THE VIABILITY OF BAUCHI GRANITE AS A FINISHING MATERIAL IN BUILDINGS

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ABSTRACT

Construction materials mostly come from the earth's natural resource. These materials however distinguish themselves through numerous processes to stand short or longer years depending on the qualities. Rocks are part of such materials found and used in different forms; granite from igneous rocks through molten process has remained a popular element in buildings. Bauchi granite is amongst such materials applied as a building finishing. The paper assessed the viability of Bauchi granite in buildings (as wearing off surface) through field investigation and Laboratory analysis, and discovered that out of the four sampled granites, Pink Bauchite, White Bauchite, White Granite and Granite Gneiss, three samples passed the mineralogy analysis while all were suitable in impact value analysis and abrasion test, with differences in the crushing value as one sample (White Bauchite) was found not suitable for application as wearing off surface. Based on this discovery, the paper concludes by recommending among others to the authorities concerned to encourage explorative activities through private partnership for gainful employment of the youths.

Keywords: Granite, Values, Wearing Off Surfaces, Building Application, Analysis.

INTRODUCTION

Building existence come through the application of various construction materials from earth resource in form of stone quarried from stratum of rocks or bricks from baked clay etc. Hence no materials is used on buildings but sourced from the earth, (Datta, 2005: 55P.) Prior to the industrial revolution, many buildings were built with natural stones. However due to advancement in transportation systems and increase in population, the supplies of stones became inadequate and other cheaper materials such as bricks were made to replace these large stones utilized in the buildings, hence its reversal for application as a finishing material.

It is therefore imperative considering the performance of some building materials of significance that may last between ten to twenty years of application as part of building elements. For such building elements to fulfill their basic operation modules, the qualities of these elements need to be investigated in order not for them to be harmful to human as well as causing other damages to available equipment, particularly those within the operative domain and meant for consumption. Among such materials is granite sourced from rocks that are termed igneous in nature. Granite had remained a popular building material. It is coarse-grained, even textured, consisting of quality feldspar, and sometimes little mica and other minerals in them. It amazes itself as a quality building material when polished giving it a sparkling appearance. Granite as well as other natural stones are incombustible. They are poor

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insulators, against transfer of heat and very good resistance in the transfer of airborne sound due to its dense nature (Barry, 1999). It can be used as a polished granite slab or counter/work tops, floors and even walls. When used on buildings, it creates elegance and quality. This paper therefore, is an assessment of the viability of Bauchi granite for application in building.

STUDY AREA.

Bauchi lies between 9^0 46^0 N and 9^0 54^0 E and $10^{)}$ 15^0 N and 16^0 23^0 E in north eastern Nigeria, situated on open plains of crystalline uplands of ancient basement rocks with remains of igneous and metamorphosed and sedimentary rocks of cretaceous tertiary age. Bauchi lies 2000ft above sea level, and has number of isolated rocky hill and low ranges that protrude from the plains. Inclusive is a water shed in the high plains around Gwallaga, Shadawanka and Tambari Steams. (Akinbileye, 2007) Thus the study was conducted within the rocky terrain of New Government Reserved Area (GRA) extension towards Sabon-Kaura, Bauchi-Bauchi metropolis.

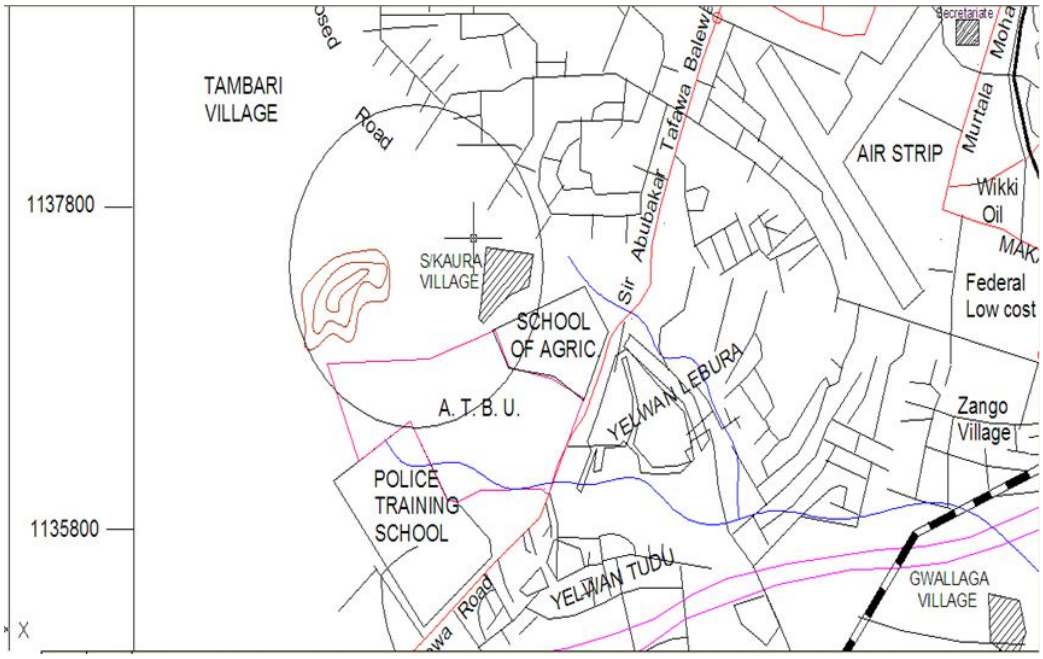


Figure 1: Map of Bauchi Showing Study Area in Circle

LOCATION AND MINEROLOGY OF BAUCHI GRANITE

Studies by Oyawoye (1958, 1961 and 1965) revealed that granite in Bauchi State existed in four main areas of Bauchi.

- Bauchi,
- Mangos
- South Kangeree and
- Yelwa

Oyawoye further stated that the dominant presence of hornblende granite formed a longer part of the complex together with quartz diorite. However the most viable in Bauchi is the twinned alkali feldspar.

It is equally distinguishable that they compose of much richer iron, eulite in nature and ferroaugite. Mostly found in pink Bauchite. This is an indication that they were formed under high pressure, serving as the primary constituents. Generally it can be suggested that the rocks were crystallized very deep if not near the base of the crust. This is most particular during the pan African orogeny with a graded migrational boundary.

This generally is the characteristics of other pan African age intrusions in Nigeria as maintaining its true character of deep origin granulites facies condition. It is worth noting that the main granite under this study is Pink Bauchite, White Bauchite, White Granite and Granite Gneiss.

Table 1: Location of Sample Granite at Sabon-Kaura

Sample	Altitude(m)	Coordinates	Date	Time
Pink Bauchite	601	N 10) 17' 37.8" E 9^0 47 47. 6"	05/07/2010	5:00pm
White Bauchite	633	N10 ^{0} 16' 54. 1" E 9^0 45 54. 1"	05/07/2010	5:00pm
White Granite	620	N$10^0$18'15.1" E 9^0 37' 23. 6"	28/06/2010	4:53 pm
Granite Gneiss	655	N 10^0 60 57. 4" E9^0 46 33. 4"	05/07/2010	5: 18pm

Source: Field Study 2010

MATERIALS AND METHODS

The study drew on a comprehensive field investigation, physical observation and laboratory analysis. The adopted strategy was the comprehensive use of tools/machines to test for mineralogy analysis, and compressive strength test of sampled granite, and or its associated properties/formation were also tested. Tools used for collecting samples include chisel, hammer, compass and Global Positioning System (GPS) for recording actual position of samples, as well as laboratory tools that included, rock cutting machine, use of carborandum powder, diamond pen, cylindrical cup, Tapping rod, steel cylinder and sieve, petrological microscope, and plain polarized light, Los Angele abrasion machine AASHTO T96-92 (ASTMC131-89) were also used in the determination of the thin section and abrasion respectively.

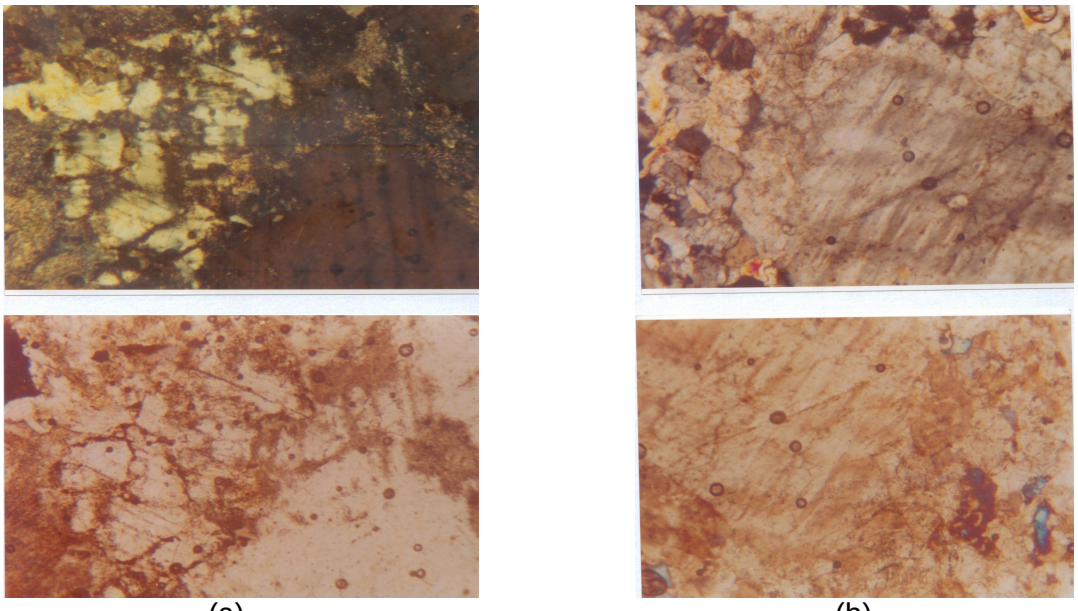
The aggregate impact value test usually was carried out to determine the toughness of the samples as such, its failure to impact load is tested in percentage, by passing through a sieve sampled materials of 2.36mm size. Different rocks are said to be giving different strength hence for the efficacy of this analysis all samples were equally subjected to compressive strength analysis in order to get their aggregate crushing value.

It is interesting noting that the compressive strength of rocks vary from 45MPa, to maximum of 545MPa, hence for the purpose of this study, a uniform size has been adopted to be 12.5mm for all the samples to be analyzed.

RESULT AND DISCUSSION

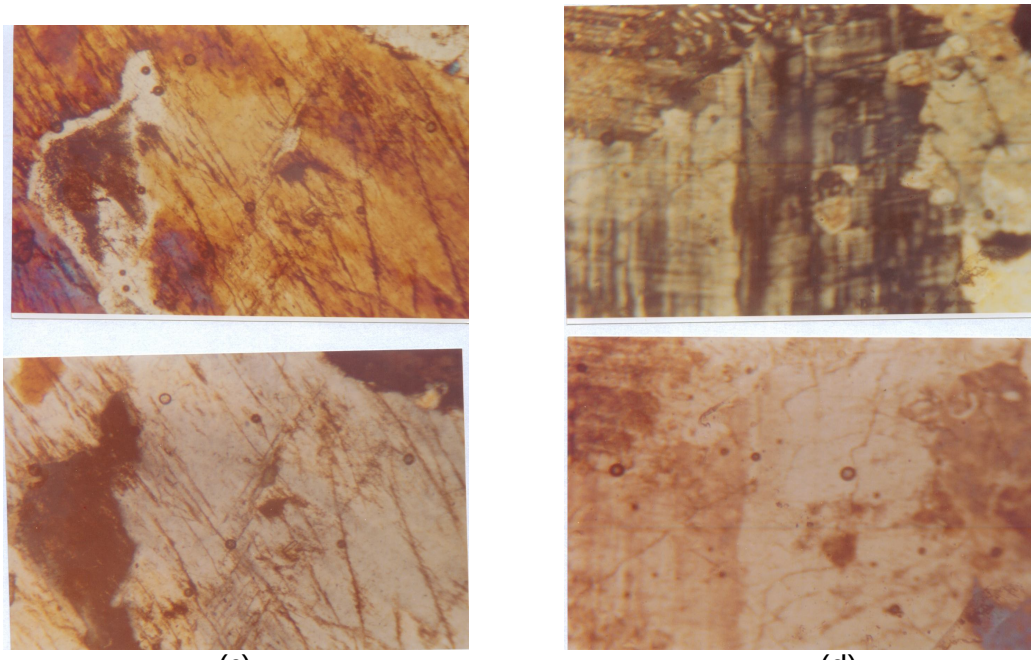
From the general observations of the physical traits of the samples through petrology thin section (plates 1a, b, c, d.) to determine the mineral component using petrological microscope as well as plain polarized light the followings were arrived at to determine the contents of mineral in them. Pink Bauchite and White Granite can be said to withstand abrasion due to the observed minerals in them and can be suitable for use in buildings, based on the observed features in table 2 below.

White Bauchite can though be said to be having traces of disintegration, and water can penetrate it easily making it deteriorate with time and can wear away if applied on wearing off surfaces. Granite Gneiss appears strong and can be durable in buildings hence the observed traits make them stronger as they are interlocked with grains binding the quartz, feldspar and mica in a singular unit. These can however be noted from the petrology thin section below as well as the summarized physical appearance as in table 2 below.



(a) (b)

Plate I: **Thin Section of (a) Pink Bauchite and (b) White Granite.**



(c) (d)

Plate II: Thin Section of (c) White Bauchite and (d) Granite Gneiss

Table 2: Summary of Observation on Petrology Thin Section of Bauchi Granite

Sample	Physical Appearance	Remarks
Pink Bauchite	Quartz, Feldspar, Plagioclase, Orthoclase	
White Granite	Hatched Tuning of Plagioclase, Feldspar, K-Feldspar, and Quartz are Predominant.	
White Bauchite	Hairlines and Perfect Cleavages Present.	
Granite Gneiss	Quartz, Feldspar Little Mica with Interlocking Grains	

Source: Laboratory Analysis 2010

Impact Value

In determining the toughness of the samples towards utilization as wearing off surfaces, the toughness has been tested and details of which revealed the average impact value falling within the range of 19-25%.

Table 3: Aggregate Impact Value of Samples

Sample	Weight of Mould and Sample (g)	Weight of Material Passing Through 2.36mm Sieve	Impact value %	Average Impact Value %
Pink Bauchite	3226	122	26.81	24
	3214	115	20.57	
White Granite	3214	108	19.01	19
	3246	111	18.59	
White Bauchite	3245	148	24.46	25
	3258	154	25.29	
Granite Gneiss	3256	116	23.63	22
	3231	113	19.42	

Source: Laboratory Analysis 2010

Hence, it can be observed that the percentage average impact values obtained from the various samples indicate that all samples are satisfactory as they can satisfy many applications. However the standard application for use by BS882:1992 as recommended is

a. 25% for heavy duty floors b) 30% for wearing surfaces
b. 45% for concrete applications. Therefore, from the obtained results of impact analysis all the samples have not passed (30% thirty percent and can be said to be satisfactory. In observing the crushing values for strength, it can be seen that the average of three samples can be said to be satisfactory and suitable for use as wearing off surfaces. While the white bauchite has values higher than the recommended values of 35%, hence may be said to be out of the range of specified percentage for wearing off surfaces.

Table 4: Average Crushing Values of All Samples

Sample	Weight of Sample (g)	Weight of Material Passing Through 2.36mm Sieve	Crushing Value %	Average Crushing Value %
Pink Bauchite	3372	1163	34.49	33.89
	3460	1153	33.29	
White Bauchite	3626	1410	38.29	38.88
	3969	1543	39.47	
White Granite	3454	1085	29.97	29.96
	3563	1067	29.94	
Granite Gneiss	3399	1147	33.74	32.58
	3453	1085	31.42	

Source: Laboratory Analysis 2010

It is worth establishing that from the sampled granite, equal sizes were cut of the granite in order to run a uniform abrasion test, the weight of all the sample was 4500g and each sample was broken to 20-25mm for ease revolutions. The adopted method was the Los Angele Abrasion Test, using the Los Angele Testing machine. This is because it will suite rubbing and matching that is convenient to the field activities.

The samples were washed and oven dried to make them ready for the test. All samples were passed through 500 revolutions inclusive of 8 sub- charges (of weight 3330g). The details of the results are shown in table 5 below;'

Table 5: Aggregate Abrasion Test

Sample	Weight of Sample (g)	Weight of Sample Passing Through 1.7mm Sieve	Abrasion Value	Percentage Abrasion
Pink Bauchite	4500	3950	550	12.2
White Bauchite	4500	3850	650	14.0
White Granite	4500	3900	600	13.0
Granite Gneiss	4500	4150	350	7.70

Source: Laboratory Analysis 2012

From the foregoing, the results can be said to go with Neville (2003). It should be noted that the observed discrepancies in the crushing values in this the factor can contribute to the reduction in the compressive strength of the samples in terms of withstanding imposed load. It is worth knowing that from the foregone test, all the samples are having low values, and can be said to be adequate for many applications, in building. However, according Singh (2004) for the stronger aggregate such as the White Bauchite having 38.88%, it needs to have a low value for applications in other area, as such the given values:

- Highway application not exceed 16 %
- Quality Wearing off surfaces not exceed 30%
- Base course not exceed 50%

The obtained results reveals that the Pink Bauchite, White Granite, Granite Gneiss stood the basic requirements for application as finishing materials for wearing-off surfaces. While the White Bauchite may be most suitable for other concrete works. It can further be observed that the presented analogy of the mineralogy of three samples were found suitable for application in building with the exception of White Bauchite which most likely is having points of possible disintegration perhaps subjecting itself readily for crushing as a concrete aggregate. Equally, from the abrasion test and based on the presented results, it can be observed that all samples were found suitable for use as wearing off surfaces however they presented various percentage of quality worthy of noting, Granite Gneiss stood the best abrasive percentage test of 7.7% Pink Bauchite 12.2%, White Granite 13.0% while the white Bauchite has 14% percent meaning that it is the least rated of the four samples. This can be said to agree with the other results presented despite it passing the abrasion test.

The presented results proved further the quality of Bauchi granite as a viable building material for use as wearing off material. It is important encouraging the use of Bauchi granite as three out the four samples proved worthy of being utilized as wearing off surfaces. It is our submission that the three granite (Pink Bauchite, White Granite and Granite Gneiss) sampled be used in building as finishes.

CONCLUSION

All sampled granite rocks are suitable in terms of average impact value application with difference in their crushing values. White Bauchite was found not to be suitable as a wearing off surface, with predominantly quartz and alkali k-feldspar in the white granite and granite gneiss, experiencing less impact and crushing effect than the pink and white granite.

It is pertinent for the authorities concerned that as an important source of revenue, the state should encourage private partnership to develop this business so as to allow for employment of people in to this sector. However, the study wishes to further recommend a study on the Bauchi granite to reveal its porosity/water absorption as well as permeability tests.

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