

THEMBAKHELE CONSULTING ENGINEERS (PTY) LTD

SOUTH AFRICAN NATIONAL BIODIVERSITY INSTITUTE

GEOTECHNICAL REPORT: WALTER SISULU BOTANICAL
GARDEN
GEOMAT LABORATORIES CC

Report No.: 0103-RTP – SANBI WSBG

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DCP LOGGING

Abbreviations and Symbols

AASTHO	American Association of State Highway and Transportation Officials
NHBRC	National Home Builders Registration Council
TCE	Thembakele Consulting Engineers (Pty) Ltd
CBR	California Bearing Ratio
COMP MC	Compaction Moisture Content
GEOMAT	GEOMAT Laboratory Services cc
G1 - G10	Standard classification of natural road building materials according to COLTO or TRH14¹
HRB	Highway Research Board
LL	Liquid Limit
LS	Linear Shrinkage
MDD	Maximum Dry Density
Mod AASHTO	Modified AASHTO test for determining MDD and OMC
OMC	Optimum Moisture Content
PI	Plasticity Index
PL	Plastic Limit
THM	Technical Methods for Highways
TLB	Tractor Loader Backhoe
WG27	YX co-ordinates projected to the 27th longitude, WGS84 datum
WG29	YX co-ordinates projected to the 29th longitude, WGS84 datum

¹ **TRH14:1985.Guidelines for Road Construction Materials.** Committee for State Road Authorities, Department of Transport, Pretoria.

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1. INTRODUCTION

1.1 Background

At the request of Thembakele Consulting Engineers, Ms Soobiah requested Geomat Laboratory Services cc through Mr Reddy, to carry out the geotechnical investigation for the development to be undertaken at Walter Sisulu Botanical Gardens, Roodepoort.

1.2 Proposed Development

The project comprised the construction and (or) extensions to the current restaurants and waiting areas of the existing building. This extension was to include amongst others refurbishments, building of the additional storey and associated constructions.

1.3 Scope and Purpose

The purpose of these geotechnical investigations was to provide materials information of the existing materials and to establish the founding conditions of the existing soils. The area is situated in the biodiversity sensitive space; the test pitting was conducted using labour workforce.

The aim was to establish the horizon of existing foundations (in areas with accessibility); and determine;

- Materials conditions of this horizon.
- Density and stability of this horizon.
- Dimension and conditions of the foundation columns and bases.

The scope of our fieldwork comprised test pit profiling and sampling, laboratory testing and thereafter the compilation of this geotechnical report.

2. SITES DESCRIPTION

2.1 Site Localities

The site is located in Roodepoort area, some 27km northwest of Johannesburg, within the boundary of the Joburg Metropolitan Municipality. This area can be accessed through M47 (Hendrik Potgieter) road from Johannesburg town.

2.2 Topography

Walter Sisulu Botanical Gardens is a nature reserve area, with natural sensitive topographical slopes, flora and fauna and wildlife features.

2.3 Climate

All investigated sites have summer rainfall, and a relatively dry winter. According to the Weinert's N-value chart, the region is situated on Weinert's N-value between 2 and 5. It has Thornthwaite's value of between -20 to 20, thus climatic region is classified as sub-humid warm climate.

3. SITE INVESTIGATION

3.1 Inspection pits

A total of three (3) test pits were excavated at the various location within the site. The test pits were excavated in extreme difficulties, due to **accessibility** restraints. The test pits were excavated using manual labour, profiled in accordance with accepted standards^{2,3} and soil samples of the materials encountered were taken for laboratory testing. The detailed soil profiles are appended in Appendix A. Furthermore, the test pits were used to determine the dimensions and conditions of the foundations columns and bases.

3.2 Dynamic Cone Penetrometer

A total of six (6) DCP tests were conducted various locations within the site. The results of the probes are presented graphically and appended on Appendix C of this report.

For ease of evaluation, the following table is provided to aid the interpretation of the DCP results with regards to the consistency of the Non-Cohesive and cohesive soils underlying the route. However it must be understood that this should merely be used as a guide as it is empirically derived and based on values and understanding of the industry norm.

² Jennings J.E., Brink A.B.A. and Williams A.A.B. (1973) Revised **Guide to Soil Profiling for Civil Engineering Purposes in South Africa**. The Civil Engineer in South Africa, January 1973.

³ Brink A.B.A. and Bruin R.M.H. (eds) (1990) **Guidelines for Soil and Rock Logging in South Africa**, 2nd Impression 2002. Proc. Geoterminology Workshop. SAIEG - AEG - SAICE 1990.

Subsoil Consistency inferred from the DCP test results.

Non Cohesive Soils		Cohesive Soils	
No of blows/300mm Penetration	Soil Consistency	No of blows/300mm Penetration	Soil Consistency
<8	Very Loose	<4	Very Soft
8-18	Loose	4-8	Soft
18-54	Medium Dense	8-15	Firm
54-90	Dense	15-24	Stiff
>90	Very Dense	24-54	Very Stiff
		>54	Hard

3.3 Materials Sampling

Sampling of insitu materials encountered during the excavation of inspection pits was undertaken during the course of the fieldwork. All disturbed samples were taken, and delivered to GEOMAT in Midrand for analysis which comprised the following;

- Foundation Indicators
- Mod AASHTO Density testing
- CBR testing

The results of the materials testing are summarised in the laboratory test summary tables, and appended as Appendix B of this report.

4. GEOTECHNICAL ASSESSMENT

4.1 Groundwater and seepage

No groundwater or seepage was encountered, however the underlying insitu soils was mainly moist.

4.2 Site Stratigraphy

4.2.1 Soil Description

The site is underlain by moist, light to dark brown, soft, topsoil to the depth of 200mm. Underlain by the topsoil are moist, dark brown, soft to medium dense, silty sands to the depths of 700mm and beyond.

4.2.2 Soil Consistency

The conducted DCP highlights the increasing bearing capacity with depth. There is an average of bearing capacity of 42mm/5blows penetration (in exception to test pit No. 2). The figure highlights our suspicion that the soils within the vicinity could have not been reworked or modified to preserve the biodiversity requirements.

4.2.3 Soil Classification and Characteristics

The characteristics and classifications of the soil samples from the laboratory results indicate that the insitu soils are silty sands under the Unified Soil Classification system, with an average grading modulus of 1,3.

The insitu materials have the following average Atterberg limits;

- Liquid Limit of 40%
- Plastic Index of 13
- Linear shrinkage of 7.4%

The materials have the average Maximum Dry Density of kg/m³ and Optimum Moisture Content of 10.3%.

Furthermore, the insitu materials have the following average CBR values;

- At 90% Mod ASSHTO with the value of 10
- At 93% Mod ASSHTO with the value of 13
- At 95% Mod ASSHTO with the value of 16
- At 97% Mod ASSHTO with the value of 20
- At 100% Mod ASSHTO with the value of 27

4.3 Laboratory testing

In order to evaluate the engineering properties of the insitu soils and their suitability as subgrade and fill material, selected bulk samples were taken from the test pits and submitted to a soils laboratory for testing. The results of the laboratory tests are given in Appendix C and summarised in Table 1 below.

Table 1

Summary of Results of Particle Size Distribution Analysis and Atterberg Limit Determinations, Compaction, and CBR Testing.

Name (Depth)	Atterberg Limits			GM	MDD Kg/m3	OMC %	CBR Values (%)					PRA	HEAVE
							90	93	95	97	100		
	LL	PI	LS										
TP 1	39	14	7.5	2.03	1920	11.4	15	19	21	25	30	A-2-6 (0)	LOW
TP 2	35	15	7.5	1.46	1841	14.3	13	17	20	24	30	A-2-6 (1)	LOW
TP 3	38	14	9	0.63	1740	17.5	2	4	6	12	20	A-6 (7)	LOW

* LL - Liquid Limit OMC - Optimum Moisture Content
 PI - Plasticity Index MDD - Modified Dry Density
 LS - Linear Shrinkage GM - Grading Modulus

5. RECOMMENDATIONS & CONCLUSIONS

5.1 Excavation and Earthworks assessment

The excavation was conducted by manual labour, without extreme difficulties. The excavation of the insitu materials can be classified as “intermediate to hard” excavation, with the normal earthmoving equipment in terms of SABS 1200.

It is recommended that all earthworks be carried out in accordance with SANS 1200 (latest version). **Cautious provisions** should be made for dealing with the vegetation, and removal and stockpiling of topsoils, since the entire are is naturally preserved.

5.2 Drainage

Both during and after construction, the site should be well graded to permit water to drain away readily and to prevent ponding of water anywhere on the ground surface. There is no indication of raised water table or ground water conditions. This investigation did not cover the sub-surface drainage, however it is recommended that the Design Engineer undertake the proper hydrology and storm water study.

5.3 Soil Resistivity and Permeability

The soil resistivity was not determined. It is however proposed that all buried pipe works should be able to withstand the potential corrosion. The site is underlain highly weathered granite soils, with fairly low permeability potentials.

5.1 NHBRC Site Classification

The proposed development will comprise double storey type residential structures.

In terms of the NHBRC Residential Site Class Designations together with the evaluation of the engineering soil characteristics at the site, it is concluded that generally the site can be designated as Site Class **C to C2** over the majority site. Hence the recommendation for strip footings and pad footing for the columns.

In an event the insitu materials has been disturbed on required modification during construction phase, a compaction effort of **93% Mod ASSHTO** should be done.

5.2 Foundation recommendations

It is recommended that the residual materials is competent for founding, and will handle the anticipated structural loads. Furthermore with two accessible columns were inspected with dimensions of **700mm x 600mm** and **790mm x 560m**, it is expected the footing has enough spread area to distribute the loadings accordingly. It is recommended that the allowable loading on the new columns (if any is required) should be limited to **250kPa**. The investigations on the columns were purely visual, and for the purposes of getting the dimensions. However, it still recommended that Design Engineer conduct the structural integrity models, to ascertain if the structure will handle the anticipated additional loadings.

If there is anticipated the terrace to be built to reach the finish level, and to supplement the excavated topsoil materials. Any required backfilling (or terrace construction) should then be carried out with G7 material, or better, compacted in 150mm layers to 93% Mod. AASHTO at -1% to +2% OMC. In an event the thickness of the terrain exceed 1.2m in depth, the allowable bearing should be limited to **250kPa** on platform.

Yours faithfully.



Isaac Shonga *PrTechniEng*



Nondumiso Khumalo *PrTechEng*

For Geomat Laboratories cc

15/05/2019

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SOIL PROFILES & POSITIONS

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MATERIAL TESTS AND RESULTS

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DCP LOGGING

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APPENDIX D

PHOTO REPORTS