

PENETRATION TESTS

The dynamic penetration test is carried out by driving a cone into the soil from ground level. The cone is fixed to hollow rods, which are connected, by length by length, as the cone penetrates into the soil. The driving equipment consists of a striker plate and a free drop hammer, which is lifted by hand.

The light dynamic probe is characterized by a 90° apex angle cone with a base area of 5cm and a hammer weight of 10kg, with a drop height of 0.5m.

The number of blows required for every 10cm penetration of the probe is counted and plotted as a function of the respective penetration depths. However in the analysis table, 300mm interval is used to predict the soil's properties.

The relative density, angle of shearing resistance (ϕ) and approximate allowable bearing capacity (KN/m²) were predicted.

- 13. Miango, Bassu LGA
- 14. Kwaki, Riyom LGA

178.2 KN/sqm @ 1.50m
101.2 KN/sqm @ 1.50m

RESULTS AND RECOMMENDATIONS

	Bearing Capacity
1. Kadyis Pankshin LGA Plateau State	280.0 KN/sqm @ 0.80m
2. Gyangyany, Kanke LGA	164.5 KN/sqm @ 1.40m
3. Ungwan-Hausau-Kanam LGA	67.3 KN/sqm @ 1.90m
4. Bashar, Wase LGA	360.0 KN/sqm @ 0.60m
5. Lohmak, Langtang North	205 KN/sqm @ 1.50m
6. Kuka, Shendam LGA	152.5 KN/sqm @ 1.50m
7. Zomo-Non, Mikang LGA	134.8 KN/sqm @ 1.55m
8. Millet, Mangu LGA	250.0 KN/sqm @ 0.35m
9. Gana-Ropp, Barkin-Ladi	213.5 KN/sqm @ 1.50m
10. LEA Kawang Jos South LGA	228.1 KN/sqm @ 1.50m
11. Maijuju, Jos East	450.0 KN/sqm @ 0.55m
12. Russa Jos North LGA	239.4 KN/sqm @ 1.50m

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Site Location	Test Point	Depth of Penetration in (mm)	No. of blows (N)	Relative Density	Angle of Shearing Resistance (°)	Allowable Approximate Bearing Capacity (KN/sqm)	Recommendation		
Kadys, Pankshin LGA Plateau State	1	000 - 300	48	Dense	35-40	159.8	Recommended BC = 300 KN/m ²		
		301 - 600	100	Very Dense	>45	333.0			
	2	601 - 1000	84	Very Dense	>45	279.7			
		901 - 1100	70	Very Dense	>45	350.0			
		000 - 300	27	Medium	30-35	89.9			
		301 - 500	91	Very Dense	>45	455.0			
					@800mm Average BC =			280.0	
	Gangyang, Kanke LGA - Plateau State	1	000 - 300	35	Dense	35-40		116.6	Recommended BC = 150 KN/m ²
			301 - 600	84	Very Dense	>45		279.7	
		2	601 - 900	21	Medium	35-40		136.5	
901 - 1200			41	Dense	35-40	136.5			
		000 - 300	26	Medium	30-35	86.6			
		301 - 600	41	Dense	35-40	136.5			
		601 - 900	21	Medium	30-35	69.9			
		901 - 1200	23	Medium	30-35	76.6			
				@1400mm Average BC =		164.5			
Ungwan-Hausau-Kanam LGA Plateau State		1	000 - 300	16	Medium	30-35	53.3	Recommended BC = 50 KN/m ²	
	301 - 900		9	Loose	25-30	30.0			
	2	601 - 1200	19	Medium	30-35	63.3			
		901 - 1500	15	Medium	30-35	50.0			
		000 - 300	5	Loose	25-30	16.7			
		301 - 600	50	Dense	35-40	166.5			
		601 - 900	27	Medium	30-35	89.9			
		901 - 1200	15	Medium	30-35	50.0			
					@1900mm Average BC =		67.3		

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Site Location	Test Point	Depth of Penetration in (mm)	No. of blows (N)	Relative Density	Angle of Shearing Resistance (°)	Allowable Approximate Bearing Capacity (KN/sqm)	Recommendation		
Bashir, Wase LGA Plateau State	1	000 - 300	121	Very Dense	>45	402.9	Recommended BC = 300 KN/m ²		
		301 - 500	79	Very Dense	>45	395.0			
	2	000 - 300	37	Dense	35-40	706.0			
		301 - 600	80	Very Dense	>45	336.3			
		601 - 700	53	Very Dense	>45	163.2			
						@600mm Average BC =		360.0	
	Lohmark, Langtang North Plateau State	1	000 - 300	67	Very Dense	40-45		223.1	Recommended BC = 200 KN/m ²
			301 - 600	83	Very Dense	>45		276.4	
		2	601 - 900	33	Dense	35-40		109.9	
			901 - 1200	90	Very Dense	>45		299.7	
		000 - 300	55	Very Dense	40-45	183.0			
		301 - 600	82	Very Dense	>45	273.1			
		601 - 900	46	Dense	35-40	153.2			
		901 - 1200	39	Dense	35-40	99.9			
				@1500mm Average BC =		205.0			
Kuka, Shendam LGA Plateau State		1	000 - 300	30	Medium	30-35	99.9	Recommended BC = 150 KN/m ²	
	301 - 600		16	Medium	30-35	53.3			
	2	601 - 900	59	Very Dense	40-45	196.5			
		901 - 1200	42	Dense	35-40	139.9			
		000 - 300	85	Very Dense	>45	283.1			
		301 - 600	24	Medium	30-35	79.9			
		601 - 900	25	Medium	30-35	83.3			
		901 - 1200	71	Very Dense	40-45	236.4			
					@1500mm Average BC =		152.5		

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Site Location	Test Point	Depth of Penetration in (mm)	No. of blows (N)	Relative Density	Angle of Shearing Resistance (°)	Allowable Approximate Bearing Capacity (KN/sqm)	Recommendation		
Zomo-Nom, Mikang LGA Plateau State	1	000 - 300	31	Medium	30-35	103.2	Recommended BC = 120 KN/m ²		
		301 - 600	47	Dense	35-40	156.5			
		601 - 900	14	Medium	30-35	46.6			
		901 - 1200	13	Medium	30-35	43.3			
		1201 - 1500	28	Medium	30-35	121.2			
		1501 - 1600	17	Medium	30-35	170.0			
		000 - 300	33	Medium	30-35	109.9			
	2	301 - 600	125	Very Dense	>45	416.3			
		601 - 900	21	Medium	30-35	69.9			
		901 - 1200	10	Loose	25-30	33.3			
		1201 - 1500	64	Very Dense	40-45	213.1			
						@1550mm Average BC =		134.8	
						Very Dense		>45	
	Millet, Mingu LGA Plateau State	1	000 - 200	146	Very Dense	>45		730.0	Recommended BC = 250 KN/m ²
			> 200	Refusal	Very Dense	>45		>730.0	
		2	000 - 300	77	Very Dense	40-45		256.4	
			301 - 500	124	Very Dense	>45		620.0	
				@350mm Average BC =	250.0				
				Very Dense	>45				
Gana-Ropp, Barkin-Ladi Plateau State	1	000 - 300	49	Dense	35-40	183.2	Recommended BC = 180 KN/m ²		
		301 - 600	47	Dense	35-40	126.5			
		601 - 900	79	Very Dense	40-45	283.1			
		901 - 1200	61	Very Dense	40-45	203.1			
		1201 - 1500	55	Very Dense	40-45	183.2			
	2	000 - 300	63	Very Dense	40-45	209.8			
		301 - 600	21	Medium	30-35	69.9			
		601 - 900	84	Very Dense	>45	279.7			
		901 - 1200	100	Very Dense	>45	333.0			
		1201 - 1500	82	Very Dense	>45	273.1			
				@1500mm Average BC =	213.5				

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Site Location	Test Point	Depth of Penetration in (mm)	No. of blows (N)	Relative Density	Angle of Shearing Resistance (°)	Allowable Approximate Bearing Capacity (KN/sqm)	Recommendation		
Kwang Plateau State	1	000 - 300	87	Very Dense	>45	289.7	Recommended BC = 200 KN/m ²		
		301 - 600	79	Very Dense	>45	263.1			
		601 - 1000	80	Very Dense	>45	266.4			
		901 - 1200	72	Very Dense	40-45	239.8			
		1201 - 1500	76	Very Dense	40-45	253.1			
		000 - 300	45	Dense	35-40	149.9			
		301 - 600	65	Very Dense	40-45	216.5			
	2	601 - 900	83	Very Dense	>45	276.4			
		901 - 1200	59	Very Dense	40-45	196.5			
		1201 - 1500	39	Dense	35-40	129.9			
						@1500mm Average BC =		228.1	
						Very Dense		>45	
						Very Dense		>45	
	Maijnu, Jos East Plateau State	1	000 - 300	132	Very Dense	>45		440.0	Recommended BC = 300 KN/m ²
			301 - 600	155	Very Dense	>45		516.0	
		2	000 - 200	28	Medium	30-35		93.2	
			301 - 500	151	Very Dense	>45		755.0	
				@550mm Average BC >	450.0				
				Very Dense	>45				
1			000 - 300	98	Very Dense	>45	326.3	Recommended BC = 120 KN/m ²	
			301 - 600	52	Very Dense	40-45	173.2		
			601 - 900	76	Very Dense	40-45	253.1		
			901 - 1200	103	Very Dense	>45	343.0		
	1201 - 1500	126	Very Dense	>45	419.6				
2	000 - 300	89	Very Dense	>45	296.4				
	301 - 600	64	Very Dense	40-45	213.1				
	601 - 900	35	Dense	35-40	116.6				
	901 - 1200	39	Dense	35-40	129.9				
	1201 - 1500	37	Dense	35-40	123.2				
					@1500mm Average BC =	239.4			
					Very Dense	>45			
Miango, Bassu LGA Plateau State	1	000 - 300	80	Very Dense	>45	266.4	Recommended BC = 150 KN/m ²		
		301 - 600	32	Dense	35-40	106.6			
		601 - 900	36	Dense	35-40	119.9			
		901 - 1200	39	Dense	35-40	129.9			
		1201 - 1500	37	Dense	35-40	133.2			
	2	000 - 300	105	Very Dense	>45	349.7			
		301 - 600	37	Dense	35-40	123.2			
		601 - 900	41	Dense	35-40	136.5			
		901 - 1200	52	Dense	40-45	173.2			
		1201 - 1500	76	Very Dense	40-45	253.1			
				@1500mm Average BC =	178.2				

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Site Location	Test Point	Depth of Penetration in (mm)	No. of blows (N)	Relative Density	Angle of Shearing Resistance (°)	Allowable Approximate Bearing Capacity (KN/sqm)	Recommended		
Kwaki, Riyom LGA Plateau State	1	000 - 300	52	Dense	35-40	173.2	Recommended BC = 80 KN/m ²		
		301 - 600	23	Medium	30-35	76.6			
		601 - 900	17	Medium	30-35	58.6			
		901 - 1200	20	Medium	30-35	66.6			
		1201 - 1500	23	Medium	30-35	76.6			
		000 - 300	82	Very Dense	>45	273.1			
	2	301 - 600	28	Medium	30-35	93.2			
		601 - 900	16	Medium	30-35	53.3			
		901 - 1200	15	Medium	30-35	50.0			
		1201 - 1500	28	Medium	30-35	93.2			
	@1500mm Average BC =							101.2	

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PROJECT - **BASIC DESIGN STUDY ON THE
PROJECT FOR CONSTRUCTION OF
ADDITIONAL CLASSROOMS FOR
PRIMARY SCHOOLS IN THE
FEDERAL REPUBLIC OF NIGERIA**

MAIN HEADING

A geotechnical investigation was requested for; Tamovic Nigeria Limited was invited to carry it out.

The investigation involved thirty four dynamic Cone Penetration tests, otherwise referred to as the Sounding - test. The tests were carried out between 20th - 25th of November 2003.

Civil engineering structures stand on the soil and to a reasonable depth such transmission of load causes the soil to settle. This settlement must however be within a permissible limit so as not to cause any adverse effect to the structure.

The investigation was conducted in accordance with DIN 4094 (Deutsche Standard) and the international organization for standardization (ISO).

The depths and results referred to in this report are below the natural ground surface in millimeter and to an average depth of 1.50 meter as requested.

IN

SITE LOCATION.

The investigation covers seventeen locations in the local government areas of Kaduna State. Two test points were conducted in each of the site. The site of investigation were some of the existing primary schools under the Local Government Education Authority.

KADUNA STATE

BY

PURPOSE OF INVESTIGATION.

To determine the sub-soil conditions of the sites to suitable depths, which could have an influence on the proposal development.

- (ii) To evaluate through the field properties of the soil and the effects it could have on the structural/geotechnical design.
- (iii) To identify and recommend the suitability of the soil being investigated from the result of the geotechnical data required for economic, safe and stable design

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PENETRATION TESTS

The dynamic penetration test is carried out by driving a cone into the soil from ground level. The cone is fixed to hollow rods, which are connected, by length by length, as the cone penetrates into the soil. The driving equipment consists of a striker plate and a free drop hammer, which is lifted by hand.

The light dynamic probe is characterized by a 900 apex angle cone with a base area of 5cm and a hammer weight of 10kg, with a drop height of 0.5m.

The number of blows required for every 10cm penetration of the probe is counted and plotted as a function of the respective penetration depths. However in the analysis table, 300mm interval is used to predict the soil's properties.

The relative density, angle of shearing resistance (ϕ) and approximate allowable bearing capacity (KN/m²) were predicted.

RESULTS AND RECOMMENDATIONS

	Bearing Capacity
1. Faki Road Primary School Kaduna	144.3 KN/sqm @ 1.5m
2. Zango Aya Primary School Igbadi Zaria Rd 2.05m	115.0 KN/sqm @
3. Sabon Yelwa Local Government Area 1.95m	140.5 KN/sqm @
4. Sabo Central Kaduna 1.75m	293.1 KN/sqm @
5. Kaya1 Giwa Loc. Govt. Area Kaduna	85.8 KN/sqm @ 2.00m
6. Likoro Local Government Area Kaduna 2.00m	128.6 KN/sqm @
7. Gaskiya Local Govt. Area Zaria 0.50m	253.1 KN/sqm @
8. Saada Primary Sch. Makarfi LGA 1.05m	181.8 KN/sqm @
9. Gangarida Ikara LGA 1.75m	157.9 KN/sqm @

10. Dawakin Bassa LGA 1.80m	151.0 KN/sqm @
11. Zunkwa LGA Zagon Katak 0.50m	300.0 KN/sqm @
12. Zambina Kaura LGA	76.7 KN/sqm @ 2.00m
13. Maigamo Lere LGA	97.5 KN/sqm @ 1.80m
14. Kushe Kagargo LGA 1.50m	111.2 KN/sqm @
15. Asso Jemma LGA 1.75m	106.6 KN/sqm @
16. Sabon Gida Kaura LGA 1.50m	129.6 KN/sqm @
17. Murchia Sabon Gari LGA	66.6 KN/sqm @ 1.50m

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Site Location	Test Point	Depth of Penetration in (mm)	No. of blows (N)	Relative Density	Angle of Shearing Resistance (°)	Allowable Approximate Bearing Capacity (KN/sqm)	Recommended		
Fakt Road - Primary School Kaduna	1	000 - 300	9	Loose	25-30	30.0	Recommended BC = 90 KN/m ²		
		301 - 600	21	Medium	30-35	69.9			
		601 - 1000	300	Very Dense	>45	750.0			
	2	000 - 300	10	Loose	25-30	33.3			
		301 - 600	4	Loose	25-30	13.3			
		601 - 900	10	Loose	25-30	33.3			
	2	901 - 1200	29	Medium	30-35	96.6			
		1201 - 1500	28	Medium	30-35	93.2			
		1501 - 1800	46	Dense	35-40	153.2			
		1801 - 2000	34	Dense	35-40	170.0			
	@1500mm Average BC =							144.3	
	Zango-Aya - Primary School Igbadi Zaria Road - Kaduna	1	000 - 300	22	Medium	30-35		73.3	Recommended BC = 130 KN/m ²
			301 - 600	10	Loose	25-30		33.3	
			601 - 1000	28	Medium	30-35		93.2	
2		901 - 1200	28	Medium	30-35	93.2			
		1201 - 1500	39	Dense	35-40	129.9			
		1501 - 1800	49	Dense	35-40	163.2			
2		1801 - 2000	31	Dense	35-40	155.0			
		000 - 300	37	Dense	35-40	123.2			
		301 - 600	33	Dense	35-40	109.9			
		601 - 900	27	Medium	30-35	89.9			
2		901 - 1200	35	Medium	30-35	116.6			
		1201 - 1500	51	Dense	35-40	169.8			
		1501 - 1800	42	Dense	35-40	139.9			
		1801 - 2100	36	Dense	35-40	119.9			
@2050mm Average BC =						115.0			
Sabon-Yewa - Local Government Area	1	000 - 300	32	Dense	35-40	106.6	Recommended BC = 180 KN/m ²		
		301 - 600	11	Medium	30-35	36.6			
		601 - 1000	22	Medium	30-35	73.3			
	2	901 - 1200	49	Dense	35-40	163.2			
		1201 - 1500	84	Very Dense	>45	313.0			
		1501 - 1900	83	Very Dense	>45	207.5			
	2	000 - 300	63	Very Dense	40-45	209.8			
		301 - 600	16	Medium	30-35	53.3			
		601 - 900	11	Medium	30-35	36.6			
		901 - 1200	59	Very Dense	40-45	196.5			
	2	1201 - 1500	57	Very Dense	40-45	189.8			
		1501 - 1800	38	Dense	35-40	129.9			
		1801 - 2000	22	Dense	35-40	110.0			
		@1950mm Average BC =						140.5	

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Site Location	Test Point	Depth of Penetration in (mm)	No. of blows (N)	Relative Density	Angle of Shearing Resistance (°)	Allowable Approximate Bearing Capacity (KN/sqm)	Recommended			
Sabon Central Kaduna	1	000 - 300	78	Very Dense	40-45	259.7	Recommended BC = 300 KN/m ²			
		301 - 600	29	Medium	30-35	96.6				
		601 - 1000	85	Very Dense	>45	283.1				
	2	1201 - 1500	76	Very Dense	40-45	253.1				
		1501 - 1800	85	Very Dense	>45	323.0				
		1801 - 2000	32	Dense	35-40	283.1				
	2	000 - 300	212	Very Dense	>45	706.0				
		301 - 600	101	Very Dense	>45	336.3				
		601 - 900	49	Dense	35-40	163.2				
		901 - 1200	41	Dense	35-40	136.5				
	2	1201 - 1500	155	Very Dense	>45	516.2				
		@1750mm Average BC =						293.1		
		Kaya 1, Giwa Local Government Area - Kaduna	1	000 - 300	72	Very Dense		40-45	239.8	Recommended BC = 70 KN/m ²
				301 - 600	24	Medium		30-35	79.9	
601 - 1000	17			Medium	30-35	56.6				
2	901 - 1200		12	Medium	30-35	40.0				
	1201 - 1500		22	Medium	30-35	73.3				
	1501 - 1800		15	Medium	30-35	50.0				
2	1801 - 2000		14	Medium	30-35	70.0				
	000 - 300		70	Very Dense	40-45	233.1				
	301 - 600		14	Medium	30-35	46.6				
	601 - 900		12	Medium	30-35	40.0				
2	901 - 1200		16	Medium	30-35	53.3				
	1201 - 1500		21	Medium	30-35	69.9				
	1501 - 1800		16	Medium	30-35	53.3				
	1801 - 2000		19	Medium	30-35	95.0				
@2000mm Average BC =						85.8				
Likoro Local Government Area - Kaduna	1	000 - 300	37	Dense	35-40	123.2	Recommended BC = 100 KN/m ²			
		301 - 600	73	Very Dense	40-45	243.1				
		601 - 1000	41	Dense	35-40	136.5				
	2	901 - 1200	26	Medium	30-35	86.6				
		1201 - 1500	31	Dense	35-40	103.2				
		1501 - 1800	36	Dense	35-40	119.9				
	2	1801 - 2000	25	Dense	35-40	125.0				
		000 - 300	57	Very Dense	40-45	189.8				
		301 - 600	40	Dense	35-40	133.2				
		601 - 900	26	Medium	30-35	86.6				
	2	901 - 1200	32	Dense	35-40	106.6				
		1201 - 1500	43	Dense	35-40	143.2				
		1501 - 1800	37	Dense	35-40	123.2				
		1801 - 2000	16	Medium	30-35	80.0				
@2000mm Average BC =						128.6				