasions first thing in the morning, midday and evening to determine base line and trends. Installation of contiguous pile walls Monitored twice a week during pile installation. During excavation, installation of temporary works and basement construction Monitored once a week during excavation unless directed by the Main Contractor who may require more frequent readings Post construction works To be agreed with Main Contractor but typically once a month for up to six months.

Monitoring existing cracks	Pre-construction Monitored on three separate occasions prior to works. Installation of sheet pile/contiguous pile walls Monitored twice a week during pile installation. During excavation Monitored once a week during excavation unless directed by the Main Contractor who may require more frequent readings. Post construction works To be agreed with Main Contractor but typically once a month for upto six months.

APPENDIX B

TRIGGER LEVELS

The following trigger levels should be adhered to when constructing the basement.

	AMBER [mm]	RED [mm]
VERTICAL MOVEMENT OF ADJACENT GABLE WALL ELEMENT AT BELSIZE SQUARE [in either direction]	5.0mm	10.0mm
VERTICAL MOVEMENT OF ADJOINING BOUNDARY WALL [in either direction]	8.0mm	15.0mm
LATERAL MOVEMENT OF BASEMENT RETAINING WALL(S)		
Building wall / head of pile	6.0mm	12.0mm
Inclinometer	12.0mm	15.0mm

APPENDIX C

LOCATIONS FOR REFLECTOR MONITORING POINTS AND INCLINOMETERS

Existing gable wall to Belsize Square

- 4 points to the flank wall of the adjacent property are proposed along the approximate floor/eaves lines. i.e 12 monitoring points evenly spaced over gable in total.

Existing boundary wall structure around the perimeter of the site

- Monitoring points at 2m horizontal internals along the boundary walls to be retained are proposed.

New retaining wall structure

- It is proposed to monitor the top level of the new retaining wall structures at 3m intervals along the head of the walls (i.e ground level)