



C.E.T.S

CENTMAX ENGINEERING TECHNOLOGY SOLUTIONS



LABORATORY AND FIELD TESTING OF FOUNDATIONS SERVICES

JOINT VENTURE OF PYRAMID TECHNICAL SERVICES AND CENTMAX ENGINEERING AND TECHNOLOGY SOLUTIONS
CETS

Our Partners and Clients



Contact Us:

Kalmax Building-Level 2

Plot 56 Bombo Road Wandegaya

Kampala, Uganda P.O. Box 7459

Tel: +256 783 707 348 | +256 701 085 148

Email: centmaxtech@gmail.com | www.centmaxgroup.com

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1.0 BACKGROUND

When we think of construction work, we often picture the construction site or even the completed project. People tend to forget the planning, investigations and groundwork that take place on-site before even a brick is laid down. Without a desktop study, site investigation and potential remedial work taking place, many projects can't go ahead. If a project was to go ahead without the benefit of these preliminary assessments, it could create a problem later down the line because the conditions of the ground on every site are very variable. In fact, the composition of the land can even vary across a short distance. This means there could be a few environmental issues, such as drainage, on one site which could impact how the land will react to new development. In addition, site history also has a considerable impact on how the land will react to added pressures or changes.

According to section 3.2.2 of the Building control regulations (2012) by Ministry of Works and Transport, Before construction activities could begin at any site, engineering geological and geotechnical investigations for foundations has to be approved in order to determine the safe bearing capacity of the soil materials and recommend suitable foundation for the structure.



Figure-1. geotechnical Engineering

The main benefits of adopting Geotechnical Investigations include: -

- i) Geotechnical investigations assess surface and groundwater drainage conditions and the impact that development would have, this provides reliable knowledge of the soil properties in so doing be in position to determine whether a particular site is suitable for the purpose intended.
- ii) provides broad knowledge of the history of the site.
- iii) provide knowledge on what remedies need to be put in place before construction can start and therefore design the appropriate foundations for the structure

2.0 OUR APPROACH TO GEOTECHNICAL INVESTIGATION

Geotechnical investigations are performed to obtain data about the subsurface soil and rock conditions of the proposed development site. This helps to understand the foundation requirements for the construction of any new infrastructures, underground utilities, underground parking lot and surrounding parking areas. These investigations are essential for design and structural engineers to recommend design criteria for the construction and design approach for each project. The general tasks are as follows:

- Determination of soil profile and groundwater status within the proposed site.
- Recommendations for foundation design and construction of various building structures and underground utilities.
- Recommendations for constructing parking areas and driveways (for light and heavy-duty asphalt paving).
- Recommendations for site preparation and surface drainage.

After geotechnical investigation, some geotechnical criteria are developed regarding foundations, excavation, retaining walls, site drainage, and site grading. These criteria help design and civil engineers to anticipate and calculate the load-bearing capacities and lateral forces on various structural elements of construction like columns, slabs, beams, plinth and walls. Such precise calculations are critical in layout planning and architectural drafting.

Centmax Engineering and Technology solutions has highly experienced professional Geotechnical Engineers, who can provide all kinds of geotechnical engineering solutions in reasonable time frame with competitive rate.

Below is the list of Tests that we can offer;

Table 1: Field Testing of Foundations

#	Name of test	Equipment used	Suitable Test Location	Test Standard
1	Soaked CBR Test	Universal CBR Testing Machine	Road layers	BS1377-2:2022-soaked CBR, heavy compaction
2	Bearing Capacity Test	Plate Load equipment	Reservoir/tank site	BS 1377 part 9: 1990 Plate Load test
3	In-situ Compaction Test	Sand Replacement cylinder/Dynamic Cone Penetrometer (DCP) equipment	Road layers/pipeline	BS 1377 part 9:1990-sand replacement Plate Load test/ASTMD/8951 M-09-

Table 2: Laboratory testing of samples.

#	Name of Test	Standard Test Method	Sample Status
1	Moisture content	BS 1377: 2: 2022	Disturbed
2	Particle size distribution	BS 1377: 2: 2022	Disturbed
3	Liquid Limit	BS 1377: 2: 2022	Disturbed
4	Plastic Limit	BS 1377: 2: 2	Disturbed
5	Plasticity Index	BS 1377: 2: 2022	Disturbed
6	Chemical Tests	BS 1377:3:2018 +A1:2021	Disturbed
7	Consolidation test	BS EN ISO 17892-9:2018	Undisturbed

Table 3: List of our equipment;

a) Drilling Rig (3N0s.)

Make:	Diamond Core Drilling Rig, China			
Model:	XY-100			
Age (years)	10 Years			
Last overhaul:	No Overhaul			
Rated Capacity:	100m – 150m depth			
Truck/trailer mounted/Tower:	Roller mounted with 8m Tower			
Years with Company:	7 Year			
Drill pipe depth/diameter:	Hole depth	150m	Drill pipe dia	42mm
		100m	Drill pipe dia	50mm
Foam/Water Injection:	Water Injection			
Mud circulation	Mud pump, mud tank, pumping hose and accessories			

b) Compressor

Make:	Kaishan Diesel Power Screw Air-Compressor - China		
Model:	KSCY550-13H		
Age (years)	3		
Last overhaul:	No Overhaul		
Rated Capacity (cfm):	550 cfm	15m ³ /min	
Rated Pressure (bar)	13 bars	1.3MPa	
Trailer Mounted:	Trailer Mounted		
Years with the Company	1 Year		

c) Miscellaneous Equipment

Drilling bits	PDC, Diamond, Tungsten, Tricone, DTH bit, etc.
Mud pump	External Mud Pump, BW 200, diesel engine

Generator	3-Phase generator, 24kVa
Well development equipment	Compressed air (compressor)
Cementing tools	Steel casting formwork, masonry tools, etc.
Fishing tools	Grabbers, over shots, corkscrew, fishing jars, etc.
audio communication equipment	Mobile phone available

List of other equipment

(All these are owned by the company)

- I. Chain spanners
- II. Pipe wrenches
- III. Adjustable spanners
- IV. Spirit levels
- V. Hacksaw
- VI. Hammers
- VII. Metal Grinders
- VIII. Measuring Tapes of different sizes, 5m, 7.5m, 10m, 30m, and 100m.
- IX. Welding plant and generator
- X. Dewatering pump

REG. No	Make/Type	Capacity	Drive configuration
UAK 849D	MITSHUBISHI Canter - Lifting Crane (pulley truck)	7 ton	2 axle, 6 wheels

3.0 DESIGN AND IMPLEMENTATION

Determination of the vertical deformation and strength characteristics of soil by the plate loading test carried out

The field exploratory activities are conducted in accordance with ASTM D1195 – 93 and BS1377, Part 9, (1990) Clause 4.1 "Determination of the vertical deformation and strength characteristics of soil by the plate loading test" Steel bearing plate assembly was placed on the existing ground which had been cleared of debris and thereafter a 10-ton loaded truck or an excavator was conveniently positioned to provide the necessary dead load to the equipment. Subsequent live loads are gradually increased by means of a hydraulic jack.

The corresponding settlement values for every applied live load are recorded from the dial gauge to 0.01mm degree of accuracy. Observations on the load increments not less than 5kN are taken until the rate of settlement was beyond the dial gauge reading for at least five minutes each time. The same process was done on the other location investigated.

The photos below show the details of the field activity.



Plate 1.0: Proposed construction site to be tested



Plates 2&3: The plate load equipment



Plates 4&5: Taking the dial gauge readings after applying the loads



Plates 6&7: A trackcavator providing the necessary live load for the equipment

Field Results

Plate load test findings

The applied loads and corresponding settlement values for the two points are as summarized in the tables below:

Ring constant: 0.01

Plate Area: 0.071m²

Table 4.0: Plate bearing test results for point 1 (TP 1)

APPLIED LOAD (KN)	BEARING PRESSURE (kN/m²)	AVERAGE SETTLEMENT (mm)	CUMMULATIVE SETTLEMENT (mm)
0	0	0.00	0.00
5	70	0.12	0.12
10	141	0.20	0.32
20	282	0.28	0.59
30	423	0.63	1.22
40	563	0.88	2.09
55	775	1.31	3.40
65	915	1.48	4.87
75	1056	1.78	6.65
85	1197	2.00	8.65
100	1408	2.41	11.06
110	1549	2.63	13.69
120	1690	2.83	16.51
130	1831	3.05	19.56
150	2113	3.63	23.19

Table 5.0: Plate bearing test results for point 2 (TP2)

APPLIED LOAD (KN)	BEARING PRESSURE (kN/m²)	AVERAGE SETTLEMENT (mm)	CUMMULATIVE SETTLEMENT (mm)
0	0	0.00	0.00
20	282	0.16	0.16
40	563	1.02	1.18
60	845	1.81	2.99
80	1127	2.78	5.77
100	1408	3.20	8.97
120	1690	3.75	12.72
140	1972	4.16	16.88
150	2113	4.63	21.50

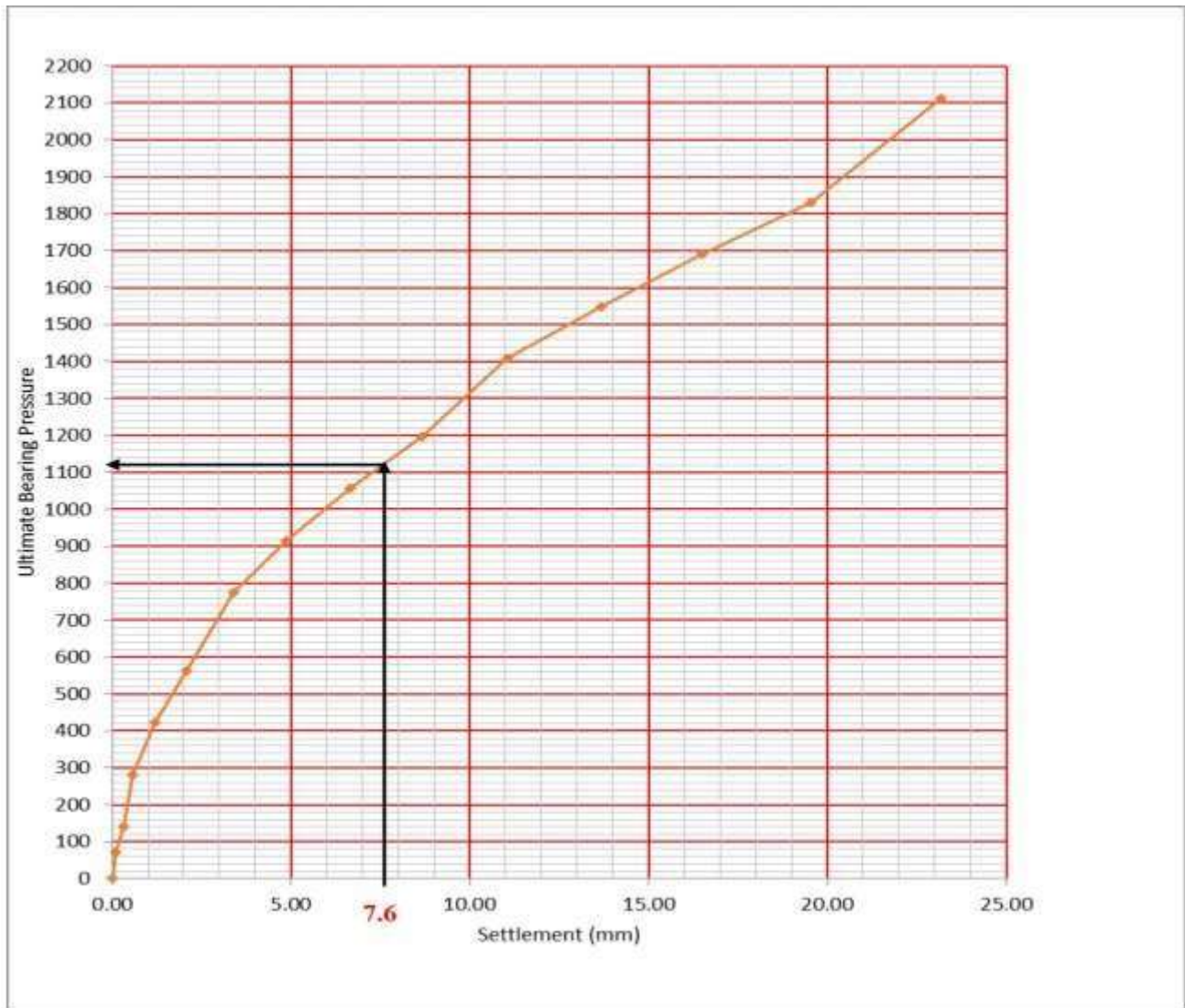


Figure 1.0: Graph of bearing pressure versus settlement for test point 1

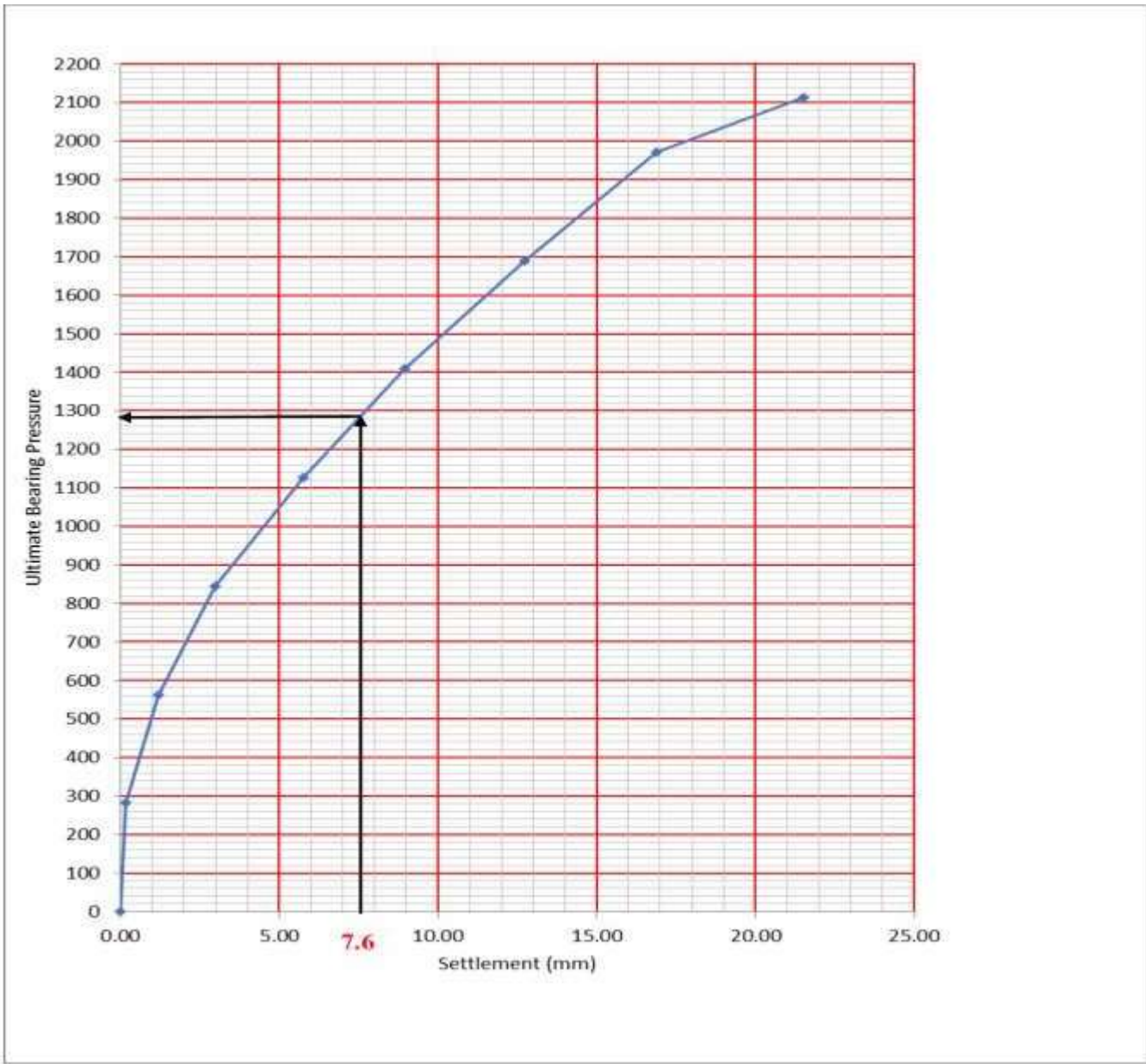


Figure 2.0: Graph of bearing pressure versus settlement for test point 2

The evaluations are summarized in Table 3.0 below.

Table 6.0: Summary of the bearing capacities for the test points

Test point	Width of foundation m	Size of plate mm	Observed settlement mm	Ultimate bearing capacity Pa	Allowable bearing capacity Pa
TP1	3.0	300	7.6	1220	406.7
TP2	3.0	300	7.6	1280	426.7

*A safety factor of 3.0 has been used here in accordance with the industry trend.

CONCLUSION

- i. The plate bearing test was conducted at two points at the site with an aim of evaluating the settlement and bearing capacity of the foundations.
- ii. The maximum applied loading of 150 kN on each point investigated yielded safe allowable bearing capacity values of 406.7 kPa for TP1 and 426.7 kPa for TP2.
- iii. The observed settlement corresponding to the allowable bearing capacity values for both test pits was 7.6mm. This settlement is less than the maximum allowable value of 25mm.

4.0 OUR TEAM OF EXPERTS

No	Technical staff	qualifications	Years of experience	Position in the company
1	Eng. Patrick Etoko <i>MUIPE, R.E., ERB No. 757</i>	MPIM (Infrastructure), PGD, B.Eng. (Civil)	20	Project manager
2	D.Eng. Mugume Bangi Rogers (PhD)	PhD (Structures), MSc (Environmental Eng.), BSc (Civil)	18	Chief Consultant
3	Opito Sam	B. Eng. (Civil), PDG (UMI)	15	Project Engineer
4	Mpungu Abubaker	Dip Civil Engineering	10	Site Manager
5	Onyango Timothy	Certificate in Fitter Machine work	7	Machine Operator
6	Kibuuka Mustafa	Certificate in Fitter Machine work	10	Machine Operator

5.0 OUR TEAM ON SITE



Geotechnical Drilling at Tororo Cement Factory



Taking the level of water table for a drilling site at Tororo Cement Factory



Materials samples extracted for further laboratory testing and analysis



A multi-disciplinary and multi-cultural team is a good blending for a successful site, 2018

6.0 SELECTED LIST OF OUR PROJECTS

	Client	Year of Completion	Brief details of works executed	Contract price
1.	Technology Consult	2017	Geotechnical drilling of 6No. boreholes each to 30mbgl for the proposed development of a master plan for Buloba Multi-User Oil Terminal facilities, Mpigi.	29,700,000/=
2.	Capital Shoppers Ltd (Marriott Hotel)	2019	Geotechnical drilling of 12No. boreholes each to 30mbgl for the proposed construction of Marriott Hotel, Nsambya, Ggaba Road.	93,500,000/=
3.	Jinja Resort Hotel	2019	Geotechnical drilling of 7No. boreholes each to 30mbgl for the proposed construction of bungee jumping site.	46,000,000/=
4.	Kakande Ministries	2018	Geotechnical drilling of 8No. boreholes each to 20mbgl for the proposed construction of Church Complex, Kampala.	36,000,000/=
5.	Chongqing International Construction Corporation (CICO)	2018	Geotechnical drilling 6No. boreholes on major bridges and 8 boreholes on swamp crossing for the project of Upgrading of Hoima – Butiaba – Wanseko Road (111km) to Bitumen Standard.	131,800,000/=
6.	China Henan Cooperation Group Co. Ltd (CHICO)	2019	Geotechnical drilling at Kakindo, Kiruruma and Ntungu Dridges along Rukungiri-Ishasha/Kanungu road.	162,215,000/=
7.	Arab Contractors Ltd	2020	Upgrading of Masaka-Bukakata road	126,000,000/=
8.	Kinyara Sugar Works	2020	Geotechnical Engineering for foundation Stability of proposed warehouse sites	65,000,000/=
9.	Tororo Cement Ltd	2022	Expansion of Tororo Cement Production Facilities	28,000,000/=
10.	Ministry of Energy and Mineral Development	2022	Geotechnical investigations of Refined Products Storage Terminal in Buloba	320,000,000/=