File Number:		160807
Date:		30/5/2016
Client:		Adams Consulting Engineers P/L Level 10/620 Bourke Street Melbourne Vic. 3000
Distribution:	-	Adams Consulting Engineers P/L
	-	Architecture Matters Pty. Ltd.

RE: Site Classification at No. 39 The Avenue, Balaclava.

A site investigation was conducted at this site on the 28th of May, 2016. The purpose of the investigation was to provide foundation recommendations for the proposed alterations and additions to the existing child care centre.

Scope of the Investigation

The site investigation included the drilling of one boreholes including exposure of the existing footing in one location. The borehole and footing exposure was conducted using hand tools. The subsurface profile was logged and bulk sampled using visual-tactile methods in accordance with AS2870-2011. Borehole log and location are shown on pages 8 and 9 of this report.

The internal footing could not be exposed at the time of the investigation. The offset between the internal footing and where the floor boards were cut was too large to practically detail the footing.

Site Description

The site is currently occupied by a single storey brick child care centre. The site has a ground cover of brick paving, garden beds and tanbark/sand play areas. Several small to medium trees are located to the front of the site. The site is approximately flat and has poor natural surface drainage.

Subsurface Conditions

Regional geology

The site is identified on the 'Geological Survey of Victoria' Melbourne Sheet (1:63,360) as being close to the contact between the provinces of Tertiary 'Brighton Group' and Quaternary 'Alluvial flats'.

Subsurface profile

See borehole log page 8. The borehole encountered:

- FILLING to a depth of 0.30m, underlain by;
- natural loose silty SAND to a depth of 0.85m, underlain by;
- stiff silty CLAY of medium plasticity to a maximum termination depth of 1.50m.

The existing fill material can be considered the equivalent of rolled sand fill in accordance with AS2870-2011 clause 6.4.2.

Soil moisture & groundwater

Borehole 1 encountered slow groundwater ingress and wet sand above the clay contact. This groundwater forms a shallow perched water table within the sand soils immediately above the clay interface. This water table may not be permanent and will be variable in depth depending on the intensity and duration of recharge. Filling and natural soils were otherwise in a moist condition.

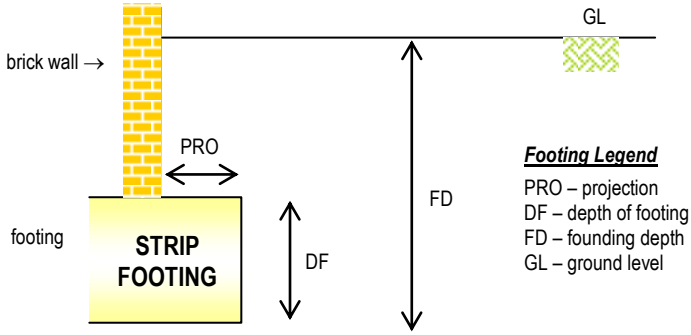
Site Classification

The site is classified as **CLASS M** in accordance with AS2870-2011.

Details of Existing Footing

The existing strip footing was exposed at borehole 1 (see figure 1). Dimensions and founding material are shown below, depths are relative to the existing surface levels at the time of the investigation.

Location:	**Borehole 1** **East wall of child care centre**
Type:	bluestone strip
Founding depth:	500mm
Depth of footing:	400mm
Projection:	0 – 50mm
Founding material:	natural silty SAND



Foundation Recommendations

Continuous strip & isolated pad/stump footings

Strip footings should be proportioned in accordance with a **CLASS M** classification, and:

- penetrate through any surface fill and natural top soils and be founded a minimum of 100mm into the natural stiff silty CLAY; and
- minimum founding depths for strip and pad footings should not be reduced to less than 600mm and 500mm respectively, below finished ground level.

Minimum founding depths for strip and pad footings are shown in table 1, and are relative to surface levels at the time of the site investigation. Site cutting or filling will alter the founding depths indicated.

Table 1

Borehole No.	**Minimum Founding Depth (m)**		**Founding material.**
	Strip	Pads	
1	0.95	0.95	stiff silty CLAY

An allowable bearing pressure of 150kPa may be adopted beneath footings founding in natural stiff silty CLAY. This pressure may be reviewed once design loads have been determined.

Isolated pad footings must not be used for masonry support without approval from this office.

Alternatively: Slab-on-ground

Site preparation

The site shall be prepared in accordance with Section 6 of AS2870-2011, where applicable. Particular attention should be given to the stripping of all vegetation and root zone material. In addition, any soft or loose material that does not respond to compaction should be excavated to achieve a firm working base.

It should be noted that where fill depths on site exceed the limit specified in clause 6.4.2 AS 2870-2011, slab panels will need to be suspended to an engineer design, in accordance with AS2870-2011. However, this can substantially increase the cost of the raft slab foundation.

Where site cutting is proposed on some filled sites, fill depths may be reduced to less than that specified in AS2870-2011, thus eliminating the need to suspend panels. It may therefore be prudent to verify the depth of filling after any site clearing (or demolition) is conducted, as substantial cost savings may be made.

For filled sites, and for sites where additional filling is placed, fill depths may exceed the requirements of AS2870-2011. However, slab panels and non-loaded beams need not be suspended where the filling either:

- meets the requirements of clause 6.4.2 AS 2870-2011, or
- is **verified** to be of 98% or greater dry density ratio as measured by standard compaction (AS1289 5.1.1).

Compaction of existing filling to a specified density or to improve the fill density from a "Rolled" to a "Controlled" category as per AS2870-2011 may be an economic option. Verification of fill density would require either certified documentation or further field work once the site has been cleared and proof rolled.

Slab-on-ground

The slab should be designed in accordance with a **CLASS M** classification, and:

- slab edge beams and heavily loaded internal beams should penetrate through any fill material and be founded a minimum of 100mm into the natural soil profile; and
- founding depths for slab edge beams should not be reduced to less than 300mm below finished ground level.

Minimum founding depths for slab edge beams are shown in table 2, and are relative to surface levels at the time of the site investigation. Site cutting or filling will alter the founding depths indicated.

Table 2

Borehole No.	**Minimum Founding Depth (m)**	**Founding material.**
	Slab edge beams & heavily loaded internal beams.	
1	0.40	natural soil profile

An allowable bearing pressure of 50kPa may be adopted beneath slab edge beams founding in the natural soil profile. For slab edge beams penetrating a minimum of 100mm into the stiff silty CLAY **throughout** the foundation excavations an allowable bearing pressure of 150kPa is available. This pressure may be reviewed once design loads have been determined.

Any isolated strip and pad footings incorporated in the design should be proportioned in accordance with a CLASS M site classification as out lined above. Designs incorporating multiple footing types should be avoided.

Wet sand

During the wetter months shallow perched water may be present within the soils immediately above the clay interface. This water table is not permanent and will be variable in depth depending on the intensity and duration of recharge. Should this material be wet at the time of the foundation excavations the foundation excavations will collapse and water ingress will occur. This will make the foundation excavations very problematic.

Accordingly, should wet saturated loose soils ('sloppy') be intersected in the loaded and edge beam excavations the trenches will need to be additionally deepened to expose a base of natural soils which are neither very loose or saturated. This may necessitate the trenches being deepened to the top of the natural silty clay throughout. This report is therefore based on findings on site at the time of the site investigation. Ground conditions can change due to shallow ground water which is beyond the control of this report.

Construction & Maintenance

Site conditions

Excavation within fill material and natural sand soils may experience short-term instability (particularly if undertaken during the wetter months) and shoring and/or over excavation should be anticipated.

Where deeper footings/edge beams are required due to the depth to the required founding material blinding concrete should be poured in the base of the excavation upon which the footing/edge beam can be constructed.

Articulation

Articulation of masonry walls should be provided as per details contained in reference (3) below. Spacing between articulation joints should not exceed a maximum of 6.0m, and should be provided at/or between:

- any new walls abutting the existing walls (as per AS 2870-2011, clause 3.1.5);
- different foundation types;
- footings founding at significantly different founding depths, or founding material; and
- points of high stress i.e. above door and window openings, changes in storey height, or above large spanning lintels.

Service trenches & easements

The presence of service trenches and easements is a common cause of unsatisfactory performance of foundations through either direct undermining or through the introduction of undesirable levels of soil moisture. For this reason, we recommend:

- Where footings/edge beams are located in close proximity or adjacent to a backfilled service trench or easements, the footing/edge beam must be deepened and founded 500mm below the level of plane of inclination of 30º (for sand) and 45° (for clay) above horizontal extending outwards from the base of the trench or filling (as illustrated by figure C6.1 AS 2870-2011). This includes service trenches which may be present on adjacent sites or on site prior to the current development (such as abandoned stormwater and sewer trenches);
- Significant additional deepening (greater than nominal depth of 1.50m) may necessitate the footing/edge beam to be suspended to an engineer design, and this office should be contacted for further advice;
- All service trenches should be sloped away from the building as per AS2870-2011 section 5.6.3(b, c and d) and be backfilled with non-permeable material as per AS2870-2011 section 5.6.3 (b).

- Backfill material should ideally comprise weak mix concrete, mortar or (preferably) cement stabilised soil, or clean adequately tamped/compacted clay placed marginally wet of optimum. Permeable or granular material such as sand, gravel, ¼ minus, or building rubble, should not be used to backfill service trenches in proximity to building foundations.

Trees

Trees/shrubs can induce 'drying' of foundation zone soils, resulting in shrinkage and consequent foundation movement and cracking. Conversely, trees/shrubs can also block or crack service pipes, resulting in leaking and wetting of foundation zone soils, with similar undesirable consequences.

Trees should therefore be prohibited a minimum distance equal to ¾ of the mature height of the tree from structures for sites of moderate reactivity, as per AS2870-2011 B2.3 (c) tree restrictions. There generally has to be a compromise between the presence of trees and foundation movement and associated cracking. Should significant trees exist or be proposed within this 'zone of influence' from the proposed structure, this office must be contacted for further advice.

Tree roots are attracted to moist ground conditions. If a relatively low and constant ground moisture condition can be maintained in the vicinity of the foundations, tree roots, which may cause volumetric changes in the foundation zone soils and/or cracking in later dry periods, will be attracted to other areas.

This office specialises in GEOTECHNICAL ENGINEERING, and not arboriculture/horticulture and tree identification. Any trees/shrubs shown on Figure 1 are schematic and not intended to be utilised in the footing design. To ensure the performance of the foundations, we recommend that once clearing (and/or demolition) is complete, any trees and shrubs remaining are identified and the Structural Engineer informed to modify the structural design accordingly. Identification will require a professional arborist or similar.

Construction

To ensure the satisfactory long term performance of foundations, it is absolutely imperative that:

- no water shall be allowed to pond or pool at the base of the foundation excavations,
- the stormwater be connected as soon as the roof is sealed. This will normally require the installation of a temporary system 'above ground' until permanent drainage is connected and operational, and
- the ground surface and pavements adjacent to the building be graded away from the building, as per the drainage requirements C5.2 AS2870-2011.

The recommendations contained in:

- AS2870-2011 Section 5.6 and 6.6 'Additional requirements for classes M, H1, H2 and E sites'; and
- Appendix B (Performance requirements and foundation maintenance), Section C5 AS2870-2011 (Detailing requirements);

should be adopted, where applicable for this site.

The recommendations contained in Appendix B (Performance requirements and foundation maintenance) and Section C5 AS2870-2011 (Detailing requirements) should be adopted where applicable for this site.

All contractors must be well **briefed** as to the requirements and specifications in this report. To minimise the likelihood of misinterpretation, this report must not be reproduced unless in full and contractors given ready access to the complete report.

This report is based on the assumptions that conditions revealed through selective sampling are indicative of the actual conditions throughout the site, i.e. correlation between boreholes. Variations between boreholes may exist due to previous land use or natural geologic processes. Additional deepening of the foundations, deeper than the minimum specified founding depths in this report, may be required. The actual subsurface conditions can be discerned only during earthworks when the subsurface profile can be directly observed.

For further information regarding geotechnical site investigation reports, refer to reference (5) below.

Inspection of all foundation excavations, site works and compaction must be conducted by a suitably qualified, experienced engineer, engineering geologist, building surveyor or similar to ensure that the founding material and site works are in accordance with this report. Should there be any doubt, this office should be immediately contacted.

Maintenance

The clay soils at this site are moderately reactive, and may experience appreciable volumetric changes with changes in moisture content (i.e. shrink upon drying and swell upon wetting).

Conventional foundations are designed to accommodate normal reactivity induced seasonal surface movements, but require that a good foundation maintenance program be implemented.

A good foundation maintenance program should be aimed at keeping foundation zone soils at a low and constant moisture content. To this end we recommend that the notes contained in AS2870-2011 Appendix B and the CSIRO Information Sheet BTF 18 (references 1 and 3) be implemented, and that particular attention be given to the points discussed below.

Site drainage

The site should be graded or drained to prevent water from ponding against or near the building. Monitoring of surface drainage paths should be ongoing. In any areas where ponding or pooling of water does occur, the surface should be regraded to direct water away from the building or to stormwater discharge points.

Garden restrictions

Garden beds should not compromise site drainage or be located directly adjacent to the building and should not be over-watered where they are near the building foundations.

Maintenance of plumbing, services and stormwater system

All services and plumbing must be well maintained and periodically checked for leaks. Guttering must be kept clean at all times and downpipes discharge all roof water into the storm water system (or rainwater tank).

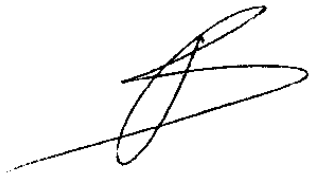
Foundation performance

It should be noted that the conventional foundations specified in AS2870-2011 may still experience some minor (non-structural) foundation movement and cracking, even where good foundation maintenance practices are undertaken, depending on environmental factors and local conditions (refer to AS2870-2011 Section 1.3.1 and Table C1 and C2 Appendix C). This reflects the necessity of achieving a balance between cost, safety and serviceability.

Alternatives to conventional foundations can be ‘tailored’ to suit the desired level of performance of the foundation system. Should minor foundation movements be intolerable, or on-going maintenance be undesirable, the foundation may be engineered accordingly. This will be a matter for the proponent to decide based on the required level of serviceability and desired performance criteria, and cost. Further advice with regard to an alternative foundation design may be obtained from this office, if required.

Please do not hesitate to contact this office, should there be any further queries.

Yours Faithfully,
HardRock Geotechnical Pty Ltd



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(Geotechnical Engineer)

References

1. AS2870-2011. "Residential slabs and footings- Construction."
2. The Cement and Concrete Association of Australia. Technical Note: TN61.
3. CSIRO Information Sheet BTF 18: "Foundation Maintenance and Footing Performance: A Homeowners Guide".
4. Institution of Engineers, Australia. 1987. "Guidelines for the Provision of Geotechnical Information in Construction Contracts".
5. AS1726-1993. "Geotechnical Site Investigations".
6. AS2159- 2009. "Piling – Design and Installation".
7. AS2159 Supp1 - 1996. "Piling – Design and Installation Guidelines".

HardRock Geotechnical P/L

Consulting geotechnical engineers.

Borehole Logs

File: 160807
Date: 28/05/2016
Supervisor: MB/ JB

Client: Adams Consulting Engineers Pty. Ltd.

Project: No. 39 The Avenue, Balaclava

Borehole No. 1 **Drilling method**: HA **Location:** see figure 1.

Depth (m)	Structure	Description	Cohesion/ density	Soil moisture/ groundwater	Testing:
	Fill	silty SAND/ rubbish/ roots	L	M	
0.30					
		silty SAND (SM), fine grained, dark brown grading to light brown	L	M	
		ferruginous gravel at clay contact	L	W	
0.85	SP				
		silty CLAY (CL), medium plasticity, brown/ grey/ orange	ST	M	
		trace gravel			
1.50		Borehole terminated at 1.50m			

Legend:

Density	**Cohesion**	**Moisture**	**HA-**hand auger **A-** Flight auger drill rig.
VL-very Loose	Soft- Soft	W - wet	Unified soil Classification symbols: CL, SM, SW
L-Loose	F- Firm	M- moist	SP- Soil profile
MD- Medium Density	ST- stiff	D- dry	Some< 15%
D - dense	VST- Very Stiff		Trace< 5%

HARDROCK GEOTECHNICAL P/L
Consulting geotechnical engineers

File: 160807
Date: 28/05/2016

LOCATION PLAN

Figure No. 1

Project:
No. 39 The Avenue, Balaclava
Scale.
Not to Scale (sketch for borehole locations).

Legend:
⊕ Borehole
□ Footing inspection