Assessment of Engineering Properties of Granites in Some Quarry Sites in Ogun State, Nigeria.

S.S. Omopariola; Dr A.A. Jimoh,

ABSTRACT: This study is based on the discovery that single size aggregates produced in some parts of Ogun State do not conform to grading requirements specified in relevant building standard and codes of practice. It is an accepted fact that the properties, mix proportion and economy of fresh and hardened concrete is strongly influenced by the properties of coarse aggregate. Samples of 9.5mm, 12.5mm, 19mm and 25mm aggregates were collected from four different quarry sites spread across the state. Laboratory tests were carried out on the Samples of these various sizes obtained from the different quarry sites. The engineering properties considered are Specific Gravities, Water Absorptions, Moisture Contents, Aggregates Impact Value and Aggregates Crushing Value in accordance to the relevant standards. Test results reveals that all the samples conform to relevant building standard and codes of practice. It was therefore concluded that although the aggregates do not conform to grading specification in the code, but the physical and mechanical properties of all the aggregates tested are okay.

Key words: Assessment, Engineering Properties, Granites, Quarry Sites.

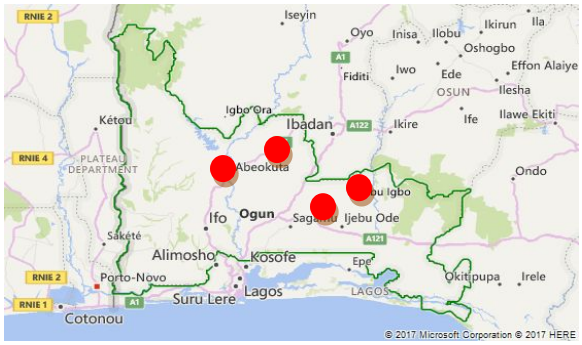
1.0 INTRODUCTION

Granite is said to be possibly the most common igneous rock type known to the general public which has been used for centuries for many different purposes such as building material and it is a preferred choice of stone over most others because of its durability, beauty and abundance [1]. According to [2] it is a most widely distributed plutonic rock in the earth crust. It has been described as the most used stone in the construction of either monumental or vernacular architecture in ancient buildings located in the North of Portugal where a wide range of granitic rocks is present in masonry constructions, depending on their petrographic features [3].

The physical and strength properties of granites depend upon many factors which include geological, lithological, physical, mechanical and environmental factors, [4]. It also depends on its formation and play an important role in determining its applications in various fields [5]. The physical properties like specific gravity, water absorption and densities of rock samples collected from different locations vary considerably [2]. In [6], it was stated that the types, quality and general properties of aggregates determine the quality of concrete because concrete is made up of about seventy five percent of aggregates.

2.0 METHODOLOGY

Granite was procured from four different quarry sites spread across three of the four geopolitical zones of the state. The quarry sites are located at Omoologede along Abeokuta – Igboora road and Papa Adeosun along Abeokuta – Ibadan road in Abeokuta North Local Government Area and Odeda Local Government Area respectively, both in Egba geopolitical zone of the state.



- *Sunday Omopariola is currently pursuing Phd program in civil engineering in University of Ilorin , Nigeria. E-mail: hfeforchrist@yahoo.com*
- *Alao Jimoh is a Phd holder currently a lecturer in the Civil engineering Department in University of Ilorin, Ilorin, Nigeria. E-mail: alaojimoh4real@yahoo.com*

Figure.1: Map of Ogun State Indicating Location of collection of samples

While the two others were at Ishara in Remo North Local Government Area and Ago – Iwoye in Ijebu North Local Government Area in Remo and Ijebu geopolitical zones respectively.

The physical properties considered for laboratory tests are specific gravity, water absorption and moisture content, while the mechanical properties tested are Aggregate Impact Value (AIV) and Aggregate Crushing Value (ACV)

2.1 Specific Gravity and Water Absorption Test

Specific Gravity and Water Absorption Tests were carried out in accordance with BS The Specific Gravity and Water Absorption were then calculated by using equation (1) and (2) respectively

The bulk specific gravity is $= \frac{A}{B-C}$ (1)

The percentage of absorption $= \frac{B-A}{A} \times 100\%$ (2)

Where A is weight of oven-dry sample in air (g), B is weight of SSD sample in air (g) and C is the weight of SSD sample in water.

2.2 Moisture Content Test

The moisture content of the coarse aggregate was done in accordance with the specifications in BS EN 1097-2008, while the values were obtained by the use of the formulae

Moisture Content (% dry mass) = $\frac{(M2-M3)}{(M2-M1)}$ x 100%(3)

The result is reported to the nearest 0.1% of the dry weight.

Where, M_1 = weight of empty container, M_2 = weight of container + sample and M_3 = weight of container + oven dry sample

2.3 Aggregate Impact Value (AIV)

Laboratory test on Aggregate Impact Value was carried out in accordance with the specifications in [7], [8] and the results were obtained using equation 4 below.

2.4 Aggregate Crushing Value (ACV)

The procedure for carrying out the test on Aggregate Crushing Value (ACV) was in accordance with the specifications in [9].

Percentage fines = $\frac{B \times 100}{A}$ (4)

Where: A is the mass of surface-dry sample (g) and B is the mass of the fraction passing the 2.36 mm sieve (g).

3.0 RESULTS AND DISCUSSION

Below are the results and findings from the study.

3.1 SPECIFIC GRAVITY

Figure 2 indicates that the 9.5mm granites from Omologede and Ishara has the highest specific gravity values of 2.78 followed by that of Ago – Iwoye with the value of 2.72, while that of Papa Adeosun has the least value of 2.63. In the case 12.5mm granites from Omologede and Papa Adeosun with specific gravity values of 2.71 has the highest values followed by that of Ishara with 2.70, while that of Ago – Iwoye has the least value of 2.66. The figure also indicates that the 19mm granites from Ago - Iwoye has the highest values of 2.86 this was followed by that of Omoologede and Papa Adeosun which has the values of 2.75 and 2.64 respectively, while that of Ishara has the least value of 2.61. While for 25mm granites, that 25mm aggregates from Omoologede has the highest value of 2.74, this was followed by that of Ishara with a value of 2.70 whole that of Papa Adeosun has the lowest value of 2.68.

On the whole, specific gravity of 19mm granites from Ago – Iwoye has the highest values 2.86 while that of the same size from Ishara. specific gravity of all the different sizes of aggregates for all quarry sites were highlighted indicating that the specific gravity of all the different sizes of aggregates for all quarry sites are

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above the minimum value specified in [10]. The values are also within the limits of 2.4 – 3.0 stated in literature [11], [6], [12] and [13].

3.2 Moisture Content

In figure 3, the moisture content value of 9.5mm granite sample from Ishara was the highest at 1.22%, that of Papa Adeosun was next with a value of 1.18%. Samples from Omoologede and Ago – Iwoye has 1.17% and 1.08% respectively. The value of the Moisture Content for 12. 5mm granites

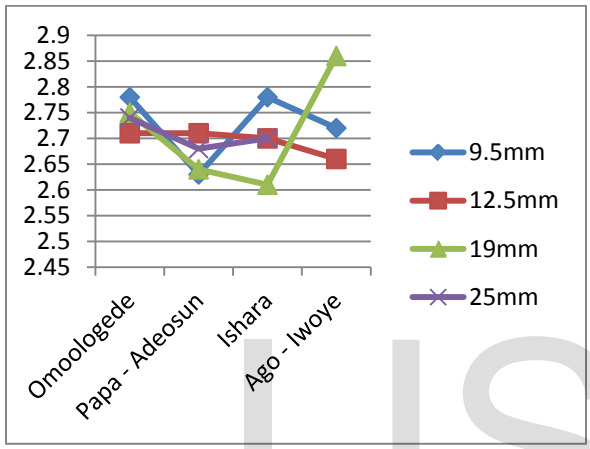

Figure 2 Values of Specific Gravity of all Aggregate sizes from all Quarry Sites

obtained from Ago – Iwoye at 1.22% was the highest, that from Papa Adeosun at 1.14% came next, then that of Omoologede 1.06%, and that of Ishara having the least value of 1.02%. For the moisture content value of 19mm granite, sample from Papa Adeosun has the highest value of 1.12%, that from Ago – Iwoye was next with the value of 0.89%, this was followed by that of Omoologede with 0.84%, while that of Ishara was the least with a value of 0.76%. The figure also shows that 25mm granites from Papa Adeosun has the highest value of 0.85%, followed by that of Omoologede with 0.70%, while that of Ishara was the least with a value of 0.69%. The moisture content reduces with the sizes of the aggregates, for samples collected from all the quarry sites. However, the values of moisture content for all the coarse aggregate falls within the limits stipulated in previous literatures. In [14] it was stated that the moisture content can range from less than one percent in gravel to up to 40 percent in very porous sandstone and expanded shale. The moisture content of all the aggregates obtained from the various quarry sites fall below the recommended value of 3% as specified in [15].

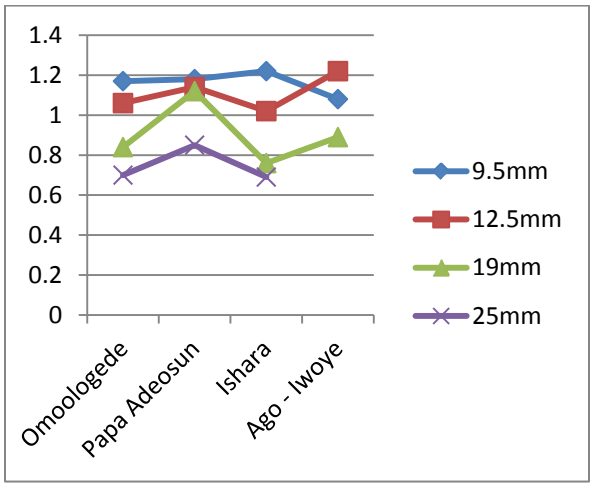

Figure 3 Values of Moisture Content of all Aggregate sizes from all Quarry Site

3.3 Water Absorption

The values contained in Figure 4 reveals that the water absorption value of 9.5mm granite samples from Ishara at 2.13% was the highest. That from Papa Adeosun was next with 1.83% while that of Ago – Iwoye and Omoologede has 1.60% and 1.24% respectively. For the water absorption value 12.5mm granite, sample from Omoologede has the highest value of 0.98%, that from Ago – Iwoye was next with the value of 0.74%, this was followed by that of Ishara with 0.66%, while that of Papa Adeosun was the least with a value of 0.59%. For 19mm granite, samples obtained from Papa Adeosun with water absorption value of 0.26% was the highest, this was followed by that from Omoologede with 0.24%, then that of Ago – Iwoye and that of Ishara had the least value of 0.22%. water absorption value of 0.32% was the highest, this was followed by that from with Papa Adeosun 0.25%, then that of Ishara had the least value of 0.16%

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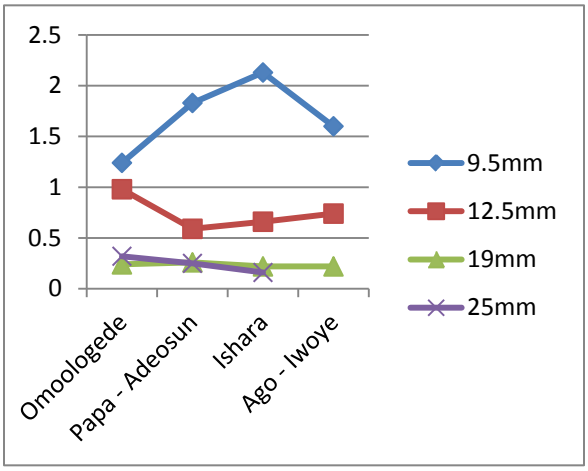

Figure 4 Values of Water Absorption of all Aggregate sizes from all Quarry Sites

The values contained in the figure indicates that the water absorption of all the different sizes of aggregates for all quarry sites are within the limits of 1% – 3% stated in literature and British Standards [16], [17], [18], [19], and [20]. It therefore follows that all the aggregates tested have very low water absorption values and hence are very suitable for concreting works.

3.4 Aggregate Impact Value

Figure 5 indicates that aggregate samples from Ago – Iwoye has the highest aggregate impact value of 28.12%, this is closely followed by that of Omoologede with a value of 27.55% and then that of Papa Adeosun with a value of 23.51%. The sample from Ishara has the lowest value of 18.30%. The Aggregates Crushing Value of 9.45% for Ago Iwoye is the highest, that of Papa Adeosun is next with a value of 7.82% and that of Ishara of 6.70% was next and that of Omoologede has the lowest value of 6.21%.

The result of the Aggregate Impact Value for all samples of granites tested in this study is between 18.30% and 28.12% which are in conformity with the requirements in relevant literatures, and specifications in relevant standards and codes of practice [21], [22], [9] and [11].

Figure 5 Values of Aggregates Impact Value and Aggregates Crushing Value of all Aggregate sizes from all Quarry Sites.

3.5 Aggregate Crushing Value

Indications from Figure 5 above reveals that the Aggregate Crushing Value of all the different sizes of aggregates for all quarry sites are considerably lesser than 35% value allowed for concreting works as stated in[10] and [11]**.** The average value of the Aggregate Crushing Value for the coarse aggregates samples considered in this research is between 6.2% and 9.45%. This is considerably lower than stated values in literature therefore, it can be said that the aggregates has a considerable lower value and is therefore very suitable for concreting work.

4.0 CONCLUSION

1. All the granites samples examined in the study meet the specified requirements for Specific Gravity and Moisture Content in as specified [7] and [8] respectively.

2. The result of Water Absorption for all the samples conform to specifications in relevant codes [15, 17, 18, 19, 20]

3 The Aggregate Impact and Aggregate Crushing Values are also un conformity with values specified in [10] and [11] respectively.

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