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Research Article

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Comparative Strength Properties of Various Termite Mound Bricks used for Building Construction (A Case Study of Plateau State)

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Abstract This research investigates and compares the strength properties of termite's mounds for building construction. Samples of mound hills were collected from the different geo-political regions of Plateau state. Field test (smell/washing/toughness test), moisture content test, particle size distribution test was carried out on mound soil samples. Also, the following tests were done on the compressed bricks, compressive strength test, water absorption test, abrasion test. The results of the test showed that termite mound soils from the northern zone do not contain organic matters while samples in the central and southern regions contain organic matter. For particle size distribution, 83% particles of the northern zone are within the silty sand region, samples from central 88% are within the silty sand region, and sample from the southern region, 83% are within the silty sand region. For moisture content determination, 36.2% of moisture was found from the northern sample, while an average of 40% from the central and 33% from the southern region. Compressive strength test at 7days was 2.7N/mm^2 for the northern sample, 2.5N/mm^2 from the central and 3.1N/mm^2 from the southern sample. At 21days, the northern sample showed no strength while the central sample showed strength of 1N/mm^2 and the southern sample showed 3.4N/mm^2. For water absorption, all the samples showed remarkable swelling and dissolution in water at 24hours. The bricks are prone to abrasion. Recommendation such as stabilizing the soil of the termite mound material by affecting the soil texture was made. Also the bricks should be protected from direct contact with water.

Keywords organic matter, soil stabilisers, termite mound modified soils

1. Introduction

In recent times, the interest of researchers, institutions and government bodies have been shifting to the **Termite Mound** technology due to activities of the termites on the soil, thereby increasing the stability of the soil. Termites are social insects of the order isopteran with about 3,000 known species, of which 75% are classified as soil feeding termites. The diets of soil-feeding termites consist of no-cellular organic material mixed with clay minerals. Their guts are formed by five compartments that present rising gradients of pH, up to 12.5 and different status of oxygen and hydrogen [1-4] in scientia Agricola (2006). These characteristic are certainly important and may effectively contribute to mound soil chemical and physical characteristics. Olaoye and Anigbogu [5] revealed in their work that the dry and wet compressive strength of the compressed earth brick (C.E.B) stabilized with termite modified soil were at maximum when the bricks where within the limit recommended by building regulation for construction of bungalow and low rise buildings. According to Olaoye and Anigbogu [5], the small mounds are only 30cm or so in height and are built by the cubiter mean species that feed under the cover of recent leaf falls while the larger mounds (less frequent) are built by wood feeders and foreign termites such as macrotermean species. This study examines those variations and their effects on the strength properties of the mounds, as obtained from the three (3) geo-political zones of Plateau State.

2. Aim and Objectives

The aim of this investigation is to compare the strength properties of termite mound bricks used for building construction by:

(i) Investigating the physical and chemical properties of the termite mound hills obtained
(ii) Establishing the strength (comprehensive, abrasion, water resistance) properties of the mounds obtained.
(iii) Comparing the relationship between the termite mounds obtained in the three (3) geopolitical region of Plateau State.

3. Methodology

The methodology adopted comprised of series of laboratory test on the termite mound material. The compressive strength, water absorption and abrasion test is also performed on the bricks produced. The result obtained was analyzed through empirical means and conclusion drawn on the suitability of the various termite mound materials used. The test carried out on the termite mound material included:

(i) Field test; Smell/Washing/Toughness
(ii) Particle size distribution
(iii) Moisture content test

Seven (7) different Local Government Areas (LGA's) in Plateau State, covering the three (3) zones of the State were selected:

(i) Northern zone comprising; Jos South L.G.A.
(ii) Central zone comprising; Bokkos, Kanam and Pankshin LGA.
(iii) The southern zone comprising Langtang South, Qua'anpan and Wase LGA

4. Result and Discussion

4.1. Field test; Smell/Washing/Toughness test

4.1.1. Jos-South Sample

Soil is very difficult to wash off; therefore, it has high silt content. Hence soil is clayey silt

4.1.2. Bokkos Sample

Soil is difficult to wash off; therefore, it has high silt content. Hence soil is clayey silt.

4.1.3. Kanam Sample

Soil gave a musty smell, sticky and difficult to wash, therefore soil is silty. Hence Soil is silty loam.

4.1.4. Pankshin sample

Soil is sticky and difficult to wash; therefore, soil has a high silty content. Hence Soil is clayey silt.

4.1.5. Langtang South Sample

Soil is sticky and difficult to wash; therefore, soil has high silt content. Hence soil is clayey silt.

4.1.6. Qua'anpan Sample

Soil is sticky and difficult to wash. It smells a little musty; therefore, soil has high silt content. Hence soil is loamy silt.

4.1.7. Wase Sample

Soil is sticky and difficult to wash. It smells a little musty, therefore soil has silt content. Hence soil is loamy silt.

4.2. Particle Size Distribution

Table 1: Jos South Sample

B.S Sieves	WT Retained (g)	% On Sieve	% Retained	% Passing
3.35mm	19	1.95	1.95	98.05
2.0mm	92.8	9.28	11.23	88.77
1.70mm	147.5	14.75	25.98	74.02
1.18mm	210	21.02	47.0	53.0
600um	114.2	11.42	58.42	41.58
425um	88.8	8.88	67.3	32.7

300um	67.5	6.75	74.05	25.95
212um	58.2	5.82	79.87	20.13
150um	42.2	4.22	84.09	15.91
75um	99.5	9.95	94.04	5.96
Pan	59.6	5.95	100.0	0

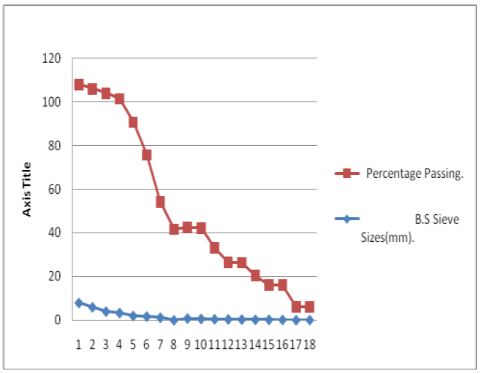

Figure 1: Gradient Curve for Jos South

4.2.1. Soil Classification for Jos South Sample

(i) (Since over 80% of this soil is coarser than No. 200 sieve or 0.2mm therefore this sample is a coarse grained soil.

(ii) Since over 80% of coarse fraction is finer than No 4 sieve or 6mm soil is sandy soil

(iii) $C_u = D_{60}/D_{10} = 7.8 > 4$ and $C_c = (D_{30})^2 / D_{10} x D_{60} = (0.4)^2 / 0.11 x 0.86 = 1.7$ which is between 1 and 3. Therefore Soil is well graded sand

(iv) Since the percentage finer than no 200 sieve is over 15% greater than 12. Therefore, soil is clayey or silty sand. And since over 15% is silty, hence soil is **Silty Sand** and not well graded sand.

Table 2: Bokkos Sample

B.S Sieves	WT Retained (g)	% On Sieve	% Retained	% Passing
3.35mm	16.9	1.69	1.69	98.31
2.0mm	32.2	3.32	5.01	94.99
1.70mm	42.6	4.26	9.27	90.73
1.18mm	86.6	8.66	17.93	82.07
600um	226.6	22.66	40.59	59.41
425um	143.9	14.39	54.98	45.02
300um	130.6	13.06	68.04	31.96
212um	101.2	10.12	78.16	21.84
150um	59.9	5.99	84.15	15.85
75um	115.9	11.59	95.74	4.26
Pan	42.6	4.26	100.0	0

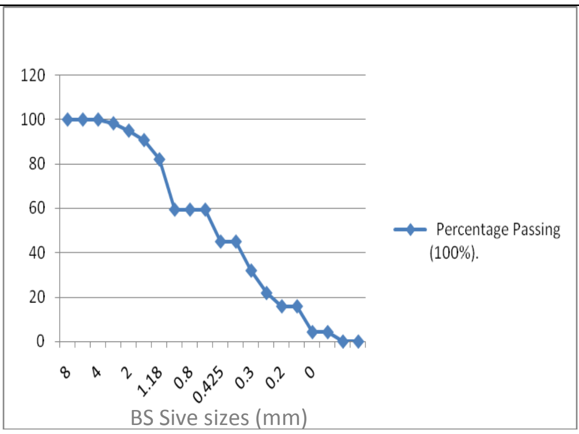

Figure 2: Gradient curve for Bokkos sample

4.2.2. Soil Classification for Bokkos sample

(i) Since over 80% of this soil is coarser than no. 200 sieve or 0.20mm, therefore this sample is a coarse grained soil

(ii) Since over 80% of coarse fraction is finer than no. 4 sieve or 6mm, soil is sandy soil

(iii) $C_u = D_{60}/D_{10} = 0.64 / 0.06 = 10.66 > 4$ and $C_c = (D_{30})^2/ D_{10}x\ D_{60} = (0.26)^2 / 0.06 \times 0.86 = 1.7$ which is between 1 and 3. Therefore Soil is well graded sand

(iv) Since the percentage finer than no. 200 sieve is over 15.00% greater than 12. Therefore, soil is clayey or silty sand. And since over 15% not finer than 0.075mm, soil is **Silty Sand** and not well graded sand.

Table 3: Kanam Sample

B.S Sieves	WT Retained (g)	% On Sieve	% Retained	% Passing
3.35mm	19	1.90	1.90	98.10
2.0mm	129	12.90	14.80	85.20
1.70mm	33	3.30	18.10	81.90
1.18mm	158	15.80	33.90	66.10
600um	277	27.70	61.60	38.40
425um	126	12.60	74.20	25.80
300um	83	8.30	82.50	17.50
212um	66	6.60	89.10	10.90
150um	37	3.70	92.80	7.20
75um	563g	5.30	98.10	1.90
Pan	19g	1.90	100.0	0

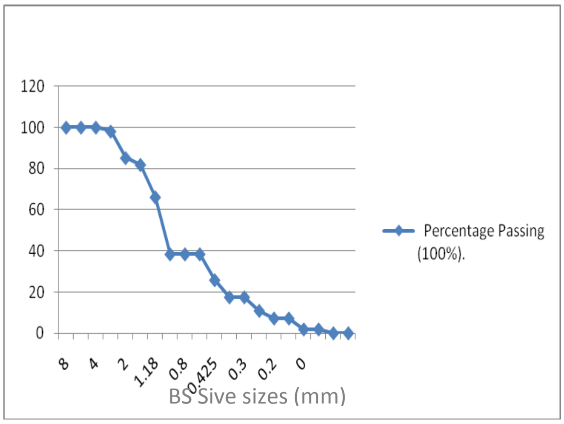

Figure 3: Gradient curve for Kanam sample

4.2.3. Soil Classification for Kanam sample

(i) Since over 90% of this soil is coarser than no. 200 sieve or 0.20mm, therefore this sample is a coarse grained soil

(ii) Since over 90% of coarse fraction is finer than no. 4 sieve or 6mm, soil is sandy soil

(iii) $C_u = D_{60}/D_{10} = 0.2 / 0.019 = 10.5 > 4$ and $C_c = (D_{30})^2/ D_{10}x\ D_{60} = (0.51)^2 / 0.019 \times 0.2 = 65$ which is not between 1 and 3. Therefore Soil is not well graded sand

(iv) Since the percentage finer than no. 200 sieve is over 13.00% greater than 12. Therefore, soil is clayey or silty sand. And since over 13% is coarser than sieve 75µm, soil is **Silty Sand**.

Table 4: Pankshin Sample

B.S Sieves	WT Retained (g)	% On Sieve	% Retained	% Passing
3.35mm	13	1.33	1.33	98.67
2.0mm	67	6.67	8.0	92.0
1.70mm	68	6.80	14.8	85.2
1.18mm	133	13.33	28.13	71.87
600um	229	22.93	51.06	48.94
425um	136	13.60	64.66	33.34

300um	95	9.47	74.13	25.87
212um	80	8.00	82.13	17.87
150um	45	4.53	86.66	13.34
75um	107	10.67	97.33	2.67
Pan	27	2.67	100.0	0

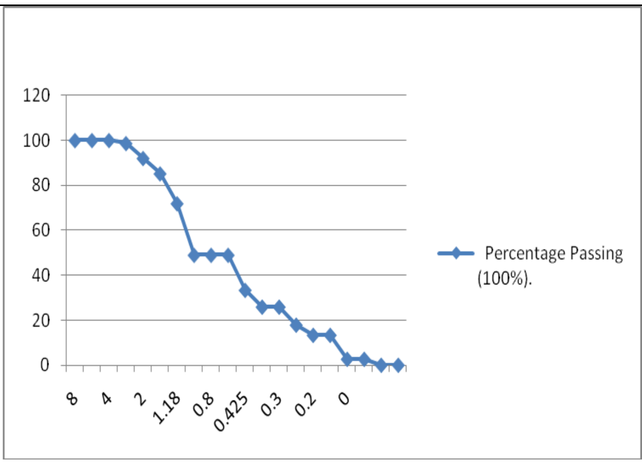

Figure 4: Gradient curve for Pankshin Sample

4.2.4. Soil Classification for Pankshin Sample

(i) Since over 80% of this soil is coarser than no. 200 sieve or 0.20mm, therefore this sample is a coarse grained soil

(ii) Since over 80% of coarse fraction is finer than no. 4 sieve or 6mm, soil is sandy soil

(iii) $C_u = D_{60}/D_{10} = 0.94 / 0.09 = 10.4 > 4$ and $C_c = (D_{30})^2 / D_{10} \text{x } D_{60} = (0.4)^2 / 0.09 \text{ x } 0.94 = 1.9$ which is not between 1 and 3. Therefore Soil is well graded sand

(iv) Since the percentage finer than no. 200 sieve is over 13.00% greater than 12. Therefore, soil is clayey or silty sand. And since over 13% is coarser than sieve 75µm, soil is **Silty Sand**.

Table 5: Langtang Sample

B.S Sieves	WT Retained (g)	% On Sieve	% Retained	% Passing
3.35mm	14	1.4	1.40	98.60
2.0mm	79	7.9	9.30	90.70
1.70mm	66	6.6	15.90	84.10
1.18mm	134	13.4	29.30	70.70
600um	170	17.0	46.30	53.70
425um	56	5.6	51.90	48.10
300um	50	5.0	56.90	44.10
212um	67	6.7	63.60	36.40
150um	38	3.8	67.40	33.60
75um	143	14.3	81.70	18.30
Pan	183	18.30	100.0	0

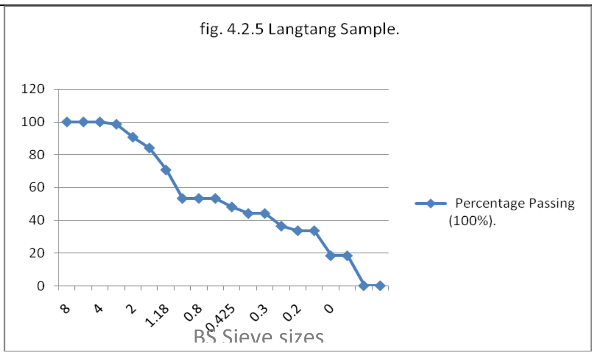

Figure 5: Gradient curve for Langtang Sample

4.2.5. Soil Classification for Langtang South Sample

(i) Since over 50% of this soil is coarser than no. 200 sieve or 0.20mm, therefore this sample is a coarse grained soil

(ii) Since over 50% of coarse fraction is finer than no. 4 sieve or 6mm, soil is sandy soil

(iii) $C_u = D_{60}/D_{10} = 0.76 / 0.048 = 15.8 > 4$ and $C_c = (D_{30})^2 / D_{10} x D_{60} = (0.09)^2 / 0.048 x 0.76 = 0.222$ which is not between 1 and 3. Therefore Soil is not well graded sand

(iv) Since the percentage finer than no. 200 sieve is over 33.00% greater than 12. Therefore, soil is clayey or silty sand. And since over 18% is finer than sieve 75µm, soil is **clayey Sand.**

Table 6: Qua'anpan Sample

B.S Sieves	WT Retained (g)	% On Sieve	% Retained	% Passing
3.35mm	8	0.80	0.8	99.20
2.0mm	24	2.40	3.2	96.80
1.70mm	43	4.27	7.47	92.53
1.18mm	100	10.0	17.47	82.53
600um	192	19.20	36.67	63.33
425um	127	12.67	49.34	50.66
300um	129	12.93	62.27	37.73
212um	125	12.53	74.80	25.20
150um	64	6.40	81.20	18.80
75um	147	14.67	95.87	4.13
Pan	41	4.13	100.0	0

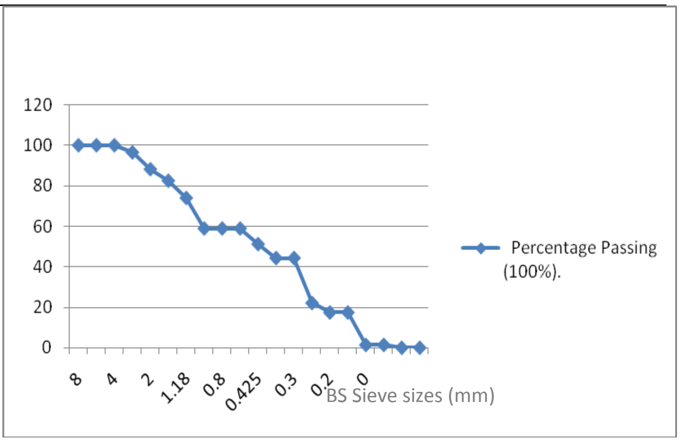

Figure 6: Gradient curve for Quan'anpan Sample

4.2.6. Soil Classification for Qua'anpan Sample

(i) Since over 80% of this soil is coarser than no. 200 sieve or 0.20mm, therefore this sample is a coarse grained soil

(ii) Since over 80% of coarse fraction is finer than no. 4 sieve or 6mm, soil is sandy soil

(iii) $C_u = D_{60}/D_{10} = 0.94 / 0.09 = 10.4 > 4$ and $C_c = (D_{30})^2 / D_{10} x D_{60} = (0.4)^2 / 0.09 x 0.94 = 1.9$ which is not between 1 and 3. Therefore Soil is well graded sand

(iv) Since the percentage finer than no. 200 sieve is over 13.00% greater than 12. Therefore, soil is clayey or silty sand. And since over 13% is coarser than sieve 75µm, soil is **Silty Sand**.

Table 7: Wase Sample

B.S Sieves	WT Retained (g)	% On Sieve	% Retained	% Passing
3.35mm	35	3.50	3.50	96.50
2.0mm	83	8.30	11.80	88.20
1.70mm	57	5.70	17.50	82.50
1.18mm	85	8.50	26.00	74.00
600um	151	15.10	41.10	58.90
425um	77	7.70	48.80	51.20
300um	69	6.90	55.70	44.30

212um	219	21.90	77.90	22.10
150um	50	5.00	82.60	17.40
75um	160	16.00	98.60	1.40
Pan	14	1.40	100.0	0

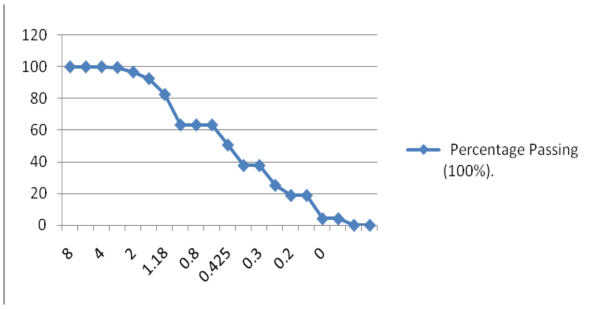

Figure 7: Gradient curve for Wase Sample

4.2.7. Soil Classification for Wase Sample

(i) Since over 80% of this soil is coarser than no. 200 sieve or 0.20mm, therefore this sample is a coarse grained soil

(ii) Since over 80% of coarse fraction is finer than no. 4 sieve or 6mm, soil is sandy soil

(iii) $C_u = D_{60}/D_{10} = 0.94 / 0.09 = 10.4 > 4$ and $C_c = (D_{30})^2 / D_{10} \times D_{60} = (0.4)^2 / 0.09 \times 0.94 = 1.9$ which is not between 1 and 3. Therefore Soil is well graded sand

(iv) Since the percentage finer than no. 200 sieve is over 13.00% greater than 12. Therefore soil is clayey or silty sand. And since over 13% is coarser than sieve 75µm, soil is **Silty Sand**.

4.3. Moisture Content Determination

Table 8: Moisture Content Determination

Location	Sample	1	2	3
Jos-South Sample	Weight of (W_0) (g)	17.50	16.0	17.00
	Weight of wet soil + can(W_1) (g)	155.0	148.00	150.00
	Weight of wet soil, (W_2) = $W_1 - W_0$(g)	137.5	132.00	133.00
	Weight of dry soil + can (W_3) (g)	118.0	109.00	119.00
	Weight of dry soil (W_4) = W_3-W_0 (g)	100.5	93.00	102.00
	Weight of water W_5, = $W_2 - W_4$ (g)	37.0	39.00	31.00
	Water content % = (W_5 / W_4) x 100	36.8	41.9	30.4
	Average water content % = Sample (1+2+3)/3	36.26	36.36	36.36
Bokkos Sample	Weight of (W_0) (g)	17.50	16.0	16.00
	Weight of wet soil + can (W_1) (g)	145	182	185
	Weight of wet soil, (W_2) = $W_1 - W_0$ (g)	127.5	166.0	169
	Weight of dry soil + can (W_3) (g)	110.0	135.0	129.0
	Weight of dry soil (W_4) = W_3-W_0 (g)	92.5	119.0	113.0
	Weight of water W_5, = $W_2 - W_4$ (g)	35.0	47.0	56.0
	Water content % = (W_5 / W_4) x 100	37.8	39.5	49.6
	Average water content % = Sample (1+2+3)/3	42.3	42.3	42.3
Kanam Sample	Weight of (W_0) (g)	17.50	17.5	17.5
	Weight of wet soil + can (W_1) (g)	171.0	162.0	172.0
	Weight of wet soil, (W_2) = $W_1 - W_0$ (g)	155.0	144.0	154.5
	Weight of dry soil + can (W_3) (g)	105.0	115.0	117.0
	Weight of dry soil (W_4) = W_3-W_0 (g)	89.0	97.5	99.5
	Weight of water W_5, = $W_2 - W_4$ (g)	66.0	47.0	55.0
	Water content % = (W_5 / W_4) x 100	74.2	48.2	55.3
	Average water content % = Sample (1+2+3)/3	59.2	59.2	59.2

Pankshin Sample.	Weight of (W_0)	(g)	17.0	17.5	17.5
	Weight of wet soil + can (W_1)	(g)	175.0	165.0	175.0
	Weight of wet soil, (W_2) = $W_1 - W_0$	(g)	158.0	148.0	157.5
	Weight of dry soil + can (W_3)	(g)	138.0	140.0	136.0
	Weight of dry soil (W_4) = W_3-W_0	(g)	121.0	123.0	188.5
	Weight of water W_5, = $W_2 - W_4$	(g)	37.0	25.0	39.0
	Water content % = (W_5 / W_4) x 100		30.6	20.3	32.9
	Average water content % = Sample	(1+2+3)/3	27.9	27.9	27.9
Langtang South Sample	Weight of (W_0)	(g)	17.5	17.5	17.5
	Weight of wet soil + can (W_1)	(g)	200	22.5	175
	Weight of wet soil, (W_2) = $W_1 - W_0$	(g)	182.5	207.5	157.5
	Weight of dry soil + can (W_3)	(g)	159.0	171.0	142.0
	Weight of dry soil (W_4) = W_3-W_0	(g)	141.5	153.5	124.5
	Weight of water W_5, = $W_2 - W_4$	(g)	41.0	54.0	33.0
	Water content % = (W_5 / W_4) x 100		29.0	35.2	26.5
	Average water content % = Sample	(1+2+3)/3	30.2	30.2	30.2
Qua'anpan Sample	Weight of (W_0)	(g)	17.5	16.0	16.0
	Weight of wet soil + can (W_1)	(g)	152.0	155.0	150.0
	Weight of wet soil, (W_2) = $W_1 - W_0$	(g)	134.5	139.0	134.0
	Weight of dry soil + can (W_3)	(g)	123.0	118.0	108.0
	Weight of dry soil (W_4) = W_3-W_0	(g)	105.5	102.0	92.0
	Weight of water W_5, = $W_2 - W_4$	(g)	29.0	37.0	42.0
	Water content % = (W_5 / W_4) x 100		27.5	36.3	45.7
	Average water content % = Sample	(1+2+3)/3	36.5	36.5	36.5
Wase Sample.	Weight of (W_0)	(g)	17.5	17.5	17.0
	Weight of wet soil + can (W_1)	(g)	192	175	175
	Weight of wet soil, (W_2) = $W_1 - W_0$	(g)	174.5	157.5	158.0
	Weight of dry soil + can (W_3)	(g)	136.0	141.0	144.0
	Weight of dry soil (W_4) = W_3-W_0	(g)	118.5	123.5	127.0
	Weight of water W_5, = $W_2 - W_4$	(g)	56.0	34.0	31.0
	Water content % = (W_5 / W_4) x 100		47.5	27.6	24.4
	Average water content % = Sample	(1+2+3)/3	33.2	33.2	33.2

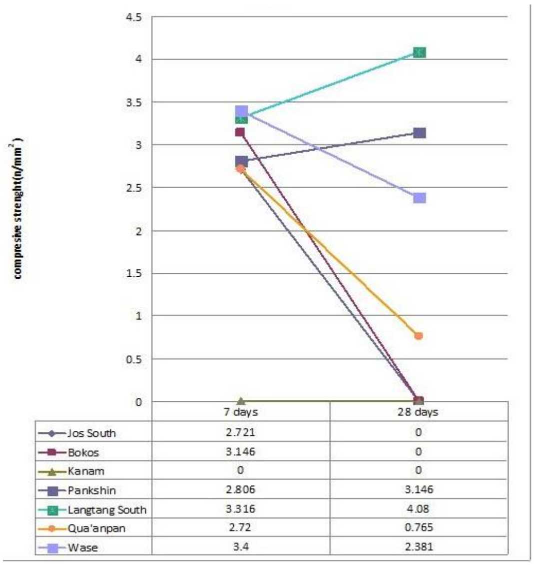

Fig. 12 Average compressive strength (N/mm²) test at 7 and 21 days

Figure 8: Average Compressive Strength (N/mm^2) Test at 7 and 21 days

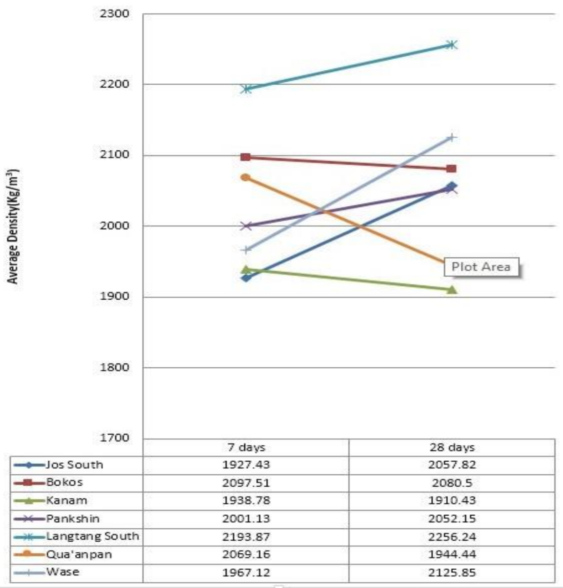

Figure 9: Average Density (Kg/m^2) Test at 7 and 21 days

4.4. Result of Water Absorption Test

After 24 hours, the samples were found to have crumbled and fragmented

Table 9: Results of Abrasion Test

Location	Brick No	Weight before brushing W_1 (g)	Weight after brushing W_2 (g)	Loss in weight (g)	% Loss in weight	Depth of penetration N (mm)
Jos-south	Average	3452.0	3424.5	27.5	0.275	2.5
Bokkos	Average	3628	3585.5	42.5	0.425	4.5
Kanam	Average	3548	3538	10	0.1	1.5
Pankshin		3243	3214	29	0.29	2.5
Langtang South		3719.5	3684	35.5	0.355	4.5
Qua'anpan		3446.5	3436	10.5	0.105	1
Wase		3513	3500.5	13	0.13	2.5

4.5. Comparing the Relationship between the Termite Mounds Obtained From the Three (3) Geopolitical Zones of the Study Area

4.5.1. Field test

The result of the field tests (smell/washing/toughness tests) showed that in the Northern Zone, the termite mound soil does not contain organic matters (Kanam sample) while others containing a major of silt soils.

While for the Southern Zone, it also showed the same results as for the Central Zone.

4.5.2. Particle Size Distribution

The result of the particle size distribution carried out in accordance with B.S 812 1975 is presented in tables, and showed that 83% particles of the soil from the Northern Zone falls within the silty sand region hence the termite mound soil does not content a balance particle distribution meetings design requirements.

While the sales from the Central Zone showed that 88% of the particles belong to the silty sand region, hence the termite mound soil does not contain a balance particle distribution meeting design requirements.

Also the soils from the Southern region showed that 83% of the particles belong to the silty sand region, hence the termite mound soil does not contain a balance particle size distribution meeting design requirements.

4.5.3. Moisture Content Determination

Shown in Table 8., is the result of the moisture content test performed on all the soil samples; the Northern Zone soils hand and average of 36.2% moisture content, while that the Central Zone had an average of about 40% with Southern Zone having a moisture content average of 33%. The central having the highest moisture content. This permits the determination of moisture content in the soil in order to achieve optimum compaction

4.5.4. Compressive Strength Test

The compressive strength test in fig.8 showed that, the compressive strength test of seven days for the North sample of bricks showed an average of 2.721N/mm^2 with the central showing the average of 2.5N/mm^2 the Southern Zone soils showed an average of 3.1N/mm^2.

At 21 days the Northern sample of soil showed an average strength of ON/mm^2, the Central showed an average of 3.4N/mm$^{2.}$ The Southern Zone soils display a higher strength characteristic of the termite mound soil.

4.5.5. Water Absorption Test

It was observed that the bricks tested by immersion in water showed a high affinity of water as there was rapid absorption state within 24hours. There were remarkable swelling and dissolution in water for all the soil obtained.

4.5.6. Abrasion Test

The result of the abrasion test shown in the table indicated that the soil sample prone to abrasion. It was also observed the soil with coarser aggregate in the sand gravel range proof more resistance to abrasion.

5. Summary

The research was aimed at comparing the strength properties of termite mound bricks for building. Test conducted include: moisture content test, particle size distribution, field test compressive strength test, water absorption test and abrasion test was carried out on the brick cubes, and these were carried in the laboratory of the Department of Building, University of Jos, Jos.

Care was taken at all stages of the different tests to ensure that the appropriate methods and techniques were employed.

Data stated below was used during the cause of the research work.

(i) Soil samples where gotten from 7 local government areas of Plateau State.
(ii) Brick cubes were cast and cured for the periods of 7 and 22 days under atmospheric temperature. A total of 126 cubes were (145 x 140 x 90mm) were cast.

6. Conclusion

Based on the various test results obtained the following conclusions were drawn**:**

(i) Most samples had coarse aggregate in sand range.
(ii) Samples with coarse aggregate and fine aggregates in the silt range had less or no compressive strength.
(iii) The strength pf the brick cubes with coarse aggregate had high strength at 7 days coining and lower strength at 28 days while aggregate with les coarse strength had high strength at 7 days and high strength at 28 days.
(iv) The bricks are prone to abrasion.
(v) The bricks fragmented and dissolved by immersion in water after 24 hours

7. Recommendations

Based on the conclusion arrived at, the following recommendations are made:

(i) When the termite mound material is used for production of bricks, the physical and chemical properties should be determined before use so as to get the best material for use.
(ii) Termite mound materials from loamy soil should not be used or applied at any stage of the building construction.
(iii) When using termite mound soil for compressed earth brick production. It is advised that the soil be stabilized.
(iv) There is a need to protect the bricks from direct contact with water when used for building.
(v) The surface of the bricks should be treated by plastering with cement / termite modified soil and mortar.

7.1. Further Recommendation

Research should be carried out on how the properties of various termite modified soil affect the properties of mortar and concrete, when termite modified soil is use as a partial replacement for cement.

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