

## 資料－12 自然条件調査結果

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

**CONTRACT -**  
**C. P. T. INVESTIGATION**

**IN**

**NIGER STATE**

**CONDUCTED**

**BY**

**TAMOVIC NIGERIA LTD**

**MAIN HEADING**

A Geotechnical investigation was requested for, Tamovic Nigeria Limited was invited to carry it out.

The investigation involved thirty dynamic Cone Penetration tests, otherwise referred to as the Sounding - test. The tests were carried out between 3<sup>rd</sup> of December 2003 and 7<sup>th</sup> of December 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.

**SITE LOCATION.**

The investigation covers seventeen locations in the local government areas of Niger 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.

**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

## Formulas

### 1. Bearing Capacity

$$BC = \left\{ \frac{H(m) \times W(KN)}{D(m) \times A(sqm)} \right\} \times N$$

Where:

Units

BC	=	Bearing Capacity	( KN/sqm )
H	=	Height of Falling	( m )
W	=	Weight of Hammer	( KN )
D	=	Depth of Penetration	( m )
A	=	Base Area of Cone	( sqm )
N	=	No of Blows	

### 2. Relative Density & Angle of Shearing Resistance:

According to DIN 4094 (Deutsche Standard) and the international organisation for standardisation (ISO) charts

## 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 ( $\phi$ ) and approximate allowable bearing capacity (KN/m<sup>2</sup>) were predicted.

## RESULTS AND RECOMMENDATIONS

	Bearing Capacity
1. Barkin Sale Niger State	142.9 KN/sqm @ 1.50m
2. Sarkin-pawa	97.2 KN/sqm @ 1.50m
3. Rafin-Kuka	77.4 KN/sqm @ 1.55m
4. Ibrahim Tako – Bida LGA	119.6 KN/sqm @ 1.50m
5. Sangl Edati	105.6 KN/sqm @ 1.50m
6. Gbara – Mokwa LGA	86.3 KN/sqm @ 1.50m
7. Makafu Gbako Niger State	206.5 KN/sqm @ 1.50m
8. Eisu Nuhu - Agale LGA	66.6 KN/sqm @ 1.50m
9. Karaya Nom Rafi	182.7 KN/sqm @ 1.05m
10. Bengi Central Area Mairiga Niger State	94.3 KN/sqm @ 1.50m
11. Rafin Karma - Kotangora	85.6 KN/sqm @ 1.50m
12. Salika Magama Niger State	111.9 KN/sqm @ 1.50m

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- 13. Rijau – Rafin Mota  
220.5 KN/sqm @ 1.15m
- 14. Korokpa - Paikolo  
123.9 KN/sqm @ 1.50m
- 15. Bakin Iku – Suleja LGA  
134.5 KN/sqm @ 1.15m

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
Barkin Sale, Minna LGA, Niger State	1	000 - 300	20	Medium	30-35	66.6	Recommended BC = 80 KN/m <sup>2</sup>
		301 - 600	38	Dense	35-40	126.5	
		601 - 900	52	Dense	35-40	173.2	
		901 - 1200	37	Dense	35-40	123.2	
		1201 - 1500	25	Medium	30-35	83.3	
	2	000 - 300	44	Dense	35-40	146.5	
		301 - 600	58	Very Dense	40-45	193.1	
		601 - 900	72	Very Dense	40-45	239.8	
		901 - 1200	58	Very Dense	40-45	193.1	
		1201 - 1500	25	Medium	30-35	83.3	
@1500mm Average BC = 142.9							
Sarkin-Pawa, Murya LGA, Niger State	1	000 - 300	30	Medium	30-35	99.9	Recommended BC = 70 KN/m <sup>2</sup>
		301 - 600	31	Medium	30-35	103.2	
		601 - 900	30	Medium	30-35	99.9	
		901 - 1200	21	Medium	30-35	69.9	
		1201 - 1500	19	Medium	30-35	63.3	
	2	000 - 300	43	Dense	35-40	143.2	
		301 - 600	40	Dense	35-40	133.2	
		601 - 900	27	Medium	30-35	89.9	
		901 - 1200	21	Medium	30-35	69.9	
		1201 - 1500	30	Medium	30-35	99.9	
@1500mm Average BC = 97.2							
Rafin-Kuka, Shiroo LGA, Niger State	1	000 - 300	33	Dense	35-40	129.9	Recommended BC = 80 KN/m <sup>2</sup>
		301 - 600	23	Medium	30-35	76.6	
		601 - 900	20	Medium	30-35	66.6	
		901 - 1200	22	Medium	30-35	73.3	
		1201 - 1600	39	Dense	35-40	97.5	
	2	000 - 300	15	Medium	30-35	50.0	
		301 - 600	17	Medium	30-35	56.6	
		601 - 900	18	Medium	30-35	59.9	
		901 - 1200	14	Medium	30-35	46.6	
		1201 - 1500	35	Dense	35-40	116.6	
@1550mm Average BC = 77.4							

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Site Location	Test Point	Depth of Penetration in (mm)	No. of blows (N)	Relative Density	Angle of Shearing Resistance (o)	Allowable Approximate Bearing Capacity (KN/sqm)	Recommendation		
Ibrahim Tanko, Mokwa LGA, Niger State	1	000 - 300	8	Loose	25-30	26.6	Recommended BC = >60 KN/m <sup>2</sup>		
		301 - 600	10	Loose	25-30	33.3			
		601 - 900	10	Loose	25-30	33.3			
		901 - 1200	15	Medium	30-35	50.0			
	1201 - 1500	18	Medium	30-35	59.9				
	2	000 - 300	33	Dense	35-40	109.9			
		301 - 600	49	Dense	35-40	163.2			
		601 - 900	73	Very Dense	40-45	243.1			
		901 - 1200	72	Very Dense	40-45	239.8			
	1201 - 1500	71	Very Dense	40-45	236.4				
	@1500mm Average BC =							119.6	
	Sangli, Edeati LGA Niger State	1	000 - 300	36	Dense	35-40		119.9	Recommended BC = 100 KN/m <sup>2</sup>
			301 - 600	24	Medium	30-35		79.9	
			601 - 900	27	Medium	30-35		89.9	
901 - 1200			42	Dense	35-40	138.6			
1201 - 1500		39	Dense	35-40	129.9				
2		000 - 300	24	Medium	30-35	79.9			
		301 - 600	23	Medium	30-35	76.6			
		601 - 900	39	Dense	35-40	129.9			
		901 - 1200	33	Dense	35-40	109.9			
1201 - 1500		28	Medium	30-35	93.2				
@1500mm Average BC =						105.6			
Gbara, Mokwa, Niger State	1	000 - 300	18	Medium	30-35	59.9	Recommended BC = 80 KN/m <sup>2</sup>		
		301 - 600	18	Medium	30-35	59.9			
		601 - 900	25	Medium	30-35	83.3			
		901 - 1200	33	Dense	35-40	109.9			
	1201 - 1500	36	Dense	35-40	119.9				
	2	000 - 300	43	Dense	35-40	143.2			
		301 - 600	22	Medium	30-35	73.3			
		601 - 900	12	Medium	30-35	40.0			
		901 - 1200	14	Medium	30-35	46.6			
	1201 - 1500	38	Dense	35-40	126.5				
@1500mm Average BC =						86.3			

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Site Location	Test Point	Depth of Penetration in (mm)	No. of blows (N)	Relative Density	Angle of Shearing Resistance (o)	Allowable Approximate Bearing Capacity (KN/sqm)	Recommendation		
Makatu, Chako LGA, Niger State	1	000 - 300	36	Dense	35-40	119.9	Recommended BC = 180 KN/m <sup>2</sup>		
		301 - 600	56	Very Dense	40-45	186.5			
		601 - 900	49	Dense	35-40	163.2			
		901 - 1200	55	Very Dense	40-45	183.2			
	1201 - 1500	62	Very Dense	40-45	206.5				
	2	000 - 300	71	Very Dense	40-45	236.4			
		301 - 600	71	Very Dense	40-45	236.4			
		601 - 900	64	Very Dense	40-45	213.1			
		901 - 1200	84	Very Dense	>45	279.7			
	1201 - 1500	72	Very Dense	40-45	239.8				
	@1500mm Average BC =							206.5	
	Etsu Nuhu, Agarie LGA, Niger State	1	000 - 200	14	Medium	30-35		46.6	Recommended BC = <60 KN/m <sup>2</sup>
			301 - 600	11	Medium	30-35		35.6	
			601 - 900	8	Loose	25-30		26.6	
901 - 1200			9	Loose	25-30	30.0			
1201 - 1500		9	Loose	25-30	30.0				
2		000 - 300	57	Very Dense	40-45	189.8			
		301 - 600	26	Medium	30-35	86.6			
		601 - 900	17	Medium	30-35	56.6			
		901 - 1200	19	Medium	30-35	63.3			
1201 - 1500		30	Medium	30-35	99.9				
@1500mm Average BC =						66.6			
Karaya Nom, Rafi LGA, Niger State	1	000 - 300	37	Dense	35-40	123.2	Recommended BC = 180 KN/m <sup>2</sup>		
		301 - 600	110	Very Dense	>45	366.3			
		601 - 900	27	Medium	30-35	89.9			
		901 - 1200	33	Dense	35-40	109.9			
	1201 - 1500	44	Dense	35-40	146.5				
	2	000 - 300	69	Very Dense	40-45	229.8			
		301 - 600	64	Very Dense	40-45	213.1			
		601 - 900	64	Very Dense	40-45	213.1			
		901 - 1200	64	Very Dense	40-45	213.1			
	1201 - 1500	64	Very Dense	40-45	213.1				
@1050mm Average BC =						182.7			

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Site Location	Test Point	Depth of Penetration in (mm)	No. of blows (N)	Relative Density	Angle of Shearing Resistance (o)	Allowable Approximate Bearing Capacity (KN/sqm)	Recommendation
Bangli Central, Mannga LGA, Niger State	1	000 - 300	29	Medium	30-35	96.6	Recommended BC = 90 KN/m <sup>2</sup>
		301 - 600	17	Medium	30-35	56.6	
		601 - 900	20	Medium	30-35	66.6	
		901 - 1200	25	Medium	30-35	83.3	
		1201 - 1500	33	Dense	35-40	106.9	
	2	000 - 300	42	Dense	35-40	139.9	Recommended BC = 90 KN/m <sup>2</sup>
		301 - 600	16	Medium	30-35	53.3	
		601 - 900	12	Medium	30-35	40.0	
		901 - 1200	18	Medium	30-35	59.9	
		1201 - 1500	71	Very Dense	40-45	236.4	
@1500mm Average BC = 94.3							
Rafin Karma, Kolangora LGA, Niger State	1	000 - 300	26	Medium	30-35	86.6	Recommended BC = >60 KN/m <sup>2</sup>
		301 - 600	56	Dense	40-45	186.5	
		601 - 900	54	Dense	40-45	179.8	
		901 - 1200	46	Dense	35-40	153.2	
		1201 - 1500	32	Dense	35-40	106.6	
	2	000 - 200	17	Medium	30-35	56.6	Recommended BC = >60 KN/m <sup>2</sup>
		301 - 600	26	Medium	30-35	86.6	
		601 - 900	39	Dense	35-40	129.9	
		901 - 1200	19	Medium	30-35	63.3	
		1201 - 1500	17	Medium	30-35	56.6	
@1500mm Average BC > 85.6							
Sarka Central, Magama LGA, Niger State	1	000 - 300	39	Dense	35-40	129.9	Recommended BC = 100 KN/m <sup>2</sup>
		301 - 600	17	Medium	30-35	56.6	
		601 - 900	21	Medium	30-35	69.9	
		901 - 1200	29	Medium	30-35	96.6	
		1201 - 1500	33	Dense	35-40	109.9	
	2	000 - 300	47	Dense	35-40	156.5	Recommended BC = 100 KN/m <sup>2</sup>
		301 - 600	23	Medium	30-35	76.6	
		601 - 900	35	Dense	35-40	116.6	
		901 - 1200	42	Dense	35-40	139.9	
		1201 - 1500	50	Dense	35-40	166.5	
@1500mm Average BC = 111.9							
Mota, Rijau LGA, Niger State	1	000 - 300	48	Dense	35-40	159.8	Recommended BC = 100 KN/m <sup>2</sup>
		301 - 600	79	Very Dense	>45	263.1	
		601 - 900	115	Very Dense	>45	575.0	
	2	000 - 300	73	Very Dense	40-45	243.1	
		301 - 600	59	Very Dense	40-45	196.5	
		601 - 900	39	Dense	35-40	129.9	
	901 - 1200	32	Dense	35-40	106.6		

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Site Location	Test Point	Depth of Penetration in (mm)	No. of blows (N)	Relative Density	Angle of Shearing Resistance (o)	Allowable Approximate Bearing Capacity (KN/sqm)	Recommendation
Rafin		1201 - 1500	27	Medium	30-35	89.9	Rect
						220.5	
@1150mm Average BC =							

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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		
Korokpa, Paikolo LGA, Niger State	1	000 - 300	28	Medium	30-35	93.2	Recommended BC = 80 KN/m <sup>2</sup>		
		301 - 600	84	Very Dense	>45	279.7			
		601 - 900	65	Very Dense	40-45	216.5			
		901 - 1200	22	Medium	30-35	73.3			
	2	1201 - 1500	19	Medium	30-35	63.3			
		000 - 300	16	Medium	30-35	53.3			
		301 - 600	60	Very Dense	40-45	199.8			
		601 - 900	23	Medium	30-35	76.6			
	Korokpa, Paikolo LGA, Niger State	2	901 - 1200	24	Medium	30-35		79.9	
			1201 - 1500	31	Dense	35-40		103.2	
						@1500mm Average BC =		123.9	
	Bikin Iku, Suleja LGA, Niger State	1	000 - 300	25	Medium	30-35		83.3	Recommended BC = 120 KN/m <sup>2</sup>
			301 - 600	20	Medium	30-35		66.6	
601 - 800			66	Very Dense	40-45	330.0			
000 - 300			33	Dense	35-40	109.9			
2		301 - 600	16	Medium	30-35	53.3			
		601 - 900	25	Medium	30-35	83.3			
		901 - 1200	43	Dense	35-40	143.2			
		1201 - 1500	62	Very Dense	40-45	206.5			
			@1150mm Average BC =	134.5					

**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 twenty eight dynamic Cone Penetration tests, otherwise referred to as the Sounding - test. The tests were carried out between 28<sup>th</sup> of November 2003 and 01<sup>st</sup> of December 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.

**CONTRACT - C. P. T. INVESTIGATION**

**IN**

**PLATEAU STATE**

**SITE LOCATION.**

The investigation covers seventeen locations in the local government areas of Plateau 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.

**CONDUCTED**

**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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