25 November 2020

PROPOSED BUILDING DEVELOPMENT
16-18 JOHN STREET AND 23-25 CHURCH AVENUE
MASCOT, NSW

IMPLEMENTATION PLAN

Da Vito Ferro Apartments Pty Ltd

SYD2020-0153AC Rev1

SYD2020-0153AC		
Date	**Revision**	**Comments**
23 November 2020	0	
25 November 2020	1	Updated to include Rev 4 of Structural Report prepared by Northrop

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Appendices

1 INTRODUCTION

Da Vito Ferro Apartments Pty Ltd has engaged CMW Geosciences (CMW) to develop an Implementation Plan for the proposed development at 16-18 John Street and 23-25 Church Ave, Mascot, NSW.

We understand that a submission has been sent for Development Application seeking Council consent for excavation and construction of four levels of basement and two 13-storey buildings. We further understand that the Council has provided an opportunity for further information to be submitted (including this Implementation Plan) before the assessment is finalised and the application referred back for Planning Panel determination.

1.1 Project Overview

The following Implementation Plan is provided in response to the queries raised in the Bayside Council correspondence letter (Ref. DA-2019/359 dated 1 October 2020). This Implementation Plan is intended to satisfy

- Geotechnical Requirements f) ii and f) iv; and
- Hydrogeological Requirement h).

This Plan also details the following:

- Geotechnical and Hydrogeological Monitoring Program (GHMP); and
- Contingency Plans and Construction Methodology for the duration of basement construction.

We note the Construction Methodology has been prepared by Northrop Consulting Engineers Pty Ltd (Northrop)

A number of Geotechnical investigations have previously been undertaken at the proposed development, and the results are presented in Report Ref GS8023-3A Geotechnical Investigation Report prepared by Aargus Pty Ltd dated 17/11/2020 (the GIR). This report references and summarises previously completed site investigations.

We have used the following documents in preparation of this Implementation Plan:

- Structural drawings prepared by Northrop (Job No. SY200474, Dwg Nos S0.00^{2}, S10.01^{2}, S10.02^{2}, S10.03^{2}, S10.04^{1}, S15.01^{1}, S20.01^{2}, S20.02^{2}, S40.01^{2}, S80.01^{2}, S80.02^{2}) dated 4 November 2020;
- Structural Report – *Proposed Basement Design* prepared by Northrop (Ref. SY200476-SR02, Rev4) dated 24 November 2020;
- Wallap Outputs prepared by Northrop (Job No. SY200476) dated 29 October 2020;
- Geotechnical Report prepared by Aargus Australia (Ref. GS8023-3A) dated 17 November 2020;
- Geotechnical Report prepared by eiaustralia (Ref. E24340.E02_Rev0) dated 27 September 2020;
- Geotechnical Report prepared by JK Geotechnics (Ref. 22451SBrpt) dated 29 October 2008;
- Architectural Drawings prepared by Squillace (Job No. PIZ1807, Dwgs DA-001 to DA-302) dated 4 April 2019;
- Bayside Council correspondence letter (Ref. DA-2019/359) dated 1 October 2020;

- Groundwater monitoring data collected by Alliance Geotechnical between 16 August 2019 and 15 November 2020 (BH3, BH4 and BH5); and
- Hydrogeological Assessment Report prepared by CMW (Ref. SYD2020-0153AB Rev0) dated 23 November 2020.

Based on the provided documents, we understand the proposed basement has four levels, and bulk excavation below existing groundwater levels to approximately Reduced Level (RL) -4.5m Australian Height Datum (AHD) is required.

Additionally, we understand the basement is proposed to be constructed with Cutter Soil Mix (CSM) basement walls, utilising a 'top-down' construction process with foundations supported on reinforced concrete bored piles and structural steel plunge columns. The support to the walls during excavation is provided by progressively cast-in-place reinforced concrete slabs.

1.2 Scope of Plan

The Implementation Plan outlines the proposed Construction Methodology (within the attached Appendix A) and the corresponding approach and procedures for instrumentation and monitoring during the construction phase of the proposed development.

The Implementation Plan details monitoring requirements and provides preliminary trigger levels based on information available at the time of writing.

1.3 Monitoring Requirements

The development construction works are proposed to be undertaken adjacent to privately owned buildings, public roads and other infrastructure. The protection and maintenance of these structures and infrastructure from excessive settlement and/or deflection or other impacts from construction activities is required.

The Geotechnical and Hydrogeological Monitoring Program contained within this Implementation Plan has been designed to:

- Verify the assumptions made in the design;
- Provide confirmation of the predicted behaviour of the support system during excavation;
- Assess the effects of the proposed construction on nearby structures and infrastructure;
- Provide sufficient information to determine how and why the proposed construction interacts with nearby structures and infrastructure;
- Provide a record of performance;
- Enable construction to be carried out safely at every stage; and
- Where required, enable appropriate contingency measures to be implemented in time.

2 STRUCTURAL DRAWINGS AND CONSTRUCTION METHODOLOGY

Based on our review of the provided information prepared by Northrop (listed in Section 1.1 above), we, being professional geotechnical and hydrological engineers, consider that both the preliminary basement design drawings and construction methodology are, in principle, satisfactory from a geotechnical perspective.

The Structural Report prepared by Northrop (Ref. SY200476-SR02) contains the current Construction Methodology and is provided as part of this Implementation Plan as Appendix A.

2.1 Basement Structural Design

Further detailed analysis must be completed by both the geotechnical engineer and structural engineer to determine the effect on nearby building foundations, particularly with respect to expected shoring wall horizontal deflections at basement level and associated vertical ground movements.

This analysis will be completed as part of a formal Safety in Design (SiD) review during the development of the detailed design and will involve advanced numerical analysis.

2.2 Construction Methodology

Prior to site works commencing, we recommend the Builder prepare a Construction Method Statement (CMS) that includes as a minimum, proposed demolition techniques (for the existing site structures), proposed equipment to be used on site, and the various inspection intervals and/or hold points outlined in this Implementation Plan and final SiD documents. It may be necessary to develop the current Construction Methodology as the design progresses.

3 GEOTECHNICAL AND HYDROGEOLOGICAL MONITORING PROGRAM

The geotechnical and hydrogeological monitoring required during construction is summarised in the table below. The areas of responsibility for the monitoring during construction is divided between the Builder (to be determined), the Project Manager (PM) (to be determined), Structural Engineer (Northrop) and Geotechnical Consultant (CMW).

Construction of the proposed development, including demolition, excavation methods, temporary support, control of groundwater seepage, shoring details etc. will require careful sequencing and needs to reflect the construction phases and hold points as detailed in the SiD documentation.

Further design decisions and discussions with the involved parties will be required during construction, and there may be a need for revisions of this Implementation Plan during construction. A pre-construction and regular construction meetings should be held to assist all parties to understand the importance of the critical aspects of the project.

The construction works are to be subject to the ongoing monitoring and review by Northrop and CMW, in accordance with this GHMP. This GHMP is intended to provide an appropriate degree of assurance that suitable geotechnical and hydrogeological design parameters have been selected and to verify the initial assumptions regarding subsurface conditions. It also addresses a situation where ground conditions unexpectedly vary from the expected.

We note that it is the Builder’s responsibility to coordinate all necessary inspections and to ensure that all approvals are obtained from the other respective parties before proceeding to the next stage.

GEOTECHNICAL AND HYDROGEOLOGICAL MONITORING PROGRAM			
Item	**Action**	**Action by**	**Date Completed**
1	Preparation of Hydrogeological Assessment Report	CMW	
2	Condition and Information Assessment of nearby building foundations and infrastructure indicating their sensitivity to settlements	Northrop	

GEOTECHNICAL AND HYDROGEOLOGICAL MONITORING PROGRAM			
Item	**Action**	**Action by**	**Date Completed**
3	Geotechnical Design of the shoring system and detailed assessment of the expected nearby settlements (if any) using proposed Construction Methodology	CMW	
4	Structural Design and preparation of Detailed Design drawings	Northrop	
5	Final geotechnical review of Detailed Design drawings, the establishment of Hold points and SiD Documents	CMW	
6	Preparation of Construction Method Statement (CMS)	Builder	
7	Geotechnical and Structural review and approval of CMS	CMW, Northrop	
8	Appointment of Acoustic Consultant to undertake vibration monitoring (refer to Vibration Monitoring Program below)	PM or Builder	
9	Set up survey monitoring points and collect baseline data prior to demolition (refer to Survey monitoring Program below)	Builder	
10	Arrange for vibration monitoring during demolition and pile/shoring installation	Builder	
11	Arrange installation of inclinometers within shoring wall and collection of baseline readings (refer to Inclinometer monitoring Program below)	Builder	
12	Geotechnical inspection of pile/shoring installation, footing excavations etc Structural inspection of plunge columns, pile cap etc	CMW Northrop	
13	Arrange installation of groundwater monitoring wells (located outside the shoring wall) and collection of baseline readings (refer to Groundwater monitoring Program below)	Builder	
14	Survey monitoring during excavation (refer to Survey monitoring Program below)	Builder	
15	Arrange for Vibration, Survey, Inclinometer and Groundwater monitoring during excavation and construction (refer various monitoring Programs below)	Builder	
16	Builder, CMW and Northrop to review monitoring data during excavation and construction (refer various monitoring Programs below)	Builder, CMW, Northrop	

4 VIBRATION MONITORING PROGRAM

Vibrations transmitted to adjacent structures must be monitored during all works that may cause vibrations. This includes tracking of plant on loose surficial sands or poorly compacted fill, during demolition and during installation of piles and shoring walls. The following vibration monitoring plan should be followed during such works.

4.1 Vibration Monitoring Locations

Final monitoring locations should be determined by CMW following review of the Condition Assessment of nearby building foundations and infrastructure. We expect monitoring will be required across the eastern and western site boundaries.

4.2 Vibration Limits

The German Standard DIN4150-3:1999 provides guidelines for acceptable structural vibrations which 'when complied with, will not result in damage that will have an adverse effect on the structures serviceability'. We recommend that an acceptable limit of transferred vibrations, measured as Peak Particle Velocity (PPV), be set no higher than 20mm/sec for continuous vibrations across site boundaries. Isolated, short lived vibration events in excess of this value (and less than 50mm/sec) would not be expected to cause structural damage. We note vibration limits should be revised after review of the Condition Assessment.

It is noted that ground vibrations are likely to be perceptible to humans at significantly lower magnitudes than those required to cause structural damage, with ground vibrations of about 0.5mm/sec to 3mm/sec generally accepted as causing annoyance to people.

4.3 Vibration Monitoring Frequency

Due to the presence of loose sands we recommend that continuous vibration monitoring be undertaken during demolition, and for the initial stages of pile installation and shoring wall installation. If measured vibration frequencies are well below the acceptable limits, continuous vibration monitoring may be suspended pending the approval of the structural and geotechnical engineers.

However, given the sensitive nature of the site consideration should be given to maintaining continuous vibration monitoring during excavation and construction.

4.4 Vibration Monitoring Instrumentation

Monitoring equipment should be NATA accredited and collect measurements of PPV. Vibration monitoring data should be collected prior to commencement of site works to identify, and take account of, any existing vibration sources. During construction, vibration monitoring instrumentation must be connected to an alarm (such as flashing lights) to indicate the vibration limit is being approached (and exceeded) and to reliably provide real time vibration information to plant operators and the on-site management team. Data from the instrumentation must be downloadable and the downloaded data suitable to provide a graphical presentation of PPV versus vibration frequency.

4.5 Contingency Plan

The Builder is responsible for monitoring the vibration monitoring alarm and implementing the following responses if an alarm is raised:

1. All work must be suspended immediately and details of the activities occurring must be recorded and provided to the Project Manager, CMW and Northrop along with the corresponding vibration monitoring data.

2. CMW must review the vibration exceedance. If vibration exceedance is confirmed then an alternative work strategy must be devised by the Builder in conjunction with the Project Manager, Northrop and CMW.
3. The Builder must provide site activity logs and vibration monitoring data at weekly intervals to the Project Manager and CMW.
4. CMW should comment on any discrepancies identified between measured vibration exceedances and the provided site logs within one week of receiving the information.

5 INCLINOMETER MONITORING PROGRAM

Inclinometer monitoring must be carried out to determine the extent of horizontal deflection of the shoring wall.

5.1 Inclinometer Monitoring Locations

Final inclinometer monitoring locations should be selected after the development of the Detailed Design and the Construction Method Statement, however we would expect that, at a minimum, inclinometer monitoring locations would be established mid-span within each of shoring walls and that inclinometers would extend to within 0.5m of the base of the wall.

We recommend inclinometers be installed attached to the proposed 610mm universal beam soldiers prior to their embedment in the CSM wall during construction. Installation of inclinometers is the responsibility of the Builder.

5.2 Inclinometer Deflection Limits

Inclinometer deflection limits should be finalised after the development of Detailed Geotechnical Design. For the purpose of this plan, deflection limits should be set for the predicted horizontal deflections expected at each basement floor slab level as summarised below. We expect that predicted horizontal deflections calculated for Basement Levels 1, 2 and 3 will be finalised during development of Detailed Design.

INCLINOMETER MONITORING DEFLECTION LIMITS				
	Wall Deflection (mm)			
Floor Level	**Church Ave**	**John Street**	**21 Church Ave**	**27 Church Ave**
Ground	10	10	10	10
Basement 1	TBD	TBD	TBD	TBD
Basement 2	TBD	TBD	TBD	TBD
Basement 3	TBD	TBD	TBD	TBD
Basement 4	40	50	50	40

TBD: To be determined during development of Detailed Design

5.3 Inclinometer Monitoring Frequency

Given the sensitive nature of the site and to ensure comprehensive monitoring and management of anticipated wall deflections we would recommend the use of a continuous monitoring system.

5.4 Inclinometer Monitoring Instrumentation

We recommend the use of conventional inclinometer techniques capable of achieving an accuracy of 1mm or less. Inclinometer monitoring instrumentation should also be connected to an alarm capable of immediately alerting site staff, the Project Manager, Builder, CMW and Northrop if the deflection limit is being approached and/or exceeded. Data from the instrumentation must be downloadable and provide a graphical presentation of deflection versus depth.

5.5 Contingency Plan

As a minimum the continuous inclinometer monitoring records must be documented and provided to the Project Manager, CMW and Northrop at the end of each day.

If inclinometer deflection limits are exceeded, or the readings indicate that either deflection rates or limits is being approached, the Builder must immediately suspend excavation works. CMW and Northrop should review the data and decide if the deflection limits should be revised or if an alternative work strategy is required.

6 SURVEY MONITORING PROGRAM

Survey monitoring must be carried out at the surface along the perimeter of the CSM wall. We note that ‘top-down’ construction provides restraint to the top of the wall, limiting movement during excavation, however, monitoring is required to confirm wall movements for correlation with inclinometer monitoring results.

6.1 Survey Monitoring Locations

Final survey monitoring locations should be selected after the development of the Detailed Design and CMS. However, we would expect that, at a minimum, survey monitoring locations would be established mid-span at the top of each of shoring wall near the location of the proposed inclinometers and/or close to the adjacent existing foundations.

6.2 Survey Deflection Limits

Survey deflection limits should be finalised after the development of Detailed Design. For the purpose of this Plan, deflection limits should be set for the predicted horizontal deflections expected at each basement floor slab level as summarised below.

SURVEY MONITORING DEFLECTION LIMITS (mm)			
Church Ave Wall	**John Street Wall**	**21 Church Ave wall**	**27 Church Ave Wall**
10	10	10	10

6.3 Survey Monitoring Instrumentation

We recommend the use of conventional survey techniques capable of achieving an accuracy of 2mm or less.

6.4 Survey Monitoring Frequency

The below frequency is based on the provided Construction Methodology prepared by Northop, and should be reviewed after the CMS has been finalised. Baseline readings must be taken soon after installation of the monitoring locations and prior to constructing the ground floor slab. Readings should then be taken:

- After construction of the ground level slab, but before the commencement of excavation to the Basement 1 RL
- After construction of the Basement 1 slab, but before the commencement of excavation to the Basement 2 RL
- After construction of the Basement 2 slab, but before the commencement of excavation to the Basement 3 RL
- After construction of the Basement 3 slab, but before the commencement of excavation to the Basement 4 RL
- After construction of the Basement 4 slab
- After removal of temporary columns (Stage 10 of the provided Construction Methodology)
- After construction of core walls to ground floor level

6.5 Contingency Plan

The survey monitoring results must be documented and provided to the Project Manager, CMW and Northrop following each round of monitoring.

If survey deflection limits are exceeded, the Builder must immediately suspend excavation works and provide monitoring data to the Project Manager, CMW and Northrop. CMW and Northrop should review the data and decide if the deflection limits should be revised or if an alternative work strategy is required. We note that revision of deflection limits could be expected, given the accuracy of the survey equipment and the expected lateral deflections.

7 GROUNDWATER LEVEL MONITORING PROGRAM

Groundwater level monitoring undertaken by Alliance Geotechnical (BH4) between 16 August 2019 and 15 November 2020 indicates natural groundwater levels range between RL 3.4m AHD and RL 4.8m AHD. As excavation below groundwater level is proposed, temporary dewatering between the shoring walls is required. Groundwater monitoring must be undertaken to confirm that the change in groundwater levels outside the shoring walls.

7.1 Groundwater Level Monitoring Locations

Groundwater level monitoring must be carried out in at least two groundwater monitoring wells located outside the shoring wall, located at the Church Avenue and John Street ends of the site. Existing wells are considered suitable, provided they are maintained in good condition and are screened at appropriate depths to capture changes in near surface groundwater levels.

7.2 Groundwater Level Monitoring Limits

The modelling undertaken in preparation of the Hydrogeological Assessment Report (Ref. SYD2020-0153AB Rev0) estimates a maximum groundwater drawdown of approximately 5m outside the shoring wall. The drawdown would be restricted to within 10m of the site boundary. Therefore, the groundwater monitoring limit will be set at RL -0.2m AHD (RL 4.8m AHD – 5.00m).

7.3 Groundwater Level Monitoring Instrumentation

Groundwater level monitoring should be undertaken with a groundwater interface probe (dip-meter).

7.4 Groundwater Monitoring Frequency

7.4.1 Continuous Groundwater Level Monitoring (Data Loggers)

Groundwater level monitoring must commence at least 4 weeks before dewatering to provide an initial baseline. Groundwater data loggers (such as a LevelSCOUT or similar) must record groundwater levels at maximum intervals of 6 hours. A barometric logger must also be retained on site to enable compensation for the groundwater data logger. Barometric pressure levels must be collected at the same time intervals groundwater levels.

7.4.2 Manual Groundwater Level Monitoring

At the commencement of dewatering, groundwater wells must be manually recorded hourly. After water levels have stabilised (3 concurrent readings within ±0.05m), the frequency of manual monitoring can be reduced to six hour intervals, and then to once daily, pending the approval of CMW.

7.5 Contingency Plan

During the period of dewatering, the groundwater monitoring results must be documented and provided to the Project Manager, CMW and Northrop at the end of each day.

If groundwater levels drop below the groundwater level limit, or the readings indicate that the limit is being approached, dewatering must be suspended and monitoring data provided to the Project Manager, CMW and Northrop for review.

CMW and Northrop should review the data and determine if the groundwater level limits should be revised or if an alternative work strategy is required.

8 COMMENTS

This Implementation Plan does not relieve the Builder from their responsibility for safe operation of the site and equipment. Only experienced and competent Builders holding appropriate insurances should be considered for this project.

This Implementation Plan has been prepared for use by Da Vito Ferro Apartments Pty Ltd in relation to the proposed development at 16-18 John Street and 23-25 Church Avenue, in accordance with generally accepted consulting practice. No other warranty, expressed or implied, is made as to the professional advice included in this report. Use of this report by parties other than Da Vito Ferro Pty Ltd and their respective consultants and contractors is at their risk as it may not contain sufficient information for any other purposes.

For and on behalf of CMW Geosciences

Prepared by:

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Reviewed and authorised by:

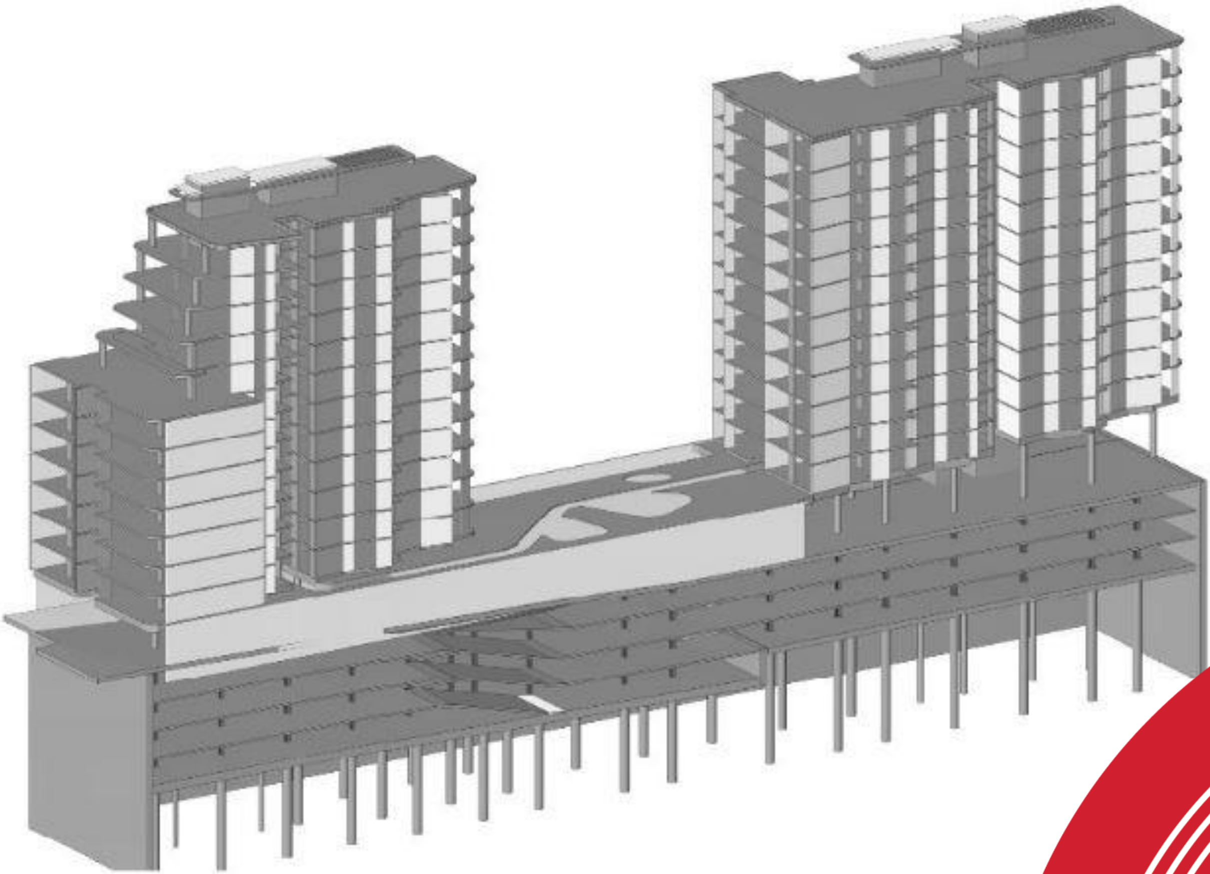
Ondrej Synac

Senior Principal Geotechnical Engineer

Distribution: 1 electronic copy to Da Vito Ferro Apartments via email
Original held at CMW Geosciences

Appendix A: Structural Report – Proposed Basement Design prepared by Northrop (Ref. SY200476-SR02) dated 30 October 2020

Appendix A
Structural Report – Proposed Basement Design



STRUCTURAL

Structural Report – Proposed Basement Design

for

Carmela & Vito Apartments

Executive Summary

The following report provides further detailed structural advice regarding the proposed basement structure design and construction for the proposed apartment development at 23-25 Church Avenue and 16-18 John Street, Mascot. This report summarises the proposed basement wall design and addresses the relevant structural engineering queries raised in Bayside Council correspondence DA-2019/359 dated 1st October 2020.

The development is proposed to be constructed with a reinforced concrete frame. The basement is proposed to be constructed with Cutter Soil Mix (CSM) basement walls, built via a top-down construction process with reinforced concrete bored pile foundations, structural steel plunge columns and reinforced concrete slabs.

In response to the specific queries raised (**Geotechnical Requirements (b), (c), (d), (g) & (h)** *DA-2019/359 dated 1st October 2020*), we make the following comments:

(b) *Determine the appropriate means of excavation/shoring in light of point (a) and proximity to adjacent property and structures. Potential vibration caused by the method of excavation and potential settlements affecting nearby footings/foundations/buildings shall be discussed and ameliorated.*
A cutter soil mix (CSM) wall is proposed to be constructed to form the basement shoring wall. A CSM wall is a retention wall constructed by mixing self-hardening slurries with the native excavated soil. A trench cutting rig with mixing tool excavates vertical panels of soil and mixes the soil with the binders as the cutting heads extend down. Once the design depth has been reached, (in this case into the bedrock), the cutting head is extracted and continuously mixes cement into the wall mix. Prior to hardening, structural steel soldiers are embedded in the wall matrix to provide the structural frame.
The primary advantages of this method are

- Low vibrations induced in construction of the wall;
- Highly accurate;
- Generally watertight (extremely low permeability); and
- Very little generation of spoil

The body of this report details the structural analysis and design results for the shoring wall. The predicted horizontal settlements of the shoring walls from our analysis have been provided in the report and are shown to generally be within tolerable limits.

(c) *Determine the required method to temporarily and permanently support the excavation for the basement adjacent to adjoining property, structures and road reserve*
The basement is proposed to be constructed via a top-down construction process. Through top-down construction, the temporary and permanent support for the basement walls are both provided by the basement slabs.

All basement walls and foundation piles are constructed from existing ground level and the supporting slabs are constructed prior to the next stage of excavation below the slab. By constructing the internal supports (the permanent slabs) prior to the next stage of excavating, the horizontal settlements of the basement walls are minimised.

(d) *Determine the existing groundwater levels in relation to basement structure, tanking and waterproofing requirement.*
Based on results from geotechnical investigation, the ground water level is expected to be at approximately RL 5.0m (2.0m to 6.0m below existing ground level). The basement excavation level is proposed to be at approximately RL-3.0m which is below the ground water level.

The basement walls are proposed to be socketed into the bedrock strata to create a cut-off wall and during construction, it is proposed to locally dewater within the site. Use of the cut-off wall socketed into the low permeability bedrock will greatly assist in controlling the volume of ground water removed, which results in a minimal effect to the ground water level at adjacent properties. This is discussed further in the Hydrogeological assessment prepared by CMW Geosciences.

It is expected that long term seepage through the bedrock will result in hydrostatic pressures being imposed on the structure. The basement is proposed to be tanked and the base slabs are designed to withstand the hydrostatic uplift pressures associated with a groundwater level of RL5.0m

(g) *Prepare a construction methodology report demonstrating that the proposed construction methods (including any excavation, and the configuration of the built structures) will have no adverse impact on any surrounding property and infrastructure*

A detailed construction methodology is outlined in the body of this report. Via the top-down construction approach, settlements are minimised and there is no drawdown of the adjacent ground water levels.

(h) *Certify that the plans, documentation and construction methodology are satisfactory from a geotechnical perspective*

Further to the information and certification statement in the body of this report, subject to the approval of a professional geotechnical engineer and hydrogeological consultants, we, Northrop engineers, being professional structural engineers, see no reason why the proposed basement design and construction methodology outlined in this report should impact the stability of the adjacent buildings. The recommended mitigation measures must be incorporated into the basement design and form part of the proposed peer review.

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1. Introduction

Northrop Engineers have been engaged by Da Vito Ferro Apartments to provide further structural advice regarding the basement design and construction for the subject development. This letter aims to summarise the proposed basement wall design, and address the relevant structural engineering queries raised in Bayside Council correspondence DA-2019/359 dated 1st October 2020.

1.1 Project Description

The proposed project encompasses 23-25 Church Avenue and 16-18 John Street, creating a through-block with a public pedestrian accessway at ground level. The development consists of a three-to-four storey basement car park, a two-storey mixed-use podium and two 13-storey residential towers. An existing industrial warehouse will also be incorporated into the podium level.

The site is bounded by John Street to the south, Church Avenue to the north and residential developments to the east and west. Both developments have basements of differing depths that are directly adjacent to the proposed basement at 23-25 Church Avenue.

The development at 27 Church Street is currently the subject of legal action from residents of Mascot Towers, its western neighbour. It is alleged that the excavation and related dewatering of the basement at 27 Church Street has caused cracking in the basement of Mascot Towers. We acknowledge that this recent issue has caused concern in the community regarding excavation and water management for future construction projects in the local area and the design and construction of basements need to appropriately consider the effects to neighboring properties and infrastructure.

1.2 Reference Documentation

The proposed design of the basement, including shoring wall and foundations has been based on the following documentation provided to Northrop; as summarised below in Table 1

Item	By	No. & Revision
Geotechnical Report	Aargus Australia	GS8023-3A (dated 17/11/2020)
Hydrogeological Assessment	CMW Geosciences	SYD2020-0153AB Rev0 (dated 23/11/2020)
Implementation Plan	CMW Geosciences	SYD2020-0153AC Rev0 (dated 23/11/2020)
Geotechnical Report	eiaustralia	E24340.G01_Rev1
Geotechnical Report	JK Geotechnics	22451SBrpt (dated 29/10/2008)
Architectural Drawings	Squillace	DA-001 to DA-302 (dated 04/10/2019)
27 Church Street – Basement Shoring Drawings	Australian Consulting Engineers	171233 (October 2017)
21 Church Street – Structural Drawings	Australian Consulting Engineers	07AH172 (September 2007)
Council Request for More Information	Bayside Council	DA-2019/359 Letter 1 October 2020

2. Structural and Geotechnical Summary

2.1 Structural Summary

The proposed development above ground will consist of post-tensioned concrete floor plates with reinforced concrete columns and core walls. Precast concrete walls will be used adjacent to the northern boundary. The main building transfer will occur on level 2 and will be approximately 600-800mm thick. The structure is proposed to be founded on bedrock, using deep foundation piles.

The proposed shoring wall system is a Cutter Soil Mix (CSM) wall, which is a 750mm wide soil-cementitious binder mix wall constructed in panels and reinforced with structural steel posts. It uses the existing soil combined with cement to produce a watertight wall. Compared to more traditional piled wall systems, its key advantage is that it can build walls to a high degree of accuracy and therefore low likelihood of any voids between panels. The basement will be socketed into the bedrock to provide a permanent cut-off for water ingress. Refer to Appendix A for the structural drawings.

Following the installation of the CSM wall, it is proposed to construct the basement using a 'top down' approach, where ground floor is constructed prior to excavation, with voids left out for removal of excavated material. This provides a restraint to the top of the wall, limiting movement of the wall, while the first basement level is excavated. B1 slab is subsequently installed before excavating to B2. This staged approach provides regular support to the shoring wall as well as removing the need for anchors through the walls.

2.2 Geotechnical Summary

The site is underlain by the following subsurface layers:

Material	Depth from surface to top of layer (m)
Fill	0
Sand	0.9-1.4
Interbedded sand and clay	9.5-11.3
Residual clay	14.6-15.3
Shale (Class V)	17-20
Shale (Class IV – III)	27

Table 1: Site Substrata

Groundwater is expected to be encountered at depths between 2.0m-6.0m below existing ground level.

The geotechnical design parameters have been interpreted from the information provided in the geotechnical reports prepared for this site and referenced above. The geotechnical design parameters for the foundation piles and the shoring walls are summarised in tables below.

Soil Unit	Ultimate End Bearing Pressure (MPa)	Ultimate Shaft Adhesion in Compression (KPa)
Residual Clay	N/A	N/A
Class V Shale	2	100
Class IV Shale	5	150
Class III Shale	20	450

Class II Shale	50	700

Table 2: Substrata Capacities

Soil Unit	Unit Weight (kN/m³)	Effective Cohesion c' (kPa)	Angle of Friction ϕ' (º)	Elastic Modulus (MPa)	Active Earth Pressure Coefficient	At-rest Earth Pressure Coefficient	Passive Earth Pressure Coefficient
Fill and loose sand	17	0	28	20	0.36	0.53	2.78
Medium dense sand	18	0	35	40	0.27	0.43	3.70
Dense to very dense sand	20	0	38	65	0.24	0.38	4.17
Class V Shale	22	10	26	50	0.3	0.5	3.0
Class IV Shale	22	50	28	200	0.3	0.5	3.0
Class III Shale	24	100	30	350	0.25	0.4	5.0

Table 3: Substrata Parameters

3. Proposed Basement Design

3.1 Design Loads

The design loads for the building have been adopted using the provisions of AS1170.0, AS1170.1, AS1170.2 and AS1170.4.

The design of the basement shoring wall has been carried out to resist the lateral soil pressures and hydrostatic pressures from the ground water level, together with the following surcharges:

Church Avenue and John Street elevations

- A general surcharge of 15kPa has been applied at ground level

27 Church Street elevation

- The 16 storey concrete framed building is founded on a raft slab at RL -1.50m
- We have calculated a building surcharge load of 160kPa, applied at RL -1.50m

21 Church Street elevation

- The 9 storey concrete framed building is founded on piles.
- A building surcharge load of 10kPa has been applied at RL 7.15m representing the basement slab
- We have calculated a building surcharge load of 80kPa has been applied at RL0.0m representing the assumed pile founding depth

3.2 Basement Wall Design Methodology

The CSM shoring wall has been designed and analysed using 'WALLAP' retaining wall analysis software. This is an industry standard tool, considered suitable for this application. The WALLAP analysis considers one elevation at a time, where wall deflections are considered to interact with the opposing side, the results are superimposed. The WALLAP analysis has been staged to incorporate the top-down construction methodology.

- The design excavation level has been set nominally 1000mm below the basement finished floor level.
- The WALLAP analysis provides results per metre length of wall. The structural steel soldiers embedded in the wall are proposed to be at 1.0m centres to correlate to the WALLAP results.
- The wall is designed to a factor of safety against overturning of 1.50

3.3 Basement Wall Design Analysis

Refer to Appendix B for the detailed WALLAP output results for each elevation.

The structural performance of the CSM wall is typically governed by the structural adequacy of the structural steel soldiers embedded within the wall. Based on the results our initial design indicates the wall will contain 610mm deep Universal I Beam Sections as vertical steel soldiers at 1000mm centres. Refer to Appendix A for the structural detail drawings.

We note that the WALLAP analysis has used the stiffness of the steel soldier only. This is inherently conservative as the CSM wall will add nominal additional stiffness, and therefore the deflection results presented would likely be larger than what occurs in practice. Further modelling is recommended during the detail design phases.

Utilising top-down construction, the shoring wall is continuously propped by the basement slabs. The WALLAP results detail the loads applied to the slabs. This load is supported within the slab and is resisted at the opposing end shoring wall. This eliminates the need for temporary tension anchors outside the lot boundary.

3.4 Estimated deflection and deflection monitoring

With the top-down construction method, the shoring walls are progressively propped by the slabs. Because of the progressively propped nature, the horizontal deflections of the shoring wall at ground level are minimized. The predicted maximum deflections (listed below) of the shoring walls occur at the base of the excavation, prior to construction of the basement raft slab.

Elevation	Predicted horizontal deflection at ground level** (mm)	Predicted horizontal deflection at base of excavation (mm)
Church Avenue	0	39
John Street	0	48
21 Church Avenue	3	49
27 Church Avenue	3	42

**** In practice there will be a nominal amount of additional horizontal deflection due to shrinkage and shortening of the supporting concrete slabs.**

General guidance in *CIRIA C580: Embedded retaining Walls* notes that the adjacent vertical ground movements due to wall deflections in top-down construction methods could be expected to be in the order of 0.15% of the excavated depth. At an excavation depth of 13300mm, vertical ground settlement at the surface of 20mm could be expected. This approximation is general in nature and the vertical settlements of adjacent properties is to be assessed by the project geotechnical engineer using finite element modelling incorporating the lateral movement of the shoring wall and the dewatering process to confirm. The actual settlements under the foundations of the building is expected to be significantly less and requires detailed geotechnical engineering assessment.

Deflection monitoring is recommended to be installed. Baseline readings should be taken prior to excavation, with readings taken every week until the basement construction has been completed.

4. Construction Sequence

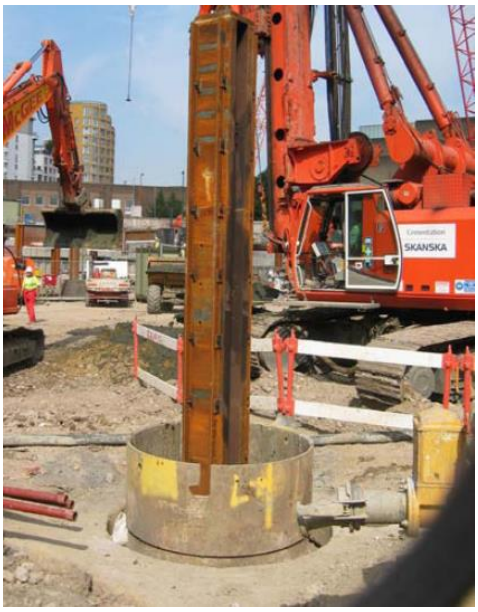
The following outlines the construction sequence to be adopted for constructing the basement. It is critical that the construction sequence is adhered to, to ensure the wall performance and stability is achieved.

The top-down construction methodology proposed is:

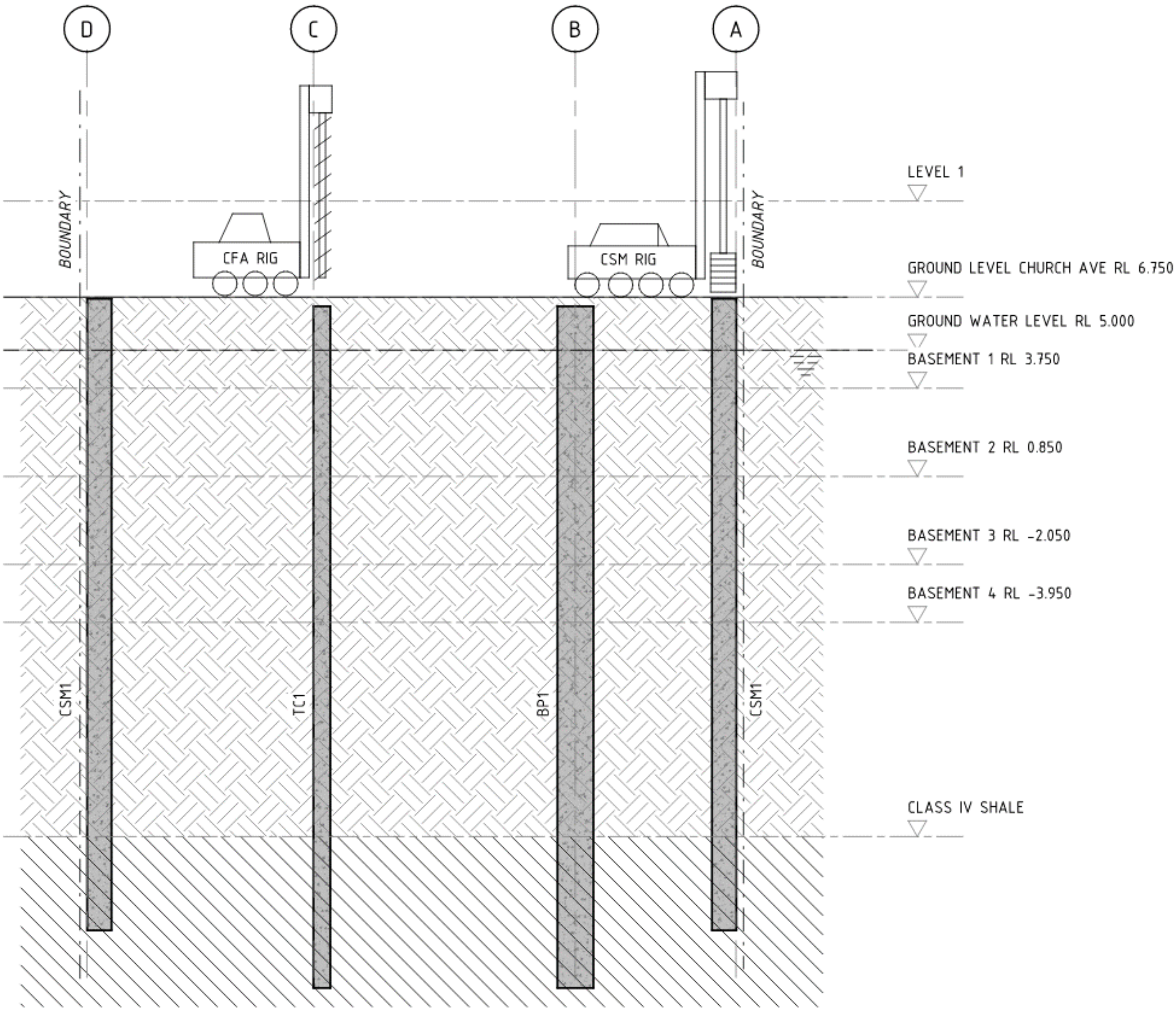
Stage 1:

- Install 750mm thick CSM shoring wall to property boundaries.
  610mm universal beam soldiers are to be embedded in the walls for the full depth at one metre spacing.
- Install 900 diameter CFA foundation piles from ground level socketed 6000mm into class III bedrock
  A reinforcement cage is to be embedded in the pile extending from base of the pile to finished level of the base slab.
  400WC303 'plunge columns' are to be embedded within the pile extending from base slab to ground level using appropriate guide system for accurate placement.
- Install temporary columns (as 600 diameter CFA piles) to support temporary penetrations. These will be removed once basement is completed

Typical Cutter Soil Mix Wall Machine



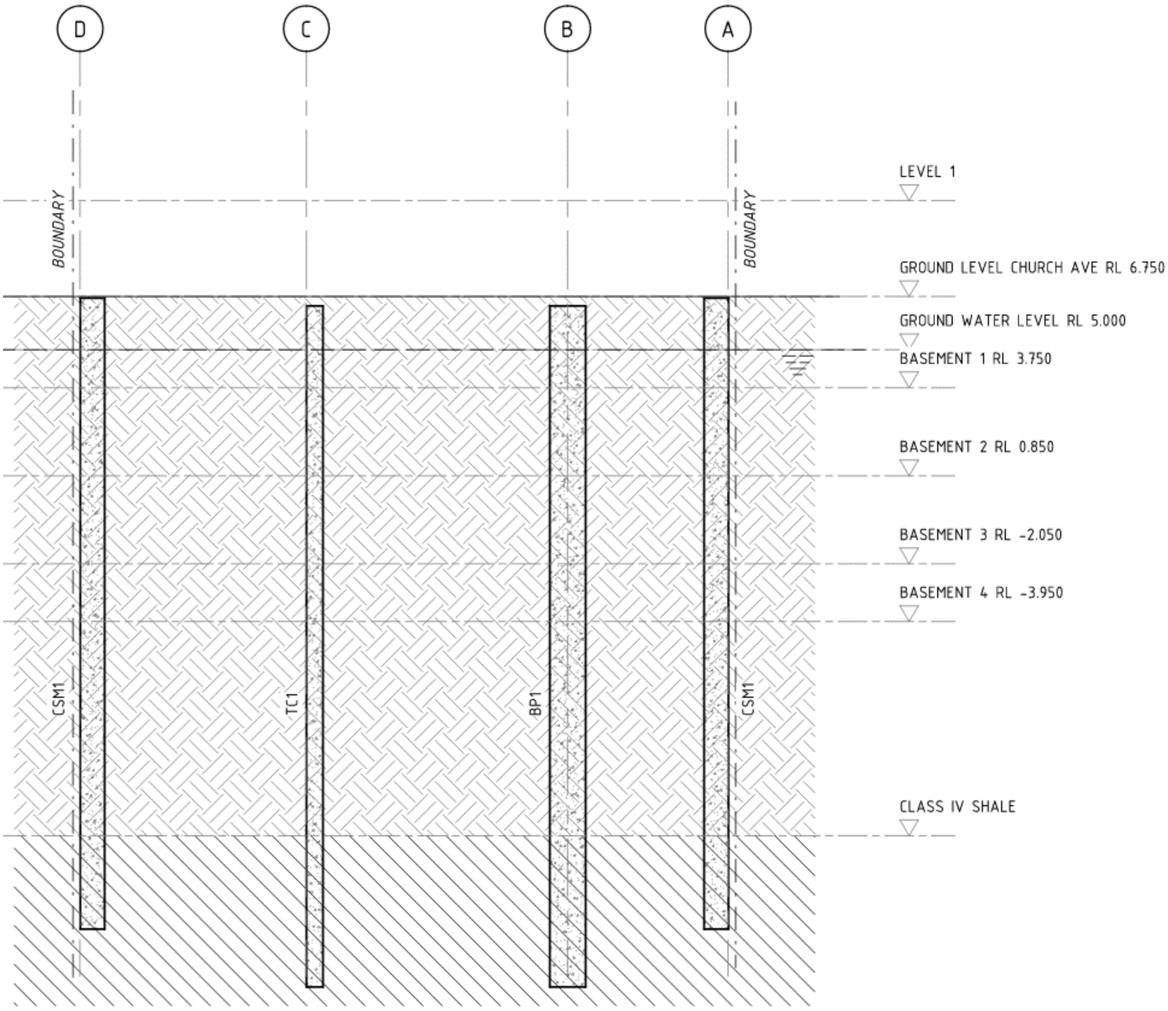
Structural Steel Plunge Column Installation



Indicative Cross-Section at Stage 1

Stage 2:

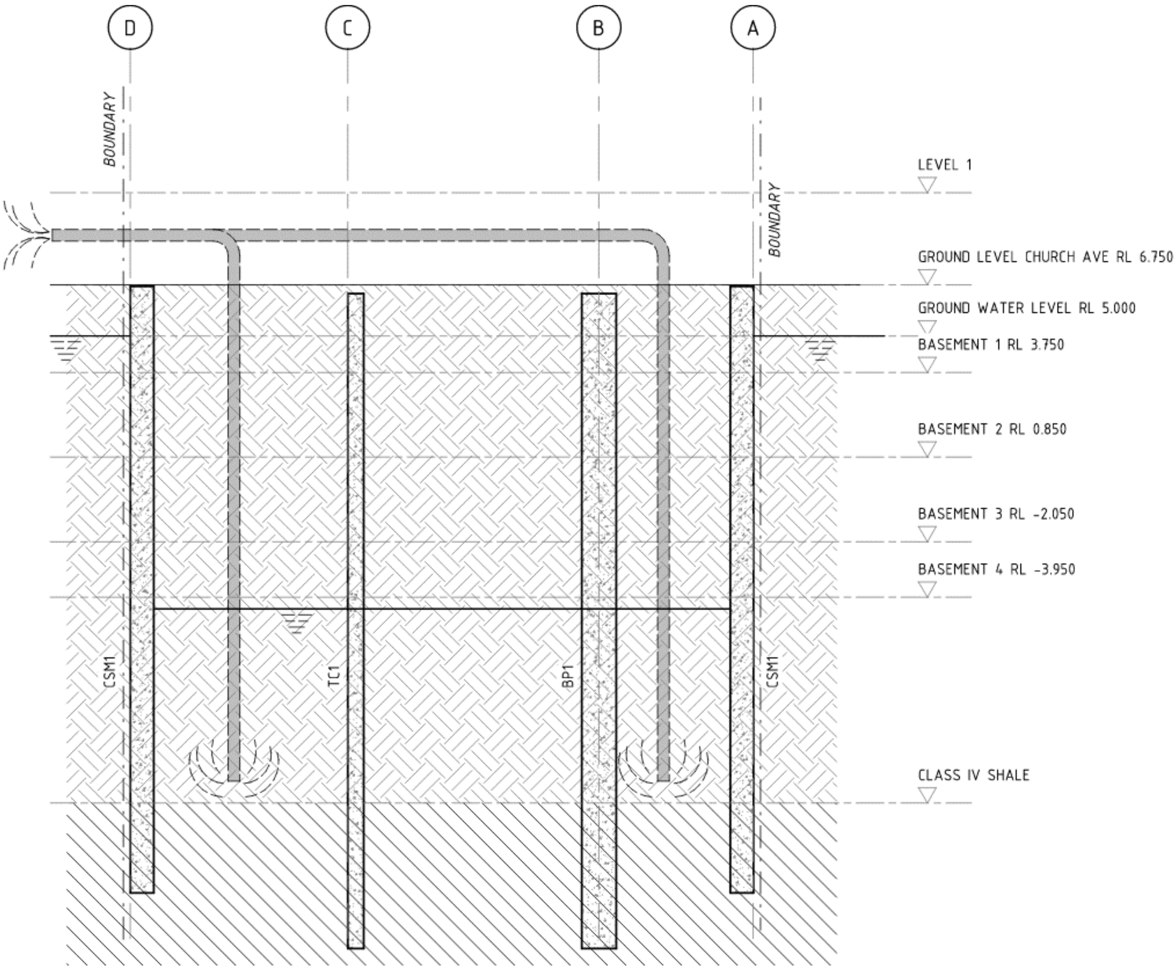
- Shoring and foundation piles/plunge columns completed



Indicative Cross-Section at Stage 2

Stage 3:

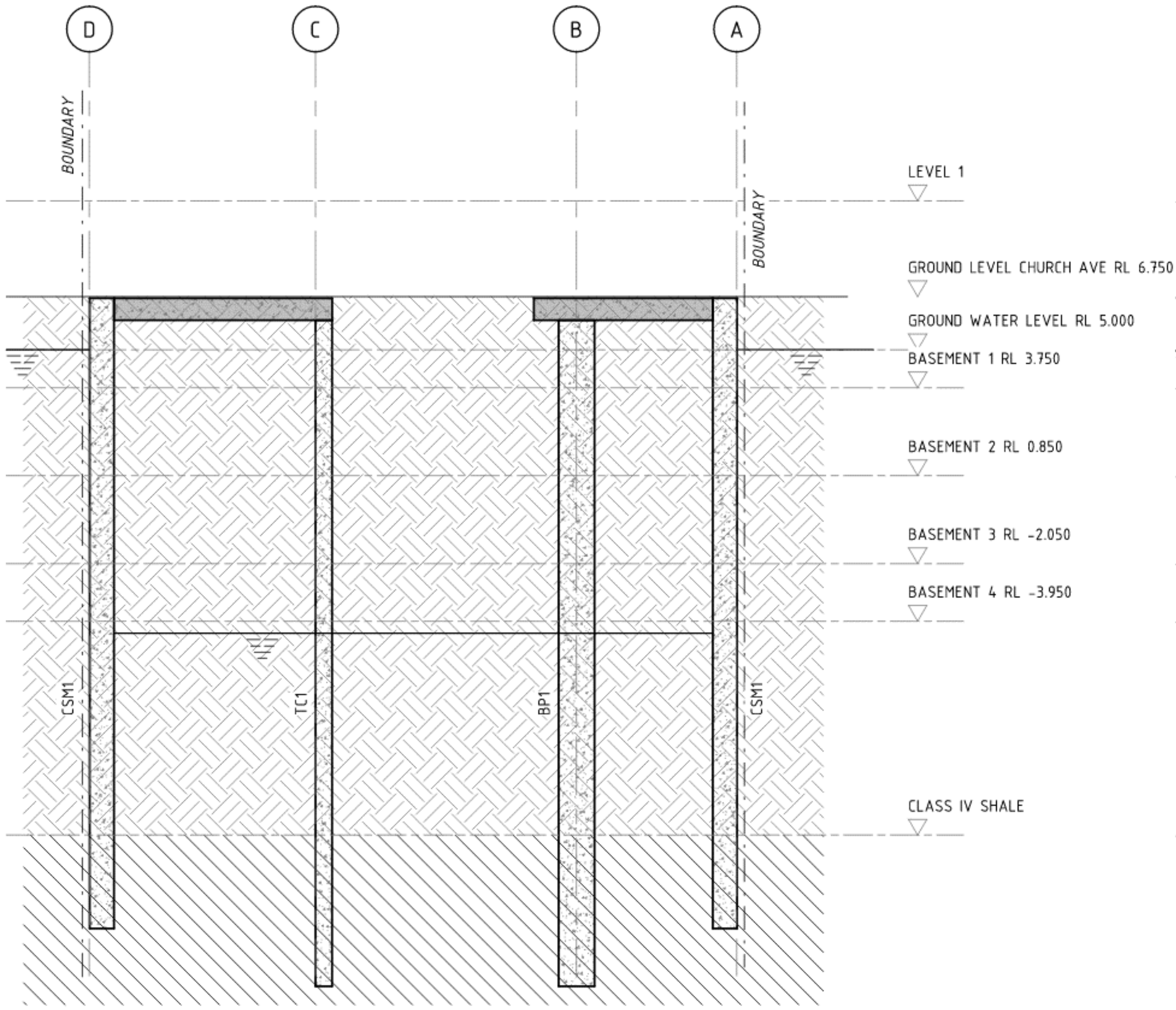
- Install dewatering wells within site boundary
- Dewater to lower the groundwater level within the property boundary
  Note: Use of the cut-off wall socketed into the low permeability bedrock will greatly assist in controlling the volume of ground water removed, which results in a minimal effect to the ground water level at adjacent properties. This is discussed further in the Hydrogeological assessment prepared by CMW Geosciences



Indicative Cross-Section at Stage 3

Stage 4:

- Construct ground floor slab with temporary penetration for plant access
  Slab to be formed and cast on firm cut ground
  Slab tied to shoring wall to provide permanent restraint and minimise deflections at top of wall during excavation
  <u>Note:</u>
  Ground floor slab is designed with load rating to safely support plant equipment (trucks, excavators, etc.) movement and staging areas
  Expected plant movement and access path is from John Street through to Church Street



<u>Indicative Cross-Section at Stage 4</u>

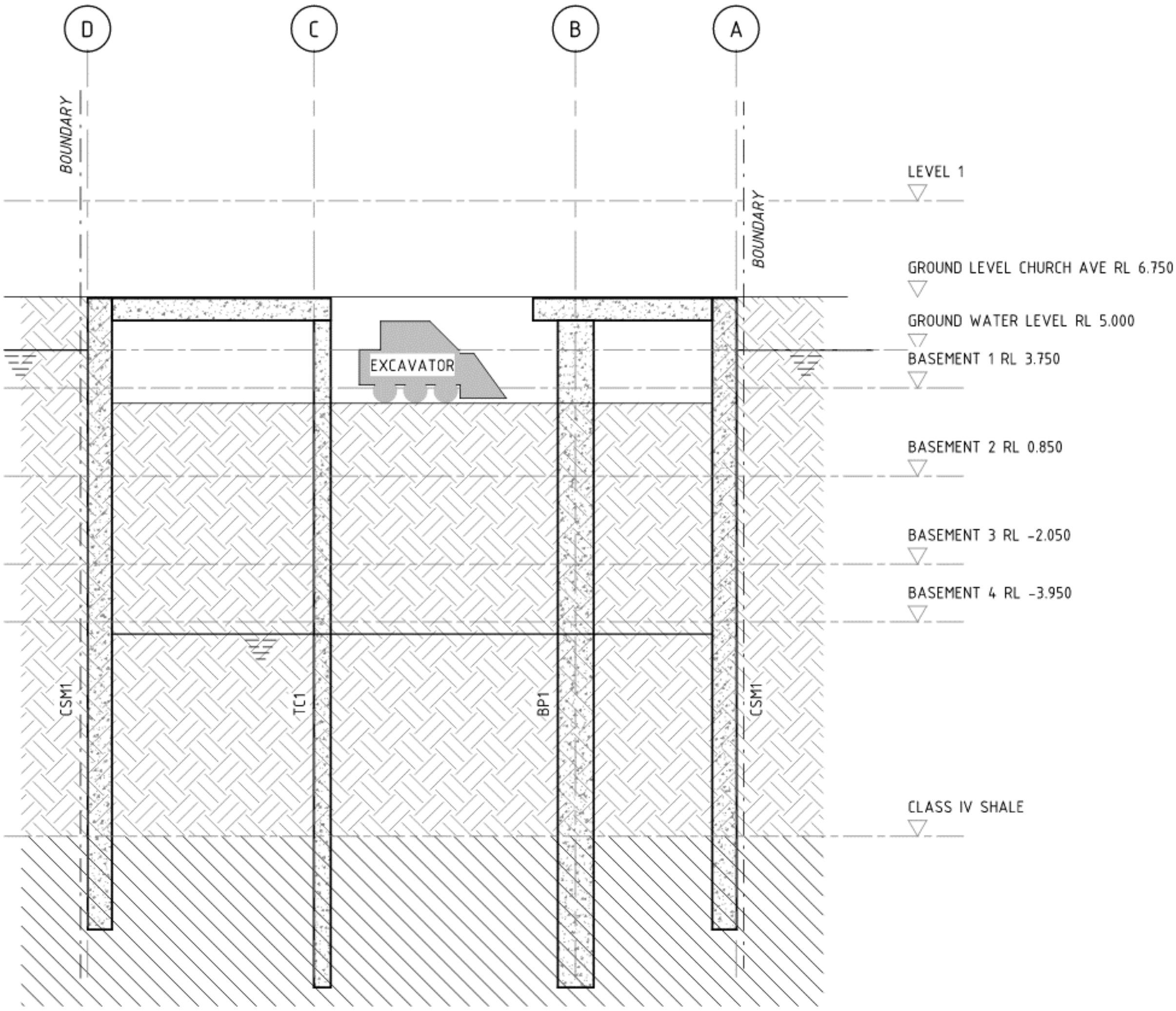
Stage 5:

- When ground level slab has reached design strength, commence excavation beneath ground floor slab to Basement 1 level

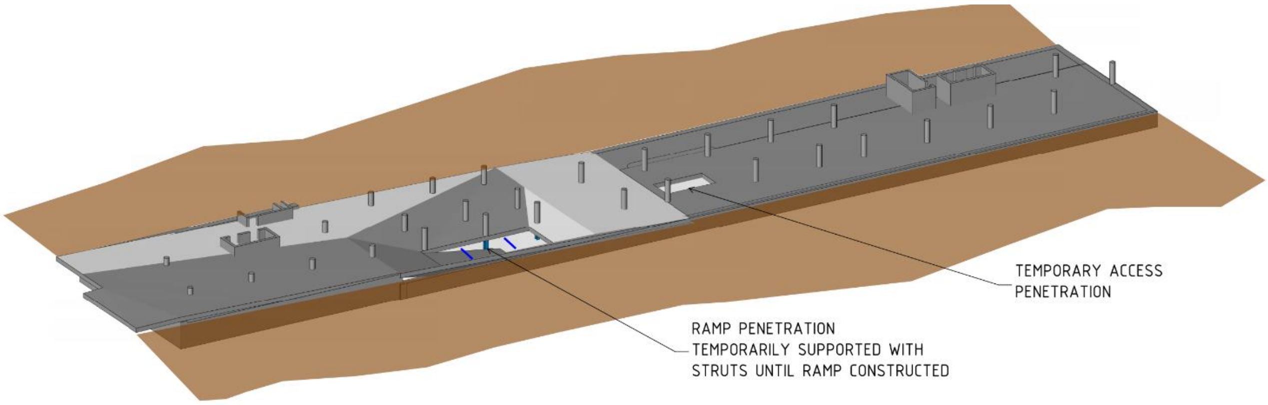
  Excavation equipment to be craned in through access penetration

  Due to low head clearances, excavation will typically be carried out by small front end loaders and bobcats

  Spoil will be stockpiled at access penetrations and craned out



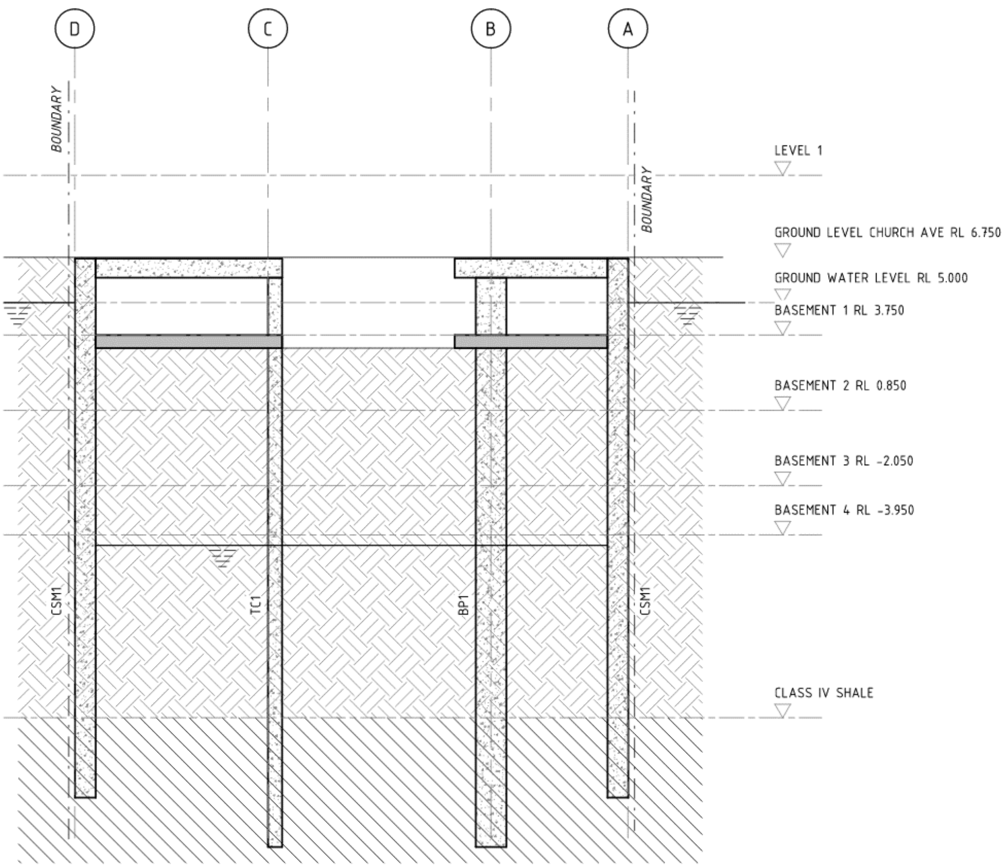
Indicative Cross-Section at Stage 5



Indicative 3D view showing ground level slab with access penetration

Stage 6:

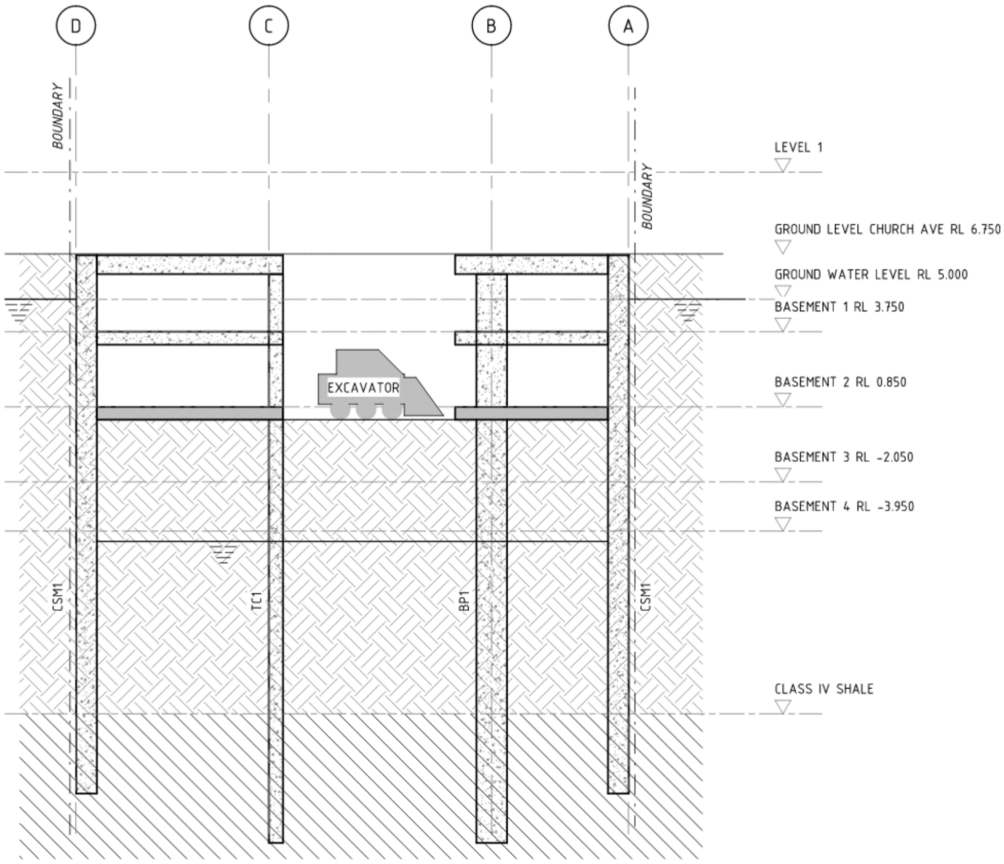
- Construct basement 1 slab with penetrations in slab for plant access



Indicative Cross-Section at Stage 6

Stage 7:

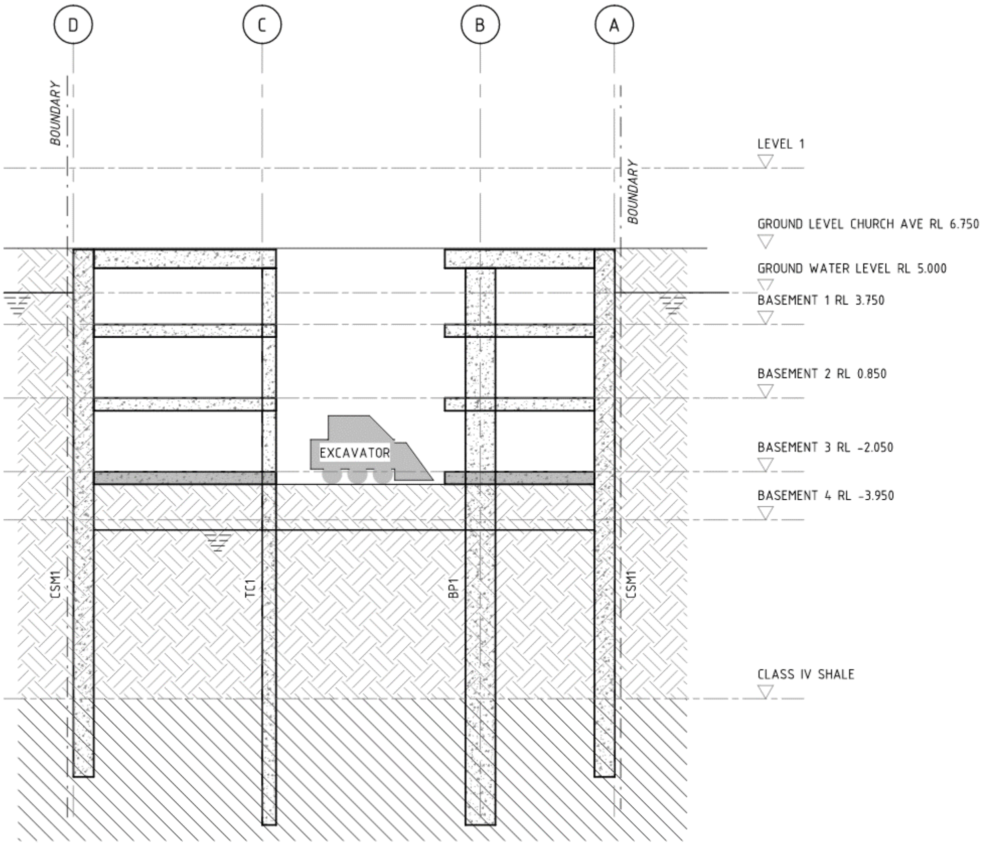
- Excavate beneath basement 1 slab to basement 2 level
- Construct basement 2 slab with penetration in slab for plant access



Indicative Cross-Section at Stage 7

Stage 8:

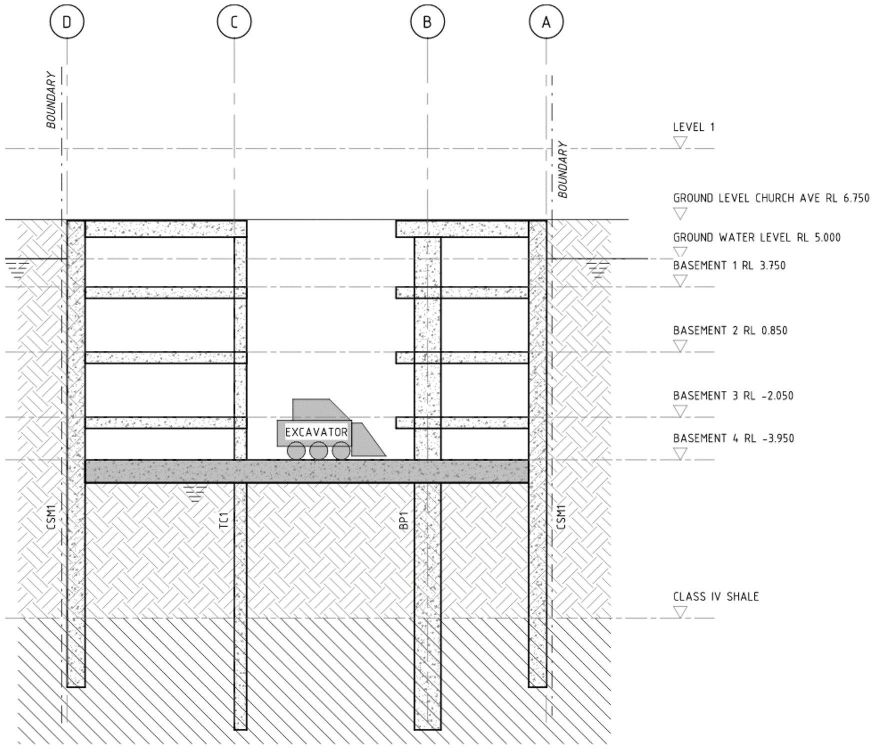
- Excavate beneath basement 2 to basement 3 level
- Construct basement 3 slab with penetration in slab for plant access



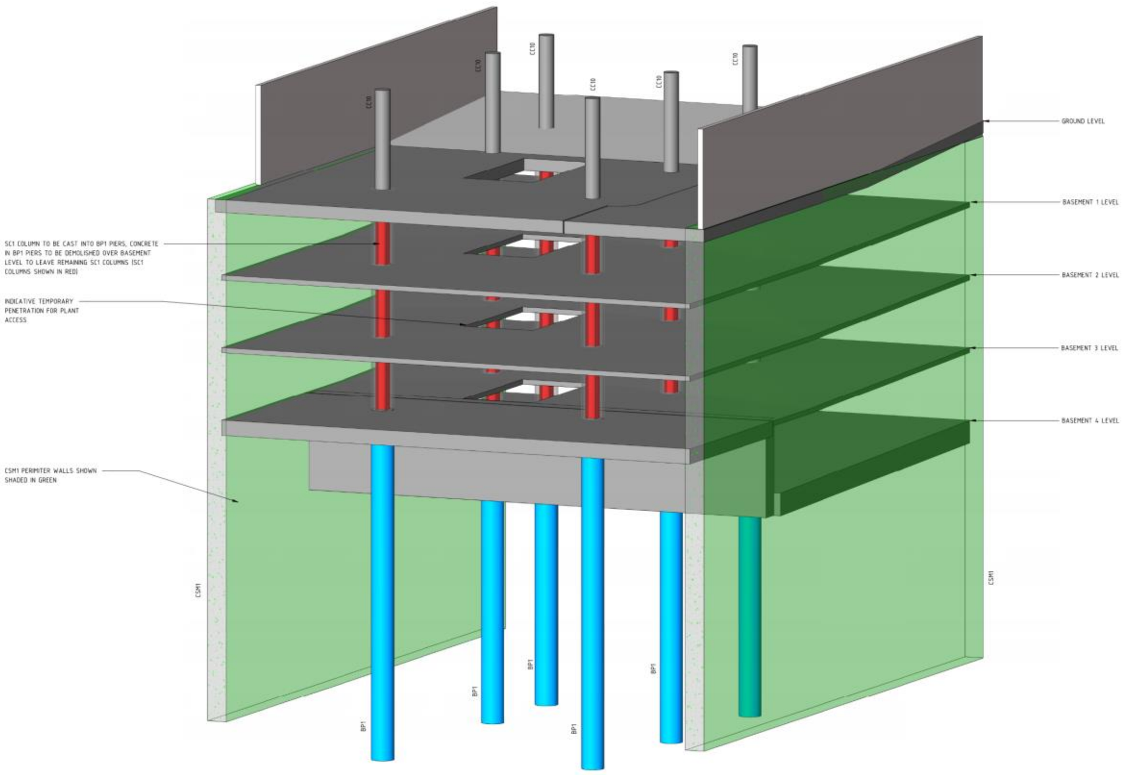
Indicative Cross-Section at Stage 8

Stage 9:

- Excavate beneath basement 3 to Basement 4 level
- Construct basement 4 slab with waterproof membrane (designed for hydrostatic uplift)



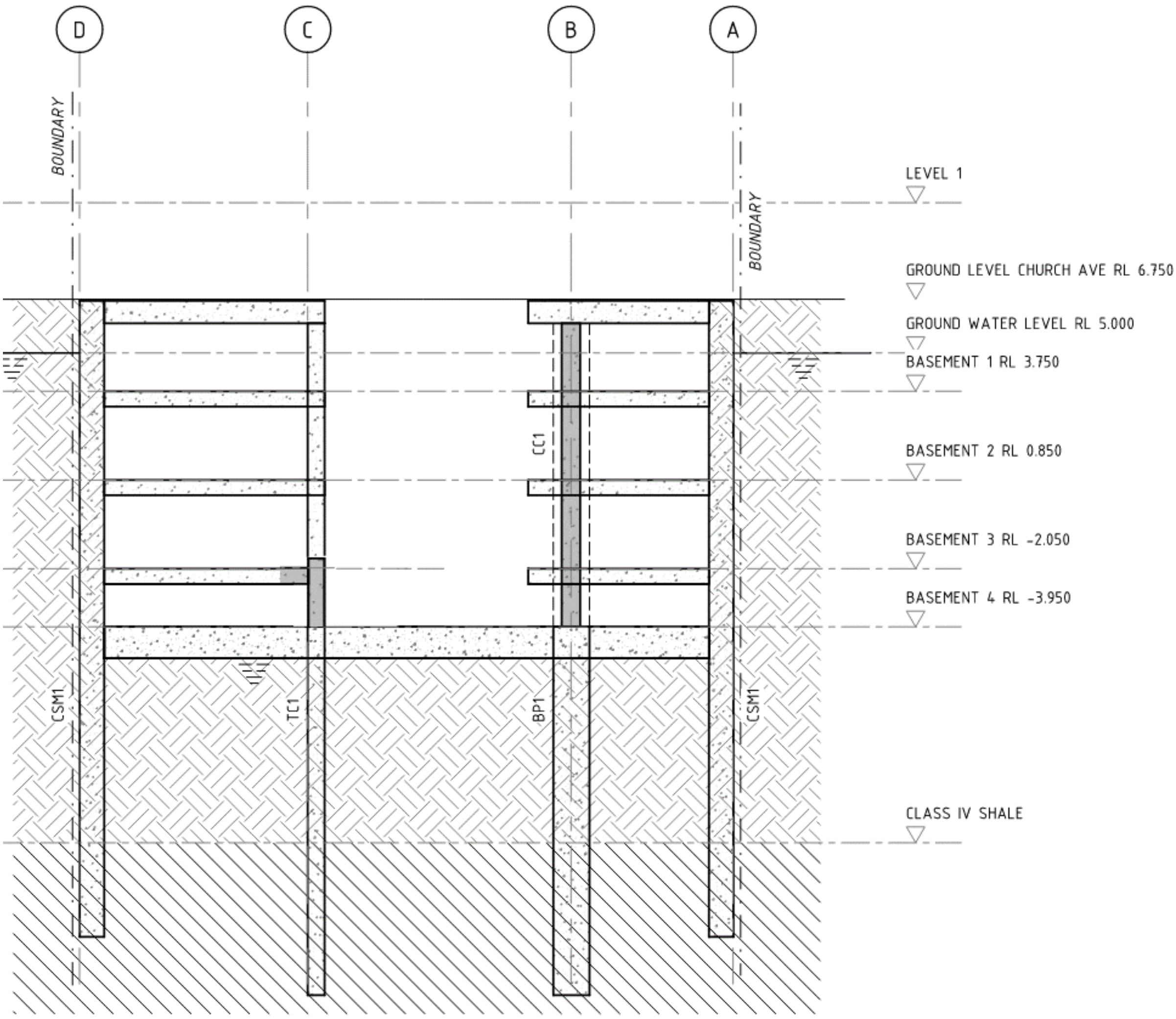
Indicative Cross-Section at Stage 9



Indicative 3D view showing basement slabs with access penetration

Stage 10:

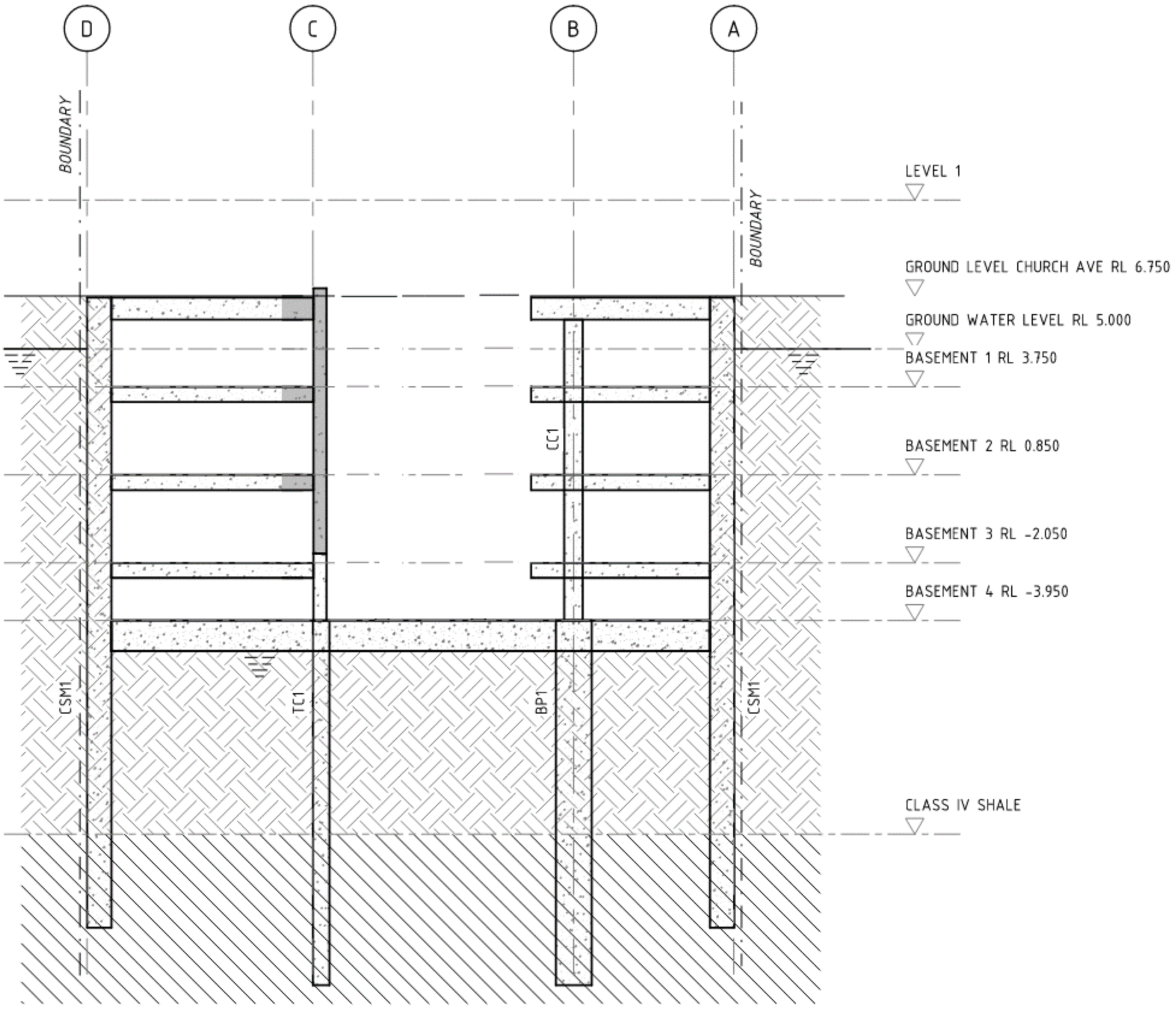
- Basement excavation and slabs are completed at stage 10
- Construct core walls from bottom up and remove temporary columns adjacent to core penetrations
- Cut back CFA piles to expose the structural steel plunge columns



Indicative Cross-Section at Stage 10

Stage 11:

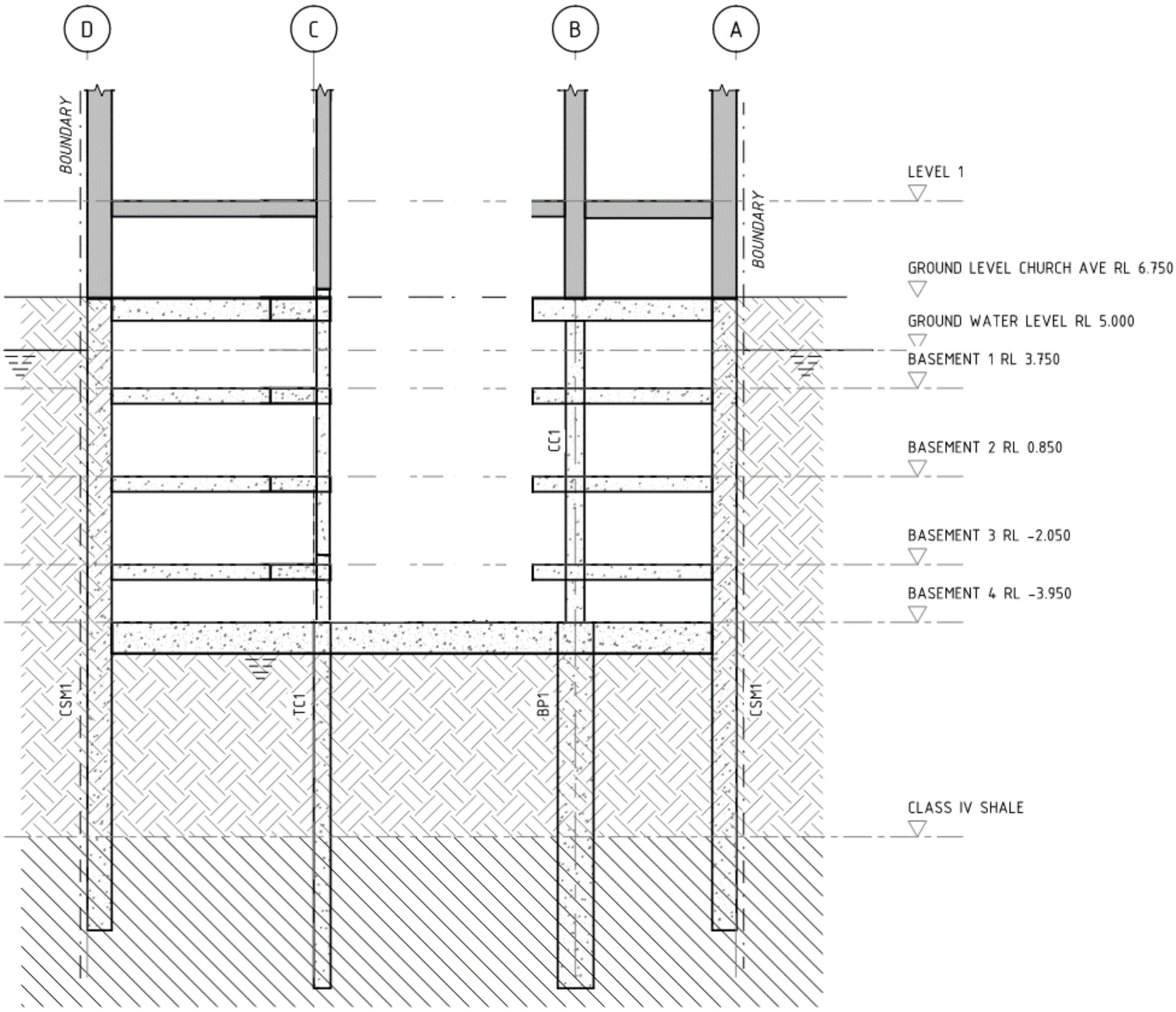
- Continue process to reach ground floor



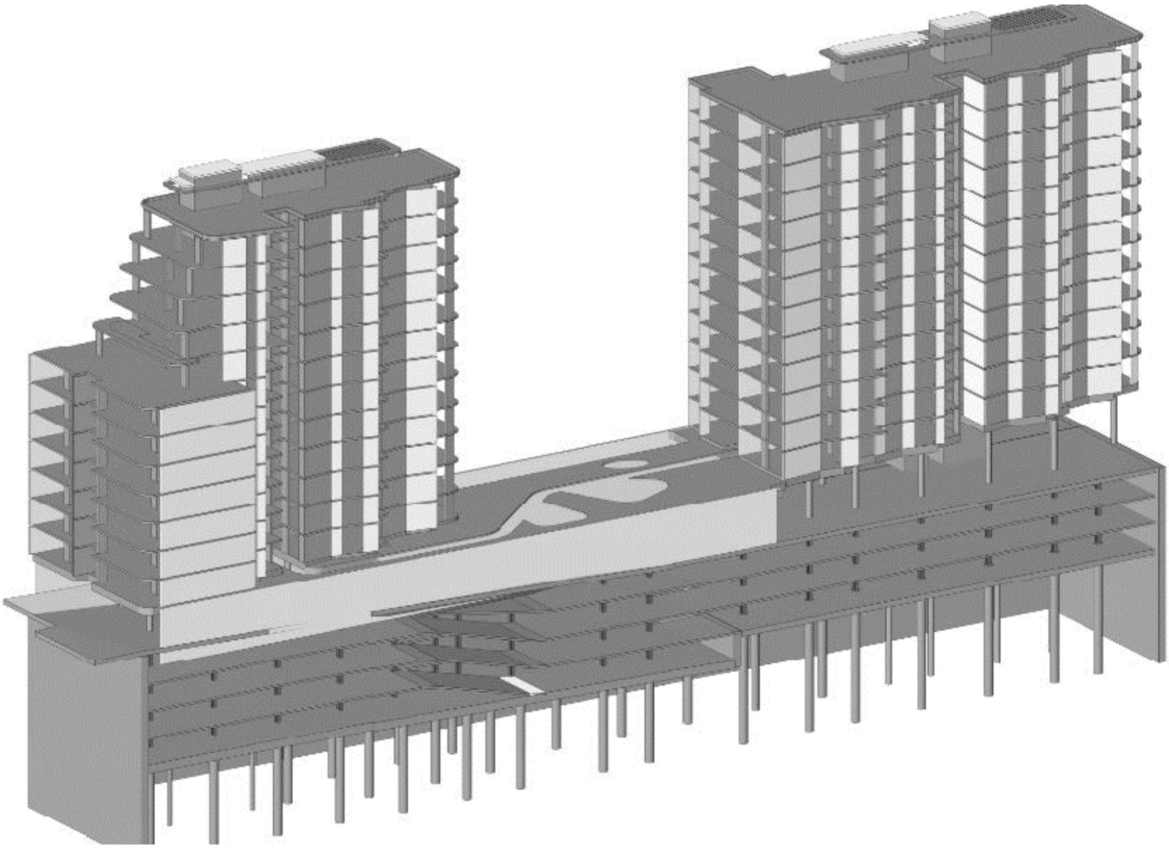
Indicative Cross-Section at Stage 11

Stage 12:

- Continue build above ground level conventionally



Indicative Cross-Section at Stage 12



Indicative 3D view at completion

5. Certification Statement

In our opinion, the proposed development, shoring and basement solution is optimised to reduce risks associated with constructing a basement for this development. This building will be founded on bedrock, reducing settlement risks of the adjacent existing buildings significantly. The provision of cutoff walls into rock minimised the impact of the current water table.

The role of the project geotechnical engineer and hydrogeological consultant in understanding the project risks and providing expert advice regarding groundwater and related settlements is critical in developing the proposed basement design. This report must be read in conjunction with advice and reports by the project Geotechnical Engineer and Hydrogeological Consultant.

Subject to the approval of a professional geotechnical engineer and hydrogeological consultants, we, Northrop engineers, being professional structural engineers, see no reason why the proposed basement design and construction methodology should impact the stability of the adjacent buildings. The recommended mitigation measures must be incorporated into the basement design and form part of the proposed peer review.

Conclusion

This report has been developed to assist with planning authority approval of the proposed development. We remain available to assist with any further queries.

Yours sincerely,

Matthew Allen

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Todd Halliday

Principal | Structural Engineer
BE(Hons) ME(Stud) MIEAust CPEng NER

References

CIRIA C580 *Embedded Retaining Walls – Guidance for economic design*, London 2003

Disclaimer: this report has been prepared for Da Vito Ferro Apartments Pty Ltd relating to the proposed development at 23-25 Church Avenue and 16-18 John Street only and is not to be used by any other party.

Date	Rev	Issue	Author	Verifier
17.08.2020	1	For Review	M. Allen	T. Halliday
27.08.2020	2	For Review	M. Allen	T. Halliday
07.09.2020	3	For Review	M. Allen	T. Halliday
25.11.2020	4	For Review	M. Allen	T Halliday