Client: Deroda Investments Ltd c/o MDesign
Construction Management Plan

Document Number : KB/CMP/73-75/AV
Draft : November 2014

Knight Build Ltd

CONSTRUCTION MANAGEMENT PLAN

73-75 Avenue Road
London
NW8 6JD

Knight Build Ltd
Childerditch Industrial Park
Childerditch Hall Drive
Brentwood, Essex
CM13 3HD
Tel: 01277 810777

ISO 9001 REGISTERED FIRM
ISO 14001 REGISTERED FIRM
OHSAS 18001 REGISTERED FIRM

Construction Management Plan	
Business Unit: Knight Build Ltd	
Project: **73-75 Avenue Road** **London** **NW8 6JD**	Project Overview
	The demolition of the existing building and the construction of a single-family dwelling house comprising basement, lower ground, ground, first and second floor level, erection of a new boundary wall, hard and soft landscaping and associated works. Once the substructure and superstructure are complete the building shall be fitted out and finished to a high specification. Tree protection Site set up and welfare Disconnection of existing services Erection of hoarding and scaffolding. Establish traffic management including loading bay. Soft strip of existing building. Demolition of existing building. Underpinning and structural works. Piling operations Substructure works Waterproofing Drainage and ducts Superstructure Roof construction. Shell and core Fit out New boundary walls Soft and hard landscaping

Knight Build Ltd

73-75 Avenue Road
London
NW8 6JD

Construction Management Plan

Prepared by

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Approved by Richard O'Leary
Knight Build Ltd

Client Deroda investments Ltd c/o MDesign

Date issued November 2014

The agreed contents of the Construction Management Plan must be complied with unless otherwise agreed with the council. The project manager shall work with the Council to review this Construction Management Plan if problems arise in relation to the construction of the Development. Any future revised plans must be approved by the council and complied with thereafter.

Contents

1 Introduction

The purpose of this document is to:

- Identify and communicate the Project Director's planned arrangements for realising customer, regulatory and the business's own requirements and objectives
- Assist the Project Manager in mobilising and managing the Project
- Inform internal and external parties of the resources and processes employed
- Define nominated roles and responsibilities
- Enable checks to be undertaken to confirm that the processes operated are suitable, adequate and effective
- Support **Knight Build's** core values namely openness, professional delivery, collaboration, and focus on sustainable, profitable growth, mutual dependency and innovation.

Compliance with requirements will be monitored and audited and improvement opportunities sought throughout the duration of the Project.

1.1 Amendment Record

Date	Rev. No.	Brief Description of Amendment
		Refer to drawing register

1.2 Distribution List

The site team will ensure that the following hold the latest version of this document whether by e-mail or hardcopy. Hardcopies will be issued under cover of a letter or Document Transmittal Sheet.

Recipient	Position	Address
TBC	TBC	TBC
TBC	TBC	TBC
TBC	TBC	TBC
TBC	TBC	TBC
TBC	TBC	TBC
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TBC	TBC	TBC
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2 Project Scope & Overview

The demolition of the existing building and the construction of a single-family dwelling house comprising of basement, lower ground, ground, first and second floor level, erection of a new boundary wall, hard and soft landscaping and associated works.

Once the substructure and superstructure are complete the building shall be fitted out and finished to a high specification.

Tree protection

Site set up and welfare

Disconnection of existing services

Erection of hoarding and scaffolding

Establish traffic management including loading bay

Soft strip of existing building

Demolition of existing building

Underpinning and structural works

Piling operations

Substructure works

Waterproofing

Drainage and ducts

Superstructure

Roof construction

Shell and core

Fit out

New boundary walls

Soft and hard landscaping

2.1 Existing On-site Conditions

The site is located at 73-75 Avenue Road in Camden which runs in a broadly north to south direction between Finchley Road and Prince Albert Road.

The site is bounded by Avenue Road to the east and Queens Grove to the south, with adjacent residential properties forming the north and west boundaries.

There are currently two points of vehicular access to the site on Avenue Road which are located either side of an adjacent pelican crossing.

The accesses provide entry and exit to off-street parking which is provided along the site frontage on an area of hard-standing which can accommodate approximately 3vehicles.

The site currently accommodates a single family house with a separate single storey enclosed swimming pool.

Whilst the site is not in a conservation area, it is located adjacent to St John's Wood conservation area and Elsworthy conservation area.

3 Legal and Other Requirements

Statutes, British Standards, Approved Codes of Practice and the like relevant to the Project are maintained on the internet.

Registers of generally applicable health and safety and environmental legislation are maintained on the internet respectively. Additional Project specific legislation and legal requirements include:

3.1 Project Documentation

The Project is based on the following as retained by the Project Manager:

Document	Date	Rev No
Employers Requirements and Drawings	TBC	
Construction Drawings and Specification	TBC	
Contract	TBC	
Construction Phase Health and Safety Plan	TBC	
Construction Management Plan	TBC	
Quality Plan	TBC	
Waste Management Plan	TBC	
Inspection & Test Plan	TBC	
Emergency Plan	TBC	
Health and Safety File	TBC	

3.2 Significant Project / Milestone Dates

Milestone dates include the following

Event / Activity	**Date**
Start on site	TBC
Project Completion	TBC

3.3 Objectives and Targets

Objectives are aimed at satisfying the client's needs including, customers, employees, regulators and other parties with interests in Knight Build's performance.

3.4 Information Required from the Client

- Pre-contract Health and Safety Plan
- Health and Safety file

3.5 Working Hours

Normal Hours of Work	Monday - Friday	08.00 to 18.00
	Saturday	08 00 to 13.00 By arrangement only
	Sunday	No working

Any work outside these hours shall require the specific approval from the Project Manager.

3.6 Key Staff Emergency Contact Numbers

John Knight 07939 016007

Richard O'Leary 07951 902442

Knight Build Ltd will operate a Quality System to BS EN ISO 9001: 2008 using Knight Build Ltd Quality Assurance Manual and Procedures.

These Procedures are listed as follows;

Procedure Ref	Title	ISO 9001 Clause
QP4	Quality Management System	4.1, 4.2, 4.2.1, 4.2.2, 4.2.3, 4.2.4.
QP5	Management Responsibility	5.1, 5.2, 5.3, 5.4, 5.4.1, 5.4.2, 5.5, 5.5.1, 5.5.2, 5.5.3, 5.6, 5.6.1, 5.6.2, 6.6.3.
QP6	Resource Management	6.1, 6.2.1, 6.2.2, 6.3, 6.4
QP7	Product Realisation	7.1, 7.4, 7.4.1, 7.4.2, 7.5, 7.5.1, 7.6,
QP8	Measurement, analysis and Improvement.	8.1, 8.2, 8.2.2, 8.3, 8.5, 8.5.2, 8.5.3

4 Management Quality System

4.1 Induction

All persons visiting or working on the Knight Build project must receive an appropriate induction before entering the work area.
The inductions will take place in the Knight Build project office.

On arrival to site, operatives must attend a method statement briefing by their employers before attending Knight Build's safety induction.
At the induction, Knight Build require to see evidence of CSCS competence for all operatives and CPCS plant training where appropriate.

Knight Build inductions will take place at 8.30am every day/by arrangement.

Re-inductions would be required for any operative who has been issued with a penalty for breaking site rules. These would be required the day after the penalty was issued and the re-induction would also include the supervisor.

At the start of the induction the operatives will be given a questionnaire for filling in personal details. The induction will cover the following as a minimum and it will be communicated with the aid of flip chart graphics or video:

- A welcoming message from the Project Manager
- Brief detail of the project
- 73-75 Avenue Road Site layout, Welfare facilities & First Aid
- Emergency Evacuation Procedures
- See It, Say It
- Worker Engagement
- Manual Handling
- Dust and Emissions
- Lifting Operations and Procedures
- Use of Plant
- Permit to work
- Temporary Works & the use of Scaffold
- Do's & Don'ts
- Site Rules
- Tool Box talks & Method Statements
- COSHH
- Delivery & Storage of Materials
- Disposal of Waste
- Reward & Disciplinary Procedures
- PPE & Knight Build Dress Code
- Use of Alcohol or drugs
- Considerate Constructors Code of Practise

At the end of the induction process the operatives must demonstrate that they have seen and understood the method statements for the tasks in hand.

Visiting sub-contract managers/supervisors shall be required to attend the general induction on commencement and ensure they receive updates on any specific hazards prior to commence if their visits are infrequent.

Client representatives and other visitors shall be accompanied by Knight Build personnel **at all times** and as a result will be excluded from the induction process.

4.2 Training

The Project Manager shall ensure that all persons under Knight Build control have received suitable and sufficient training in the aspect of the area of works for which he/she is responsible. Knight Build may require evidence of such training and will, if not satisfied, direct the individuals concerned to undergo and show competence in such training as Knight Build may specify - this may include training provided by Knight Build. In addition to this, if necessary, the Project Manager shall also arrange in conjunction with the suppliers of the Specialist Contractors to provide specific training and guidance to their members of staff in the use of particular products used on the site.

4.3 First Aid

The Project Manager is to ensure that first aid facilities and trained first aiders are available in conformance with the health and safety manual and that the first aid post in the site office is marked on the site plan.

All first aid provisions will be in accordance with the First aid regulations 1981 and all updates and amendments to the regulations including 2014.

First aiders will be identified by a white cross/green background sticker displayed on their hard hats.

First Aiders

Name	Location	Tel
TBC	Site	
TBC	Site	
TBC	Site	

4.4 Accident and Incident Management

All accidents and incidents are to be reported and managed in accordance with the Knight Build accident procedure. In particular, all accidents and near misses or dangerous occurrences shall be reported to Knight Build site management who will advise the Senior Safety Advisor or Environmental Advisor, as appropriate.

All accidents will be internally investigated and reported to the HSE where necessary in line with the RIDDOR Regulations 2013.

4.5 Programme

Issued prior to commencement, copy in Appendix G

4.6 Fire Prevention

4.6.1 Informing All Personnel

- All personnel will be advised at induction of fire procedures, including the current location of fire escape routes, exits and muster point. This information will be displayed in a prominent location on site.

- Each time the procedure is changed all personnel will be advised by notices and at weekly site safety meetings.

4.6.2 Fire Safety Actions

- Inspections will be carried out and the completed sheets will be filed in the Safety Folder.
- Liaise with the Fire Brigade, where deemed necessary, to visit, inspect and give advice. All reports / comments will be issued to the Safety Adviser.

4.6.3 Basic Fire Safety Procedures

The Project Manager is responsible for ensuring that

- Fire risk assessment is available and up to date.
- A Fire marshal / warden (responsible person) is nominated.
- Fire alarms are installed to enable an audible warning to be given to everyone on site.
- Fire escape routes and exit points are clearly signed and kept clear at all times.
- Each fire point is clearly marked, and contains a CO_2 or Powder & an H_2O extinguisher and is inspected weekly.
- A hot works permit system is effectively implemented and managed.
- Regular fire drills are undertaken and recorded.

Subcontractors are responsible for ensuring that:

- All COSHH materials are removed from site in accordance with Waste Management legislation. All general waste is to be deposited in general waste skips provided by the sub-contractor.

All personnel on site have a duty to:

- Ensure escape routes are kept clear of storage hazards and obstructions at all times.
- Ensure good housekeeping is maintained and prevent the accumulation of combustible material.
- Remove unwanted materials at regular intervals.
- Ensure all waste material awaiting disposal is kept in an area away from temporary buildings, stores or equipment.
- Not burn rubbish on site

4.6.4 Smoking Restrictions

Smoking is strictly prohibited in all areas, apart from a designated smoking area that will be established on site away from the view of the public.
There will be NO SMOKING allowed by operatives or any other site users outside the hoarding or the boundary of the site.

4.6.5 Highly Flammable Gases, Liquids and other Materials

- All specialist contractors are to undertake a job specific risk assessment for the storage and use of the above materials. This assessment will also incorporate the identification of specific fire hazards, risks and precautions.

- The results of risk assessments are to be communicated to Knight Build. Persons exposed to specific fire risks are to be informed accordingly.
- Specialist contractors are to provide their own labelled designated secure storage enclosures. These enclosures shall enable separation of different gases and full and empty bottles. The location of these is to be agreed with Knight Build site management.

  The storage of all dangerous materials on site will adhere to 'The Dangerous Substances and Explosive Atmospheres Regulations 2002' (DSEAR).

4.7 Emergency Procedures

The Project Manager will ensure that the Emergency Plans at Appendix D are maintained up to date and that direct and subcontractor employees are briefed with applicable fire safety, environmental and emergency evacuation procedures. He will also ensure that trials are carried out to ensure the effectiveness and practicability of the procedures.

- Spillage of fuel or chemicals - See, Appendix E1 – Spillage Procedure.
- Evacuation from a confined space.
- Recovering a fallen worker suspended by a harness.
- Where recovery of an injured or incapacitated person would be complicated because of circumstances or location e.g. a deep excavation or the roof.

4.8 Site Security

The site will be enclosed and secured by specific constructed hoarding and monarflex secured to the scaffold.

Where the works require removal and adaption of the hoarding / monarflex this will be carried out and completed before the end of the shift, security of the site is to be maintained at all times.

4.9 Workplace Inspections

The Project Manager will ensure that the following workplace inspections are undertaken in accordance with the Knight Build Management System.
The Project Manager will take necessary action, so far as is reasonably practicable, to remove risks identified during these inspections. Employees are to be encouraged to support Knight Build with maintaining safety on this project.

The subcontractor managers/supervisors are required to carry out work place inspections and be satisfied before operatives are put to work.

The site management must ensure that the access & egress routes to the site accommodation and place of work are clear at all times.
The Project Manager shall ensure that Environment & Safety inspection is carried out for the entire site on a weekly basis and appropriate actions are taken on items found that require actions.

Inspections of temporary works/scaffold shall be carried out by competent persons and logged in the safety file.

4.10 Communications

As part of our commitment to open communication, we will inform our clients of all issues that might reasonably be relevant to them. Requests for information from the media / similar external bodies are to be referred to the client or their representatives.

Communication/Consultation with the workforce is carried out in the following manner.

Project Level

Pre-award & Pre-start Meetings - Safety matters are discussed at the pre-commencement meetings and at the regular specialist contractors' progress meetings. A monthly Directors Safety meeting will be also held on site to discuss issues that concern Knight Build Ltd. Attendance to the meeting by all directors is mandatory.

Safety & Environmental meetings – The weekly Progress Meeting with the sub-contractor/s will include safety and environmental items, they will be held in the Knight Build Project office. Attendance to this meeting is mandatory. All Issues that are raised and discussed shall be rectified and recorded. Minutes of meetings will be distributed to site staff and the subcontractor/s.

Morning Co-ordination Meeting – A brief meeting is held every day between 8.00- 8.10 am to discuss daily safety issues, logistics, and proposed works for the day, and interface of works, expected visitors and deliveries. Project / Site manager or an appointed person is expected to attend this meeting.
Any issues that had arisen the previous day will also be discussed.

Site Operative Level

Toolbox and method statement briefings are given to all operatives and trades.

Individual Level

To improve the safety level on site, Knight Build has an open door policy where we would expect feedback from the workforce and others who may have concerns on current safety issues or suggestions for improvement. This could be done by bringing the issue to the attention of any Knight Build member of staff.
Knight Build will also carry out operative engagements with individuals or groups to either develop on good practice or rectify poor practice.

All engagement / consultation with employees or other site operatives will be carried out in line with the 'Consultation with Employees Regulations 1996'.

4.11 Site Rules

The Site Rules, which are contained in Appendix F, are displayed in the site canteen and communicated during site inductions.

4.12 Permit to Work Systems

The following require permits:

Type of Permit	Issued by
Hot works	Nominated Knight Build personnel only
Permit to Dig	Nominated Knight Build personnel only

Permit to enter excavation or confined space	Nominated Knight Build personnel only
Permit to Strike/ Dismantle	Temporary works co-ordinator
Demolition Permit	Nominated Knight Build personnel only
Permit to Load	Temporary works co-ordinator

Hot Works Permit

- All hot works activities undertaken are strictly controlled and co-ordinated by Knight Build.
- Persons undertaking hot works are to be suitably trained and competent.
- The nominated person will issue the permit on a daily basis after undertaking an appropriate assessment of the nature of the works and associated fire risks.
- The permit recipient is expected to sign in the hot works permit by confirming to undertake the responsibility for taking necessary safety precautions to the area where the hot works is to be carried out.
- Hot works permit cannot be collected for and on behalf of another person.
- The person undertaking hot works shall provide their own suitable fire extinguisher for the task in hand. The fire extinguishers provided by Knight Build at the fire points shall not be removed for this purpose.
- Hot works operations shall cease at least 1 hour before the end of that shift to allow for a final inspection by the issuer, permits must then be signed off.
- There will be a board positioned to display the areas where the hot works are currently being carried out.
- All hot works permit must be logged in and closed out on a daily basis. The register of this shall be kept in a place where it can be accessed at any time.
- All permit holders are to wear a permit vest which is to be issued by the Knight Build site team. The vest is to be returned at the same time as the signed off permit.

4.13 Reward and Discipline

To promote a positive health, safety and environmental culture, Knight Build operates reward and discipline schemes.

The reward will be issued monthly to individuals who complete the Knight Build “See it, Say It” cards with the best safety comments/observations/concerns or any other general comments. This will be linked to attitudes of safety on site and good working practices.

Penalties are issued for breaches of site rules. Major breaches or repeat offenders will result in removal of the responsible operatives from site.

4.14 Risk Management

The hazards specific to this project have been identified and are included in Appendix C. The Project Manager will ensure that all aspects of the works controlled by Knight Build are subject to formal risk assessments carried out by competent persons. This will normally be carried out by the specialist contractor and agreed through the method statement approval process.

A Risk Register shall be maintained as Appendix C or similar.

Where risks to the long term health of construction operatives exists as a consequence of the type of work or construction process being undertaken, the

materials used or the work environment, a specific and detailed Risk Assessment must be carried out. This may include comprehensive:

- Noise Assessments.
- Control of Dust and Emissions.
- Whole Body or Hand Arm Vibration (HAVS) Risk Assessments
- Manual Handling
- Risk Assessment for exposure to potentially hazardous substances (COSHH).

4.15 Personal Protective Equipment

Specialist Subcontractors

Their employers shall issue all operatives with suitable PPE for the task in hand. Operatives are expected to inform Knight Build Ltd if their employers do not issue them with the appropriate PPE. Knight Build would take appropriate action to ensure that PPE would be available to them.

All Knight Build personnel employed on the site and for those visiting Knight Build staff will be issued with appropriate PPE for the task in hand.

Both Knight Build and subcontractors must keep adequate supply of these on sites.
The following is **MANDATORY** on this site:

- Hard hats
- Safety steel toe capped boots
- High visibility jackets (generally a yellow colour-except for a banks man where an orange colour will be used)
- Gloves – (Appropriate as identified by the specialist subcontractor)
- Eye protection – (Relevant to the task at hand)

All PPE / RPE issued and worn on site is in accordance with the ‘Personal Protective Equipment Regulations 2002’ and relevant European EN standards.

4.16 Non-conformance

All non-conformances are to be reported and managed in accordance with non-conformance procedures.

Details that describe the non-conformance process will include or make reference to:

- Correction (carry out rework or repair)
- Corrective action (measures to prevent recurrence)
- Preventive action (measures to prevent occurrence)

4.17 Delivery, Storage and Distribution of Materials

All deliveries shall be notified to Knight Build at least 24 hours before arriving on site so as to avoid congestion and delay in unloading.

Details of proposed deliveries are to be advised at the morning co-ordination meetings when storage locations are to be agreed.

All sub-contractors are to have a method statement and risk assessment carried out for unloading from flatbed vehicles/trailers.

All vehicles must have safety rails fitted or means to protect operatives working from the back of a lorry.

Knight Build Ltd are members of the Fleet Operator Recognition Scheme (FORS) and encourage all associated supplies to achieve Bronze membership at a minimum if they are delivering to Knight Build sites.

The FORS standard is a voluntary scheme with a purpose of raising the level of quality within fleet operations.

The FORS standard is based upon legal compliance, safety, efficiency and environmental protection.

4.18 Site Traffic Management and Access

Refer to the Site Traffic Management and access in Appendix H. This will be reviewed as and when necessary.

4.19 Plant

Only qualified and trained operatives shall be permitted to operate plant and machinery. This includes abrasive wheel and cartridge-powered tools. All plant operators must hold an appropriate and valid CPCS card. Copies of training certificates are required and must be made available to Knight Build at the induction prior to commencing work.

Plant and equipment shall be inspected prior to its use on each occasion, regularly serviced and maintained in a good working order to ensure that the exhaust emissions are of best possible quality and noise emissions are as low as feasible. Compressors/generators shall be positioned in such a way there is adequate ventilation to avoid build of toxic fumes. A copy of weekly plant inspection forms shall be given to Knight Build.

A plant register shall be maintained showing the type of plant used on site. All plant that is used for lifting purposes on site must have a valid certificate laid down under the “Lifting Operations and Lifting equipment Regulations 1998” (LOLER). These certificates shall also be kept in the site safety file.

The method of refuelling shall be appropriate to minimise the risk of spillage and any oil leaks will be attended to before a significant hazard occurs.

4.20 Temporary works

All temporary works will be controlled in accordance with the Knight Build Temporary Works Procedure and coordinated by the nominated Temporary Works Co-ordinator. See section 6 for project roles and responsibilities.

4.21 Lifting Operations (including Hoists)

The management of all Lifting Operations will comply with Knight Build, Lifting Operations procedure. All plant and equipment involved in lifting operations, including hoists, will be identified, certificated and entered onto an up-to-date register. A register of weekly inspections will be held on site and as detailed in the Lifting Operations.

Lifting Plans will be compiled and issued to site for all lifting plant and equipment by the KBL Appointed Person.

The blank record sheets will be held in the site safety record folder the Project Manager should ensure that they obtain a set of record sheets from Knight Build.

The Project manager will be responsible and will monitor the above procedures.

4.22 Working at Height

The Project Manager is the nominated Work at Height Coordinator for the project. It will be his responsibility to ensure activities to be carried out at height (or depth) have been the subject of a review, and an action plan to comply with the Working at Heights Regulations is in place. The purpose of the review is to minimise the possibility of people, materials or tools falling from height or people being hit by persons, materials or equipment/tools falling from height.

4.23 Noise

Where there is a significant noise, control measures must be identified, implemented and monitored as per the guidance for employers on the Control of Noise at Work Regulations 2005.

As a guide, noise, which prevents someone from hearing another person speaking in a normal voice 1m away, requires measures to be taken. Operations shall be subject to noise assessment as required and appropriate control measures implemented in accordance with the Knight Build Construction Safety and Environmental Procedures.

All sub-contractors are to implement best practicable means to minimise noise in accordance with current regulations. Where necessary, sub-contractors shall include with their risk assessment a noise assessment that will identify the control measures to mitigate excess noise emissions. Knight Build management will halt all operations as necessary if deemed to be unreasonably noisy.

All possible steps shall be taken to reduce the noise levels to the acceptable limits. (e.g.; maintenance, alternative plant, alternative methodology, positioning of plant, acoustic screens/barriers, time spent and as a last resort with the issue of PPE).

All sub-contractors shall issue Personal Protective Equipment to their operatives to comply with the requirements of noise at work regulations 2005

Knight Build management reserves the right to halt any operations deemed to be causing an unreasonable noise level.

4.24 Control of Hazardous Substances

Any person wishing to bring onto site any hazardous substance as defined by the Control of Substances Hazardous to Health Regulations 2002 (COSHH) or with a potential to harm the environment, must notify Knight Build. They shall also provide a COSHH Assessment identifying all necessary control measures.

4.25 Protection of the Public.

The site hoarding and scaffolding around the site boundary will provide site security and preventing unauthorised access onto site. Adequate lighting and signage will be provided informing the general public it is a construction site and no unauthorised access is permitted.

A full time Traffic Marshal will be stationed outside the site during all of the working day to direct all access and egress movements of vehicles visiting the site and also ensure that all pedestrians and other road users are able to pass the site safely.

4.26 Management of Specialist Contractors

Specialist Contractors will be managed in accordance with the requirements of the Knight Build ISO procedures and management systems.

4.27 Dust and Emissions.

All site activities that may generate dust must be planed, suppression measures must be established, implemented and maintained to minimise the spreading of dust and emissions.

Knight Build will follow best practice guidance from the HSE and London councils.

(SEE CONTROL OF DUST AND EMISSIONS RISK ASSESSMENT APPENDIX K)

5 Organisation and Personnel

5.1 Organisation Chart

The project organisation chart is included in Appendix A and prominently displayed on the site notice boards.

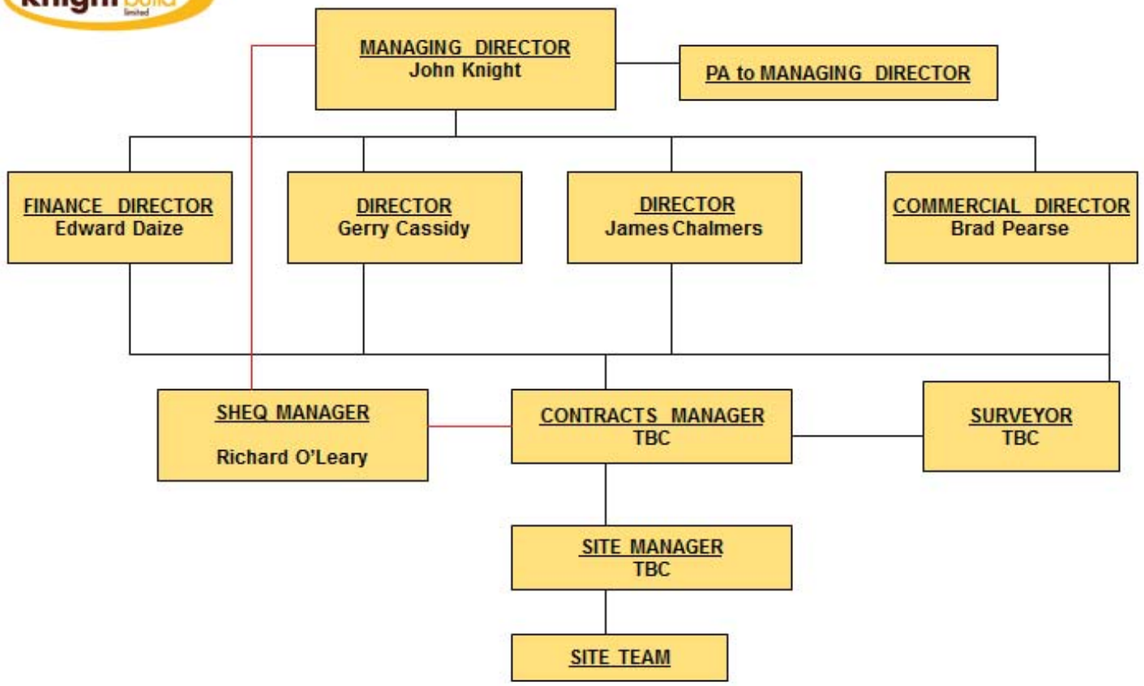
5.2 Project Directory

The Project Directory is included at Appendix B.

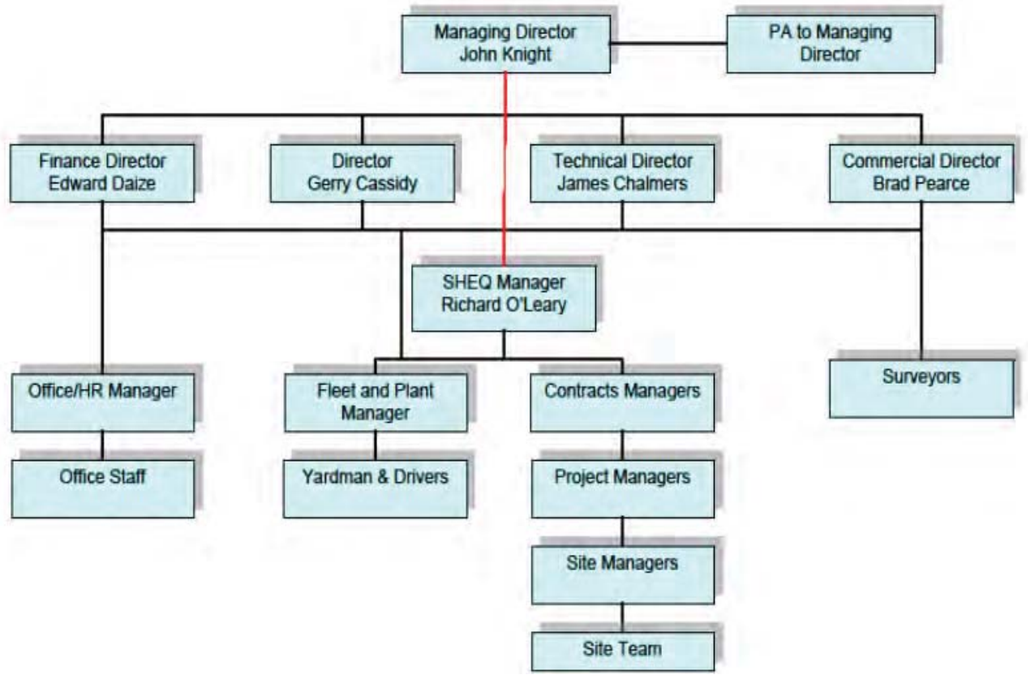
6 Appendix A – Organisation Chart

See attached

73-75 Avenue Road

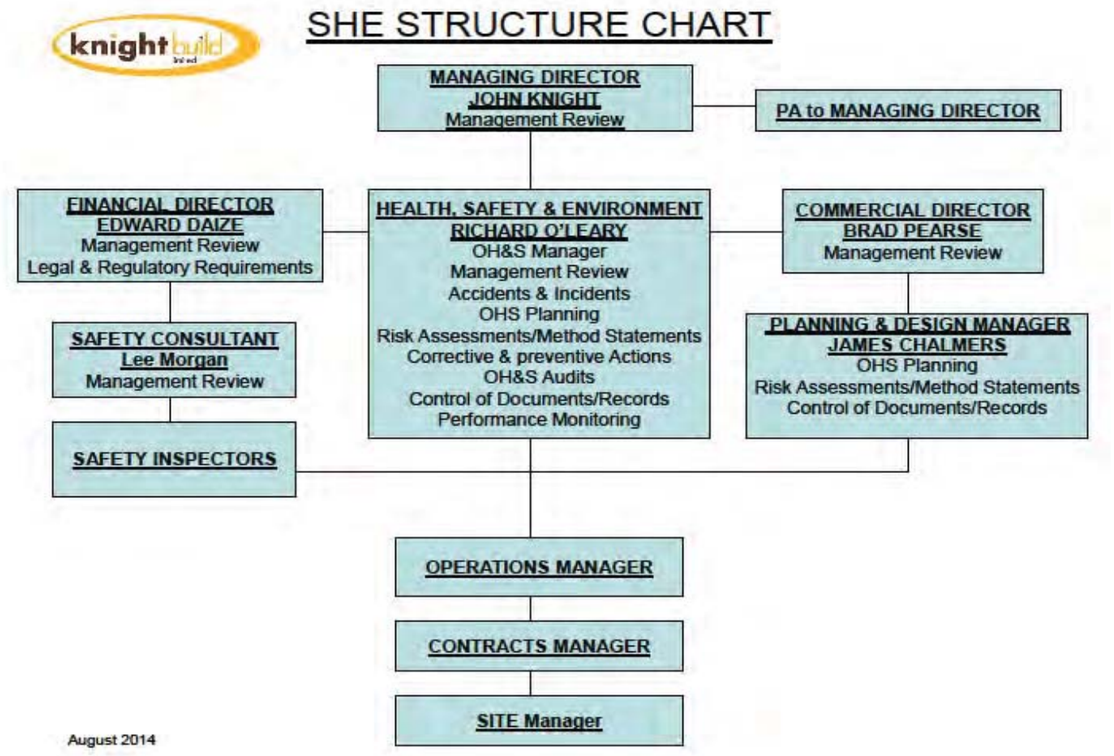


Project Management Structure



7 Appendix B – Project Directory

See attached.



	Key personnel		
	Position	**Contact**	**Contact Details**
Name	**Client** Deroda Investments Ltd c/o mdesign 25 Grosvenor Street London W1K 4QN	**Contact** Philip Gamble	**Tel:** 020 7258 8517 philip@mdesignlondon.com
Name	**Architect** Purcell 15 Bermondsey Square Tower Bridge Road London SE1 3UN	**Contact** Dimitrios Dakos	**Tel:** 020 7397 7171 Dimitrios.dakos@purcelluk.com
Name	**Structural Engineer** HEYNE|TILLETT|STEEL 77 Bastwick Street London EC1V 3PZ	**Contact** Neil Cameron	**Tel:** 0207 870 8050
Name	**M&E Consultant** Ridge and Partners LLP Harling House 47-51 Great Suffolk Street London SE1 0BS	**Contact** James Green	**Tel:** 01993 815184 jmegreen@ridge.co.uk
Name	**Interior Designer / Project Manager** mdesign 25 Grosvenor Street London W1K 4QN	**Contact** Philip Gamble	**Tel:** 020 7258 8517 philip@mdesignlondon.com
Name	**Landscape Consultant** Randle Siddeley Associates 3 Palmerston Court Palmerston Way London SW8 4AJ	**Contact** Divya Umakanth	**Tel:** 020 7627 7271
Name	**Planning Consultant** Savills 33 Margaret Street London W1G 0JD	**Contact** Katie Hale	**Tel:** 020 7420 6378 khale@savills.com
Name	**Principle Contractor.** Knight Build Ltd Unit 22 Childerditch Industrial Park Brentwood Essex CM13 3HD	**Contact** John Knight	**Tel:** 01277 810777 07939 016007 John.knight@knightbuild.co.uk

8 Appendix C – Site Environmental Risk Assessment

See attached

SITE: 73-75 Avenue Road, London, NW8

SITE ENVIRONMENTAL RISK ASSESSMENT

Form EP07-B	ENVIRONMENTAL RISKS AND OPPORTUNITIES ASSOCIATED WITH ACTIVITY														
ACTIVITY	Dust And Emissions	Noise	Vibration	Emissions & odours	Pollution of water courses	Pollution of ground water	Ground contam-ination	Archaeology	Wildlife & countryside	Wastes arisings	Recoverable materials	Use of energy	Use of water	Use of raw materials	Others (state)
Guidance Ref.															
Site survey	N/A	✓	N/A	✓	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Site set up	✓	✓	✓	✓	✓	✓	N/A	N/A	N/A	✓		✓	✗	✓	
Site clearance	✗	✗	✗	✗	✓	✗	✗	N/A	N/A	✗	✗	✓	✗	✓	
Demolition	✗	✗	✗	✗	✓	✗	✗	✓	N/A	✗	✗	✓	✗	✓	
Asbestos removal	✗	✓	✓	✓	✓	✗	✗	N/A	N/A	✗	✓	✓	✗	✓	
Waste removal & disposal	✗	✗	✓	✗	✓	✗	✗	N/A	N/A	✗	✗	✓	✗	✓	
Piling	✓	✗	✗	✓	✓	✗	✗	✓	N/A	✗	✓	✓	✓	✓	
Groundwork's	✗	✗	✗	✓	✓	✗	✗	✓	N/A	✗	✓	✓	✓	✗	
Drainage	✓	✗	✗	✓	✓	✗	✗	✓	N/A	✓	✗	✓		✗	
Concrete Activities	✗	✗	✗	✓	✓	✗	✗	N/A	N/A	✗	✗	✓	✗	✗	
Structural Erection	✓	✗	✗	✓	✓	✓	N/A	N/A	N/A	✓	✓	✓	✓	✓	
Brickwork	✓	✗	✓	✓	✓	✓	N/A	N/A	N/A	✓	✓	✓	✓	✓	
Cladding including windows	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Roads & kerbs/external works	✓	✓	✗	✓	✓	✓	✓	N/A	N/A	✓	✓	✓	✓	✓	
Services-electrical	✓	✓	✓	✓	N/A	N/A	N/A	N/A	N/A	✓	✓	✓	✓	✓	
Services-mechanical	N/A	✓	✓	✓	N/A	N/A	N/A	N/A	N/A	✓	✓	✓	✓	✓	
Roofing	N/A	✓	✓	✓	N/A	N/A	N/A	N/A	N/A	✓	✓	✓	✓	✓	
Internal partitions	N/A	✓	✓	✓	N/A	✓	N/A	N/A	N/A	✓	✓	✓	✓	✓	
Ceilings	N/A	✓	✓	✓	N/A	✓	N/A	N/A	N/A	✓	✓	✓	✓	✓	
Carpentry & joinery	N/A	✓	✓	✓	N/A	✓	N/A	N/A	N/A	✓	✓	✓	✓	✓	
Floor finishes	N/A	✓	✓	✓	N/A	✓	N/A	N/A	N/A	✓	✓	✓	✓	✓	
Decorations	N/A	✓	✓	✓	N/A	✓	N/A	N/A	N/A	✓	✓	✓	✓	✓	
Personnel, transport to/from site	✓	✓	✓	✓	N/A	N/A	N/A	N/A	N/A	✓	✓	✗	✓	✓	

SITE ENVIRONMENTAL RISK ASSESSMENT

Approved by: Richard O'Leary

Date: November 2014

Print Name: Danny O'Leary

Position: H&S Manager

Key:

✗ Site specific measures required at this site

✓ No specific requirements beyond general environmental measures

73-75 Avenue Road, London, NW8

9 Appendix D – Emergency Plan

See attached

EMERGENCY PLANNING GUIDE 73-75 Avenue Road, London, NW8

Hazard Description	Risk/s Arising	Existing Controls	Required Controls	Site Notes
FIRE – Due to planned work processes	a) People trapped ▪ Fatal injury/ies ▪ Fatal asphyxiation ▪ Burn injuries	▪ Segregation of flammable substances, gases and liquids ▪ Hot-work Permit controls ▪ Emergency evacuation plan	▲ **Explain controls at initial induction and following any variation.** ▲ **Upgrade controls in the event of any physically or disabled person being present on site.**	
	b) Compressed gases and accelerants	▪ Use restricted to named trades and specialisations ▪ Dedicated storage arrangements ▪ Signage displayed ▪ MSDS on site file ▪ Permit to Work controls	**Check:** ▲ **contractors' risk assessments/ safety method statements;** ▲ **standard of understanding and compliance;** ▲ **that compressed gases and accelerants are locked away and secured once a task is completed.**	
	c) Electrical apparatus overheating or being overloaded	Controls include: ▪ Anticipated load calculated and allowed for ▪ All portable electrical appliances and leads subject to PAT requirements ▪ Supply subject to quarterly planned inspections.	**Check:** ▲ **and confirm PAT compliance.** ▲ **daily - MDUs OUs for damage or defects etc;** ▲ **and record the cause/s of any power failure;** ▲ **at least three-monthly examination and report of 240v + electrical supply**	
FIRE – Due to malicious intent	a) People trapped within the building or temporary accommodation units	▪ Site specific standards detailed in the project Construction Phase Health and Safety Plan and supplemented by the Fire Safety Plan ▪ Signing in/out control for all personnel and visitors	▲ **Provide emergency/back-up lighting and check periodically.** ▲ **Keep all access/egress routes clear – inspect compliance standards at least daily.** ▲ **Ensure signing in/out controls are complied with by all individuals attending site.** ▲ **Where disregarded, implement disciplinary procedures.**	
	b) Trespassers trapped within the building or temporary accommodation units	Site perimeter fencing and entrance points subject to end of shift inspection in respect of: ▪ Integrity ▪ Security ▪ Suitability	**Double-check and secure voids where children or youngsters may gain access to the site.**	
	c) Combustion accelerated by on-site fuel sources	▪ Isolation of liquid fuel supplies, including diesel fuel ▪ Spillages/overflows to be cleared at the end of each shift ▪ Prohibition of overnight storage of petrol on site ▪ Compressed gas cylinders to be stored in a dedicated secure area	▲ **Check the entire site at the end of each shift.** ▲ **Prohibit or reduce the number of compressed gas cylinders left overnight on site.** ▲ **Prohibit or restrict on site the number or quantity of materials/products classified as 'Highly' or 'Extremely' flammable.** ▲ **Ensure that solvent containers are properly closed/sealed.**	

73-75 Avenue Road, London, NW8

10 Appendix E – Spillage Procedure

See attached

EMERGENCY PLANNING GUIDE

Hazard Description	Risk/s Arising	Existing Controls	Required Controls	Site Notes
EMERGENCY EVACUATION ROUTES - Unmarked or unclear	a) Occupant confusion	All workers and visitors must attend an initial site Safety Induction before entering or starting work on site	**Check safety induction register daily. Any person who has not been inducted will not be allowed to remain in the construction/live areas**	
	b) Occupant complacency	Fire Marshals are required to patrol all locations on and around site to ensure routes are: ▪ Clearly signed ▪ Clear of obstruction ▪ Adequately illuminated	**Fire Safety Plan to be referred to for site specific and prevailing requirements**	
	c) Uncontrolled disposal of flammable and/or combustible waste	Trades will be directed to clear their waste arisings as directed by manufacturers/suppliers as work is progressed	**Any disregard for the control of flammable or combustible waste management to be subject to the Company's disciplinary and contractual requirements**	
VEHICLE and MOBILE PLANT CONTROL - Supervision and Co-ordination	a) Vehicles or mobile plant obstructing dedicated emergency service access routes	▪ Ideally one-way vehicular traffic and mobile plant routes to be established and clearly signed	▲ **Dedicated traffic and mobile plant routes to be identified on the site Traffic Management Plan.** ▲ **Preferred arrival and turning points for fire tenders to be established and marked.**	
	b) Outbreak of fire on board vehicles or mobile plant	▪ All vehicles authorised to be on site to have a suitable and fully charged fire extinguisher on board ▪ Where mobile plant has a flame suppression system this must be subject to inspection in accord-ance with the manufacturer's instructions	▲ **Check Company task safety method statements for precise requirements.** ▲ **Check contractors' risk assessment for vehicles and mobile plant – emergency procedures should be in place.**	
	c) Storage of loose spare fuel containers on board petrol powered vehicles	Maximum permissible storage limited to 5 litre in an approved plastic container	**Site specific restrictions and limitations to be notified to contractors and other suppliers in advance of their arrival on site - e.g. pre-contract meetings or specified on materials purchase forms.**	

SPILL RESPONSE PROCEDURE

In case of spillage of oils or chemicals report immediately to the Knight Build site Manager. If it affects drains the KBL site manager will then report it to the SQE Manager who will investigate the incident, take steps to reduce any Environmental damage and the notify the Environmental agency and the local sewage undertaker.

Identify the source of the pollution and stop the flow immediately.
Switch off all sources of ignition.

AVOID THE SPILLAGE SPREADING

Check the drainage plan; where will the spillage go?
Stop the flow if possible.

USE THE SPILL KIT

Dam the flow with earth, sand or polythene.
Divert from drains wherever possible.

Do not wash spillage into the drainage system – it only makes things worse. Never use detergents. Use sand or absorbent pads to mop it up.

If the spill has already entered the drains, block off the lowest point of the drain system before it leaves the site.

Shovel contaminated sand, earth or granules into sacks or skips according to size. These must be correctly disposed of according to the type of contamination. Oil pools can be removed by sludge-gulper first.

Knight Build SQE Manager – Richard O'Leary Tel: 07951 902442
Environment Agency Emergency Hotline – Tel: 0800 807060
Sewerage Undertaker for the area – (obtain number)

ISO 9001 REGISTERED FIRM
ISO 14001 REGISTERED FIRM
OHSAS 18001 REGISTERED FIRM

11 Appendix F – Site Rules

See attached

73-75 Avenue Road, London, NW8

SITE RULES

- READ, UNDERSTAND AND FOLLOW THE TASK SPECIFIC METHOD STATEMENT. If you cannot work safely, then stop and reassess the risk and adapt the Method Statement with you supervisor. REMEMBER - NO METHOD STATEMENT – NO WORK.
- High visibility clothing to be worn at all times on site.
- Hard hats to be worn at all times on site.
- Safety footwear to be worn at all times on site.
- All other personal protective equipment (PPE) when provided is to be used as directed.
- The consumption of food and drink will only be permitted within the defined site boundary in the location for eating.
- No smoking is permitted inside any of the buildings. All personnel will carry out their duties with regard for their own health, safety and welfare and will have regard for the health, safety and welfare of others.
- No fire or burning rubbish.
- Ensure any open excavations, pits, wells, basement landings, manholes, etc are securely fenced when unattended.
- Ensure the traffic management plan is complied by all site users.
- Gas appliances must be turned off and disconnected at the gas bottle out of working hours.
- No hot works to be carried out without a permit to work. (This excludes gas burning and abrasive saws).
- No connection to live services without a permit to work.

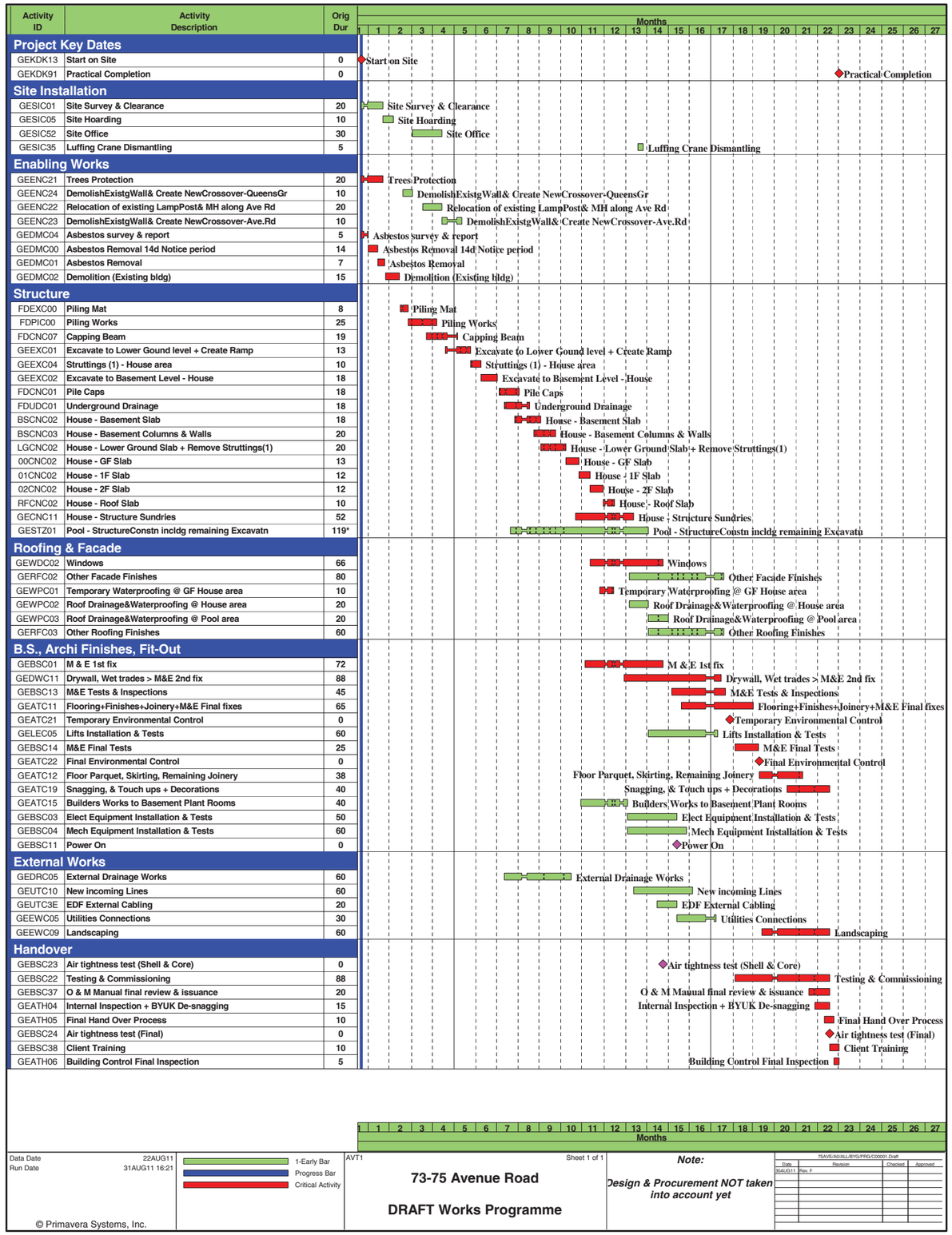
- No materials whatsoever are to be removed from the site without written authority.
- No vehicle or plant to be left running unattended at any time.
- All foreign object debris to be removed from site to secure area for disposal.
- Maintain clear access / egress routes at all times, do NOT create slip, trip and fall hazards. Store materials and equipment in the agreed allocated areas.
- Always use the walkways provided.
- Electrical plant, hand held tools and leads to be properly tested on a regular basis. Do not use unsafe equipment on site, report any defects and keep leads tidy.
- The wearing of shorts is not acceptable and a minimum of a short sleeved T Shirt is required beneath high visibility clothing.
- Understand the Site Fire Strategy, the interface with adjoining operational areas and the impact your work may have on others.
- The use or possession of drugs / alcohol on site is strictly prohibited.
- Only operate plant / tools if you are trained, competent and authorized to do so.
- The use of foul language and threatening behavior will NOT be tolerated.

All areas other than those required for providing personnel access to the site and contract area and for the delivery of material and removal of debris, are out of bounds to contracting personnel at all times. No access to adjoining properties will be allowed without prior authority from the Contract Administrator.

73-75 Avenue Road, London, NW8

12 Appendix G – Programme Durations

See attached

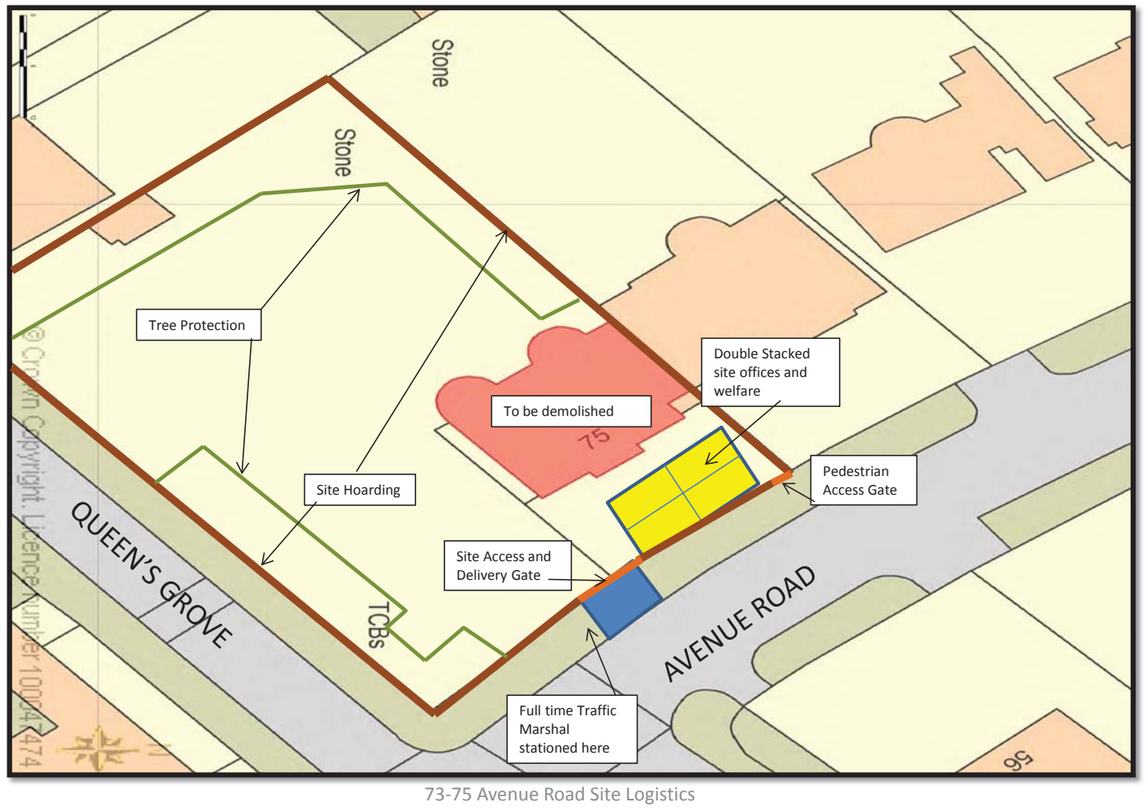


Activity ID	Activity Description	Orig Dur
Project Key Dates		
GEKDK13	Start on Site	0
GEKDK91	Practical Completion	0
Site Installation		
GESIC01	Site Survey & Clearance	20
GESIC05	Site Hoarding	10
GESIC52	Site Office	30
GESIC35	Luffing Crane Dismantling	5
Enabling Works		
GEENC21	Trees Protection	20
GEENC24	DemolishExistgWall& Create NewCrossover-QueensGr	10
GEENC22	Relocation of existing LampPost& MH along Ave Rd	20
GEENC23	DemolishExistgWall& Create NewCrossover-Ave.Rd	10
GEDMC04	Asbestos survey & report	5
GEDMC00	Asbestos Removal 14d Notice period	14
GEDMC01	Asbestos Removal	7
GEDMC02	Demolition (Existing bldg)	15
Structure		
FDEXC00	Piling Mat	8
FDPIC00	Piling Works	25
FDCNC07	Capping Beam	19
GEEXC01	Excavate to Lower Gound level + Create Ramp	13
GEEXC04	Struttings (1) - House area	10
GEEXC02	Excavate to Basement Level - House	18
FDCNC01	Pile Caps	18
FDUDC01	Underground Drainage	18
BSCNC02	House - Basement Slab	18
BSCNC03	House - Basement Columns & Walls	20
LGCNC02	House - Lower Ground Slab + Remove Struttings(1)	20
00CNC02	House - GF Slab	13
01CNC02	House - 1F Slab	12
02CNC02	House - 2F Slab	12
RFCNC02	House - Roof Slab	10
GECNC11	House - Structure Sundries	52
GESTZ01	Pool - StructureConstn incldg remaining Excavatn	119*
Roofing & Facade		
GEWDC02	Windows	66
GERFC02	Other Facade Finishes	80
GEWPC01	Temporary Waterproofing @ GF House area	10
GEWPC02	Roof Drainage&Waterproofing @ House area	20
GEWPC03	Roof Drainage&Waterproofing @ Pool area	20
GERFC03	Other Roofing Finishes	60
B.S., Archi Finishes, Fit-Out		
GEBSC01	M & E 1st fix	72
GEDWC11	Drywall, Wet trades > M&E 2nd fix	88
GEBSC13	M&E Tests & Inspections	45
GEATC11	Flooring+Finishes+Joinery+M&E Final fixes	65
GEATC21	Temporary Environmental Control	0
GELEC05	Lifts Installation & Tests	60
GEBSC14	M&E Final Tests	25
GEATC22	Final Environmental Control	0
GEATC12	Floor Parquet, Skirting, Remaining Joinery	38
GEATC19	Snagging, & Touch ups + Decorations	40
GEATC15	Builders Works to Basement Plant Rooms	40
GEBSC03	Elect Equipment Installation & Tests	50
GEBSC04	Mech Equipment Installation & Tests	60
GEBSC11	Power On	0
External Works		
GEDRC05	External Drainage Works	60
GEUTC10	New incoming Lines	60
GEUTC3E	EDF External Cabling	20
GEEWC05	Utilities Connections	30
GEEWC09	Landscaping	60
Handover		
GEBSC23	Air tightness test (Shell & Core)	0
GEBSC22	Testing & Commissioning	88
GEBSC37	O & M Manual final review & issuance	20
GEATH04	Internal Inspection + BYUK De-snagging	15
GEATH05	Final Hand Over Process	10
GEBSC24	Air tightness test (Final)	0
GEBSC38	Client Training	10
GEATH06	Building Control Final Inspection	5

13 Appendix H - Site Traffic Management & Access

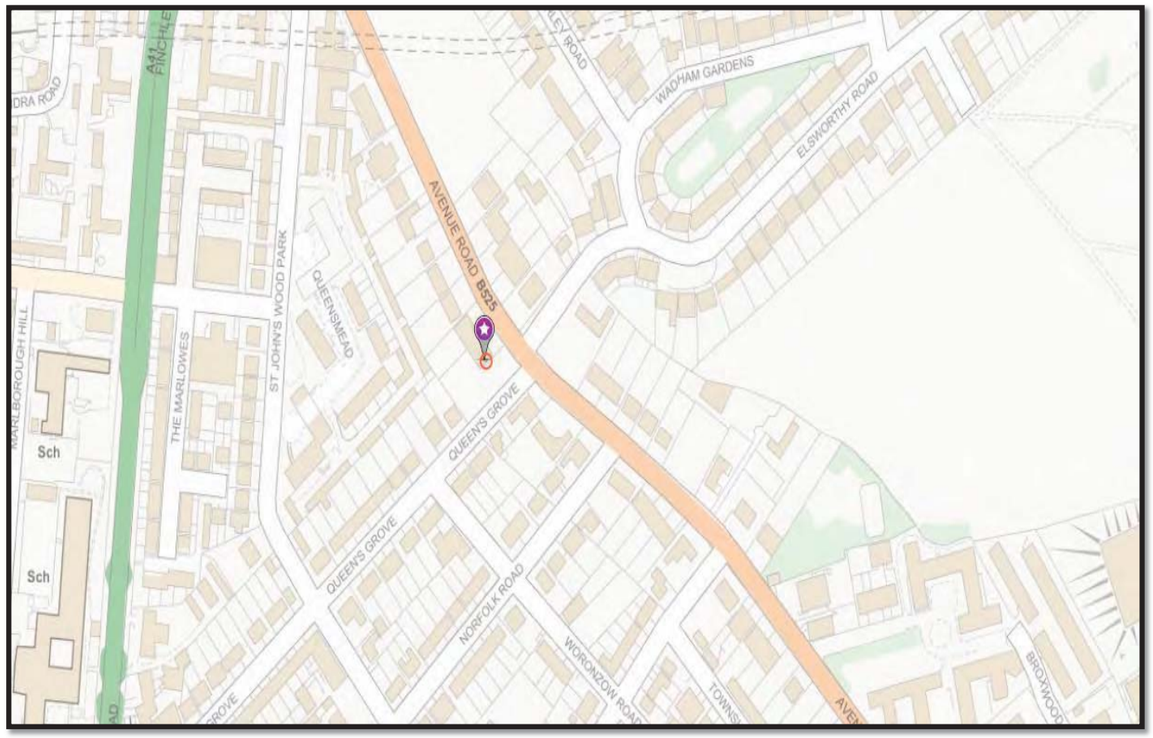
See attached

73-75 Avenue Road, London NW8 6JD



73-75 Avenue Road Site Logistics

73-75 Avenue Road, London NW8 6JD



73-75 Avenue Road Site Logistics

14 Appendix J - Fire Risk Assessment

See attached

KNIGHT BUILD LTD
PROJECT / SITE
FIRE RISK ASSESSMENT

Premises	73-75 Avenue Road. London NW8 6JD
Department	Construction Project
Date of Assessment	
Assessment completed by (competent person)	

1. Hazard	**Comments & Observations**
a. Electrical Installation:	
Condition	
Last Inspected	
Portable Appliances	
Last Inspected	
Use of Circuit Breakers	
b. Heating:	
Portable Heaters	
Location	
Proximity of Combustible Items	
Fixed Heating	
c. Flammable Solutions:	
Storage	
Use	
d. Processes:	
Machinery	
Materials	
Fire Protection	
e. Fire Appliances:	
Hand Appliances	
Hose Reels	
Sprinklers	
Alarms	
Maintenance	
f. Means of Escape:	
Fire Exits	
Signs	
Evacuation Drills	

Safety, Health & Welfare Policy
& Procedures Document

g.	**Housekeeping:**	**Comments & Observation**
	Removal of Waste	
	Smoking	
	Storage Arrangements	
	Use of Fork Lift Trucks	
	Charging Overnight	
	Environmentally sensitive areas	
	Liquefied Petroleum Gas (LPG) Cylinders	
	Hazard	
a.	**Premises:**	
	Combustible Construction	
	Combustible Linings	
	Legal compliance	
	Warning equipment to correct standard / commissioned / tested	
	Exposure From Adjoining Premises	
	Communication with Adjoining Premises	
	Occupation of Adjoining Premises	
b.	**Fire Plan:**	
	Nominated Personnel	
	Adequately Trained	
	Fire Brigade Contact	
Close Out:		
	Person carrying out assessment:	
	Assessment complete:	
	Signature:	
	Date:	
	Project Director / Senior Project Manager	
	Actions complete:	
	Signature:	
	Date:	
	Fire Safety Plan:	
	Results included in Fire Safety Plan:	
	Signature:	
	Date:	

15 Appendix K - The Control of Dust and Emissions.

See attached

Risk Assessment No. KB /RA/001

SPECIFIC RISK ASSESSMENT

Site Name: The Morrison						**Site Number: 73 – 75 Avenue Road**			
Site Location: London, NW8						**Specialist Discipline: Control of Dust and Emissions.**			
Assessor: Richard O'Leary		**Signed:**				**Date: November 2014**			
Activity / Element	**Full Description of Hazards**	**Who at risk**	**Initial Risk Rating**			**Control Measures Specified**	**Residual Risk Rating**		
			L	**C**	**R**		**L**	**C**	**R**
Pre-Site Preparation	Failure to plan site activities to deal with specific pollution problems (dust and emissions).	All	H	H	H	1. Follow best practice and prevent dust and other pollutant emissions from being carried outside the boundary. 2. Compile method statements and risk assessments. 3. Machinery, fuel and chemical storage and dust generating activities will not be located close to boundaries and sensitive receptors if at all possible. 4. Erect effective barriers around dusty activities (The front of the site will be fully scaffolded with a monarflex screen) 5. Notify the Local Authority Building Control Team. 6. Inventory and timetable of all dust generating activities. 7. Erection of solid barriers to site	L	L	L

						boundary. □. All site personnel to be fully trained. □. Identify responsible person in charge.			
Haul Routes, Access Routes	□eneration of dust and emissions, □ailure to maintain □aul and access routes	All	□	□	□	□. □se consolidated surfaces on all haul roads (Tarmac) to reduce dust emissions. 2. □egularly inspect all access and haul roads for integrity and repair if re□uired. 3. □aily sweeping and cleaning. 4. Impose speed limits.	L	L	L
Damping down haul routes both within and outside the site	□orming of wet areas. Causing splashing, □enerating puddles.	All	□	□	□	□. Approved wet methods or mechanical road sweepers on all roads during periods of dry weather. 2. Clean road edges and pavement using wet method. 3. □se approved wet method or mechanical road sweepers on all roads at least once a day. 4. □rovide hard standing areas for vehicles and regularly inspect and clean these areas. 5. □ here possible use sustainable sources of water, e.g. dewatering or extraction holes. 6. Contact the Environment Agency to recycle any collected material or run□off	L	L	L

						water – according to legal re□uirements.			
Vehicles	□ust and emissions created by vehicles.	All	□	□	□	□. □ e will carry out the following controls to reduce dust and particulates associated with vehicles□such as that from exhaust emissions, the contact of tyres on the road surface or dust blowing from material being carried. 2. All vehicles must switch off engines – no idling. 3. □et speed limits. 4. Cover and secure all loads entirely with clean sheets that are entering and leaving the site. 5. □ ash vehicle wheels when leaving site. 6. □educe the number of vehicle movements where possible. 7. Control of □ueuing or parked vehicles outside the site both during and before the site opens.	L	L	L
Site monitoring protocols	Managing the generation of dust and emissions. □ust and emissions from works activities. □ust and emissions from vehicles.	All	□	□	□	□. Employ best practice at all times. 2. Take into account the impact of dust and particulates on occupational exposure standards to minimise worker exposure and breaches of air □uality ob□ectives that may occur outside of the site boundary such as by visual assessment 3. □eep an accurate log of complaints from	L	L	L

						the public.. 4. □etermine the prevailing wind direction across the site and plan site activities to suit. 5. Monitor dust deposition and spoiling rates as these can be used to indicate nuisance. 6. □ e will carry out a visual inspection of site activities, dust controls and site conditions and record in a daily dust log. 7. □ e will appoint a designated person to regular monitor air □uality on a daily basis on this site using a hand held monitor and check against site set limits. □. The site set limit on this site will be 25□ ug□ □m3 over □5 minutes (or 2□□ ug□m3 for TE□M measurement).			
Site entrances / exits	□ust and emissions escaping through site entrance. Build□up of dust and emissions at site entrance. Mud and dust on the road.	All	□	□	□	□. □ e will employ the following control measures to help prevent dust being spread outside the site boundary by site vehicles at entrances and exits. 2. All vehicles to be inspected prior to leaving site 3. □ull time traffic marshal to be in place during all working hours 4. □ heel□wash all vehicles entering and leaving the site.	L	L	L

						5. Traffic marshal controlling the site entrance. 6. □ut in place procedures for effective cleaning of vehicles and inspection which should include full inspection of underside and wheels of vehicle. 7. Ensure the loading of materials is done with the lowest drop height. □. □ehicles carrying dusty materials should be securely covered before leaving site. □. Enter all information of all vehicles entering□leaving site in a log book.			
Mobile crushing plant.						**NO CRUSING TO TAKE PLACE ON SITE**			
Excavation and earthworks.	□ust and emissions generated by works activity.	All	□	□	□	□. All dusty activities should be damped down, especially during dry weather. 2. Temporarily cover earthworks where possible. 3. □e□vegetate exposed areas to stabilise surfaces.	L	L	L
Stockpiles and storage mounds.	□ust and emissions generated from stockpiles. Loose materials blowing across site	All	□	□	□	□. □o not maintain long term stockpiles on site. 2. Minimise drop heights to control the fall of materials (dust) 3. □eep stock piles away from the site boundary.	L	L	L

	and in to public areas.					4. Cover stock piles if possible. 5. Take into account the predominant wind direction when siting the position of stockpiles. 6. □euse hard□core where possible to avoid unnecessary vehicle movements. 7. Erect fences of similar height and si□e to the stockpile to act as wind barriers and keep these clean using wet methods □. □eep stock piles damped down.			
Cutting, grinding and sawing.	□ust and emissions generated from cutting, grinding and sawing work activities.	All	□	□	□	□. All e□uipment should be fitted with water suppressant systems. 2. □se dust extraction techni□ues where possible. 3. □o not carry out cutting activities where dust is driven directly into public areas. 4. □se pre□cut materials where possible. 5. □se local exhaust ventilation	L	L	L
Chutes and skips	□ust and emissions generated from the loading of skips and the using of chutes.	All	□	□	□	□. □ecurely cover skips. 2. Minimise drop heights. 3. □egularly damp down surfaces with water. 4. Completely enclose skips where possible. 5. □o not carry out works in windy conditions	L	L	L
Scabbling.	□ust and emissions	All	□	□	□	□. Best □ractice management must be in	L	L	L

	generated by □cabbling works.					place at all time. 2. Avoid scabbling works where ever possible. 3. □re□wash works surfaces. 4. □creen off works areas 5. □acuum up all dusty residue rather than sweeping away.			
Demolition.	□ust and emissions generated from demolition works and activities.	All	□	□	□	□. All dusty activities should be damped down, especially during dry weather. 2. □trip and screen the building with suitable material and strip the inside of the building before demolition begins. 3. Notify the □ealth and □afety Executive of the works to take place. 4. □nly licenced and competent operatives will be used. 5. Clearly identify the location of asbestos containing materials before starting work. 6. □rocedures put in place to sample and analyse suspect materials. 7. Independent air sampling will be carried out to ensure standards are met. □. □isposal of asbestos□containing materials to licensed waste sites according to □□E guidelines before the demolition works commence. □. Materials will be removed from site as soon as possible to reduce stock piling.	L	L	L

Waste Disposal /Burning	□ust and emissions generated from waste disposal and burning activities	ALL	□	□	□	□. There will be no burning allowed on site at any time. 2. All excess material will be used elsewhere on site, sent to other sites to be used, sent to transfer stations for recycling, sent back to the supplier for re□ stacking or at the very last resort sent to landfill. 3. All skips to be labelled and sorted where possible. 4. Materials to be stored away from sensitive locations. 5. □ e will employ a □ust□in□time delivery system to reduce the amount of time materials are stored on site.	L	L	L

Dealing with spillages	Emissions and contamination rising from spillages.	All	□	□	□	□. The following measures will be implemented on this pro□ect. 2. Bunded areas will be used wherever practicable. 3. □egular site inspections will be carried out looking for spillages. 4. □pill kids will be placed around the site and operatives trained in their use. 5. Certain spillages will be cleaned using agreed wet handling methods. 6. □acuum and sweep activities will be regularly carried out to prevent the build□ up of fine waste dust material, which is spilled on the site, and is designated as waste and will be removed from site as per the site waste management plan. 7. The Environment Agency, London □ire and Emergency □lanning Authority (L□E□A) will be informed if harmful substances are spilled.	L	L	L

L = Likelihood **C = Consequence** **R = Risk (Likelihood x Consequence)**	**Likelihood: Low Risk = L, Medium Risk = M, High Risk = H,** **Consequence : Low Risk = L, Medium Risk = M, High Risk = H,**

16 Appendix L - Air Quality and Carbon Reduction

See attached

73-75 Avenue Road, London, NW8 6JD.
Air Quality and Carbon Reduction Method of Works.

Procedures will be put in place to ensure that the air quality will be maintained throughout all stages of the construction works at the above project and carbon emissions are minimised as much as possible when using plant and machinery and receiving deliveries as well as removing waste and spoil from site.

Records will be kept recording all vehicle movements to and from site as well insisting that all vehicles are of a standard that produce low emissions.

Air quality monitoring will be undertaken from day one on site and records kept and issued to confirm the standard achieved (a trigger action level for PM10 concentrations of 200ug/m3 (15 minutes average) shall be used to identify incidences of elevated dust emissions at the site boundary. The 73-75 Avenue Road project shall comply with the trigger action throughout the demolition , substructure and superstructure phases of this project.

The site is of a size where construction plant will be used on a daily basis for excavation and demolition but is not of a size that large plant and equipment will be constantly running and tracking across the site moving and placing spoil, waste and other materials.

Please also refer to other sections of the Construction Management Plan for other control methods and procedures

Appendix C: Site Environmental Risk Assessment.
Appendix K: The Control of Dust Emissions Risk Assessment.
Appendix N: Environmental & Safety Hazards.

The following best practise measures shall be implemented as a minimum throughout the development of the 73-75 Avenue Road project.

- Machinery, fuel chemical storage and dust generating activities will not be located or undertaken close to boundaries and sensitive receptors where possible.
- The erection of barriers will be carried out around all dusty activities where possible and buildings that are to be demolished will be fully scaffolded with a monarflex screen and water used as a dust suppression.
- Hand held approved air quality monitors will be used 3 times every day (first thing in the morning, lunch time and prior to works completion for the day) they will also be used if the need arises to check the air quality for any given reason. The location positions will be agreed and maintained.

- Inventory and timetable of all dust generating activities will be maintained and air quality results recorded, maintained and issued to the local authority at agreed periods.
- Regular tool box talks, inductions and site briefings will be given to the work force relating to carbon emissions and air quality.
- Hand standings will be established using tarmac for the standing and loading of vehicles these areas will be inspected at regular intervals and repaired if necessary.
- The site is not large enough to imposed speed limits and all vehicles will be under the control of a banks man.
- During dry weather water suppression will be used on all hard standings access and exit routes to reduce the generation of dust.
- Where water used for dust suppression can not be re-used a discharge licence will be obtained from Thames Water and the water will be disposed of through a settlement tank as per the Thames Water guidelines and licence requirements.
- No dust generating activities will be carried out in high winds or on days where suppression methods may fail.
- A designated person will be appointed as the regular monitor of air quality on a daily basis on this site using a hand held monitor and will check against the site action levels and limits.
- The trigger action level on this site will be 200 ug/m3 over 15 minutes.
- An on site alert system will be established on site that will be sent to the site team and KBL head office by email, an email specifying details of an alerts will also be sent to the LBC.
- An electronic report will be sent to LBC air quality officer every 3 months as required.
- LBC will be notified of any changes of the location and operation of dust PM10 monitoring instrumentation.
- A 24 hour phone / email hotline will be set up so that residents can complain about high dust or PM10 levels directly to the developer, also the environmental teams contact numbers will be displayed on the site hoarding.
- All vehicles will be inspected prior to leaving site ensuring that the load is correctly covered and the wheels and underside of the vehicle is clean.
- A jet wash will be available on site at all times.
- The loading of lorries will be carried out with the minimum / lowest drop height.
- All information relating to vehicles entering / leaving site will be recorded and logged.
- Any stock piles of materials will be damped down and covered.
- There will be no crushing undertaken on site.
- Skips will be enclosed or covered at all times.
- No burning is allowed to be carried out on site at any time.
- All excess materials will be used elsewhere on site or other sites, sent to transfer stations for recycling or sent back to the supplier for restacking .

- All construction vehicles delivering to site shall comply with the Euro 4 emissions standard and low emission fuels are to be used.
- No vehicles will be allowed to idle unnecessarily when on site, engines are to be turned off at all times when the vehicle is standing.
- All vehicles visiting site must hold current MOT certificates and this will be part of any order issued.
- Only low emission plant fitted with catalysts, diesel particulates filters or similar devices shall be used on this site. Knight Build do not own any of its own plant or equipment and all such items are hired in new or nearly new from a national supplier to ensure all equipment is in good condition and is certificated. (no repairs are carried out on site all plant and equipment is exchanged).
- A TBS electric supply will be established prior to works commencing so it is not expected that petrol or diesel generators will be used.
- Only ultra low sulphur diesel will be used on this project and will be delivered to site directly from the supplier and placed into double bunded bowsers that will be located in a specific area with drip trays and spill kits.

Knight Build Ltd are a Bronze member of FORS and will ensure that all companies delivering to this site are also accreditated by FORS or will abide by the FORS minimum standards in the first instance whilst they apply for the FORS accreditation.

Knight Build will also commit to adopt green fleet management practices that will result in a 10% reduction in tail-pipe CO^2 emissions over the duration of the construction phase of the project.

Knight Build are also a member of SMARTwaste and will issued waste, CO^2 and energy statistics each month.

17 Appendix M - Highway Measures

See attached

73-75 Avenue Road, London, NW8 6JD
Construction Traffic Management Procedures .

The following procedures will be in place to control the daily construction traffic servicing the 73-75 Avenue Road project. This will also address neighbours, residents, pedestrians and other road users that may be affected by the project.

The area around 73-75 Avenue Road consists of residential roads with controlled parking zone which includes both Avenue Road and Queens Grove . There are no on-street parking facilities in the immediate vicinity of the site on Avenue Road due to the presence of the zig-zag markings associated with the adjacent pelican crossing.

An application will be made to London Borough of Camden to relocate the pelican crossing for the construction period of the project.

WORKING HOURS WILL BE.

Monday to Friday 08.00 – 18.00.
Saturday 08.00 – 13.00.

It is not intended to work on Saturdays unless for emergencies.

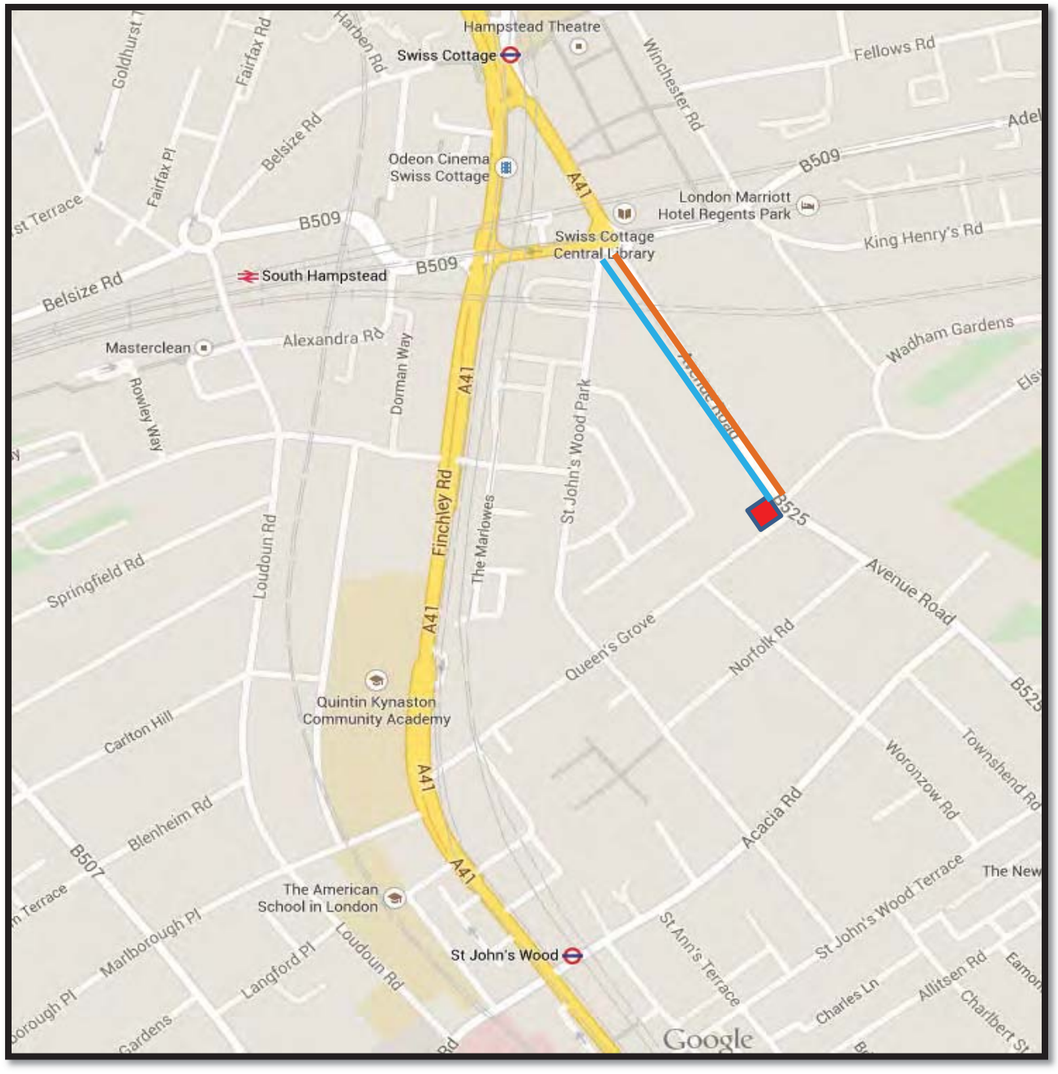
ACCESS TO SITE

It is intended that all vehicles will approach and leave the site by the same route from the junction of A41 / B509 down Avenue Road and turn into the site entrance just before the junction with Queens Grove.

ACCESS FROM SITE.

Then when leaving exit the site gate turning left into Avenue Road and driving back to the junction of A41 / B509.

Access to site ——— Access from site ———



CONTRACTORS DELIVERING TO SITE.

In order to ensure all contractors, delivery companies, and visitors are aware of the traffic routes and restrictions, a number of methods will be implemented. A copy of the agreed routes to and from site along with all restrictions will be sent to all delivery and collection companies when orders are placed and only agreement of these routes and restrictions will allow the order to be signed and placed.
Verbal briefings within the site induction to all contractors and visitors to site. This information will include the implications of not complying with the guidelines and the effect this will have on future business.

VEHICLES ENTERING AND LEAVING THE SITE.

Vehicular access will be through the site vehicle entrance gates that will be manned by a full time Traffic Marshal . No Vehicles will allowed to park or be unloaded / loaded out side of the site. A full time Traffic Marshall will be used for directing and controlling all loading and unloading activities and also to ensure that all footpath and road users can pass the loading area safely and without disruption.

APPROXIMATE VEHICLES TYPES AND NUMBERS.

TASK	DURATION	Number of Vehicles per Day
Site Set Up and Demolition	7 Weeks	12 (8)
Substructure, Superstructure	44 Weeks	14 (10)
Roofing and Facade	24 Weeks	9 (6)
Fit Out	42 Weeks	12 (8)
External Works	36 □ eeks	□□ (7)

(x) Of which are HGV Vehicles

The main types of vehicles that will be accessing the site are as follows:
Delivery Vehicle: 7m x 2m
6 wheel Muck Away Vehicle: 8.1m x 2.6m – 26 tonnes
Concrete Lorry: 9.3m x 3.1m – 30 tonnes

There will be a parking area within the site boundary for delivery vehicles.

DELIVERIES AND COLLECTIONS.

Site deliveries will be between 9.30am and 4.30pm these will be controlled by a full time Traffic Marshal and the site manager by mobile phone, all deliveries are to be booked in with the Knight Build Logistics Manager at our head office 24 hours before and all deliveries are to ring site 30 minutes prior to arriving on site to confirm the loading area is clear, this information will be part of the agreed order.

VEHICLE WHEEL WASH FACILITIES.

Vehicle wheel washing facilities will be provided in the form of a jet wash.
Part of the full time Traffic Marshals duties will be to maintain a clean and presentable loading area, footpath and nearby carriageway at all times.
A road brush will be available if required and will be on site within an hour of notification.

PROTECTION OF THE PUBLIC HIGHWAY

The site will be kept in a clean and safe condition. The areas adjacent to the site will be regularly inspected and any rubbish or litter removed. Adjacent roads and pavements will be kept clean, and at no point will residue or other detritus be washed into the drainage system.

Perimeter hoardings will be repainted as necessary and will be kept in a neat and tidy condition. Any graffiti will be quickly removed from the hoardings.

Offloading / loading will be from within the site only,. Materials will not be stored on public footpaths or carriageway. Protection will be laid on the road under all skips and any specific items of work that may cause damage to public highway but activities outside of the site are not planned.

Waste and rubbish will be regularly removed from site and not allowed to accumulate so as to cause a safety or fire hazard. Activities that have the potential to cause dust will be carefully monitored and dust reduction methods employed. This will include water spray, dust extraction, and localised screening where appropriate.

Welfare facilities will be provided on site to discourage operatives from frequenting the interface between the site and public areas. Site operatives will not be allowed to congregate or loiter on the footpath adjacent to the site.

VEHICLE CALL UP PROCEDURE

A full time Traffic Marshal will be based outside the site during all working hours.
Procedures and restrictions will be sent to all delivery and collection companies at the time the order is placed.

All deliveries and collections must be booked in with our Logistics Manager 24 hours before delivery and she will confirm unloading / loading slots.
All vehicles attending site must contact the Site Manager / Traffic Marshal by mobile phone at least 30 minutes prior to arriving to confirm that the loading area will be clear, vehicles that do not follow this procedure will be turned away and told to return at a different time or the next day.

Drivers that persistently fail to abide by the delivery procedures will be given one warning and then be banned from attending sited.
No vehicles will be allowed to stack or park on either Avenue Road or any of the other roads in the borough, they will be told to keep moving at all times or book another slot for the following day.
The agreed delivery times 09.30am – 4.30pmwill be rigorously maintained, no vehicles will be accepted unless it can be loaded / unloaded prior to the 4.30pm cut off time.

RESPONSIBILITY FOR VEHICLE MOVEMENTS.

The Site Manager is responsible for the control of all vehicle movements and will be aided by the site Traffic Marshal and the KBL Logistics Manager.
It is planned to issue delivery sheets the day before so everyone involved knows what deliveries to expect and will be ready for them.

ARRANGEMENTS FOR VEHICLE LOADING AND COLLECTIONS.

The strategy for the delivery, distribution and storage of materials is extremely important. All drivers are requested to ring the site at least 30 minutes prior to arriving to confirm the loading area is clear. A booking in system for deliveries will be adopted throughout the entire length of the project. This system will allocate a sufficient time period in the loading area depending on the nature of the delivery/action.
If for some unforeseen reason the area is not clear, the vehicles will wait in a suitable location outside of the borough if time permits within the agreed loading periods or be rescheduled for the next day.

CONTRACTORS PARKING

There will be no parking on site or in the nearby roads, all site operatives, subcontractor, supervisors and managers will be urged to use public transport at all times. Additional storage areas and lock boxes will be provided on site for tools and work ware.

There are a number of buses that operate within walking distance of the site as well as under ground rail services

EXISTING WAITING AND LOADING RESTRICTIONS

All off-loading and loading will be carried out from within the site.

An application will be made to have the existing Pelican Crossing relocated for the duration of the works so that sight lines of pedestrians waiting to cross and crossing the road are not obscured by construction traffic.

IMPACT ON OTHER HIGHWAY USERS

We have no intension of storing plant, equipment or materials outside of the site.

If skips are required a permit will be obtained and these will be collected on the same day as delivery but the majority of the collections of waste and debris will be by wait and load vehicles who will be under the directions of the Traffic Marshals throughout the loading / unloading period.

It is the goal of Knight Build for the duration of these works to provide a clean and safe area within and outside of the 73-75 Avenue Road project for the removal of waste and other delivery vehicles.

PROTECTION OF PEDESTRIANS FROM CONSTRUCTION WORKS.

Special provision will be made for vulnerable users using the footways and carriageways near or adjacent to our project, we will ensure that wheel chair users, the elderly, people with walking difficulties, young children, people with prams, blind and partially sighted people can make their way passed our site without any obstructions, plant or construction vehicles causing them difficulties or distress, this will be controlled by a full time Traffic Marshal.
We will write to all nearby schools and advise them of our project, site and delivery times and provide the contract numbers of the site team and also head office contacts.

EXISTING FOOTPATH AND CARRIAGEWAY

We are not intending to close the footpath or carriageway outside of 73-75 Avenue Road for any reason .
During the construction of new crossovers and utility works temporary footpaths will be established and maintained.

TRAFFIC DIVERSIONS

There will be no requirement for a traffic diversion during this project.

SPOIL AND WASTE REMOVAL

We will be using both wait and load and skip lorries for the removal of spoil which will be directly loaded from within the site.

CONCRETE DELIVERIES

Concrete deliveries will be required for enabling, substructure, and superstructure works.

The majority of concrete deliveries will be delivered from the ready mixed trucks, the maximum dwell time for the discharge of concrete will be 40 minutes.
It is intended to programme the works so that concrete deliveries will be carried out during the morning period and waste away during the afternoon, that way if there are any delays at the concrete plant it will not impact the 4.30pm delivery cut of time.

SCAFFOLDING ON, OVER OR ADJACENT TO THE PUBLIC HIGHWAY.

There is no requirement for the erection of any scaffolding out side of the site boundary during this project.

UTILITY SERVICES

There will be a need to disconnect the present incoming services (gas, electric and water) and arrange for temporary builders suppliers to be established for Electric and Water this will require excavations to be carried out in the carriageway by both UKPN and National Grid, during the fit out period new power supplies will need to be connected resulting in a final excavation in the carriageway. The correct applications will be made by the Utility Services..

GENERAL MANAGEMENT ISSUES

A review of the CTMP will be carried out at the weekly project team site meeting and again at the clients fortnightly meetings, where changes or additions are required the CTMP will be revised and a copy sent to London Borough of Camden for approval, at the same meetings any complaints or problems incurred prior to the meeting will be discussed and addressed.

We would send newsletters to neighbours and residents of Avenue Road and others nearby effected by the project to advise of any changes that may affect them.

The project Contracts Manager will be responsible for ensuring that this is carried out.

COORDINATION OF TRAFFIC ARRANGEMENTS WITH OTHER DEVELOPMENTS IN THE AREA.

This will be the responsibility of the Site Manager, prior to commencing the project we will provide our contact numbers to all other projects in the area or on the nearby access and egress routes, we will ask for their details in return and try to set up a procedure between all developments regarding traffic movements, this will be overseen by the project Contracts Manager.

We will maintain a daily dialect with all nearby projects, we will send and request weekly look ahead and short term programme so that deliveries can be managed and planed between the sites.
Our Traffic Marshal will be constantly on the lookout for any incidents that may cause congestion or concern to the residents, our deliveries will all be contactable by phone and if there is any problems or incidents in the area where our delivery may cause congestion it will be delayed or cancelled.

COMPLAINTS.

Contact numbers and names for the members of the site team will be distributed by a newsletter prior to starting the project and the same details will be erected on the site hoarding, the site manager will initially deal with any complaints in the first instance.

We will also provide 24 hour contact numbers which are different from the site team.

If the complaint is addressed directly to the site it will be the Site Manager who takes the complaint and if not closed out on the spot, the action will be the responsibility of the Contracts Manager; all complaints will be recorded and discussed at the site weekly meetings and the Clients fortnightly Progress meetings.

800 Group Directors will address any complaint that cannot be closed out by the site team and Contracts Manager.

LOCAL DOMESTIC AND COMMERCIAL WASTE COLLECTIONS (are not disrupted)

The size and type of deliveries that will be visiting site will all be able to pull into the site boundary keeping the road clear at all times, but we will contact the London Borough of Camden waste collection depot and confirm the times of both collections and arrange our deliveries / collections to prevent any disruption.

18 Appendix N - Environmental & Safety Hazards

See attached

73-75 Avenue Road, London, NW8 6JD

Environmental and Safety Restrictions, Risks and Hazards

The road and pavements adjacent to this project are in a generally good and maintained condition and suitable protection by way of road plates, ply etc. is to be implemented, ensuring that trip hazards for pedestrians are eliminated and wheelchair and pushchair access is facilitated.

Proper office facilities will be established on site to facilitate the management of the site safety and environment procedures and to ensure that best practise management is in place for all activities.

On-going design changes may result with the requirement of further environment and safety procedures.

Significant Environment, Safety and Design Construction Concerns and Hazards.

- The Work at Height Regulations 2005.
- Use of personal protective equipment, including helmets, boots, gloves, hi-vis, ear protection and eye protection.
- All plant and equipment on site to be maintain and in safe working order (certification to be provided and copies kept on site)
- All plant to be operated by trained and competent operative (CPCS required)
- Appropriate warning signage is to be erected across the site.
- Safe and agreed disposal of materials from the site (all materials to be reused or re-cycled where possible.
- Safe working at heights – the use of lanyards / body harnesses as required by all personnel.
- Safe storage of materials, (just in time deliveries to prevent materials been stored on site for long periods
- Maintaining emergency fire escape signage during the works (Fire Plan and directions)
- Maintain all access and egress routes from the site and surrounding buildings so as to keep the level of disruption, congestion and inconvenience down to a minimum.
- Erection of full scaffolding with monarflex sheeting to help with the control of dust and emissions
- Liaise with other contractors in the area to prevent any clash of deliveries that may cause congestion.
- Risk of Fire.
- The protection from dust, emissions, masonry debris, air bourn particles during the course of the works.
- The safety of the public, road users and site operatives at all times.
- Striking of buried services.

- Hazards from noise
- Hazards from vibration.
- Hazards from emissions
- Trips and falls
- Collapse of structure
- Collapse of excavations.
- Access and Egress
- Asbestos.
- Pollution.
- Manual Handling.
- Scaffold Erection.
- COSHH
- Waste Management
- Lifting with excavators or other equipment.
- Temporary works.
- Temporary Services.

Site specific method statements and risk assessments will be produced to manage the above list and any other activities where a risk or hazard may be present.

The work force on this site will receive.

- Full site inductions
- Daily morning safety briefings
- Method Statement and Risk Assessment inductions
- Weekly tool box talks
- On site task training.

Appendix F

Ground Movement Analysis

Document Control

Project title	73-75 Avenue Road, London, NW8 6JD	**Project ref**	J14383
Report prepared by	Matthew Penfold MSci MSc DIC CGeol FGS		
Report checked by	Martin Cooper BEng CEng MICE FGS		
Report approved for issue by	Steve Branch BSc MSc CGeol FGS FRGS MIEnvSc		

Issue No	Status	Date	Approved for Issue
1	Final	11 February 2015	

This report has been issued by the GEA office indicated below. Any enquiries regarding the report should be directed to the office indicated or to Steve Branch in our Herts office.

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☐ Nottinghamshire tel 01509 674888 midlands@gea-ltd.co.uk

CONTENTS

1.0 INTRODUCTION

Geotechnical and Environmental Associates (GEA) has been commissioned by Heyne Tillett Steel, on behalf of Deroda Investments Limited, to complete a ground movement assessment for the proposed redevelopment of this site at 73–75 Avenue Road, London, NW8 6JD, which is to include excavation of a double level basement.

A site investigation has previously been carried out by GEA (report ref J10229, dated December 2010), which was updated to include a hydrogeological assessment (report ref J10229a) in February 2011 and the findings have been used in the derivation of parameters for use in this assessment.

Additional investigation (report ref J14383/AB/1, dated February 2015) has also recently been undertaken to investigate the presence of a tributary of the former River Tyburn. The findings of this work have been reported separately but it may be noted that investigation did find any significant evidence to indicate the presence of this former water course beneath the site.

A detailed UXO threat assessment (report ref 2111AT01, dated February 2015) has also recently been undertaken by 1st Line Defence and has indicated that there is a moderate risk, such that mitigation measures will be required during the development.

The purpose of this assessment has been to determine the effects of the proposed basement construction upon the neighbouring structures.

1.1 Proposed Development

It is understood that it is proposed to demolish the existing building and construct two semi-detached three-storey houses with a double level basement extending to a depth of about 8.5 m. The proposed basement will extend beneath the entire footprint of the proposed new houses and into the rear garden and will be formed with a contiguous piled wall.

It is understood the garden above the basement will be reinstated with a hard covered terrace, whilst the remainder of the garden will remain unchanged

This report is specific to the proposed development and the advice herein should be reviewed prior to commencement of construction.

1.2 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, the number of locations where the ground was sampled and the number of soil, gas or groundwater samples tested; 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 approximately 250 m to the northeast of St John's Wood Barracks and fronts onto Avenue Road to the northeast. It is bounded to the northwest by a house (No 77 Avenue Road), to the south by Queen's Grove and to the west by detached houses and their associated gardens. It may be additionally located by National Grid Reference 526920, 183820.

The site is rectangular in shape and measures approximately 40 m by 25 m. A two-storey house occupies the northern part of the site with a tarmac driveway in the northeast. To the south of the house is a swimming pool which has a textile arched roof structure.

The garden area occupying the eastern and western part of the site is sensibly level, but for a rectangular patio area directly to the rear of the house; the house itself and the front driveway are elevated relative to the garden by approximately 0.4 m.

Vegetation at the site includes a large number of semi-mature and mature deciduous trees of various species, located on all boundaries.

3.0 SUMMARY OF GROUND CONDITIONS

The 2010 / 2011 investigation confirmed the expected ground conditions, in that, beneath a moderate thickness of made ground, comprising brown silty gravelly clay with brick fragments, which extended to depths of between 0.90 m and 1.40 m, London Clay was encountered and proved to the full depth investigated of 25.45 m.

The London Clay initially comprised a naturally reworked layer of brown gravelly clay, extending to depths of 2.9 m and 4.30 m in Borehole Nos 1 and 2 respectively, whereupon firm becoming stiff mottled brown clay was encountered to depths of 7.40 m and 9.40 m respectively. Stiff becoming very stiff grey fissured clay was encountered below the brown clay and extended to the full depth investigated of 25.45 m. A claystone was encountered in Borehole No 1 at 7.40 m.

Groundwater was not encountered during the drilling, but subsequent monitoring measured groundwater at a depth of 7.7 m.

The recent investigation has broadly confirmed the expected ground conditions in that, below a variable thickness of made ground, the London Clay Formation was encountered and proved to the full depth of the investigation of 3.0 m. This investigation was concentrated in the area between the existing house and adjacent swimming pool and indicated a significant and variable amount of made ground with numerous obstructions that restricted the depths of a number of the boreholes. Where proved, the made ground generally extended to depths of between 1.2m and 2.3 m and in two boreholes was found to be underlain by greyish yellow or orange-brown sand and gravel to a depth of 2.10m. It is unclear whether this material was made ground imported as part of the swimming pool construction, was naturally occurring. The underlying London Clay comprised soft to firm, becoming stiff, orange-brown becoming brown occasionally gravelly silty clay.

Groundwater was not encountered during drilling. However, the made ground was noted to be wet in a number of locations.

A review of deep borehole records held on the British Geological Society (BGS) database, the closest of which is located 300 m to the north of the site, indicates that the London Clay extends to depths of between 80 m to 85 m, below which the Lambeth Group, Thanet Sand and Upper Chalk were found to be present.

4.0 CONSTRUCTION SEQUENCE

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

Essentially the sequence may be considered as three groups of activities, the first two comprising the short and medium term temporary works whilst the third represents the construction of the permanent works.

It may be necessary to consider some form of support to the garden walls during construction of the basement although piled retaining walls are being adopted for the basement, which should minimise the effects on neighbouring structures. 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 piling contractor once appointed.

4.1 Temporary Support to Piled Walls

Following the installation of the bored pile wall and capping beams, temporary props will be installed and the basement excavation will proceed. The detail of section sizes and spacings will be finalised by the contractor but should be appropriate for such a basement excavation. It is anticipated that the general philosophy adopted will be for diagonal braces to be used across the corners or returns of the basement walls whilst props will be positioned at regular intervals along the long walls of the basement. Where horizontal restraint cannot be provided by other parts of the piled wall the prop forces will be provided by so-called ‘flying shores’ where the reaction to horizontal forces is provided by pile caps, gravity blocks or basement thickenings in the centre of the excavation.

It is anticipated that steel temporary props will be used with strut forces spread along the wall by steel waling beams fixed to the piles. Although the detail of the propping is to be finalised there is the option to use hydraulic ‘active’ props where the propping force is applied prior to excavation in order to minimise movement at critical locations.

Excavation will proceed in stages and in broad terms the order of operations will be install capping beam props, excavate to a suitable depth below the next propping level, install props and then repeat the operation until the final excavation level has been reached.

4.2 Permanent Works

When the final excavation depths have been reached the permanent works will be formed. The basement is understood to comprise reinforced concrete walls with a drained cavity lining the inside of the bored pile wall. Reinforced concrete will be used for floor slabs and it is anticipated that heave protection will be installed beneath the lowest slabs.

It is anticipated that the floor slabs will be constructed lowest level first and when each floor has achieved adequate strength, the temporary props will be removed and the subsequent walls and floors cast until the structure is complete.

5.0 GROUND MOVEMENTS

An assessment of ground movements within and surrounding the excavation has been undertaken using the X-Disp and P-Disp computer programs licensed from the OASYS suite of geotechnical modelling software from Arup. These programs are commonly used within the ground engineering industry and are considered to be appropriate tools for this analysis.

The X-Disp program has been used to predict ground movements likely to arise from the construction of the proposed basement. This includes the settlement of the ground (vertical movement) and the lateral movement of soil behind the proposed retaining walls (horizontal movement).

The analysis of potential ground movements within the excavation, as a result of unloading of the underlying soils, has been carried out using the Oasys P-Disp (Version 19.2 – Build 12) software package and is based on the assumption that the soils behave elastically, which provides a reasonable approximation to soil behaviour at small strains.

For the purpose of these analyses, the corners have been defined by x and y coordinates, with the x-direction parallel with the orientation north-south, whilst the y-direction is parallel with the orientation of east-west. Vertical movement is in the z-direction.

The full outputs of all the analyses can be provided on request but samples of the output movement contour plots are included within the appendix.

5.1 Ground Movements – Surrounding the Basement

5.1.1 Model Used

For the X-Disp analysis, the soil movement relationships used for the embedded retaining walls are the default values within CIRIA report C580[1], which were derived from a number of historic case studies.

The ground movement curves for ‘excavations in front of high stiffness wall in clay’ have been adopted as being considered most appropriate for the London Clay. The magnitudes of ground differential movement predicted by the program have been assessed.

5.1.2 Results

An assessment of ground movements surrounding the excavation has been undertaken by GEA using the X-Disp computer program licensed from the OASYS suite of programmes from Arup. The predicted movements are summarised in the table below.

Phase of Works	Wall Movement (mm)	
	Vertical Settlement	Horizontal Movement
Pile Installation	<|5	<5
Basement Excavation	5 to 10	10 to 15
Combined Movements	<10	15 to 20

[1] Gaba, A, Simpson, B, Powrie, W and Beadman, D (2003) *Embedded retaining walls – guidance for economic design* .CIRIA Report C580.

The analysis has indicated that the maximum vertical and horizontal settlements that will result from pile installation are less than 5 mm. The maximum vertical settlement that will take place behind the walls as a result of the basement excavation is unlikely to exceed 10 mm with up to 10 mm to 15 mm of maximum horizontal movement.

The movements arising from the combined piling and excavation phases are therefore not likely to exceed 10 mm of vertical settlement, whilst the maximum horizontal movements are anticipated to be between 15 mm to 20 mm.

The movements calculated are considered to represent a worst case scenario, particularly as the movements resulting from basement excavation will be minimised due to control of the propping in the temporary works and a regime of monitoring.

5.2 Movements within the Excavation (Heave)

5.2.1 Model Used

At this site unloading of the London Clay will take place as a result of the basement excavation and the reduction in vertical stress 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. Drained parameters have been used to provide an estimate of the total long-term movement.

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 drained and undrained stiffness respectively, to values of undrained cohesion, as described by Padfield and Sharrock[2] and Butler[3] and more recently by O’Brien and Sharp[4]. Relationships of $E_u = 500\ C_u$ and $E' = 300\ C_u$ for the cohesive soils and 2000 x SPT ‘N’ for granular soils have been used to obtain values of Young’s modulus. More recent published data[5] indicates stiffness values of 750 x Cu for the London Clay and a ratio of E’ to Cu of 0.75, but it is considered that the use of the more conservative values provides a sensible approach for this stage in the design.

The proposed construction of the new basement will result in a net unloading of roughly 160 kN/m².

A rigid boundary for the analysis has been set within the London Clay at a depth of about 80 m below existing ground level, where nearby BGS records indicate that the base of this formation is likely to be present. Below this depth the essentially incompressible soils of the Lambeth Group should be present.

5.2.2 Results

The P-Disp analysis indicates that, by the time the basement construction is complete, up to 40 mm of heave is likely to have taken place at the centre of the proposed excavations, reducing to approximately 15 mm at the edges.

[2] Padfield CJ and Sharrock MJ (1983) *Settlement of structures on clay soils*. CIRIA Special Publication 27
[3] Butler FG (1974) *Heavily overconsolidated clays: a state of the art review*. Proc Conf Settlement of Structures, Cambridge, 531-578, Pentech Press, Lond
[4] 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
[5] 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

In the long term, following completion of the basement construction, a further 60 mm of heave is estimated as a result of long term swelling of the underlying London Clay.

The results of the P-Disp analysis also indicate the likely impact of the proposed basement construction beyond the site boundaries. On the basis of the analysis, total vertical heave movements outside the proposed basement are unlikely to exceed 20 mm at a distance of approximately 5 m, reducing to less the 10 mm at distances of between 10 m to 15 m.

The potential movements are summarised in the table below.

Location	Movement (mm)		
	Short-term Heave (Excavation Phase)	Long-term Heave (post construction)	Total Heave
Centre of excavation (max heave)	40	60	100
Edge of excavation	15	20	35
At 5 m from edge of excavation	7.5	12.5	20

In order to mitigate the effects of heave on the new building, the basement boxes could be designed to transmit heave forces into the wall piles or onto tension piles within the basement.

Alternatively, or in any case, a void should be incorporated into the design to accommodate these potential long term movements. If a compressible material is used beneath the slab, it will need to be designed to be able to resist the potential uplift forces generated by the ground movements. In this respect potential heave pressures are typically taken to equate to around 50 % to 60 % of the total unloading pressure.

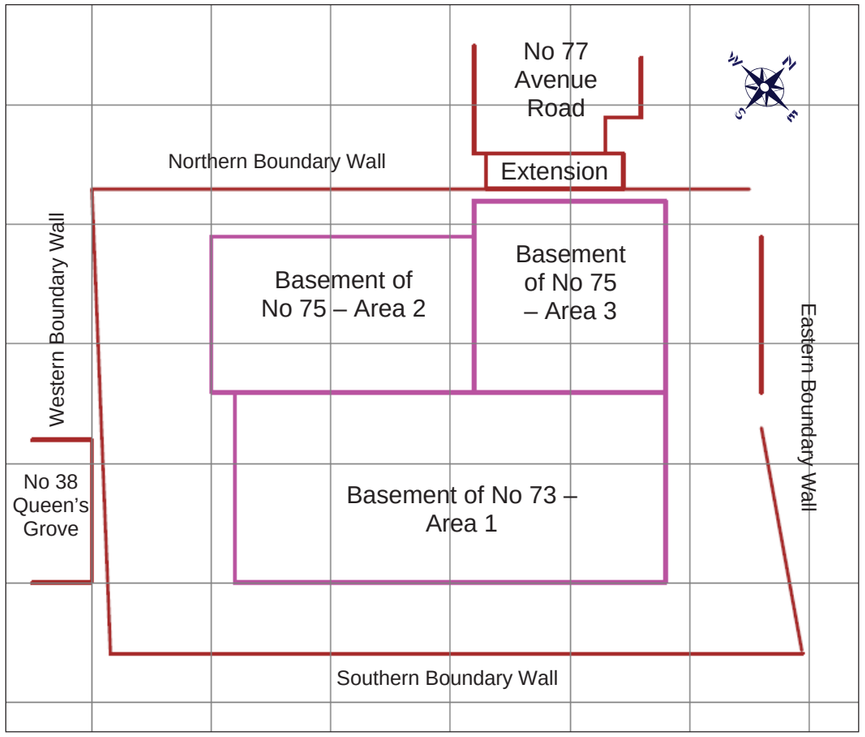
6.0 DAMAGE ASSESSMENT

In addition to the above assessment of the likely movements that will result from the proposed development, some of the neighbouring structures have been set as sensitive structures, requiring Building Damage Assessments, on the basis of the classification given in Table 2.5 of C580[1]. This includes;

- The adjoining property of Ns 77 Avenue Road, to the north;
- No 38 Queen’s Grove, located to the west of the site; and
- the boundary walls of the site.

The sensitive structures have been modelled as lines in the analysis and are the lines along which the damage assessment has been undertaken. For clarity these critical lines are shown on the plan below.

For the analyses it has been assumed that neither of the adjoining buildings have basements, such that the average foundation depths can therefore be assumed as being close to existing ground level.



6.1 Damage to Neighbouring Structures

The combined movements resulting from both pile installation and basement excavation calculated using the X-Dips modelling software have been used to carry out an assessment of the likely damage to adjacent properties and the results are summarised in the table below.

The potential heave movements predicted by P-Disp have not been included in this assessment, which can therefore be considered as conservative, as these movements are likely to have a mitigating effect on the downward settlement predicted by X-Disp.

Building Damage Assessment		
Sensitive Structure	**Elevation**	**Category of Damage***
Boundary Walls	Western	Category 0 (Negligible)
	Northern	Category 0 (Negligible)
	Eastern	Category 0 (Negligible)
	Southern	Category 0 (Negligible)
No 38 Queen's Grove	Eastern Elevation	Category 0 (Negligible)

(building footprint at ground level)	Northern Elevation	Category 0 (Negligible)
	Southern Elevation	Category 0 (Negligible)
No 77 Avenue Road - Extension (building footprint at ground level)	Southern Elevation	Category 0 (Negligible)
	Western Elevation	Category 0 (Negligible)
	Eastern Elevation	Category 0 (Negligible)
No 77 Avenue Road (building footprint at ground level)	Southern Elevation	Category 0 (Negligible)
	Western Elevation	Category 0 (Negligible)
	Eastern Elevation	Category 0 (Negligible)

**Refer to Table 2.5 of C580[1]: Classification of visible damage to walls.*

The building damage reports for sensitive structures highlighted in the above table predict that the damage to the adjoining and nearby structures would generally be Category 0 (negligible).

On this basis, the damage that would inevitably occur as a result of such an excavation would fall well within the acceptable limits.

6.2 Monitoring of Ground Movements

The predictions of ground movement based on the ground movement analysis will be checked by monitoring of adjacent properties and structures. The structures to be monitored during the construction stages will include;

- the adjoining properties of No 38 Queen's Grove and No 77 Avenue Road;
- the existing boundary walls with the adjoin properties, Queen's Grove and Avenue Road; and
- the sections of bored piled walls.

Condition surveys of the above existing structures will 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.

7.0 CONCLUSIONS

The analysis has concluded that the predicted damage to the neighbouring properties would be 'Negligible'. On this basis, the damage that would inevitably occur as a result of such an excavation would fall well within the acceptable limits.

The two phases of work, piling and subsequent excavation will in practice be separated by a number of weeks during which time construction of capping beams and pile curing will take place. This will provide an opportunity for the ground movements during and immediately after piling 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.

73–75 Avenue Road, London, NW8 6JD
Deroda Investments Limited
Ground Movement
Assessment Report

APPENDICES

SOIL DISPLACEMENT MODEL RESULTS

X-DISP ANALYSIS

Pile Installation

Contour Plots of Vertical Movements and Horizontal Movements

Basement Excavation

Contour Plots of Vertical and Horizontal Movements

Pile Installation and Basement Excavation

Contour Plots of Combined Vertical Movements and Horizontal Movements

P-DISP ANALYSIS

Short Term Movement

Total Movement

BUILDING DAMAGE ASSESSMENT (X-DISP)

Tabular Output of Results

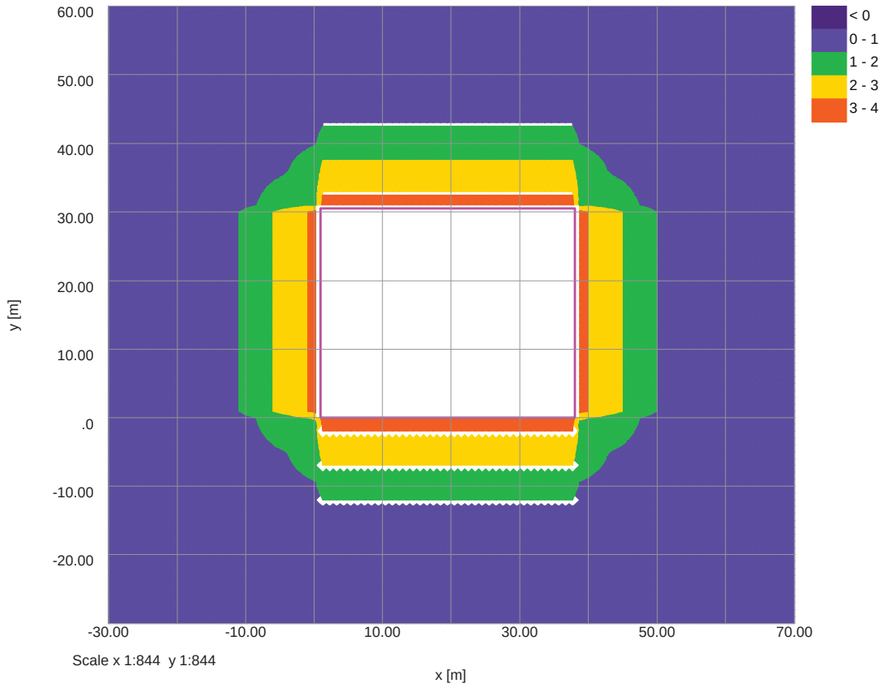
Oasys

73-75 Avenue Road

Pile Installation

Job No.	Sheet No.	Rev.
J14383		
Drg. Ref.		
Made by MP	Date 10-Feb-2015	Checked

Vertical Settlement Contours: Grid 1 (level 0.000m) (Interval 1mm)



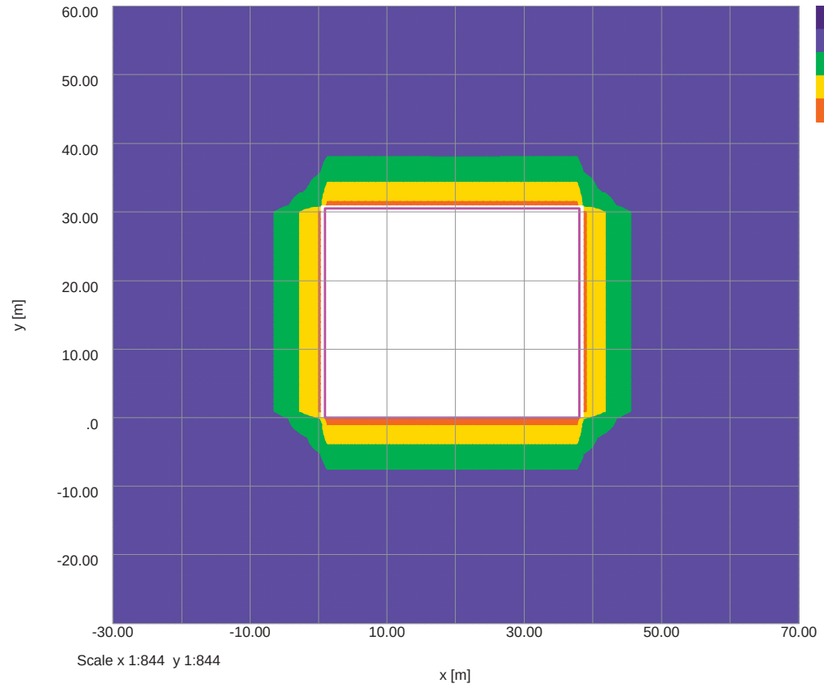
Oasys

73-75 Avenue Road

Pile Installation

Job No.	Sheet No.	Rev.
J14383		
Drg. Ref.		
Made by MP	Date 10-Feb-2015	Checked

Horizontal Displacement Contours: Grid 1 (level 0.000m) Interval 1mm



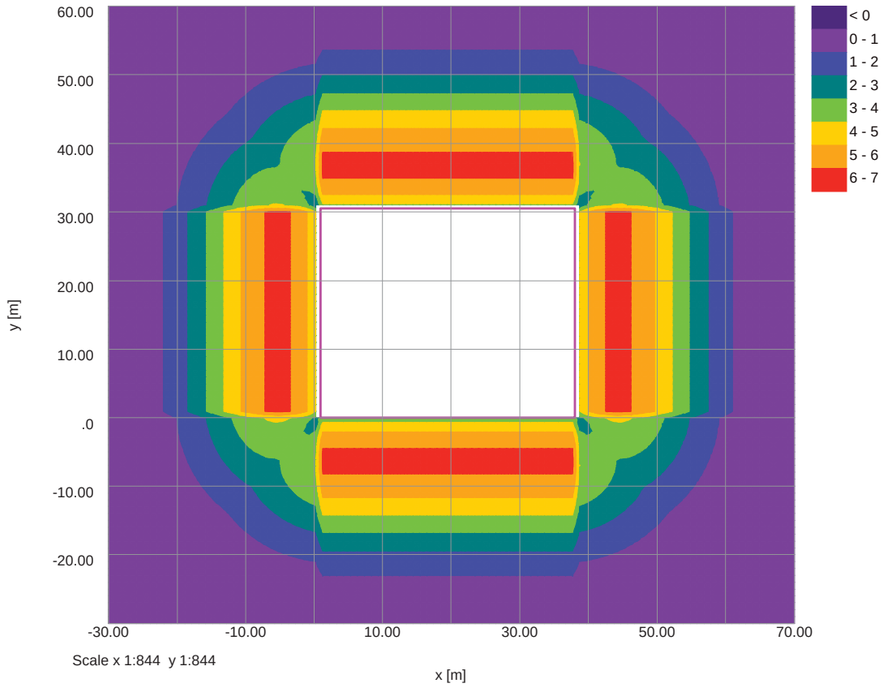
Oasys

73-75 Avenue Road

Excavation Phase

Job No.	Sheet No.	Rev.
J14383		
Drg. Ref.		
Made by MP	Date 09-Feb-2015	Checked

Vertical Settlement Contours: Grid 1 (level 0.000m) (Interval 1mm)



Scale x 1:844 y 1:844

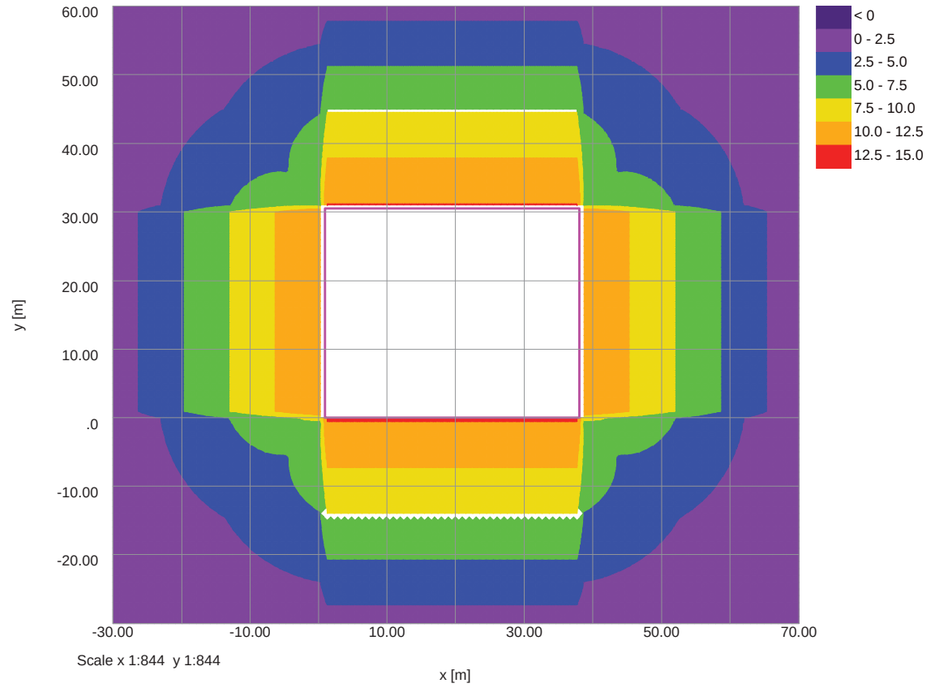
Oasys

73-75 Avenue Road

Excavation Phase

Job No.	Sheet No.	Rev.
J14383		
Drg. Ref.		
Made by MP	Date 09-Feb-2015	Checked

Horizontal Displacement Contours: Grid 1 (level 0.000m) Interval 2.5mm



Scale x 1:844 y 1:844

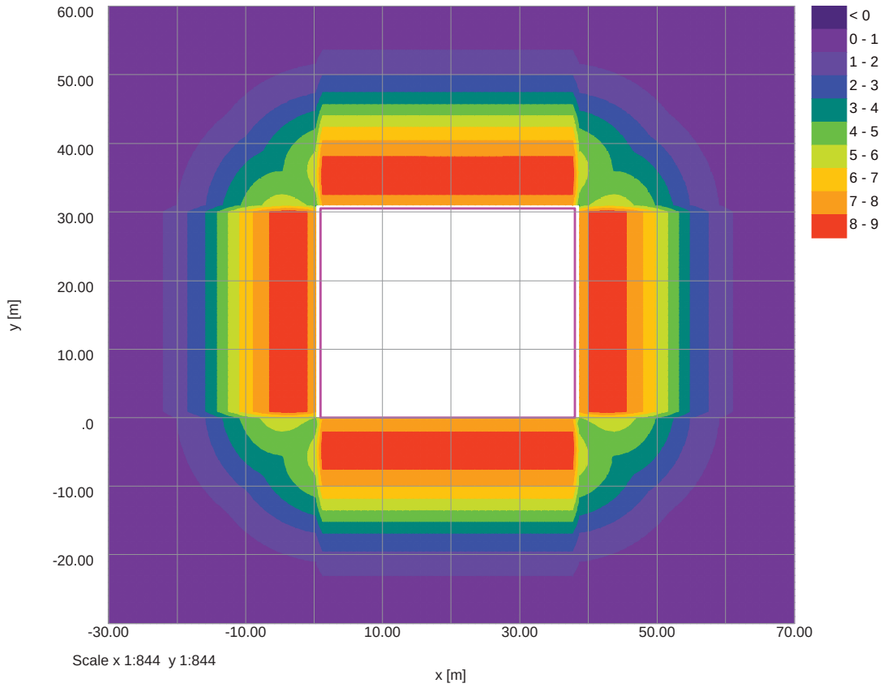
Oasys

73-75 Avenue Road

Combined Movements

Job No.	Sheet No.	Rev.
J14383		
Drg. Ref.		
Made by MP	Date 10-Feb-2015	Checked

Vertical Settlement Contours: Grid 1 (level 0.000m) (Interval 1mm)



Scale x 1:844 y 1:844

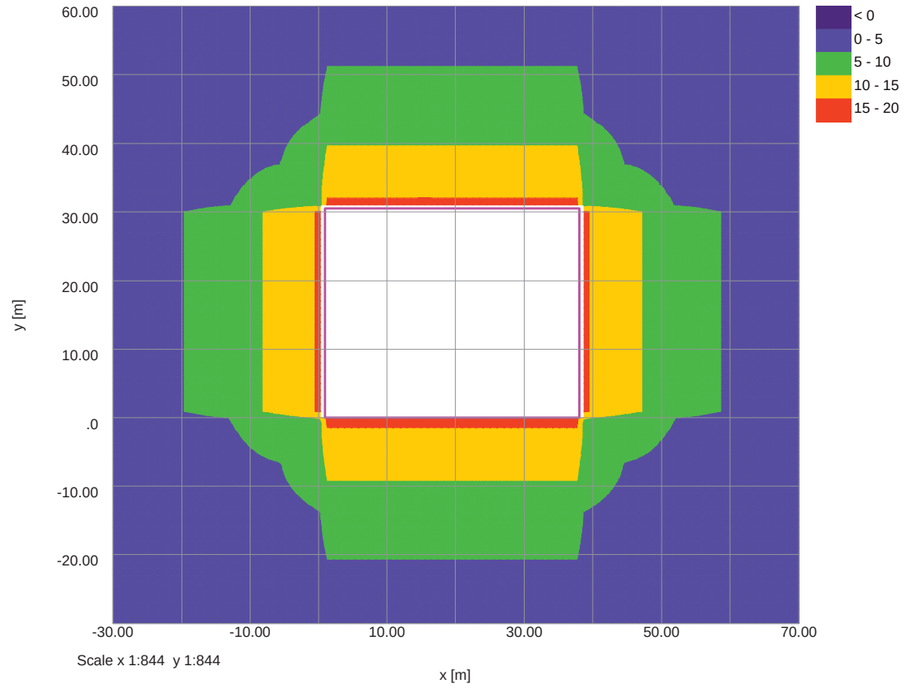
Oasys

73-75 Avenue Road

Combined Movements

Job No.	Sheet No.	Rev.
J14383		
Drg. Ref.		
Made by MP	Date 10-Feb-2015	Checked

Horizontal Displacement Contours: Grid 1 (level 0.000m) Interval 5mm



Scale x 1:844 y 1:844

Oasys

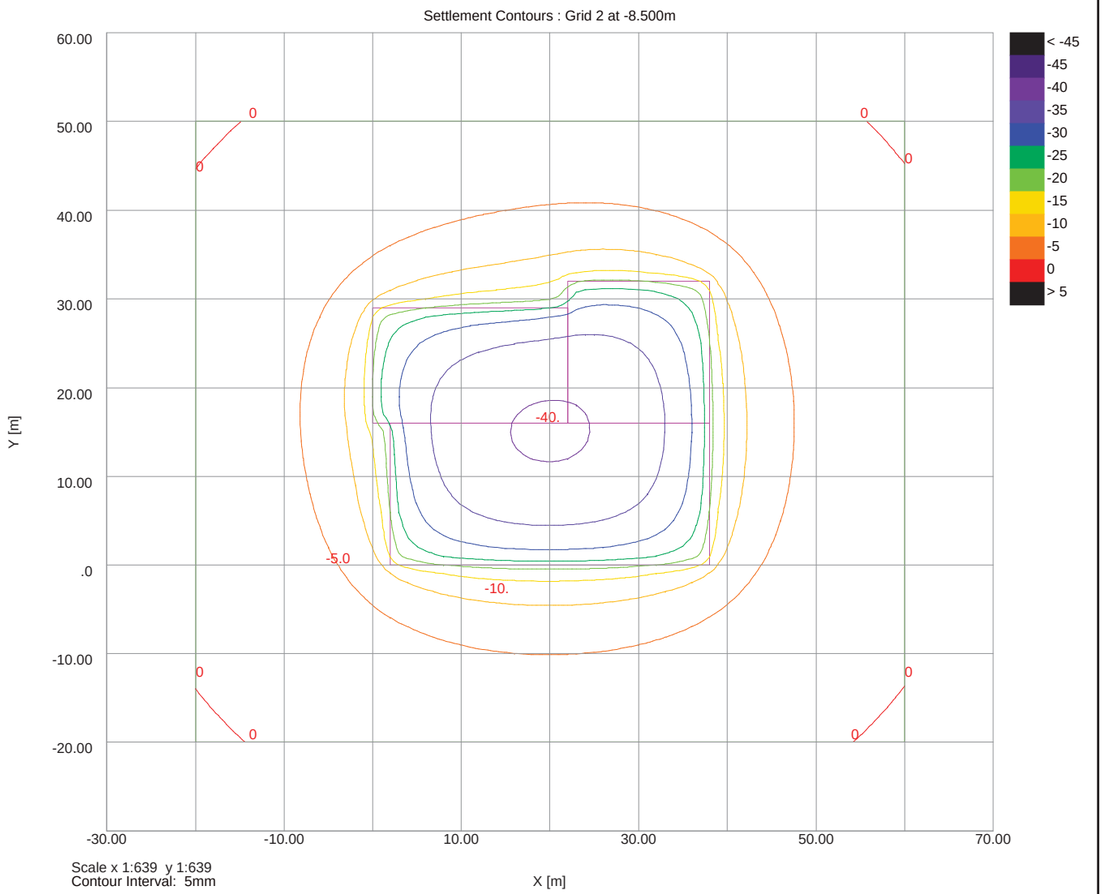
73-75 Avenue Road, NW8

Short-term Heave

Job No.	Sheet No.	Rev.
J14383		

Drg. Ref.

Made by	Date	Checked
MP	06-Feb-2015	



Oasys

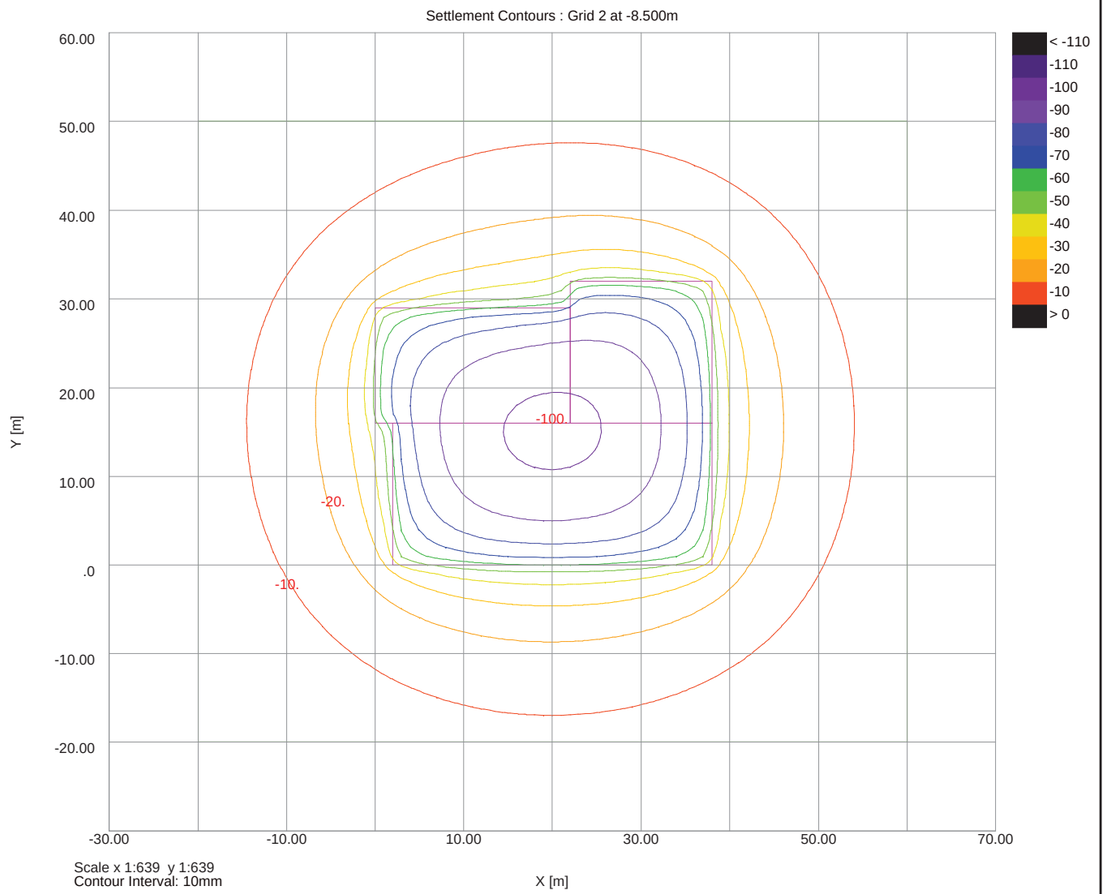
73-75 Avenue Road, NW8

Total Heave

Job No.	Sheet No.	Rev.
J14383		

Drg. Ref.

Made by	Date	Checked
MP	06-Feb-2015	



Specific Building Damage Results - Horizontal Displacements

Structure: Western Boundary Wall | Sub-structure: Sub 1

Dist.	Coordinates				Displacements		
	x	y	z	x	y	Along the Line	Perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	-8.50000	-6.00000	-1.00000	3.9557	2.4983	2.3445	-4.0488
1.0007	-8.53846	-5.00000	-1.00000	4.3632	2.2871	2.1178	-4.4478
2.0015	-8.57692	-4.00000	-1.00000	4.7764	1.9950	1.8099	-4.8495
3.0022	-8.61538	-3.00000	-1.00000	5.1782	1.6156	1.4154	-5.2365
4.0030	-8.65385	-2.00000	-1.00000	5.5474	1.1493	0.93521	-5.5874
5.0037	-8.69231	-1.00000	-1.00000	5.8608	0.60469	0.37899	-5.8798
6.0044	-8.73077	0.00000	-1.00000	6.0976	0.0	-0.23435	-6.0931
7.0052	-8.76923	1.00000	-1.00000	9.0865	0.0	-0.34922	-9.0798
8.0059	-8.80769	2.00000	-1.00000	9.0721	0.0	-0.34867	-9.0654
9.0067	-8.84615	3.00000	-1.00000	9.0577	0.0	-0.34812	-9.0510
10.007	-8.88462	4.00000	-1.00000	9.0433	0.0	-0.34756	-9.0366
11.008	-8.92308	5.00000	-1.00000	9.0288	0.0	-0.34701	-9.0222
12.009	-8.96154	6.00000	-1.00000	9.0144	0.0	-0.34645	-9.0078
13.010	-9.00000	7.00000	-1.00000	9.0000	0.0	-0.34590	-8.9934
14.010	-9.03846	8.00000	-1.00000	8.9856	0.0	-0.34534	-8.9789
15.011	-9.07692	9.00000	-1.00000	8.9712	0.0	-0.34479	-8.9645
16.012	-9.11538	10.00000	-1.00000	8.9567	0.0	-0.34424	-8.9501
17.013	-9.15385	11.00000	-1.00000	8.9423	0.0	-0.34368	-8.9357
18.013	-9.19231	12.00000	-1.00000	8.9279	0.0	-0.34313	-8.9213
19.014	-9.23077	13.00000	-1.00000	8.9135	0.0	-0.34257	-8.9069
20.015	-9.26923	14.00000	-1.00000	8.8990	0.0	-0.34202	-8.8925
21.016	-9.30769	15.00000	-1.00000	8.8846	0.0	-0.34146	-8.8781
22.016	-9.34615	16.00000	-1.00000	8.8702	0.0	-0.34091	-8.8636
23.017	-9.38462	17.00000	-1.00000	8.8558	0.0	-0.34035	-8.8492
24.018	-9.42308	18.00000	-1.00000	8.8413	0.0	-0.33980	-8.8348
25.018	-9.46154	19.00000	-1.00000	8.8269	0.0	-0.33925	-8.8204
26.019	-9.50000	20.00000	-1.00000	8.8125	0.0	-0.33869	-8.8060
27.020	-9.53846	21.00000	-1.00000	8.7981	0.0	-0.33814	-8.7916
28.021	-9.57692	22.00000	-1.00000	8.7837	0.0	-0.33758	-8.7772
29.021	-9.61538	23.00000	-1.00000	8.7692	0.0	-0.33703	-8.7628
30.022	-9.65385	24.00000	-1.00000	8.7548	0.0	-0.33647	-8.7483
31.023	-9.69231	25.00000	-1.00000	8.7404	0.0	-0.33592	-8.7339
32.024	-9.73077	26.00000	-1.00000	8.7260	0.0	-0.33537	-8.7195
33.024	-9.76923	27.00000	-1.00000	8.7115	0.0	-0.33481	-8.7051
34.025	-9.80769	28.00000	-1.00000	8.6971	0.0	-0.33426	-8.6907
35.026	-9.84615	29.00000	-1.00000	8.6827	0.0	-0.33370	-8.6763
36.027	-9.88462	30.00000	-1.00000	8.6683	0.0	-0.33315	-8.6619
37.027	-9.92308	31.00000	-1.00000	5.7036	-0.26108	-0.48009	-5.6893
38.028	-9.96154	32.00000	-1.00000	5.4587	-0.74698	-0.95622	-5.4259
39.029	-10.00000	33.00000	-1.00000	5.1645	-1.1737	-1.3714	-5.1155

Structure: Northern Boundary Wall | Sub-structure: Sub 2

Dist.	Coordinates				Displacements		
	x	y	z	x	y	Along the Line	Perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	-10.00000	33.00000	-1.00000	5.1645	-1.1737	5.1645	-1.1737
1.0000	-9.00000	33.00000	-1.00000	5.3179	-1.3295	5.3179	-1.3295
2.0000	-8.00000	33.00000	-1.00000	5.4471	-1.5131	5.4471	-1.5131
3.0000	-7.00000	33.00000	-1.00000	5.5425	-1.7320	5.5425	-1.7320
4.0000	-6.00000	33.00000	-1.00000	5.5895	-1.9962	5.5895	-1.9962
5.0000	-5.00000	33.00000	-1.00000	5.5644	-2.3185	5.5644	-2.3185
6.0000	-4.00000	33.00000	-1.00000	5.4281	-2.7140	5.4281	-2.7140
7.0000	-3.00000	33.00000	-1.00000	5.1131	-3.1957	5.1131	-3.1957
8.0000	-2.00000	33.00000	-1.00000	4.5050	-3.7542	4.5050	-3.7542
9.0000	-1.00000	33.00000	-1.00000	3.7802	-4.7253	3.7802	-4.7253
10.000	0.00000	33.00000	-1.00000	2.5622	-6.4056	2.5622	-6.4056
11.000	1.00000	33.00000	-1.00000	0.0	-7.9144	0.0	-7.9144
12.000	2.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
13.000	3.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
14.000	4.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
15.000	5.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
16.000	6.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
17.000	7.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
18.000	8.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
19.000	9.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
20.000	10.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
21.000	11.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
22.000	12.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
23.000	13.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
24.000	14.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
25.000	15.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
26.000	16.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
27.000	17.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
28.000	18.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
29.000	19.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
30.000	20.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
31.000	21.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
32.000	22.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
33.000	23.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
34.000	24.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
35.000	25.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
36.000	26.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
37.000	27.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
38.000	28.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
39.000	29.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
40.000	30.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
41.000	31.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
42.000	32.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
43.000	33.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
44.000	34.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
45.000	35.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
46.000	36.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
47.000	37.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
48.000	38.00000	33.00000	-1.00000	0.0	-7.9144	0.0	-7.9144
49.000	39.00000	33.00000	-1.00000	-2.5622	-6.4056	-2.5622	-6.4056
50.000	40.00000	33.00000	-1.00000	-3.7802	-4.7253	-3.7802	-4.7253
51.000	41.00000	33.00000	-1.00000	-4.5050	-3.7542	-4.5050	-3.7542
52.000	42.00000	33.00000	-1.00000	-5.1131	-3.1957	-5.1131	-3.1957
53.000	43.00000	33.00000	-1.00000	-5.4281	-2.7140	-5.4281	-2.7140
54.000	44.00000	33.00000	-1.00000	-5.5644	-2.3185	-5.5644	-2.3185
55.000	45.00000	33.00000	-1.00000	-5.5895	-1.9962	-5.5895	-1.9962

Structure: Eastern Boundary Wall | Sub-structure: Top

Dist.	Coordinates				Displacements		
	x	y	z	x	y	Along the Line	Perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	46.00000	29.00000	-1.00000	-9.7500	0.0	0.0	-9.7500
1.0000	46.00000	28.00000	-1.00000	-9.7500	0.0	0.0	-9.7500
2.0000	46.00000	27.00000	-1.00000	-9.7500	0.0	0.0	-9.7500
3.0000	46.00000	26.00000	-1.00000	-9.7500	0.0	0.0	-9.7500
4.0000	46.00000	25.00000	-1.00000	-9.7500	0.0	0.0	-9.7500
5.0000	46.00000	24.00000	-1.00000	-9.7500	0.0	0.0	-9.7500
6.0000	46.00000	23.00000	-1.00000	-9.7500	0.0	0.0	-9.7500
7.0000	46.00000	22.00000	-1.00000	-9.7500	0.0	0.0	-9.7500
8.0000	46.00000	21.00000	-1.00000	-9.7500	0.0	0.0	-9.7500
9.0000	46.00000	20.00000	-1.00000	-9.7500	0.0	0.0	-9.7500
10.000	46.00000	19.00000	-1.00000	-9.7500	0.0	0.0	-9.7500
11.000	46.00000	18.00000	-1.00000	-9.7500	0.0	0.0	-9.7500
12.000	46.00000	17.00000	-1.00000	-9.7500	0.0	0.0	-9.7500
13.000	46.00000	16.00000	-1.00000	-9.7500	0.0	0.0	-9.7500

Oasys
73-75 Avenue Road
Combined Movements

Job No.	Sheet No.	Rev.
J14383		
Drg. Ref.		
Made by MP	Date 10-Feb-2015	Checked

Dist.	Coordinates				Displacements		
	x	y	z	x	y	Along the Line	Perpendicular to Line

Structure: Eastern Boundary Wall | Sub-structure: Bottom

Dist.	Coordinates				Displacements		
	x	y	z	x	y	Along the Line	Perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	46.00000	13.00000	-1.00000	-9.7500	0.0	-1.7663	-9.5887
1.0168	46.18421	12.00000	-1.00000	-9.6809	0.0	-1.7538	-9.5207
2.0337	46.36842	11.00000	-1.00000	-9.6118	0.0	-1.7413	-9.4528
3.0505	46.55263	10.00000	-1.00000	-9.5428	0.0	-1.7288	-9.3849
4.0673	46.73684	9.00000	-1.00000	-9.4737	0.0	-1.7163	-9.3169
5.0841	46.92105	8.00000	-1.00000	-9.4046	0.0	-1.7038	-9.2490
6.1010	47.10526	7.00000	-1.00000	-9.3355	0.0	-1.6912	-9.1811
7.1178	47.28947	6.00000	-1.00000	-9.2664	0.0	-1.6787	-9.1131
8.1346	47.47368	5.00000	-1.00000	-9.1974	0.0	-1.6662	-9.0452
9.1514	47.65789	4.00000	-1.00000	-9.1283	0.0	-1.6537	-8.9772
10.168	47.84211	3.00000	-1.00000	-9.0592	0.0	-1.6412	-8.9093
11.185	48.02632	2.00000	-1.00000	-8.9901	0.0	-1.6287	-8.8414
12.202	48.21053	1.00000	-1.00000	-8.9211	0.0	-1.6162	-8.7734
13.219	48.39474	0.00000	-1.00000	-5.9308	0.0	-1.0744	-5.8327
14.236	48.57895	-1.00000	-1.00000	-5.6686	0.53584	-1.5539	-5.4777
15.252	48.76316	-2.00000	-1.00000	-5.3565	0.99534	-1.9493	-5.0875
16.269	48.94737	-3.00000	-1.00000	-5.0140	1.3740	-2.2596	-4.6821
17.286	49.13158	-4.00000	-1.00000	-4.6582	1.6739	-2.4900	-4.2779
18.303	49.31579	-5.00000	-1.00000	-4.3025	1.9011	-2.6491	-3.8869
19.320	49.50000	-6.00000	-1.00000	-3.9565	2.0643	-2.7469	-3.5171

Structure: Southern Boundary Wall | Sub-structure: Sub 5

Dist.	Coordinates				Displacements		
	x	y	z	x	y	Along the Line	Perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	-8.50000	-6.00000	-1.00000	3.9557	2.4983	3.9557	2.4983
1.0000	-7.50000	-6.00000	-1.00000	3.8816	2.7399	3.8816	2.7399
2.0000	-6.50000	-6.00000	-1.00000	3.7429	2.9943	3.7429	2.9943
3.0000	-5.50000	-6.00000	-1.00000	3.5256	3.2544	3.5256	3.2544
4.0000	-4.50000	-6.00000	-1.00000	3.3381	3.6416	3.3381	3.6416
5.0000	-3.50000	-6.00000	-1.00000	3.1644	4.2192	3.1644	4.2192
6.0000	-2.50000	-6.00000	-1.00000	2.8406	4.8697	2.8406	4.8697
7.0000	-1.50000	-6.00000	-1.00000	2.3185	5.5644	2.3185	5.5644
8.0000	-0.50000	-6.00000	-1.00000	1.5608	6.2434	1.5608	6.2434
9.0000	0.50000	-6.00000	-1.00000	0.56811	6.8173	0.56811	6.8173
10.000	1.50000	-6.00000	-1.00000	0.0	10.500	0.0	10.500
11.000	2.50000	-6.00000	-1.00000	0.0	10.500	0.0	10.500
12.000	3.50000	-6.00000	-1.00000	0.0	10.500	0.0	10.500
13.000	4.50000	-6.00000	-1.00000	0.0	10.500	0.0	10.500
14.000	5.50000	-6.00000	-1.00000	0.0	10.500	0.0	10.500
15.000	6.50000	-6.00000	-1.00000	0.0	10.500	0.0	10.500
16.000	7.50000	-6.00000	-1.00000	0.0	10.500	0.0	10.500
17.000	8.50000	-6.00000	-1.00000	0.0	10.500	0.0	10.500
18.000	9.50000	-6.00000	-1.00000	0.0	10.500	0.0	10.500
19.000	10.50000	-6.00000	-1.00000	0.0	10.500	0.0	10.500
20.000	11.50000	-6.00000	-1.00000	0.0	10.500	0.0	10.500
21.000	12.50000	-6.00000	-1.00000	0.0	10.500	0.0	10.500
22.000	13.50000	-6.00000	-1.00000	0.0	10.500	0.0	10.500
23.000	14.50000	-6.00000	-1.00000	0.0	10.500	0.0	10.500
24.000	15.50000	-6.00000	-1.00000	0.0	10.500	0.0	10.500
25.000	16.50000	-6.00000	-1.00000	0.0	10.500	0.0	10.500
26.000	17.50000	-6.00000	-1.00000	0.0	10.500	0.0	10.500
27.000	18.50000	-6.00000	-1.00000	0.0	10.500	0.0	10.500
28.000	19.50000	-6.00000	-1.00000	0.0	10.500	0.0	10.500
29.000	20.50000	-6.00000	-1.00000	0.0	10.500	0.0	10.500
30.000	21.50000	-6.00000	-1.00000	0.0	10.500	0.0	10.500
31.000	22.50000	-6.00000	-1.00000	0.0	10.500	0.0	10.500
32.000	23.50000	-6.00000	-1.00000	0.0	10.500	0.0	10.500
33.000	24.50000	-6.00000	-1.00000	0.0	10.500	0.0	10.500
34.000	25.50000	-6.00000	-1.00000	0.0	10.500	0.0	10.500
35.000	26.50000	-6.00000	-1.00000	0.0	10.500	0.0	10.500
36.000	27.50000	-6.00000	-1.00000	0.0	10.500	0.0	10.500
37.000	28.50000	-6.00000	-1.00000	0.0	10.500	0.0	10.500
38.000	29.50000	-6.00000	-1.00000	0.0	10.500	0.0	10.500
39.000	30.50000	-6.00000	-1.00000	0.0	10.500	0.0	10.500
40.000	31.50000	-6.00000	-1.00000	0.0	10.500	0.0	10.500
41.000	32.50000	-6.00000	-1.00000	0.0	10.500	0.0	10.500
42.000	33.50000	-6.00000	-1.00000	0.0	10.500	0.0	10.500
43.000	34.50000	-6.00000	-1.00000	0.0	10.500	0.0	10.500
44.000	35.50000	-6.00000	-1.00000	0.0	10.500	0.0	10.500
45.000	36.50000	-6.00000	-1.00000	0.0	10.500	0.0	10.500
46.000	37.50000	-6.00000	-1.00000	0.0	10.500	0.0	10.500
47.000	38.50000	-6.00000	-1.00000	-0.56811	6.8173	-0.56811	6.8173
48.000	39.50000	-6.00000	-1.00000	-1.5608	6.2434	-1.5608	6.2434
49.000	40.50000	-6.00000	-1.00000	-2.3185	5.5644	-2.3185	5.5644
50.000	41.50000	-6.00000	-1.00000	-2.8406	4.8697	-2.8406	4.8697
51.000	42.50000	-6.00000	-1.00000	-3.1644	4.2192	-3.1644	4.2192
52.000	43.50000	-6.00000	-1.00000	-3.3381	3.6416	-3.3381	3.6416
53.000	44.50000	-6.00000	-1.00000	-3.5256	3.2544	-3.5256	3.2544
54.000	45.50000	-6.00000	-1.00000	-3.7429	2.9943	-3.7429	2.9943
55.000	46.50000	-6.00000	-1.00000	-3.8816	2.7399	-3.8816	2.7399
56.000	47.50000	-6.00000	-1.00000	-3.9557	2.4983	-3.9557	2.4983
57.000	48.50000	-6.00000	-1.00000	-3.9774	2.2728	-3.9774	2.2728
58.000	49.50000	-6.00000	-1.00000	-3.9565	2.0643	-3.9565	2.0643

Structure: 38 Queens Grove | Sub-structure: Eastern elevation

Dist.	Coordinates				Displacements		
	x	y	z	x	y	Along the Line	Perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	-10.00000	0.00000	-1.00000	5.7787	0.0	0.0	-5.7787
1.0000	-10.00000	1.00000	-1.00000	8.6250	0.0	0.0	-8.6250
2.0000	-10.00000	2.00000	-1.00000	8.6250	0.0	0.0	-8.6250
3.0000	-10.00000	3.00000	-1.00000	8.6250	0.0	0.0	-8.6250
4.0000	-10.00000	4.00000	-1.00000	8.6250	0.0	0.0	-8.6250
5.0000	-10.00000	5.00000	-1.00000	8.6250	0.0	0.0	-8.6250
6.0000	-10.00000	6.00000	-1.00000	8.6250	0.0	0.0	-8.6250
7.0000	-10.00000	7.00000	-1.00000	8.6250	0.0	0.0	-8.6250
8.0000	-10.00000	8.00000	-1.00000	8.6250	0.0	0.0	-8.6250
9.0000	-10.00000	9.00000	-1.00000	8.6250	0.0	0.0	-8.6250
10.000	-10.00000	10.00000	-1.00000	8.6250	0.0	0.0	-8.6250
11.000	-10.00000	11.00000	-1.00000	8.6250	0.0	0.0	-8.6250
12.000	-10.00000	12.00000	-1.00000	8.6250	0.0	0.0	-8.6250

Structure: 38 Queens Grove | Sub-structure: Northern elevation

Dist.	Coordinates				Displacements		
	x	y	z	x	y	Along the Line	Perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	-15.00000	12.00000	-1.00000	6.7500	0.0	6.7500	0.0
1.0000	-14.00000	12.00000	-1.00000	7.1250	0.0	7.1250	0.0
2.0000	-13.00000	12.00000	-1.00000	7.5000	0.0	7.5000	0.0
3.0000	-12.00000	12.00000	-1.00000	7.8750	0.0	7.8750	0.0
4.0000	-11.00000	12.00000	-1.00000	8.2500	0.0	8.2500	0.0
5.0000	-10.00000	12.00000	-1.00000	8.6250	0.0	8.6250	0.0

Structure: 38 Queens Grove | Sub-structure: Southern elevation

Dist.	Coordinates				Displacements		
	x	y	z	x	y	Along the Line	Perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]

Dist.	Coordinates x	y	z	Displacements x	y	Along the Line	Perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	-15.00000	0.00000	-1.00000	4.5225	0.0	4.5225	0.0
1.0000	-14.00000	0.00000	-1.00000	4.7737	0.0	4.7737	0.0
2.0000	-13.00000	0.00000	-1.00000	5.0250	0.0	5.0250	0.0
3.0000	-12.00000	0.00000	-1.00000	5.2762	0.0	5.2762	0.0
4.0000	-11.00000	0.00000	-1.00000	5.5275	0.0	5.5275	0.0
5.0000	-10.00000	0.00000	-1.00000	5.7787	0.0	5.7787	0.0

Structure: 77 Avenue Road | Sub-structure: Extension - South

Dist.	Coordinates x	y	z	Displacements x	y	Along the Line	Perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	-10.00000	33.00000	-1.00000	5.1645	-1.1737	5.1645	-1.1737
1.0000	-9.00000	33.00000	-1.00000	5.3179	-1.3295	5.3179	-1.3295
2.0000	-8.00000	33.00000	-1.00000	5.4471	-1.5131	5.4471	-1.5131
3.0000	-7.00000	33.00000	-1.00000	5.5425	-1.7320	5.5425	-1.7320
4.0000	-6.00000	33.00000	-1.00000	5.5895	-1.9962	5.5895	-1.9962
5.0000	-5.00000	33.00000	-1.00000	5.5644	-2.3185	5.5644	-2.3185
6.0000	-4.00000	33.00000	-1.00000	5.4281	-2.7140	5.4281	-2.7140
7.0000	-3.00000	33.00000	-1.00000	5.1131	-3.1957	5.1131	-3.1957
8.0000	-2.00000	33.00000	-1.00000	4.5050	-3.7542	4.5050	-3.7542
9.0000	-1.00000	33.00000	-1.00000	3.7802	-4.7253	3.7802	-4.7253
10.000	0.00000	33.00000	-1.00000	2.5622	-6.4056	2.5622	-6.4056
11.000	1.00000	33.00000	-1.00000	0.0	-7.9144	0.0	-7.9144
12.000	2.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
13.000	3.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
14.000	4.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
15.000	5.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
16.000	6.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
17.000	7.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
18.000	8.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
19.000	9.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
20.000	10.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
21.000	11.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
22.000	12.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
23.000	13.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
24.000	14.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
25.000	15.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
26.000	16.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
27.000	17.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
28.000	18.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
29.000	19.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
30.000	20.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
31.000	21.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
32.000	22.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
33.000	23.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
34.000	24.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
35.000	25.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
36.000	26.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
37.000	27.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
38.000	28.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
39.000	29.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
40.000	30.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
41.000	31.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
42.000	32.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
43.000	33.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
44.000	34.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
45.000	35.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
46.000	36.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
47.000	37.00000	33.00000	-1.00000	0.0	-11.813	0.0	-11.813
48.000	38.00000	33.00000	-1.00000	0.0	-7.9144	0.0	-7.9144
49.000	39.00000	33.00000	-1.00000	-2.5622	-6.4056	-2.5622	-6.4056
50.000	40.00000	33.00000	-1.00000	-3.7802	-4.7253	-3.7802	-4.7253
51.000	41.00000	33.00000	-1.00000	-4.5050	-3.7542	-4.5050	-3.7542
52.000	42.00000	33.00000	-1.00000	-5.1131	-3.1957	-5.1131	-3.1957
53.000	43.00000	33.00000	-1.00000	-5.4281	-2.7140	-5.4281	-2.7140
54.000	44.00000	33.00000	-1.00000	-5.5644	-2.3185	-5.5644	-2.3185
55.000	45.00000	33.00000	-1.00000	-5.5895	-1.9962	-5.5895	-1.9962

Structure: 77 Avenue Road | Sub-structure: Extension - West

Dist.	Coordinates x	y	z	Displacements x	y	Along the Line	Perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	23.00000	33.00000	-1.00000	0.0	-11.813	-11.813	0.0
1.0000	23.00000	34.00000	-1.00000	0.0	-11.438	-11.438	0.0
2.0000	23.00000	35.00000	-1.00000	0.0	-11.062	-11.062	0.0
3.0000	23.00000	36.00000	-1.00000	0.0	-10.687	-10.687	0.0

Structure: 77 Avenue Road | Sub-structure: Extension - East

Dist.	Coordinates x	y	z	Displacements x	y	Along the Line	Perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	34.50000	33.00000	-1.00000	0.0	-11.813	-11.813	0.0
1.0000	34.50000	34.00000	-1.00000	0.0	-11.438	-11.438	0.0
2.0000	34.50000	35.00000	-1.00000	0.0	-11.062	-11.062	0.0
3.0000	34.50000	36.00000	-1.00000	0.0	-10.687	-10.687	0.0

Structure: 77 Avenue Road | Sub-structure: Southern elevation

Dist.	Coordinates x	y	z	Displacements x	y	Along the Line	Perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	22.00000	36.00000	-1.00000	0.0	-10.687	0.0	-10.687
1.0417	23.04167	36.00000	-1.00000	0.0	-10.687	0.0	-10.687
2.0833	24.08333	36.00000	-1.00000	0.0	-10.687	0.0	-10.687
3.1250	25.12500	36.00000	-1.00000	0.0	-10.687	0.0	-10.687
4.1667	26.16667	36.00000	-1.00000	0.0	-10.687	0.0	-10.687
5.2083	27.20833	36.00000	-1.00000	0.0	-10.687	0.0	-10.687
6.2500	28.25000	36.00000	-1.00000	0.0	-10.687	0.0	-10.687
7.2917	29.29167	36.00000	-1.00000	0.0	-10.687	0.0	-10.687
8.3333	30.33333	36.00000	-1.00000	0.0	-10.687	0.0	-10.687
9.3750	31.37500	36.00000	-1.00000	0.0	-10.687	0.0	-10.687
10.417	32.41667	36.00000	-1.00000	0.0	-10.687	0.0	-10.687
11.458	33.45833	36.00000	-1.00000	0.0	-10.687	0.0	-10.687
12.500	34.50000	36.00000	-1.00000	0.0	-10.687	0.0	-10.687

Structure: 77 Avenue Road | Sub-structure: Western elevation

Dist.	Coordinates x	y	z	Displacements x	y	Along the Line	Perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	22.00000	36.00000	-1.00000	0.0	-10.687	-10.687	0.0
1.0000	22.00000	37.00000	-1.00000	0.0	-10.313	-10.313	0.0
2.0000	22.00000	38.00000	-1.00000	0.0	-9.9375	-9.9375	0.0
3.0000	22.00000	39.00000	-1.00000	0.0	-9.5625	-9.5625	0.0
4.0000	22.00000	40.00000	-1.00000	0.0	-9.1875	-9.1875	0.0
5.0000	22.00000	41.00000	-1.00000	0.0	-8.8125	-8.8125	0.0
6.0000	22.00000	42.00000	-1.00000	0.0	-8.4375	-8.4375	0.0
7.0000	22.00000	43.00000	-1.00000	0.0	-8.0625	-8.0625	0.0
8.0000	22.00000	44.00000	-1.00000	0.0	-7.6875	-7.6875	0.0
9.0000	22.00000	45.00000	-1.00000	0.0	-7.3125	-7.3125	0.0

Oasys
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Job No.	Sheet No.	Rev.
J14383		
Drg. Ref.		
Made by MP	Date 10-Feb-2015	Checked

Dist.	Coordinates x	y	z	Displacements x	y	Along the Line	Perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	33.00000	36.00000	-1.00000	0.0	-10.687	-10.687	0.0
1.0000	33.00000	37.00000	-1.00000	0.0	-10.313	-10.313	0.0
2.0000	33.00000	38.00000	-1.00000	0.0	-9.9375	-9.9375	0.0
3.0000	33.00000	39.00000	-1.00000	0.0	-9.5625	-9.5625	0.0

Structure: 77 Avenue Road | Sub-structure: Eastern elevation - mid

Dist.	Coordinates x	y	z	Displacements x	y	Along the Line	Perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	33.00000	39.00000	-1.00000	0.0	-9.5625	0.0	-9.5625
1.0000	34.00000	39.00000	-1.00000	0.0	-9.5625	0.0	-9.5625
2.0000	35.00000	39.00000	-1.00000	0.0	-9.5625	0.0	-9.5625
3.0000	36.00000	39.00000	-1.00000	0.0	-9.5625	0.0	-9.5625

Structure: 77 Avenue Road | Sub-structure: Eastern elevation - upper

Dist.	Coordinates x	y	z	Displacements x	y	Along the Line	Perpendicular to Line
[m]	[m]	[m]	[m]	[mm]	[mm]	[mm]	[mm]
0.0	36.00000	39.00000	-1.00000	0.0	-9.5625	-9.5625	0.0
1.0000	36.00000	40.00000	-1.00000	0.0	-9.1875	-9.1875	0.0
2.0000	36.00000	41.00000	-1.00000	0.0	-8.8125	-8.8125	0.0
3.0000	36.00000	42.00000	-1.00000	0.0	-8.4375	-8.4375	0.0
4.0000	36.00000	43.00000	-1.00000	0.0	-8.0625	-8.0625	0.0
5.0000	36.00000	44.00000	-1.00000	0.0	-7.6875	-7.6875	0.0
6.0000	36.00000	45.00000	-1.00000	0.0	-7.3125	-7.3125	0.0

Specific Building Damage Results - Vertical Displacements

Structure: Western Boundary Wall | Sub-structure: Sub 1

Dist.	Coordinates x	y	z	Displacements z
[m]	[m]	[m]	[m]	[mm]
Vertical Offset 1				
0.0	-8.50000	-6.00000	-1.00000	2.8334
1.0007	-8.53846	-5.00000	-1.00000	3.0138
2.0015	-8.57692	-4.00000	-1.00000	3.1884
3.0022	-8.61538	-3.00000	-1.00000	3.3556
4.0030	-8.65385	-2.00000	-1.00000	3.5130
5.0037	-8.69231	-1.00000	-1.00000	3.6576
6.0044	-8.73077	0.00000	-1.00000	3.7857
7.0052	-8.76923	1.00000	-1.00000	5.6394
8.0059	-8.80769	2.00000	-1.00000	5.6284
9.0067	-8.84615	3.00000	-1.00000	5.6174
10.007	-8.88462	4.00000	-1.00000	5.6062
11.008	-8.92308	5.00000	-1.00000	5.5950
12.009	-8.96154	6.00000	-1.00000	5.5837
13.010	-9.00000	7.00000	-1.00000	5.5723
14.010	-9.03846	8.00000	-1.00000	5.5608
15.011	-9.07692	9.00000	-1.00000	5.5493
16.012	-9.11538	10.00000	-1.00000	5.5377
17.013	-9.15385	11.00000	-1.00000	5.5260
18.013	-9.19231	12.00000	-1.00000	5.5142
19.014	-9.23077	13.00000	-1.00000	5.5024
20.015	-9.26923	14.00000	-1.00000	5.4905
21.016	-9.30769	15.00000	-1.00000	5.4785
22.016	-9.34615	16.00000	-1.00000	5.4665
23.017	-9.38462	17.00000	-1.00000	5.4543
24.018	-9.42308	18.00000	-1.00000	5.4421
25.018	-9.46154	19.00000	-1.00000	5.4299
26.019	-9.50000	20.00000	-1.00000	5.4176
27.020	-9.53846	21.00000	-1.00000	5.4052
28.021	-9.57692	22.00000	-1.00000	5.3927
29.021	-9.61538	23.00000	-1.00000	5.3802
30.022	-9.65385	24.00000	-1.00000	5.3676
31.023	-9.69231	25.00000	-1.00000	5.3550
32.024	-9.73077	26.00000	-1.00000	5.3423
33.024	-9.76923	27.00000	-1.00000	5.3295
34.025	-9.80769	28.00000	-1.00000	5.3167
35.026	-9.84615	29.00000	-1.00000	5.3038
36.027	-9.88462	30.00000	-1.00000	5.2908
37.027	-9.92308	31.00000	-1.00000	3.4813
38.028	-9.96154	32.00000	-1.00000	3.3500
39.029	-10.00000	33.00000	-1.00000	3.2040

Structure: Northern Boundary Wall | Sub-structure: Sub 2

Dist.	Coordinates x	y	z	Displacements z
[m]	[m]	[m]	[m]	[mm]
Vertical Offset 1				
0.0	-10.00000	33.00000	-1.00000	3.2040
1.0000	-9.00000	33.00000	-1.00000	3.3801
2.0000	-8.00000	33.00000	-1.00000	3.5191
3.0000	-7.00000	33.00000	-1.00000	3.6120
4.0000	-6.00000	33.00000	-1.00000	3.6493
5.0000	-5.00000	33.00000	-1.00000	3.6210
6.0000	-4.00000	33.00000	-1.00000	3.5172
7.0000	-3.00000	33.00000	-1.00000	3.3282
8.0000	-2.00000	33.00000	-1.00000	3.0467
9.0000	-1.00000	33.00000	-1.00000	2.9398
10.000	0.00000	33.00000	-1.00000	3.1600
11.000	1.00000	33.00000	-1.00000	3.5359
12.000	2.00000	33.00000	-1.00000	5.2774
13.000	3.00000	33.00000	-1.00000	5.2774
14.000	4.00000	33.00000	-1.00000	5.2774
15.000	5.00000	33.00000	-1.00000	5.2774
16.000	6.00000	33.00000	-1.00000	5.2774
17.000	7.00000	33.00000	-1.00000	5.2774
18.000	8.00000	33.00000	-1.00000	5.2774
19.000	9.00000	33.00000	-1.00000	5.2774
20.000	10.00000	33.00000	-1.00000	5.2774
21.000	11.00000	33.00000	-1.00000	5.2774
22.000	12.00000	33.00000	-1.00000	5.2774
23.000	13.00000	33.00000	-1.00000	5.2774
24.000	14.00000	33.00000	-1.00000	5.2774
25.000	15.00000	33.00000	-1.00000	5.2774
26.000	16.00000	33.00000	-1.00000	5.2774
27.000	17.00000	33.00000	-1.00000	5.2774
28.000	18.00000	33.00000	-1.00000	5.2774
29.000	19.00000	33.00000	-1.00000	5.2774
30.000	20.00000	33.00000	-1.00000	5.2774
31.000	21.00000	33.00000	-1.00000	5.2774
32.000	22.00000	33.00000	-1.00000	5.2774
33.000	23.00000	33.00000	-1.00000	5.2774
34.000	24.00000	33.00000	-1.00000	5.2774
35.000	25.00000	33.00000	-1.00000	5.2774
36.000	26.00000	33.00000	-1.00000	5.2774
37.000	27.00000	33.00000	-1.00000	5.2774
38.000	28.00000	33.00000	-1.00000	5.2774

Dist.	Coordinates x [m]	y [m]	z [m]	Displacements z [mm]
39.000	29.00000	33.00000	-1.00000	5.2774
40.000	30.00000	33.00000	-1.00000	5.2774
41.000	31.00000	33.00000	-1.00000	5.2774
42.000	32.00000	33.00000	-1.00000	5.2774
43.000	33.00000	33.00000	-1.00000	5.2774
44.000	34.00000	33.00000	-1.00000	5.2774
45.000	35.00000	33.00000	-1.00000	5.2774
46.000	36.00000	33.00000	-1.00000	5.2774
47.000	37.00000	33.00000	-1.00000	5.2774
48.000	38.00000	33.00000	-1.00000	3.5359
49.000	39.00000	33.00000	-1.00000	3.1600
50.000	40.00000	33.00000	-1.00000	2.9398
51.000	41.00000	33.00000	-1.00000	3.0467
52.000	42.00000	33.00000	-1.00000	3.3282
53.000	43.00000	33.00000	-1.00000	3.5172
54.000	44.00000	33.00000	-1.00000	3.6210
55.000	45.00000	33.00000	-1.00000	3.6493

Structure: Eastern Boundary Wall | Sub-structure: Top

Dist.	Coordinates x [m]	y [m]	z [m]	Displacements z [mm]
Vertical Offset 1				
0.0	46.00000	29.00000	-1.00000	6.0449
1.0000	46.00000	28.00000	-1.00000	6.0449
2.0000	46.00000	27.00000	-1.00000	6.0449
3.0000	46.00000	26.00000	-1.00000	6.0449
4.0000	46.00000	25.00000	-1.00000	6.0449
5.0000	46.00000	24.00000	-1.00000	6.0449
6.0000	46.00000	23.00000	-1.00000	6.0449
7.0000	46.00000	22.00000	-1.00000	6.0449
8.0000	46.00000	21.00000	-1.00000	6.0449
9.0000	46.00000	20.00000	-1.00000	6.0449
10.000	46.00000	19.00000	-1.00000	6.0449
11.000	46.00000	18.00000	-1.00000	6.0449
12.000	46.00000	17.00000	-1.00000	6.0449
13.000	46.00000	16.00000	-1.00000	6.0449

Structure: Eastern Boundary Wall | Sub-structure: Bottom

Dist.	Coordinates x [m]	y [m]	z [m]	Displacements z [mm]
Vertical Offset 1				
0.0	46.00000	13.00000	-1.00000	6.0449
1.0168	46.18421	12.00000	-1.00000	6.0129
2.0337	46.36842	11.00000	-1.00000	5.9784
3.0505	46.55263	10.00000	-1.00000	5.9413
4.0673	46.73684	9.00000	-1.00000	5.9018
5.0841	46.92105	8.00000	-1.00000	5.8599
6.1010	47.10526	7.00000	-1.00000	5.8158
7.1178	47.28947	6.00000	-1.00000	5.7695
8.1346	47.47368	5.00000	-1.00000	5.7212
9.1514	47.65789	4.00000	-1.00000	5.6708
10.168	47.84211	3.00000	-1.00000	5.6185
11.185	48.02632	2.00000	-1.00000	5.5644
12.202	48.21053	1.00000	-1.00000	5.5086
13.219	48.39474	0.00000	-1.00000	3.6523
14.236	48.57895	-1.00000	-1.00000	3.4927
15.252	48.76316	-2.00000	-1.00000	3.3211
16.269	48.94737	-3.00000	-1.00000	3.1396
17.286	49.13158	-4.00000	-1.00000	2.9505
18.303	49.31579	-5.00000	-1.00000	2.7554
19.320	49.50000	-6.00000	-1.00000	2.5563

Structure: Southern Boundary Wall | Sub-structure: Sub 5

Dist.	Coordinates x [m]	y [m]	z [m]	Displacements z [mm]
Vertical Offset 1				
0.0	-8.50000	-6.00000	-1.00000	2.8334
1.0000	-7.50000	-6.00000	-1.00000	2.9254
2.0000	-6.50000	-6.00000	-1.00000	2.9790
3.0000	-5.50000	-6.00000	-1.00000	2.9895
4.0000	-4.50000	-6.00000	-1.00000	3.0671
5.0000	-3.50000	-6.00000	-1.00000	3.2466
6.0000	-2.50000	-6.00000	-1.00000	3.4298
7.0000	-1.50000	-6.00000	-1.00000	3.6210
8.0000	-0.50000	-6.00000	-1.00000	3.8240
9.0000	0.50000	-6.00000	-1.00000	4.0395
10.000	1.50000	-6.00000	-1.00000	6.1950
11.000	2.50000	-6.00000	-1.00000	6.1950
12.000	3.50000	-6.00000	-1.00000	6.1950
13.000	4.50000	-6.00000	-1.00000	6.1950
14.000	5.50000	-6.00000	-1.00000	6.1950
15.000	6.50000	-6.00000	-1.00000	6.1950
16.000	7.50000	-6.00000	-1.00000	6.1950
17.000	8.50000	-6.00000	-1.00000	6.1950
18.000	9.50000	-6.00000	-1.00000	6.1950
19.000	10.50000	-6.00000	-1.00000	6.1950
20.000	11.50000	-6.00000	-1.00000	6.1950
21.000	12.50000	-6.00000	-1.00000	6.1950
22.000	13.50000	-6.00000	-1.00000	6.1950
23.000	14.50000	-6.00000	-1.00000	6.1950
24.000	15.50000	-6.00000	-1.00000	6.1950
25.000	16.50000	-6.00000	-1.00000	6.1950
26.000	17.50000	-6.00000	-1.00000	6.1950
27.000	18.50000	-6.00000	-1.00000	6.1950
28.000	19.50000	-6.00000	-1.00000	6.1950
29.000	20.50000	-6.00000	-1.00000	6.1950
30.000	21.50000	-6.00000	-1.00000	6.1950
31.000	22.50000	-6.00000	-1.00000	6.1950
32.000	23.50000	-6.00000	-1.00000	6.1950
33.000	24.50000	-6.00000	-1.00000	6.1950
34.000	25.50000	-6.00000	-1.00000	6.1950
35.000	26.50000	-6.00000	-1.00000	6.1950
36.000	27.50000	-6.00000	-1.00000	6.1950
37.000	28.50000	-6.00000	-1.00000	6.1950
38.000	29.50000	-6.00000	-1.00000	6.1950
39.000	30.50000	-6.00000	-1.00000	6.1950
40.000	31.50000	-6.00000	-1.00000	6.1950
41.000	32.50000	-6.00000	-1.00000	6.1950
42.000	33.50000	-6.00000	-1.00000	6.1950
43.000	34.50000	-6.00000	-1.00000	6.1950
44.000	35.50000	-6.00000	-1.00000	6.1950
45.000	36.50000	-6.00000	-1.00000	6.1950
46.000	37.50000	-6.00000	-1.00000	6.1950
47.000	38.50000	-6.00000	-1.00000	4.0395
48.000	39.50000	-6.00000	-1.00000	3.8240
49.000	40.50000	-6.00000	-1.00000	3.6210
50.000	41.50000	-6.00000	-1.00000	3.4298
51.000	42.50000	-6.00000	-1.00000	3.2466
52.000	43.50000	-6.00000	-1.00000	3.0671
53.000	44.50000	-6.00000	-1.00000	2.9895
54.000	45.50000	-6.00000	-1.00000	2.9790
55.000	46.50000	-6.00000	-1.00000	2.9254
56.000	47.50000	-6.00000	-1.00000	2.8334
57.000	48.50000	-6.00000	-1.00000	2.7084
58.000	49.50000	-6.00000	-1.00000	2.5563

Structure: 38 Queens Grove | Sub-structure: Eastern elevation

Oasys
73-75 Avenue Road
Combined Movements
Job No. J14383 | Sheet No. | Rev.
Drg. Ref.
Made by MP | Date 10-Feb-2015 | Checked

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

Dist.	Coordinates x [m]	y [m]	z [m]	Displacements z [mm]
Vertical Offset 1				
0.0	-10.00000	0.00000	-1.00000	3.5186
1.0000	-10.00000	1.00000	-1.00000	5.2516
2.0000	-10.00000	2.00000	-1.00000	5.2516
3.0000	-10.00000	3.00000	-1.00000	5.2516
4.0000	-10.00000	4.00000	-1.00000	5.2516
5.0000	-10.00000	5.00000	-1.00000	5.2516
6.0000	-10.00000	6.00000	-1.00000	5.2516
7.0000	-10.00000	7.00000	-1.00000	5.2516
8.0000	-10.00000	8.00000	-1.00000	5.2516
9.0000	-10.00000	9.00000	-1.00000	5.2516
10.000	-10.00000	10.00000	-1.00000	5.2516
11.000	-10.00000	11.00000	-1.00000	5.2516
12.000	-10.00000	12.00000	-1.00000	5.2516

Structure: 38 Queens Grove | Sub-structure: Northern elevation

Dist.	Coordinates x [m]	y [m]	z [m]	Displacements z [mm]
Vertical Offset 1				
0.0	-15.00000	12.00000	-1.00000	3.2860
1.0000	-14.00000	12.00000	-1.00000	3.6934
2.0000	-13.00000	12.00000	-1.00000	4.1028
3.0000	-12.00000	12.00000	-1.00000	4.5056
4.0000	-11.00000	12.00000	-1.00000	4.8921
5.0000	-10.00000	12.00000	-1.00000	5.2516

Structure: 38 Queens Grove | Sub-structure: Southern elevation

Dist.	Coordinates x [m]	y [m]	z [m]	Displacements z [mm]
Vertical Offset 1				
0.0	-15.00000	0.00000	-1.00000	2.2016
1.0000	-14.00000	0.00000	-1.00000	2.4746
2.0000	-13.00000	0.00000	-1.00000	2.7489
3.0000	-12.00000	0.00000	-1.00000	3.0188
4.0000	-11.00000	0.00000	-1.00000	3.2777
5.0000	-10.00000	0.00000	-1.00000	3.5186

Structure: 77 Avenue Road | Sub-structure: Extension - South

Dist.	Coordinates x [m]	y [m]	z [m]	Displacements z [mm]
Vertical Offset 1				
0.0	-10.00000	33.00000	-1.00000	3.2040
1.0000	-9.00000	33.00000	-1.00000	3.3801
2.0000	-8.00000	33.00000	-1.00000	3.5191
3.0000	-7.00000	33.00000	-1.00000	3.6120
4.0000	-6.00000	33.00000	-1.00000	3.6493
5.0000	-5.00000	33.00000	-1.00000	3.6210
6.0000	-4.00000	33.00000	-1.00000	3.5172
7.0000	-3.00000	33.00000	-1.00000	3.3282
8.0000	-2.00000	33.00000	-1.00000	3.0467
9.0000	-1.00000	33.00000	-1.00000	2.9398
10.000	0.00000	33.00000	-1.00000	3.1600
11.000	1.00000	33.00000	-1.00000	3.5359
12.000	2.00000	33.00000	-1.00000	5.2774
13.000	3.00000	33.00000	-1.00000	5.2774
14.000	4.00000	33.00000	-1.00000	5.2774
15.000	5.00000	33.00000	-1.00000	5.2774
16.000	6.00000	33.00000	-1.00000	5.2774
17.000	7.00000	33.00000	-1.00000	5.2774
18.000	8.00000	33.00000	-1.00000	5.2774
19.000	9.00000	33.00000	-1.00000	5.2774
20.000	10.00000	33.00000	-1.00000	5.2774
21.000	11.00000	33.00000	-1.00000	5.2774
22.000	12.00000	33.00000	-1.00000	5.2774
23.000	13.00000	33.00000	-1.00000	5.2774
24.000	14.00000	33.00000	-1.00000	5.2774
25.000	15.00000	33.00000	-1.00000	5.2774
26.000	16.00000	33.00000	-1.00000	5.2774
27.000	17.00000	33.00000	-1.00000	5.2774
28.000	18.00000	33.00000	-1.00000	5.2774
29.000	19.00000	33.00000	-1.00000	5.2774
30.000	20.00000	33.00000	-1.00000	5.2774
31.000	21.00000	33.00000	-1.00000	5.2774
32.000	22.00000	33.00000	-1.00000	5.2774
33.000	23.00000	33.00000	-1.00000	5.2774
34.000	24.00000	33.00000	-1.00000	5.2774
35.000	25.00000	33.00000	-1.00000	5.2774
36.000	26.00000	33.00000	-1.00000	5.2774
37.000	27.00000	33.00000	-1.00000	5.2774
38.000	28.00000	33.00000	-1.00000	5.2774
39.000	29.00000	33.00000	-1.00000	5.2774
40.000	30.00000	33.00000	-1.00000	5.2774
41.000	31.00000	33.00000	-1.00000	5.2774
42.000	32.00000	33.00000	-1.00000	5.2774
43.000	33.00000	33.00000	-1.00000	5.2774
44.000	34.00000	33.00000	-1.00000	5.2774
45.000	35.00000	33.00000	-1.00000	5.2774
46.000	36.00000	33.00000	-1.00000	5.2774
47.000	37.00000	33.00000	-1.00000	5.2774
48.000	38.00000	33.00000	-1.00000	3.5359
49.000	39.00000	33.00000	-1.00000	3.1600
50.000	40.00000	33.00000	-1.00000	2.9398
51.000	41.00000	33.00000	-1.00000	3.0467
52.000	42.00000	33.00000	-1.00000	3.3282
53.000	43.00000	33.00000	-1.00000	3.5172
54.000	44.00000	33.00000	-1.00000	3.6210
55.000	45.00000	33.00000	-1.00000	3.6493

Structure: 77 Avenue Road | Sub-structure: Extension - West

Dist.	Coordinates x [m]	y [m]	z [m]	Displacements z [mm]
Vertical Offset 1				
0.0	23.00000	33.00000	-1.00000	5.2774
1.0000	23.00000	34.00000	-1.00000	5.7275
2.0000	23.00000	35.00000	-1.00000	6.0176
3.0000	23.00000	36.00000	-1.00000	6.1671

Structure: 77 Avenue Road | Sub-structure: Extension - East

Dist.	Coordinates x [m]	y [m]	z [m]	Displacements z [mm]
Vertical Offset 1				
0.0	34.50000	33.00000	-1.00000	5.2774
1.0000	34.50000	34.00000	-1.00000	5.7275
2.0000	34.50000	35.00000	-1.00000	6.0176
3.0000	34.50000	36.00000	-1.00000	6.1671

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

Structure: 77 Avenue Road | Sub-structure: Southern elevation

Dist.	Coordinates x	y	z	Displacements z
[m]	[m]	[m]	[m]	[mm]
Vertical Offset 1				
0.0	22.00000	36.00000	-1.00000	6.1671
1.0417	23.04167	36.00000	-1.00000	6.1671
2.0833	24.08333	36.00000	-1.00000	6.1671
3.1250	25.12500	36.00000	-1.00000	6.1671
4.1667	26.16667	36.00000	-1.00000	6.1671
5.2083	27.20833	36.00000	-1.00000	6.1671
6.2500	28.25000	36.00000	-1.00000	6.1671
7.2917	29.29167	36.00000	-1.00000	6.1671
8.3333	30.33333	36.00000	-1.00000	6.1671
9.3750	31.37500	36.00000	-1.00000	6.1671
10.417	32.41667	36.00000	-1.00000	6.1671
11.458	33.45833	36.00000	-1.00000	6.1671
12.500	34.50000	36.00000	-1.00000	6.1671

Structure: 77 Avenue Road | Sub-structure: Western elevation

Dist.	Coordinates x	y	z	Displacements z
[m]	[m]	[m]	[m]	[mm]
Vertical Offset 1				
0.0	22.00000	36.00000	-1.00000	6.1671
1.0000	22.00000	37.00000	-1.00000	6.1946
2.0000	22.00000	38.00000	-1.00000	6.1175
3.0000	22.00000	39.00000	-1.00000	5.9522
4.0000	22.00000	40.00000	-1.00000	5.7141
5.0000	22.00000	41.00000	-1.00000	5.4176
6.0000	22.00000	42.00000	-1.00000	5.0760
7.0000	22.00000	43.00000	-1.00000	4.7016
8.0000	22.00000	44.00000	-1.00000	4.3056
9.0000	22.00000	45.00000	-1.00000	3.8983

Structure: 77 Avenue Road | Sub-structure: Eastern elevation - lower

Dist.	Coordinates x	y	z	Displacements z
[m]	[m]	[m]	[m]	[mm]
Vertical Offset 1				
0.0	33.00000	36.00000	-1.00000	6.1671
1.0000	33.00000	37.00000	-1.00000	6.1946
2.0000	33.00000	38.00000	-1.00000	6.1175
3.0000	33.00000	39.00000	-1.00000	5.9522

Structure: 77 Avenue Road | Sub-structure: Eastern elevation - mid

Dist.	Coordinates x	y	z	Displacements z
[m]	[m]	[m]	[m]	[mm]
Vertical Offset 1				
0.0	33.00000	39.00000	-1.00000	5.9522
1.0000	34.00000	39.00000	-1.00000	5.9522
2.0000	35.00000	39.00000	-1.00000	5.9522
3.0000	36.00000	39.00000	-1.00000	5.9522

Structure: 77 Avenue Road | Sub-structure: Eastern elevation - upper

Dist.	Coordinates x	y	z	Displacements z
[m]	[m]	[m]	[m]	[mm]
Vertical Offset 1				
0.0	36.00000	39.00000	-1.00000	5.9522
1.0000	36.00000	40.00000	-1.00000	5.7141
2.0000	36.00000	41.00000	-1.00000	5.4176
3.0000	36.00000	42.00000	-1.00000	5.0760
4.0000	36.00000	43.00000	-1.00000	4.7016
5.0000	36.00000	44.00000	-1.00000	4.3056
6.0000	36.00000	45.00000	-1.00000	3.8983

Specific Building Damage Results - All Segments

Structure: Western Boundary Wall | Sub-structure: Sub 1

Vertical Offset from Line for Vertical Movement Calculations [m]	Segment	Start [m]	Length [m]	Curvature [m]	Deflection Ratio [%]	Average Horizontal Strain [%]	Max. Tensile Strain [%]	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature [m]	Damage Category
0	1	0.0	4.0329	Sagging	385.34E-6	-0.035356	0.0070721	556.11E-6	-180.26E-6	77550.	0 (Negligible)
	2	4.0329	2.4115	Hogging	0.025511	-0.049904	0.018001	613.27E-6	-0.0018525	2384.2	0 (Negligible)
	3	6.4443	30.136	Sagging	0.0034664	-430.06E-6	926.94E-6	146.86E-6	-0.0018525	2005.9	0 (Negligible)
	4	36.580	1.9164	Hogging	0.029789	-0.038414	0.021003	476.00E-6	0.0018084	2490.4	0 (Negligible)
	5	38.497	0.50329	Hogging	0.0	-0.041483	0.0082966	415.00E-6	145.96E-6	2317.4	0 (Negligible)

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

Structure: Northern Boundary Wall | Sub-structure: Sub 2

Vertical Offset from Line for Vertical Movement Calculations [m]	Segment	Start [m]	Length [m]	Curvature [m]	Deflection Ratio [%]	Average Horizontal Strain [%]	Max. Tensile Strain [%]	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature [m]	Damage Category
0	1	0.0	7.1407	Sagging	0.0055608	-0.0019167	0.0052390	608.45E-6	281.73E-6	11828.	0 (Negligible)
	2	7.1407	4.2115	Hogging	0.017324	-0.11938	0.025135	0.0025688	-0.0017415	2002.1	0 (Negligible)
	3	11.352	2.6478	Sagging	0.031889	0.0	0.044812	0.0	-0.0017415	1896.8	0 (Negligible)
	4	14.000	31.000	None	0.0	0.0	0.0	0.0	0.0 -		0 (Negligible)
	5	45.000	2.6478	Sagging	0.031889	0.0	0.044812	0.0	0.0017415	1896.8	0 (Negligible)
	6	47.648	4.2115	Hogging	0.017324	-0.11938	0.025135	0.0025688	0.0017415	2002.1	0 (Negligible)
	7	51.859	3.1407	Sagging	0.0031068	-0.017891	0.0037455	608.45E-6	-281.73E-6	11812.	0 (Negligible)

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

Structure: Eastern Boundary Wall | Sub-structure: Top

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

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Movement Calculations [m]	Segment	Start [m]	Length [m]	Curvature	Deflection Ratio [%]	Average Horizontal Strain [%]	Max. Tensile Strain [%]	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature [m]	Damage Category
0	1	0.0	13.000	None	0.0	0.0	0.0	0.0	0.0 -		0 (Negligible)

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

Structure: Eastern Boundary Wall | Sub-structure: Bottom

Vertical Offset from Line for Vertical Movement Calculations [m]	Segment	Start [m]	Length [m]	Curvature	Deflection Ratio [%]	Average Horizontal Strain [%]	Max. Tensile Strain [%]	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature [m]	Damage Category
0	1	0.0	12.757	Sagging	0.0073747	0.0034973	0.0098274	-532.47E-6	0.0018247	2181.4	0 (Negligible)
	2	12.757	2.4714	Hogging	0.025079	-0.025086	0.017321	-532.47E-6	0.0018247	2489.4	0 (Negligible)
	3	15.229	3.7711	Sagging	282.47E-6	-0.020578	0.0041165	388.96E-6	195.90E-6	105500.	0 (Negligible)

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

Structure: Southern Boundary Wall | Sub-structure: Sub 5

Vertical Offset from Line for Vertical Movement Calculations [m]	Segment	Start [m]	Length [m]	Curvature	Deflection Ratio [%]	Average Horizontal Strain [%]	Max. Tensile Strain [%]	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature [m]	Damage Category
0	1	0.0	2.2291	Sagging	0.0011410	-0.011780	0.0024087	217.34E-6	-91.987E-6	25285.	0 (Negligible)
	2	2.2291	7.1942	Hogging	0.011066	-0.046781	0.010001	993.72E-6	-0.0021567	2030.8	0 (Negligible)
	3	9.4233	2.5767	Sagging	0.037205	-0.012715	0.039013	568.43E-6	-0.0021567	1690.0	0 (Negligible)
	4	12.000	32.000	None	0.0	0.0	0.0	0.0	0.0 -		0 (Negligible)
	5	44.000	2.5767	Sagging	0.037205	-0.012715	0.039013	568.43E-6	0.0021567	1690.0	0 (Negligible)
	6	46.577	7.1942	Hogging	0.011066	-0.046781	0.010001	993.72E-6	0.0021567	2030.8	0 (Negligible)
	7	53.771	4.2291	Sagging	0.0017979	-0.0062293	0.0013386	217.34E-6	152.16E-6	26203.	0 (Negligible)

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

Structure: 38 Queens Grove | Sub-structure: Eastern elevation

Vertical Offset from Line for Vertical Movement Calculations [m]	Segment	Start [m]	Length [m]	Curvature	Deflection Ratio [%]	Average Horizontal Strain [%]	Max. Tensile Strain [%]	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature [m]	Damage Category
0	1	0.0	3.0000	Sagging	0.038512	0.0	0.036780	0.0	-0.0017330	461.62	0 (Negligible)
	2	3.0000	9.0000	None	0.0	0.0	0.0	0.0	0.0 -		0 (Negligible)

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

Structure: 38 Queens Grove | Sub-structure: Northern elevation

Vertical Offset from Line for Vertical Movement Calculations [m]	Segment	Start [m]	Length [m]	Curvature	Deflection Ratio [%]	Average Horizontal Strain [%]	Max. Tensile Strain [%]	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature [m]	Damage Category
0	1	0.0	0.97802	Sagging	0.0	0.037500	0.037500	-374.86E-6	-407.20E-6	235970.	0 (Negligible)
	2	0.97802	4.0220	Sagging	827.51E-6	0.037500	0.038174	-374.86E-6	-409.27E-6	33659.	0 (Negligible)

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

Structure: 38 Queens Grove | Sub-structure: Southern elevation

Vertical Offset from Line for Vertical Movement Calculations [m]	Segment	Start [m]	Length [m]	Curvature	Deflection Ratio [%]	Average Horizontal Strain [%]	Max. Tensile Strain [%]	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature [m]	Damage Category
0	1	0.0	0.97802	None	0.0	0.025125	0.025125	-251.19E-6	-272.86E-6	352110.	0 (Negligible)
	2	0.97802	4.0220	Sagging	554.50E-6	0.025125	0.025577	-251.19E-6	-274.25E-6	50226.	0 (Negligible)

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

Structure: 77 Avenue Road | Sub-structure: Extension - South

Vertical Offset from Line for Vertical Movement Calculations [m]	Segment	Start [m]	Length [m]	Curvature	Deflection Ratio [%]	Average Horizontal Strain [%]	Max. Tensile Strain [%]	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature [m]	Damage Category
0	1	0.0	11.500	None	0.0	0.0	0.0	0.0	0.0 -		0 (Negligible)

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

Structure: 77 Avenue Road | Sub-structure: Extension - West

Vertical Offset from Line for Vertical Movement Calculations [m]	Segment	Start [m]	Length [m]	Curvature	Deflection Ratio [%]	Average Horizontal Strain [%]	Max. Tensile Strain [%]	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature [m]	Damage Category
0	1	0.0	3.0000	Sagging	0.0051171	0.037500	0.042660	-374.86E-6	-449.99E-6	6066.5	0 (Negligible)

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

Structure: 77 Avenue Road | Sub-structure: Extension - East

Vertical Offset from Line for Vertical Movement Calculations [m]	Segment	Start [m]	Length [m]	Curvature	Deflection Ratio [%]	Average Horizontal Strain [%]	Max. Tensile Strain [%]	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature [m]	Damage Category
0	1	0.0	3.0000	Sagging	0.0051171	0.037500	0.042660	-374.86E-6	-449.99E-6	6066.5	0 (Negligible)

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

Structure: 77 Avenue Road | Sub-structure: Southern elevation

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

Vertical Movement Calculations					Strain	Strain	Horizontal Displacement Curve	Vertical Displacement Curve	Curvature	
[m]		[m]	[m]	[%]	[%]	[%]			[m]	
0	1	0.0	12.500	None	0.0	0.0	0.0	0.0	0.0 -	0 (Negligible)

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

Structure: 77 Avenue Road | Sub-structure: Western elevation

Vertical Offset from Line for Vertical Movement Calculations	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature	Damage Category
[m]		[m]	[m]		[%]	[%]	[%]			[m]	
0	1	0.0	9.0000	Sagging	0.0061676	0.037500	0.046068	-374.86E-6	407.12E-6	9206.1	0 (Negligible)

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

Structure: 77 Avenue Road | Sub-structure: Eastern elevation - lower

Vertical Offset from Line for Vertical Movement Calculations	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature	Damage Category
[m]		[m]	[m]		[%]	[%]	[%]			[m]	
0	1	0.0	3.0000	Sagging	0.0033029	0.037500	0.039580	-374.86E-6	165.24E-6	9206.1	0 (Negligible)

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

Structure: 77 Avenue Road | Sub-structure: Eastern elevation - mid

Vertical Offset from Line for Vertical Movement Calculations	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature	Damage Category
[m]		[m]	[m]		[%]	[%]	[%]			[m]	
0	1	0.0	3.0000	None	0.0	0.0	0.0	0.0	0.0 -		0 (Negligible)

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

Structure: 77 Avenue Road | Sub-structure: Eastern elevation - upper

Vertical Offset from Line for Vertical Movement Calculations	Segment	Start	Length	Curvature	Deflection Ratio	Average Horizontal Strain	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature	Damage Category
[m]		[m]	[m]		[%]	[%]	[%]			[m]	
0	1	0.0	5.0000	Sagging	0.0024747	0.037500	0.039905	-374.86E-6	395.80E-6	16206.	0 (Negligible)

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

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

Structure: Western Boundary Wall | Sub-structure: Sub 1

Vertical Offset from Line for Vertical Movement Calculations	Deflection Ratio	Average Horizontal Strain	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]		[mm]	[%]			[m]	[m]	
0	0.029789	-0.049904	-0.0018525	5.6389	0.021003	613.27E-6	-0.0018525	2317.4	2005.9	0 (Negligible)

Structure: Northern Boundary Wall | Sub-structure: Sub 2

Vertical Offset from Line for Vertical Movement Calculations	Deflection Ratio	Average Horizontal Strain	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]		[mm]	[%]			[m]	[m]	
0	0.031889	-0.11938	0.0017415	5.2774	0.044812	0.0025688	0.0017415	2002.1	1896.8	0 (Negligible)

Structure: Eastern Boundary Wall | Sub-structure: Top

Vertical Offset from Line for Vertical Movement Calculations	Deflection Ratio	Average Horizontal Strain	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]		[mm]	[%]			[m]	[m]	
0	0.0	0.0	0.0	6.0449	0.0	0.0	0.0	-	-	0 (Negligible)

Structure: Eastern Boundary Wall | Sub-structure: Bottom

Vertical Offset from Line for Vertical Movement Calculations	Deflection Ratio	Average Horizontal Strain	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]		[mm]	[%]			[m]	[m]	
0	0.025079	-0.025086	0.0018247	6.0449	0.017321	-532.47E-6	0.0018247	2489.4	2181.4	0 (Negligible)

Structure: Southern Boundary Wall | Sub-structure: Sub 5

Vertical Offset from Line for Vertical Movement Calculations	Deflection Ratio	Average Horizontal Strain	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]		[mm]	[%]			[m]	[m]	
0	0.037205	-0.046781	-0.0021567	6.1950	0.039013	993.72E-6	-0.0021567	2030.8	1690.0	0 (Negligible)

Structure: 38 Queens Grove | Sub-structure: Eastern elevation

Vertical Offset from Line for Vertical Movement Calculations	Deflection Ratio	Average Horizontal Strain	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]		[mm]	[%]			[m]	[m]	
0	0.038512	0.0	-0.0017330	5.2516	0.036780	0.0	-0.0017330	-	461.62	0 (Negligible)

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Vertical Offset from Line for Vertical Movement Calculations	Deflection Ratio	Average Horizontal Strain	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]		[mm]	[%]			[m]	[m]	
0	827.51E-6	0.037500	-409.27E-6	5.2516	0.038174	-374.86E-6	-409.27E-6	-	33659.	0 (Negligible)

Structure: 38 Queens Grove | Sub-structure: Southern elevation

Vertical Offset from Line for Vertical Movement Calculations	Deflection Ratio	Average Horizontal Strain	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]		[mm]	[%]			[m]	[m]	
0	554.50E-6	0.025125	-274.25E-6	3.5186	0.025577	-251.19E-6	-274.25E-6	-	50226.	0 (Negligible)

Structure: 77 Avenue Road | Sub-structure: Extension - South

Vertical Offset from Line for Vertical Movement Calculations	Deflection Ratio	Average Horizontal Strain	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]		[mm]	[%]			[m]	[m]	
0	0.0	0.0	0.0	5.2774	0.0	0.0	0.0	-	-	0 (Negligible)

Structure: 77 Avenue Road | Sub-structure: Extension - West

Vertical Offset from Line for Vertical Movement Calculations	Deflection Ratio	Average Horizontal Strain	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]		[mm]	[%]			[m]	[m]	
0	0.0051171	0.037500	-449.99E-6	6.1671	0.042660	-374.86E-6	-449.99E-6	-	6066.5	0 (Negligible)

Structure: 77 Avenue Road | Sub-structure: Extension - East

Vertical Offset from Line for Vertical Movement Calculations	Deflection Ratio	Average Horizontal Strain	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]		[mm]	[%]			[m]	[m]	
0	0.0051171	0.037500	-449.99E-6	6.1671	0.042660	-374.86E-6	-449.99E-6	-	6066.5	0 (Negligible)

Structure: 77 Avenue Road | Sub-structure: Southern elevation

Vertical Offset from Line for Vertical Movement Calculations	Deflection Ratio	Average Horizontal Strain	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]		[mm]	[%]			[m]	[m]	
0	0.0	0.0	0.0	6.1671	0.0	0.0	0.0	-	-	0 (Negligible)

Structure: 77 Avenue Road | Sub-structure: Western elevation

Vertical Offset from Line for Vertical Movement Calculations	Deflection Ratio	Average Horizontal Strain	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]		[mm]	[%]			[m]	[m]	
0	0.0061676	0.037500	407.12E-6	6.1946	0.046068	-374.86E-6	407.12E-6	-	9206.1	0 (Negligible)

Structure: 77 Avenue Road | Sub-structure: Eastern elevation - lower

Vertical Offset from Line for Vertical Movement Calculations	Deflection Ratio	Average Horizontal Strain	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]		[mm]	[%]			[m]	[m]	
0	0.0033029	0.037500	165.24E-6	6.1946	0.039580	-374.86E-6	165.24E-6	-	9206.1	0 (Negligible)

Structure: 77 Avenue Road | Sub-structure: Eastern elevation - mid

Vertical Offset from Line for Vertical Movement Calculations	Deflection Ratio	Average Horizontal Strain	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]		[mm]	[%]			[m]	[m]	
0	0.0	0.0	0.0	5.9522	0.0	0.0	0.0	-	-	0 (Negligible)

Structure: 77 Avenue Road | Sub-structure: Eastern elevation - upper

Vertical Offset from Line for Vertical Movement Calculations	Deflection Ratio	Average Horizontal Strain	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Maximum Gradient of Horizontal Displacement Curve	Maximum Gradient of Vertical Displacement Curve	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
[m]	[%]	[%]		[mm]	[%]			[m]	[m]	
0	0.0024747	0.037500	395.80E-6	5.9522	0.039905	-374.86E-6	395.80E-6	-	16206.	0 (Negligible)

Specific Building Damage Results - Critical Segments within Each Structure

Structure Name	Parameter	Critical Sub-Structure	Critical Segment	Start	End	Curvature	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
				[m]	[m]			[mm]	[%]	[m]	[m]	
Western Boundary Wall	Maximum Slope	Sub 1	2	4.0329	6.4443	Hogging	**0.0018525**	4.6006	0.018001	2384.2	-	0 (Negligible)
	Maximum Settlement	Sub 1	3	6.4443	36.580	Sagging	0.0018525	**5.6389**	926.94E-6	-	2005.9	0 (Negligible)
	Max. Tensile Strain	Sub 1	4	36.580	38.497	Hogging	0.0018084	4.2897	**0.021003**	2490.4	-	0 (Negligible)
	Min. Radius of Curvature (Hogging)	Sub 1	5	38.497	39.000	Hogging	145.96E-6	3.2816	0.0082966	**2317.4**	-	0 (Negligible)

Structure Name	Parameter	Critical Sub-Structure	Critical Segment	Start	End	Curvature	Maximum Slope	Maximum Settlement	Max. Tensile Strain	Min. Radius of Curvature (Hogging)	Min. Radius of Curvature (Sagging)	Damage Category
	Min. Radius of Curvature (Sagging)	Sub 1	3	6.4443	36.580	Sagging	0.0018525	5.6389	926.94E-6	-	**2005.9**	0 (Negligible)
Northern Boundary Wall	Maximum Slope	Sub 2	2	7.1407	11.352	Hogging	**0.0017415**	4.1491	0.025135	2002.1	-	0 (Negligible)
	Maximum Settlement	Sub 2	3	11.352	14.000	Sagging	0.0017415	**5.2774**	0.044812	-	1896.8	0 (Negligible)
	Max. Tensile Strain	Sub 2	3	11.352	14.000	Sagging	0.0017415	5.2774	**0.044812**	-	1896.8	0 (Negligible)
	Min. Radius of Curvature (Hogging)	Sub 2	6	47.648	51.859	Hogging	0.0017415	4.1491	0.025135	**2002.1**	-	0 (Negligible)
	Min. Radius of Curvature (Sagging)	Sub 2	3	11.352	14.000	Sagging	0.0017415	5.2774	0.044812	-	**1896.8**	0 (Negligible)
Eastern Boundary Wall	Maximum Slope	Bottom	1	0.0	12.757	Sagging	**0.0018247**	6.0449	0.0098274	-	2181.4	0 (Negligible)
	Maximum Settlement	Top	1	0.0	13.000	Sagging	0.0	**6.0449**	0.0	-	-	0 (Negligible)
	Max. Tensile Strain	Bottom	2	12.757	15.229	Hogging	0.0018247	4.4943	**0.017321**	2489.4	-	0 (Negligible)
	Min. Radius of Curvature (Hogging)	Bottom	2	12.757	15.229	Hogging	0.0018247	4.4943	0.017321	**2489.4**	-	0 (Negligible)
	Min. Radius of Curvature (Sagging)	Bottom	1	0.0	12.757	Sagging	0.0018247	6.0449	0.0098274	-	**2181.4**	0 (Negligible)
Southern Boundary Wall	Maximum Slope	Sub 5	2	2.2291	9.4233	Hogging	**0.0021567**	4.9519	0.010001	2030.8	-	0 (Negligible)
	Maximum Settlement	Sub 5	3	9.4233	12.000	Sagging	0.0021567	**6.1950**	0.039013	-	1690.0	0 (Negligible)
	Max. Tensile Strain	Sub 5	3	9.4233	12.000	Sagging	0.0021567	6.1950	**0.039013**	-	1690.0	0 (Negligible)
	Min. Radius of Curvature (Hogging)	Sub 5	6	46.577	53.771	Hogging	0.0021567	4.9519	0.010001	**2030.8**	-	0 (Negligible)
	Min. Radius of Curvature (Sagging)	Sub 5	3	9.4233	12.000	Sagging	0.0021567	6.1950	0.039013	-	**1690.0**	0 (Negligible)
38 Queens Grove	Maximum Slope	Eastern elevation	1	0.0	3.0000	Sagging	**0.0017330**	5.2516	0.036780	-	461.62	0 (Negligible)
	Maximum Settlement	Eastern elevation	1	0.0	3.0000	Sagging	0.0017330	**5.2516**	0.036780	-	461.62	0 (Negligible)
	Max. Tensile Strain	Northern elevation	2	0.97802	5.0000	Sagging	409.27E-6	5.2516	**0.038174**	-	33659.	0 (Negligible)
	Min. Radius of Curvature (Hogging)		-	-	-	-	-	-	-	-	-	-
	Min. Radius of Curvature (Sagging)	Eastern elevation	1	0.0	3.0000	Sagging	0.0017330	5.2516	0.036780	-	**461.62**	0 (Negligible)
77 Avenue Road	Maximum Slope	Extension - West	1	0.0	3.0000	Sagging	**449.99E-6**	6.1671	0.042660	-	6066.5	0 (Negligible)
	Maximum Settlement	Western elevation	1	0.0	9.0000	Sagging	407.12E-6	**6.1946**	0.046068	-	9206.1	0 (Negligible)
	Max. Tensile Strain	Western elevation	1	0.0	9.0000	Sagging	407.12E-6	6.1946	**0.046068**	-	9206.1	0 (Negligible)
	Min. Radius of Curvature (Hogging)		-	-	-	-	-	-	-	-	-	-
	Min. Radius of Curvature (Sagging)	Extension - West	1	0.0	3.0000	Sagging	449.99E-6	6.1671	0.042660	-	**6066.5**	0 (Negligible)
	Min. Radius of Curvature (Hogging)	Extension - West	1	0.0	3.0000	Sagging	449.99E-6	6.1671	0.042660	-	**6066.5**	0 (Negligible)

Specific Building Damage Results - All Combined Segments

Structure: Western Boundary Wall | Sub-structure: Sub 1

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

No structures have segments combined.

Structure: Northern Boundary Wall | Sub-structure: Sub 2

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

No structures have segments combined.

Structure: Eastern Boundary Wall | Sub-structure: Top

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

No structures have segments combined.

Structure: Eastern Boundary Wall | Sub-structure: Bottom

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

No structures have segments combined.

Structure: Southern Boundary Wall | Sub-structure: Sub 5

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

No structures have segments combined.

Structure: 38 Queens Grove | Sub-structure: Eastern elevation

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

Oasys
73-75 Avenue Road
Combined Movements

Job No.	Sheet No.	Rev.
J14383		
Drg. Ref.		
Made by MP	Date 10-Feb-2015	Checked

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

No structures have segments combined.

Structure: 38 Queens Grove | Sub-structure: Northern elevation

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

No structures have segments combined.

Structure: 38 Queens Grove | Sub-structure: Southern elevation

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

No structures have segments combined.

Structure: 77 Avenue Road | Sub-structure: Extension - South

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

No structures have segments combined.

Structure: 77 Avenue Road | Sub-structure: Extension - West

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

No structures have segments combined.

Structure: 77 Avenue Road | Sub-structure: Extension - East

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

No structures have segments combined.

Structure: 77 Avenue Road | Sub-structure: Southern elevation

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

No structures have segments combined.

Structure: 77 Avenue Road | Sub-structure: Western elevation

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

No structures have segments combined.

Structure: 77 Avenue Road | Sub-structure: Eastern elevation - lower

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

No structures have segments combined.

Structure: 77 Avenue Road | Sub-structure: Eastern elevation - mid

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

No structures have segments combined.

Structure: 77 Avenue Road | Sub-structure: Eastern elevation - upper

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

No structures have segments combined.

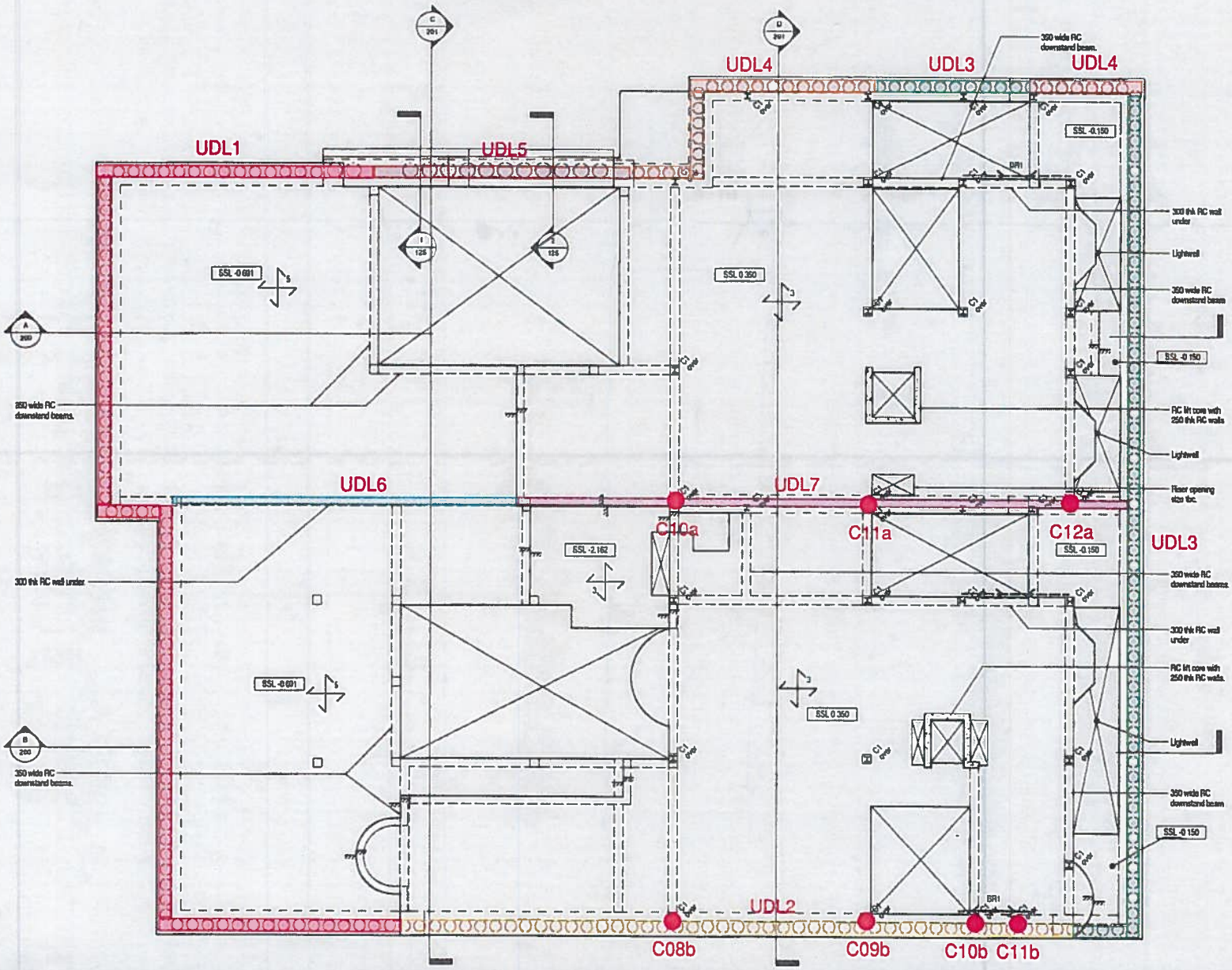
Appendix G

Flood Risk Assesment

HEYNE TILLETT STEEL

Appendix H

Structural Calculations



Ref	DL P (kN/m)	LL P (kN/m)	Hydrostatic P (kN/m)
UDL1	238	30	-210
UDL2	200	30	-210
UDL3	110	10	-210
UDL4	130	15	-110
UDL5	110	10	-110
UDL6	250	50	-350
UDL7	270	50	-350

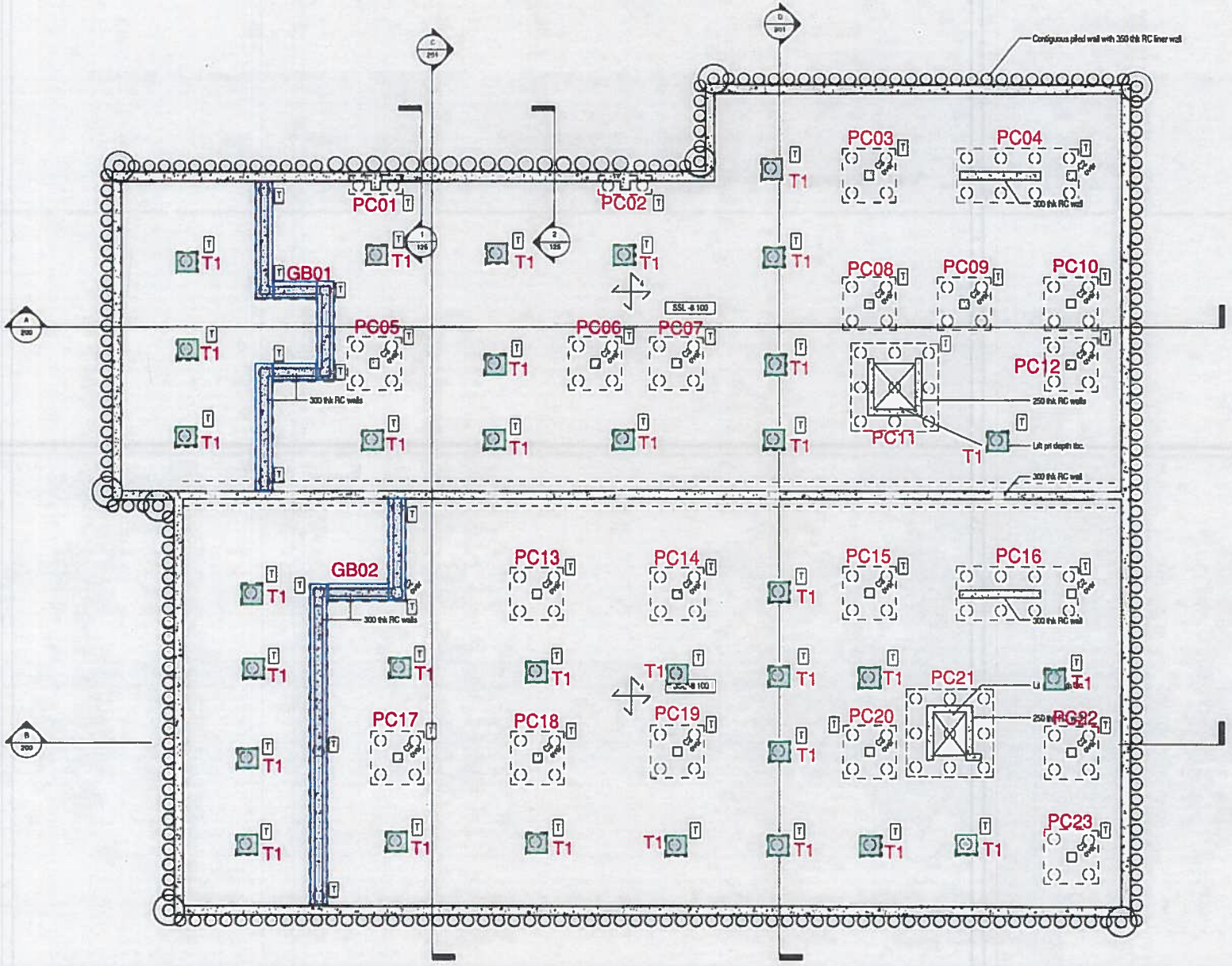
Ref	DL P (kN)	LL P (kN)
C10a	180	50
C11a	220	60
C12a	185	55
C08b	210	70
C09b	230	100
C10b	185	50
C11b	95	40

Note

1. All loads are unfactored.
2. All loads are preliminary and are subject to change with design development.
3. +ve compression, -ve tension.
4. Moment due to wind can only occur in one direction at any one time. i. cannot act simultaneously.
5. Worst case positive and negative pressures to be derived from suitable combination of the unfactored loads.
6. Hydrostatic forces have been derived based upon the water table actir at 1m below ground level. Design should take account of no hydrostatic forces as well.
7. Heave forces due to clay expansion have been removed due to clayboard.

HEYNE|TILLETT|STEEL
STRUCTURAL ENGINEERS

Job: Avenue Rd
Date: 03.02.15
Title: SK015 - Foundation Loads - Ground Floor
Eng: AE
Job No: 1247
Sheet:
Rev: P1



Ref	DL P 0	LL P (kN)	Hydrostatic P (kN)	Moment Wind Mx (kNm)	Mz (kNm)
PC01	426	74	-658	0	0
PC02	274	58	-791	0	0
PC03	961	190	-1400	0	0
PC04	1300	230	-1960	0	0
PC05	1484	278	-1050	0	0
PC06	731	155	-980	0	0
PC07	1604	382	-1050	0	0
PC08	716	235	-980	0	0
PC09	559	178	-1050	0	0
PC10	630	125	-840	0	0
PC11	2027	452	-1820	1620	1620
PC12	733	163	-910	0	0
PC13	814	165	-1680	0	0
PC14	1472	303	-1750	0	0
PC15	1105	255	-1540	0	0
PC16	1830	359	-1890	0	0
PC17	1218	231	-1330	0	0
PC18	1228	233	-1400	0	0
PC19	1733	415	-1680	0	0
PC20	913	324	-1260	0	0
PC21	1718	331	-2030	1620	1620
PC22	805	170	-1120	0	0
PC23	650	110	-840	0	0
T1	150	40	-1050	0	0

Ref	DL P (kN/m)	LL P (kN/m)	Hydrostatic P (kN/m)
GB01	213	60	-210
GB02	213	60	-210

Note

1. All loads are unfactored.
2. All loads are preliminary and are subject to change with design development.
3. +ve compression, -ve tension.
4. Moment due to wind can only occur in one direction at any one time. i.e. cannot act simultaneously.
5. Worst case positive and negative pressures to be derived from suitable combination of the unfactored loads.
6. Hydrostatic forces have been derived based upon the water table acting at 1m below ground level. Design should take account of no hydrostatic forces as well.
7. Heave forces due to clay expansion have been removed due to clayboard.

HEYNE|TILLETT|STEEL
STRUCTURAL ENGINEERS

Job: Avenue Rd
Date: 03.02.15
Title: SK016 - Foundation Loads - Ground Floor
Eng: AE
Job No: 1247
Sheet:
Rev: P1

Job	Averun Rd.	Date	17/02/15
Title	Basement - Tension Pile.	Eng.	AE.
Job No.	1247	Sheet	Rev.

HEYNE TILLETT STEEL

Tension Pile Design & Spacing.

$\alpha = 0.5$.

$\alpha \cdot Cu$ (8.0m) = 45 kN/m²

$\alpha \cdot Cu$ (25m) = 110 kN/m²

~~288~~ kN/m. $\frac{65}{(25-8)} = 3.82$.

Linear change between 8.0m to 25m.

? IS THAT CONFIRMED IN S7 ?

Assume 15m + 2m in length ignoring first 2m of capacity accounts for pile cap & disturbance.

$\alpha \cdot Cu$ @ 10m = 52.6 kN/m² ✓

$\alpha \cdot Cu$ @ 25m = 110 kN/m² ✓

$\alpha \cdot Cu$ Ave = 81.3 kN/m²

450 Ø CFA.

Skin Friction $q_s = \alpha \cdot Cu \cdot A$

α = 0.5 (Softness factor)

$\alpha \cdot Cu$ = 81.3

A_s = $\pi \times 0.45 \times 15$ = 21.2 m²

q_s = 81.3 × 21.2 = 1722 kN.

Allow safety factor = (2.6) ? 3.0 / 3.5.

$\therefore q$ = 1722 / 2.6 = 662 kN / pile.

600 Ø CFA

A_s = $\pi \times 0.6 \times 15$ = 28.3 m²

q_s = 81.3 × 28.3 = 2300 kN.

Allow safety factor = 2.6

$\therefore q$ = 2300 / 2.6 = 884 kN/Pile.

Job	Avenue Rd.	Date	17/02/15
Title	Basement Heave.	Eng.	AE.
Job No.	1247	Sheet	Rev.

HEYNE TILLETT STEEL

Heave From Overburden Removal.

Max Excavation = = 8.4m

Density of Clay = = 20 kN/m3

∴ Heave = 8.4 × 20 = 168 kN/m3

Basement Slab SW = 0.35 × 25 = 8.75 kN/m2

(SLS) Resultant Uplift = 168 - 8.75 = 159 kN/m2

* Adopt cellcare to prevent heave pressures.

* Plasticity of London Clay is 25% - 30% (Reference BRE Digest 240).

* Adopt 13/18 Void = 160 under basement slab.

- CHECK SI FOR VOLUME REDUCTION

x x²

Job	Avenue Rd	Date	17/02/15
Title	Basement - Tension P-Ls.	Eng.	AE.
Job No.	1267	Sheet	Rev.

HEYNE TILLETT STEEL

Hydrostatic Pressure.

Assume water table 1m below ground level.

Head = 8.4 − 1.0 = 7.4 m.

Pw = 10 kN/m²

Uplift = 74 kN/m²

Basand SW = 0.35 × 25 = 8.75 kN/m²

Nett uplift = 74 − 8.75 = 65 kN/m²

Check 450 ⌀ CFA

P-L Cap SW = 0.3 × (0.75²) × 25 = 4 kN.

P-L SW = $\frac{\pi \times 0.45^2}{4}$ × 25 × 15 = 60 kN

Area Supported = 662/65 + 1m²

= 10.2 + 1.0 = 11.2 m²

Used 600 ⌀ CFA

P-L Cap SW = 0.3 × (0.9²) × 25 = 6.1 kN.

P-L SW = $\frac{\pi \times 0.6^2}{4}$ × 25 × 15 = 106 kN.

Area Supported = 884/65 + $\frac{112}{65}$ =

= 13.6 + 1.7 = 15.3 m²

- TALK THROUGH

Job	Alverne Rd.	Date	17/02/15
Title	Basement - Main Pile Design	Eng.	AE.
Job No.	1267	Sheet	Rev.

HEYNE TILLETT STEEL

Main Pile Design Check.

Highest Gravity Load.

GK = 1750 kN.

QK = 450 kN.

Total SLS = 2200 kN.

* Values include Basement Slab & Pile Cap.

4No. / Piles = 2200/4 = 550 kN.

450 ϕ Pile

Individual Pile = $c_u \cdot N_c \cdot A_b + \alpha c_u \cdot A_s$ q?

$= 1980 \times \frac{\pi \times 0.45^2}{4} + 81.3 \times \pi \times 0.45 \times 15$

$= 315 + 1724$

$= 2039$ kN

Factor of Safety = 2.6

Capacity = 2039/2.6 = 784 kN.

- RL PILING ESTIMATE

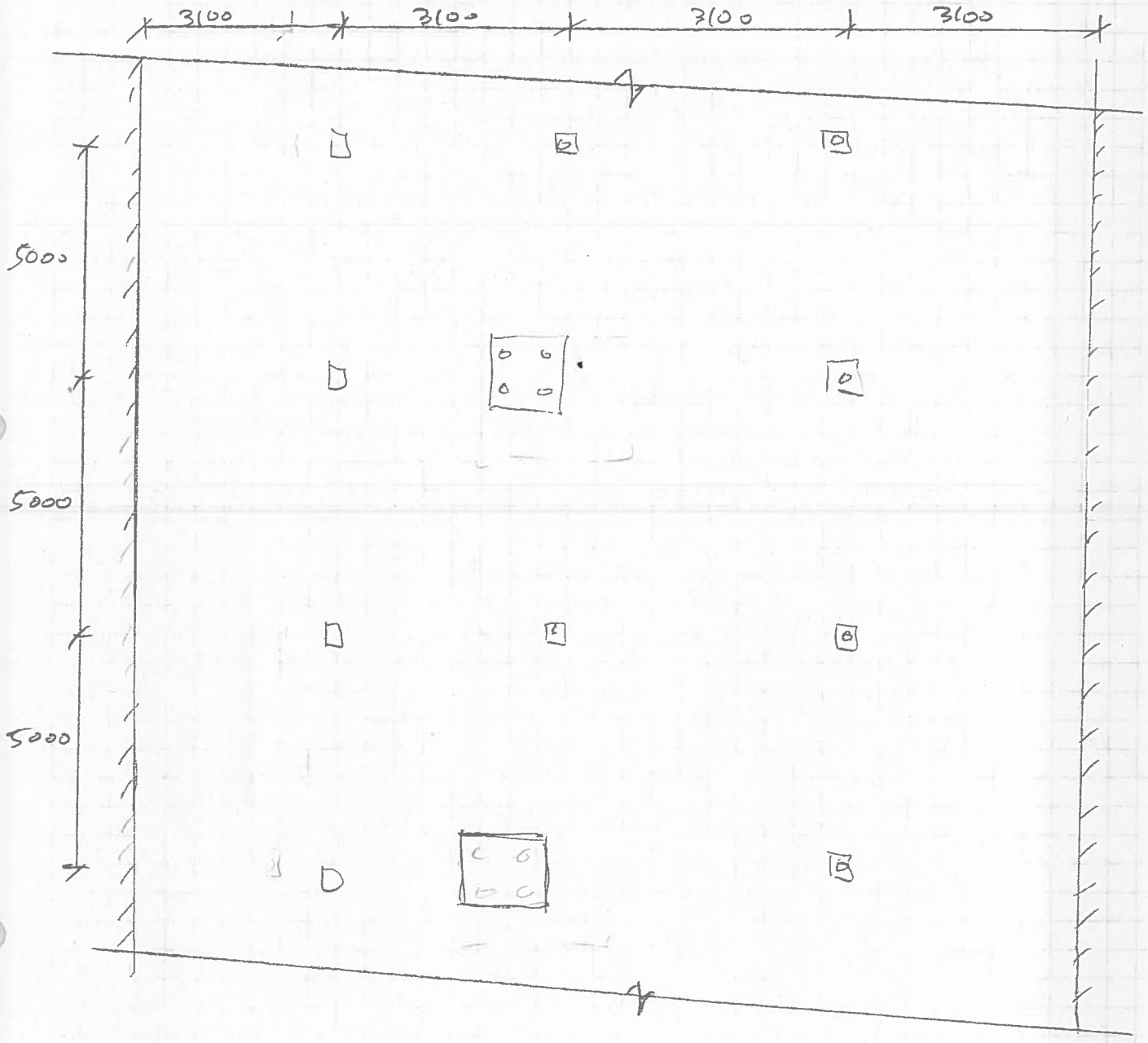
$q = N_c c_u A_b$

$\frac{\pi d^2}{2}$

Job	Avenue Rd.	Date	17/02/15
Title	Basement - Slab.	Eng.	AE.
Job No.	1267	Sheet	Rev.

HEYNE TILLETT STEEL

Check Basement Slab as suspended Flat Slab.



Loading

Hydrostatic uplift = 76 kN/m²

SW Slab = 8.75 kN/m²

ULS uplift = 0.9G + 1.2Qu

= 0.9(8.75) + 1.2(76)

= -81 kN/m²

Job Averon Rd Date 17/02/15

Title Basement Slab. Eng. AE.

Job No. 1247 Sheet Rev.

HEYNE TILLETT STEEL

Prime Direction.

F = 81 x 5.0 x 3.1 = 1255 kN

l = 3.1 m

0.086 F.L = 0.086 x 1255 x 3.1 = 334 kNm.

Colum Strip - negative = 0.75 x 334 = 250.

Colum Strip = l/2 = 3.1/2 = 1.55

Slab Moment = 250/1.55 = 162 kNm

Secondary Direction.

l = 5.0m.

0.086 F.L = 0.086 x 1255 x 5.0 = 539 kNm.

Colum Strip Negative = 0.75 x 539 = 405 kNm.

Colum Strip = l/2 = 1.55

Slab Moment = 405/1.55 = 261 kNm

Slab Reinforcement

Slab = 350 mm

Grade = C35/45

d = 300 mm 40+10

50 mm Cover?

$k = M/bd^2 f_{ck} = 261 \times 10^6 / (1000 \times 300^2 \times 35) = 0.08$

$z = d/2\left[1+\sqrt{(1-3.53k)}\right] = \frac{300}{2}\left[1+\sqrt{1-3.53 \times 0.08}\right] = 0.92d$

$z = 0.92 \times 300 = 276$ mm.

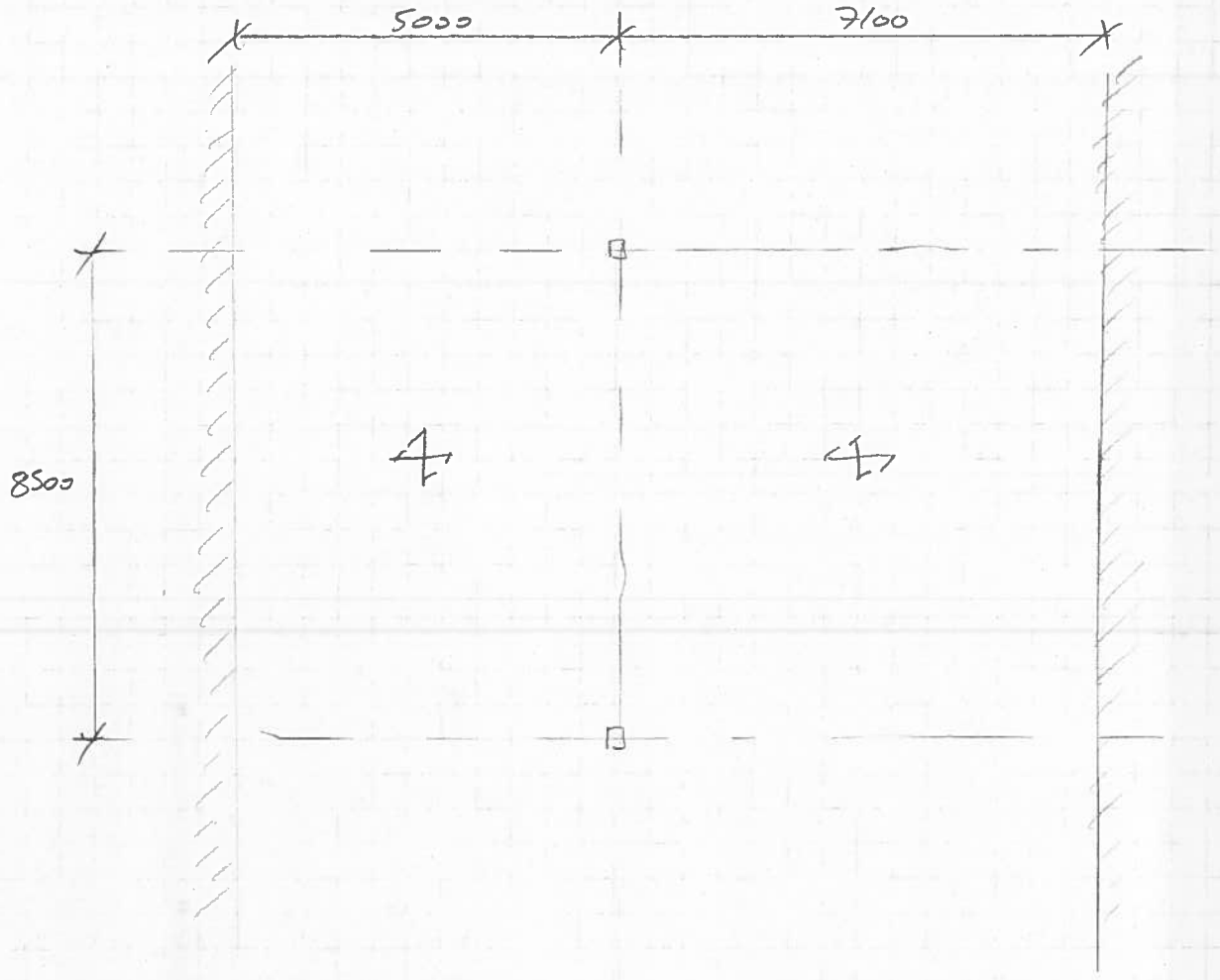
$A_{sreq} = \frac{M}{0.87 \cdot f_y \cdot z} = \frac{261 \times 10^6}{0.87 \times 500 \times 276} = 2173 \text{ mm}^2/\text{m}$

Provide B20 @ 100 c/c over columns = 3142 mm²/m

Job	Avenue Rd.	Date	17/06/15
Title	Basent - Lower Ground Slab.	Eng.	AE.
Job No.	1247	Sheet	Rev.

HEYNE TILLETT STEEL

Lower Ground Lid Slab.



Loading:

Slab SW = 0.3 x 25 = 7.5 kN/m²

SDL = 3.5 = 3.5 kN/m²

Live = 2.5 = 2.5 kN/m²

ULS = 1.35(7.5 + 3.5) + 1.5(2.5) = 18.6 kN/m²

Job	Avenue Rd.	Date	17/02/15
Title	Basement - Lower Ground Slab.	Eng.	AE.
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HEYNE TILLETT STEEL

Bending Moments

$F = 186 \times 7.1 \times 8.5 = 1122$ kN.

$L = 8.5$m.

$0.086 \cdot F.L = 0.086 \times 1122 \times 8.5 = 820$ kNm.

Colum Strip Negative $= 0.75 \times 820 = 615$ kNm.

Colum Strip $= l/2 = 7.1/2 = 3.55$ m.

Slab Moment $= 615/3.55 = \underline{173}$ kNm.

Slab Thickness = 300m.

Grade = C35/45

$k_2 = 173 \times 10^6 / 1000 \times 250^2 \times 35 = 0.079$

$z = d/2 \left[1 + \sqrt{1 - 3.53k}\right]$

$= 0.92\,d$

$z = 230$ mm.

$A_{s\,req} = M / 0.87 \cdot f_y \cdot z$

$= 173 \times 10^6 / 0.87 \times 500 \times 230$

$= 1729\ mm^2$

Provide. B16 @ 100c/c = 2011 mm^2/m.

Over Columns.

Job	Avenue Rd.	Date	17/02/15
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HEYNE TILLETT STEEL

Midspan Deflection check

Midspan Moment = $0.086 \cdot F \cdot L$ = 820 kNm.

Midspan Beam = 0.45×820 = 369 kNm.

Bay width = 3.75

Midspan Moment = $369 / 3.75$ = 98 kNm.

$k_{1.} = M/bd^2 f_{cu}$

$= 98 \times 10^6 / 1000 \times 250^2 \times 35 = 0.045$

$z = 0.95d$.

$A_{s req} = 98 \times 10^6 / 0.87 \cdot 500 \times 237 = 950 \text{ mm}^2/\text{m}$

$A_{s prov} = B16 @ 100 c/c = 2011 \text{ mm}^2/\text{m}$.

$f_s = \frac{2 \cdot f_y \cdot A_{s req}}{3 \cdot A_{s prov}} \times \frac{1}{\beta}$

$= \frac{2 \times 500 \times 950}{3 \times 2011} \times \frac{1}{1.0}$

$= 157 \text{ N/mm}^2$

$M/bd^2 = 1.568$

Modification factor = 1.69 (T. 3.10)

Basic Span/depth = 26 (T3.9)

Span/depth = $1.69 \times 26 = 43.9$

Actual = $7500/250 = 30$ (OK).

Job: Avenue Rd.	Date: 17/02/15
Title: Basement - Lower Ground Slab.	Eng. AE.
Job No. 1247	Sheet	Rev.

HEYNE TILLETT STEEL

Check Punching Shear @ Lower Ground.

Area supported = 5.675 × 6.075 = 36.5 m²

Loadings

Slab = 0.3×25 = 7.5 kN/m²

SDL = 3.5 = 3.5 kN/m²

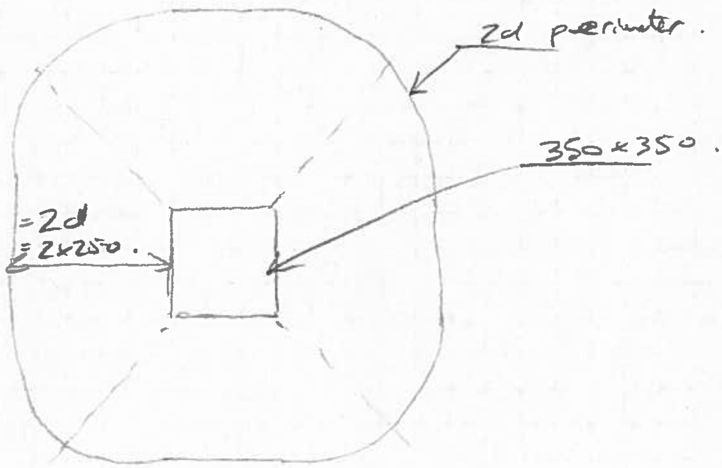
Live = 2.5 = 2.5 kN/m²

ULS = 1.35(8.75 + 3.5) + 1.5(2.5) = 18.6 kN/m²

Column Load = 18.6 × 36.5 = 642 kN.

β = 1.15

V = 642 × 1.15 = 740 kN.



u = (π × 1350) + 4×350 = 5640 mm. (5400)

Punching Shear = 740×10³ / 5640×250 = 0.52 N/mm²

No punching links Required!

Job	Alverne Rd	Date	17/02/15
Title	Basement - RC Colum.	Eng.	AE
Job No.	1247	Sheet	Rev.

HEYNE TILLETT STEEL

RC Colum design

Axial load

$G = 1750$ kN.

$Q = 450$ kN

ULS $= 1.35(1750) + 1.5(450) = 3000$ kN.

Load conservative as this includes basement slab.

$N = 0.35 f_c \cdot A_c + 0.67 \cdot f_y \cdot A_s$

Assume 8 No B25 bars

$A_s = 8 \times \pi \times 25^2/4 = 3926 \text{ mm}^2$

$A_{Gold} = 350 \times 350 = 122500 \text{ mm}^2$

$A_c = 122500 - 3926 = 118574 \text{ mm}^2$

$N = 0.35 \times 40 \times 118574 + 0.67 \times 500 \times 3926$

$N = 1660 + 1375$

$N = 2975$ kN.

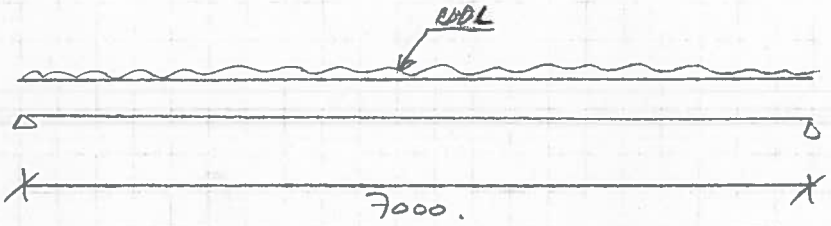
Adequate as load down is conservative.

Job	Avenue Rd.	Date	17/02/15
Title	Basant - Lower Ground Courtyard upstand.	Eng.	AE.
Job No.	1247	Sheet	Rev.

HEYNE TILLETT STEEL

Downstand Beam @ Ground Level.
- Supporting 1m Soil.

* Downstand beam supports edge of flat slab surrounding the courtyard opening.
* Edge beam has glazed facade under. Required deflection limit of span/500 or 10mm. Whichever is more onerous.
* Edge beam supports 1m of soil.



UDL

Slab = 0.4 x 25 x 3.0 = 30 kN/m

SW Beam = 1.0 x 0.35 x 25 = 8.75 kN/m

SOIL = 20 x 1.0 x 3.0 = 60 kN/m.

Live = 3.0 x 3.0 = 9.0 kN/m

ULS = 1.35(30 + 8.75 + 60) + 1.5(9.0) = 166 kN/m

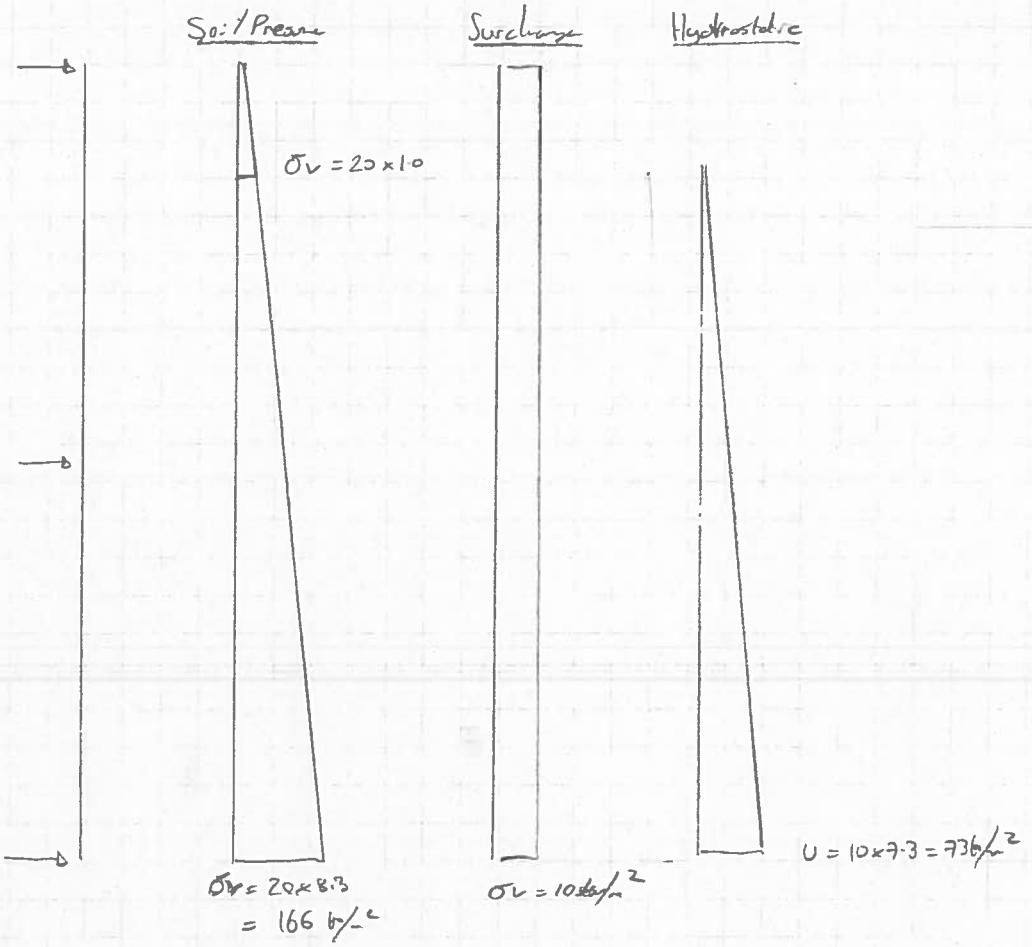
Moment = $wl^2/8$ = $166 \times 7^2/8$ = 900 kNm.

Shear = $wl/2$ = $166 \times 7/2$ = 515 kN.

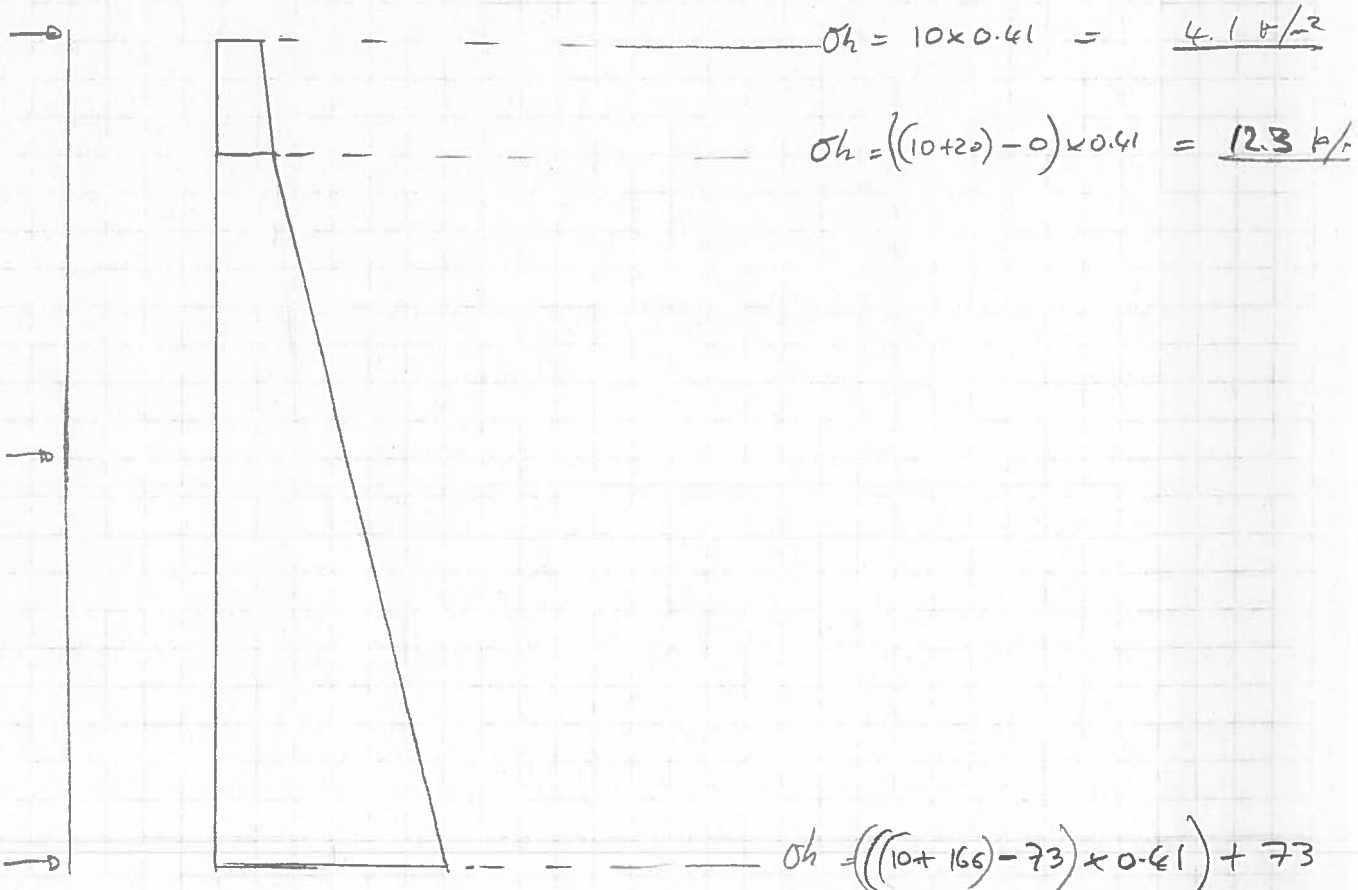
BEAM DESIGN.

Job	Avenue Rd	Date	17/02/15
Title	Basement - Retaining Wall.	Eng.	AE.
Job No.	1247	Sheet	Rev.

HEYNE TILLETT STEEL

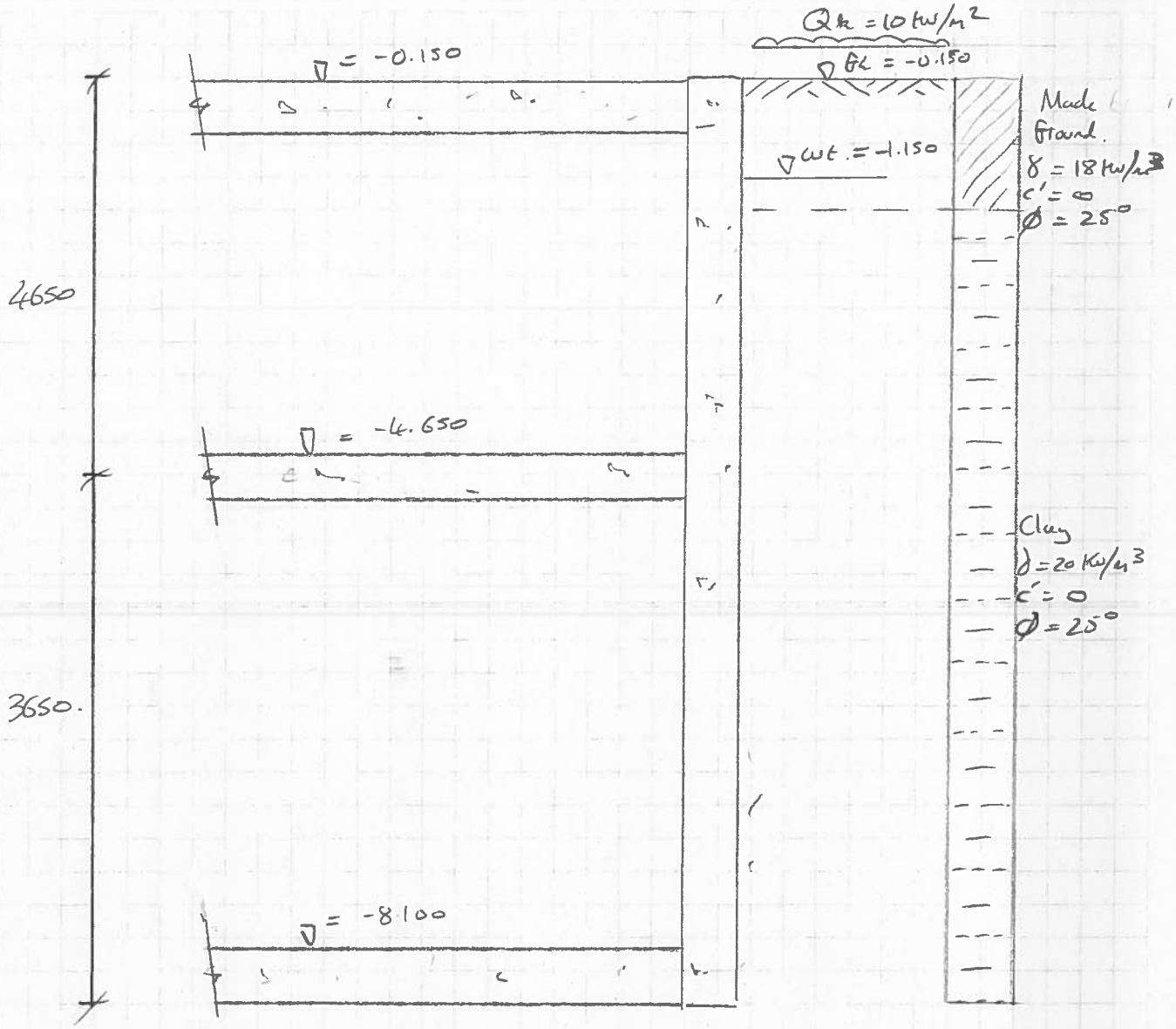


Vertical Stress



Job	Avenue Rd.	Date	17/02/15
Title	Basement - Retaining Wall	Eng.	AB.
Job No.	1247	Sheet	Rev.

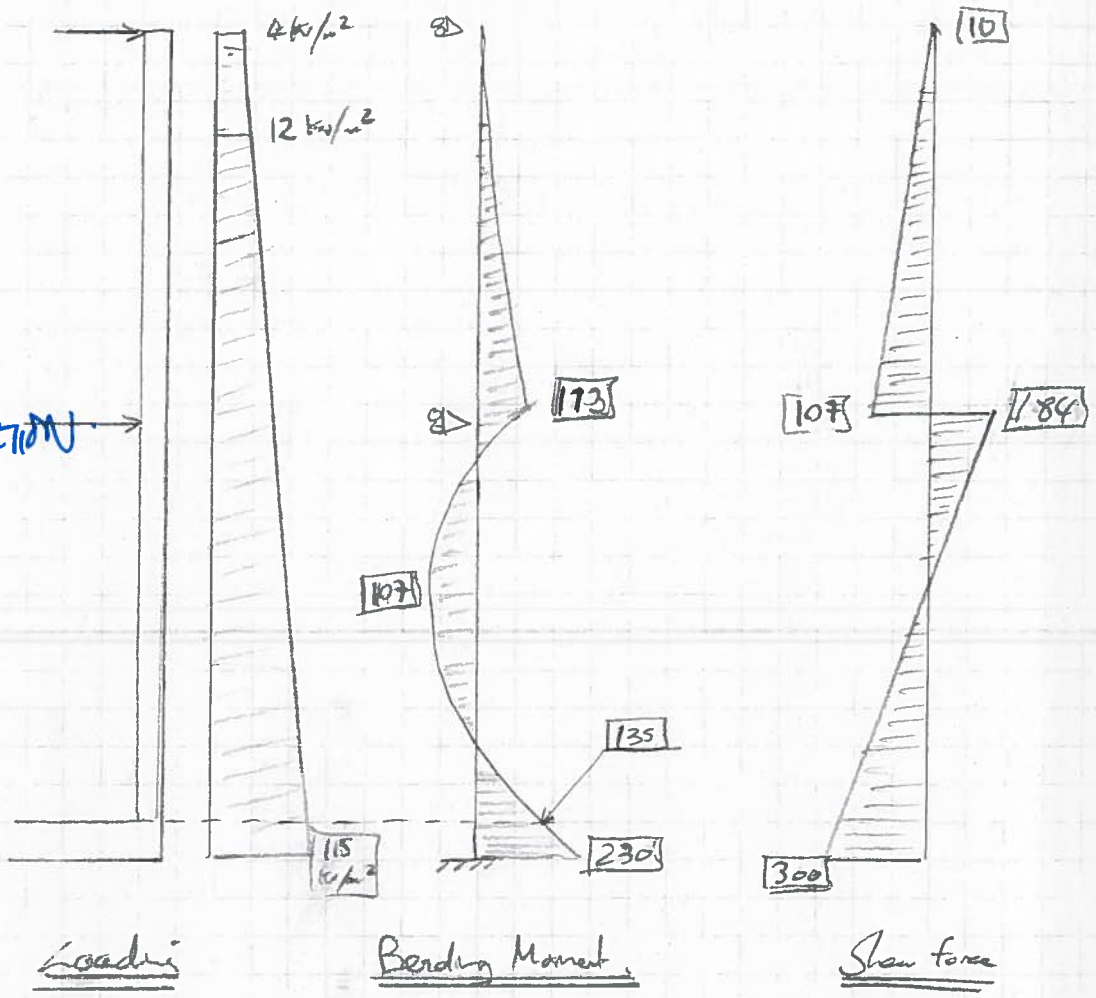
HEYNE TILLETT STEEL



	Combination ①	Combination ②.
Density of soil - Made Ground - Clay	18 kN/m³ 20 kN/m³	18 kN/m³ 20 kN/m³
ϕ'	25°	20°
K_h = K_{active} (i.e some movement assumed) $\beta = 0°$ (No inclination of soil).	$= \frac{\cos\beta - \left(\sin^2\phi_d - \sin^2\beta\right)^{0.5}}{\cos\beta + \left(\sin^2\phi_d - \sin^2\beta\right)^{0.5}} \times 1.0$ $= \frac{(1.0 - 0.422)}{1.42}$	$\frac{1.0 - 0.36}{1.58}$
	= 0.41	0.42

Job	Avenue Rd.	Date	17/02/15
Title	Basement - Retaining Wall.	Eng.	AF.
Job No.	1267	Sheet	Rev.

HEYNE TILLETT STEEL



Job	Avenue Rd.	Date	17/02/15
Title	Basement - Retaining wall.	Eng.	AE.
Job No.	1267	Sheet	Rev.

HEYNE TILLETT STEEL

Worst Case Bending Moment.

- Check @ Base support.

$M = 135$ kNm.

$k = \frac{M}{bd^2 f_{cu}} = \frac{135 \times 10^6}{1000 \times 210^2 \times 32} = 0.095$

$z = d/2 \left[1 + (1 - 3.53k)^{0.5}\right]$

$= 0.91d.$

$z = 140.$

$A_{s req} = \frac{M}{0.87 \cdot f_y \cdot z} = \frac{135 \times 10^6}{0.87 \times 500 \times 140}$

$= 1633 \text{ mm}^2/\text{m}.$

Adopt B16 s @ 100 c/c $A_{s prov} = 2011 \text{ mm}^2/\text{m}.$

Check shear @ d from support.

$V = 225$ kN.

$v = \frac{225 \times 10^3}{210 \times 1000}$

$= 1.07 \text{ N/mm}^2 > 0.5$

$\therefore$ Provide links @ base of wall.

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