iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 10 **Issue:** IV **Month of publication:** April 2022

DOI: https://doi.org/10.22214/ijraset.2022.41614

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue IV Apr 2022- Available at www.ijraset.com

The Strength of Concrete Made from Various Aggregate

Aditya Ahire[1], Mujahid Shaikh[2], Akshay Sonawane[3], Athrva Handge[4], Vikaskumar Roy[5], Prof. P. G. Chavan[6], Prof. S. M. Shukia[7]
[1, 2, 3, 4, 5]Students, [6]Head of Department, [7]Lecturer, Department of Civil engineering, Guru Gobind Singh Polytechnic, Nashik

Abstract: The cost of river sand is much due to excessive cost of transportation from its natural sources. Also huge amount of depletion of these sources leads to environmental problems. Also environmental transportation and other constraints make the availability and use of river sand less attractive, hence it is very necessary now to find substitutes or replacements for river sand. The result for the sieve analysis carried out showed that the aggregates fell within the upper and lower limits of grading requirement.

The specific gravity of river sand used was 2.6, while that of grit was determined and the results obtained from two outcomes were 2.23 and 2.45, and the average found was 2.34. The bulk density of river sand was found to be 1550kg/m3 and that of grit was 1650kg/m3.

The slump obtained from specimens with different W/C of 0.35, 0.45 and 0.60 ranged from 51 – 86mm. The concrete produced from 100% grit as fine aggregate with a water-cement ratio of 0.45, produced a maximum compressive strength of 29.56 N/mm3 at the highest curing age in days, while sand alone as fine aggregate in one of the concrete mix, produced the least compressive strength of 17.33 N/mm3. Hence, the use of grit in construction is considered more economical since it offers optimum utilization and it is commonly available at different quarry sites.

I. INTRODUCTION

Concrete is regarded as the most widely used man-made material in the world, seconded only to water as the most utilized substance [1]. It is one of the most important construction materials, comparatively economical, easy to make, offering continuity and solidity and fast to bind with other materials. It is made up of cement, fine aggregate (sand), coarse aggregate (crushed or uncrushed stones) and water in the proper proportions. The key to good quality concrete are the raw materials required to make the concrete.

It has been shown that the strength of concrete depends mainly on the water-cement ratio, the slump, cement-aggregate ratio, the quality of cement, gradation of the aggregates and the efficiency of the curing technique.Also the specific gravity, particle size analysis, shape and surface texture of aggregates also has significant impact on the properties of wet and hardened concrete, while the mineralogical composition, toughness, elastic modulus generally account for significant impact on the hardened state of concrete.

In an attempt to investigate the variations in mixing water requirements as it affects aggregate, wills [10] studied the particle shape of fine and coarse aggregate as regards water requirement for adequate hydration of concrete. It was observed that the shape of the fine aggregate has a significance effect on water requirement than that of coarse aggregate.

In an attempt to investigate the variations in mixing water requirements as it affects aggregate, wills [10] studied the particle shape of fine and coarse aggregate as regards water requirement for adequate hydration of concrete. It was observed that the shape of the fine aggregate has a significance effect on water requirement than that of coarse aggregate.

From the forgoing, considering the permitted limits, the particle size distribution of the fine aggregate was found to have a greater effect on the properties of concrete than that of coarse aggregates [11]. As a result, the choice of the appropriate type of fine aggregate for concrete production is of great concern giving that river sand which is the most common fine aggregate in the production of concrete has become very expensive and relatively scarce. Hence, there is a great need for alternative materials from industrial wastes such as grit, also called quarry dust which is locally available at different quarry sites.

From the forgoing, considering the permitted limits, the particle size distribution of the fine aggregate was found to have a greater effect on the properties of concrete than that of coarse aggregates [11]. As a result, the choice of the appropriate type of fine aggregate for concrete production is of great concern giving that river sand which is the most common fine aggregate in the production of concrete has become very expensive and relatively scarce. Hence, there is a great need for alternative materials from industrial wastes such as grit, also called quarry dust which is locally available at different quarry sites.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue IV Apr 2022- Available at www.ijraset.com

II. MATERIALS AND METHOD

A. River Sand
River sand obtained from Choba river, Rivers State, Nigeria was used as fine aggregate for this experimental work.

B. Grit (Quarry Dust)
The quarry dust used in this work was obtained from the abundant deposits at Akamkpa quarry site in Akamkpa Local Government Area of Cross Rivers State, Nigeria. Quarry dust is a fine rock particle, grey in colour.

C. Coarse Aggregate
Gravel was used as course aggregate for this experimental work.

D. Water
Water used in the experiment was clean tap water free from impurities capable of undermining the chemical reaction of cement with the water. Density and PH value of water were 1000kg/m3 and 6.9 respectively.

E. Cement
Ordinary Portland cement purchased at the building material market in Port Harcourt from local distributors. The cement was well protected from dampness and it had a mass of 50kg.

F. Sieve Analysis
Sieve analysis of the fine aggregates were carried out and the results displayed in table 1, below.

Table 1: Sieve Analysis Results

Sieve Size	Grit (%passing through)	Sand (% passing through)
4.75mm	100	100
2.36mm	100	100
1.18mm	81	93
0.60mm	44	60
0.30mm	6	18
0.15mm	1	4

This conforms to grading zone III

G. Specific Gravity
Specific gravity test was carried out on the grit sample and is expressed in the table 2, below.

Table 2: Specific Gravity Table

BOTTLE/TEST NUMBER	1	2
Weight of Bottle only (g)…………M1	28.45	28.50
Weight of Bottle and Dry Sample (g)…..M2	78.50	80.26
Weight of Bottle, sample and water (g)…..M3	158.4	161
Weight of bottle and water (g)……M4	113.7	111.5
Gs = M2 – M1 ÷ (M4 – M1) – (M3 – M2)	2.23	2.45
Average (Gs)	2.34	

H. Mix Design, Casting and Curing

Mix design involves the calculation of various materials needed to produce a given volume of concrete. In this research, 3 cubes of dimensions 150mm x 150mm x 150mm were used in other to produce a good concrete. A consideration of the design is therefore necessary in order to come up with the appropriate mix in accordance with BS 1881 part 125:1986. The concrete was produced in three different batches;

1) Batch 1 100% river sand as fine aggregate
2) Batch 2 100% grit (quarry dust) as fine aggregate
3) Batch 3 50% river sand and 50% grit

The concrete cubes were made in standard moulds at a mix design ratio of 1:2:4 and w/c of 0.35, 0.45 and 0.60. The slump of the wet concrete was measured maintaining the specifications of the BS 1881: Part 102 (1983). For each type of fine aggregates 3 cubes (150x150mm) were cast also in accordance to BS 1881: Part 108 (1983). After one day of casting, the concrete cubes were removed from the mould and were transferred to a water tank for curing until the specimens are ready for compression test.

Figure 1: Grit sample

Figure 2: Concrete Mix Sample

Figure 3: Concrete Placing in Cube Moulds

Figure 4: Cubes in Curing Tank

I. Compressive Test Testing

The concrete cubes were cured and compression test carried out at 3, 7, 14, 21, and 28 days. Three cubes were tested for each water cement ratio and the average taken as the compressive strength of the concrete.

III. RESULTS AND DISCUSSION

A. Properties of Aggregates

The result for the sieve analysis carried out showed that the aggregates fell within the upper and lower limits of grading envelope indicating that it is very suitable for construction works.

B. Specific Gravity

The specific gravity of river sand was obtained as 2.6, while that of grit was determined as shown in table 2. The results obtained from two outcomes were 2.23 and 2.45, and the average found was 2.34. This was taken as the specific gravity for grit and it falls within the standard range for fine aggregates.

C. Bulk Density

The bulk density of river sand was found to be 1550kg/m3 and that of grit was 1650kg/m3. This implied lower void to be filled by cement and water as result of its densely packed nature and proper gradation.

D. Porosity and Absorption

The amount of absorption for concrete specimens of 0.35, 0.45 and 0.60 were obtained. It ranged from (0.70 – 1.2) as a result of low porosity due to densely packed and fine nature of the fine aggregates.

E. Slump and Workability

The results of the slump test of the wet concrete specimens were also obtained.

The slump obtained from different W/C of 0.35, 0.45 and 0.60 ranged from 51 – 86mm. The slump at a w/c of 0.60 was relatively higher than those of other 0.35 and 0.45, indicating the concrete produced better workability at increased absorption and w/c. At lower water-cement ratio more paste will be required to make the mix cohesive and produce better workability.

F. Compressive Strength

The result for the compression test on the concrete is shown in Table 3, for the concrete specimens considered. It was generally observed that the compressive strength increases with age of curing. The highest strength was obtained from concrete made with grit alone as fine aggregate, followed by the concrete made from equal combination of river sand and grit as fine aggregate. The lowest strength was recorded with concrete containing 100% river sand as fine aggregate, while the concrete containing 100% grit with a water-cement ratio of 0.45, produced a maximum compressive strength of 29.56 N/mm3 at the highest curing age in days, while sand alone as fine aggregate in one of the concrete mix, produced the least compressive strength of 17.33 N/mm3.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue IV Apr 2022- Available at www.ijraset.com

Table 3: Compressive Strength Results of different Concrete Specimens

Concrete	Age in Days	Compressive Strength (N/mm2)
Cement, River Sand and Gravel	3	7.56
	7	9.33
	14	11.11
	21	12.5
	28	17.33
Cement, Grit and Gravel	3	11.56
	7	15.11
	14	23.56
	21	26.15
	28	29.56
Cement, River Sand, Grit and Gravel	3	9.33
	7	10.67
	14	17.34
	21	19.95
	28	23.60

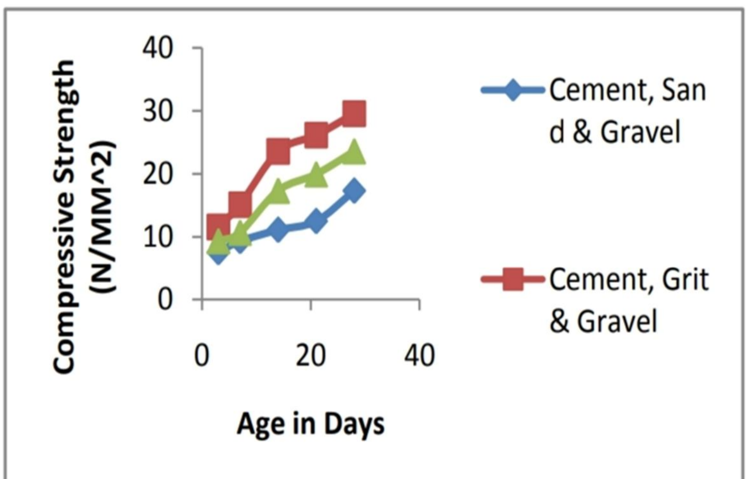


Figure 1: Graph of Compressive Strength of Concrete Against Age in Days

IV. CONCLUSION

The following conclusion can be drawn based on the results and discussion of the study conducted:

1) Maximum compressive strength for the three concrete samples was obtained at the longest curing age of 28 days.
2) Highest compressive strength was obtained from concrete sample mix of cement, grit and gravel.
3) The results indicate that characteristics of the concrete such as compressive strength, which can be considered a secondary and dependent property is governed by the packing density of the mixture and are independent of grading and particle shape of the fine aggregate used for production of concrete.
4) The use of grit in construction is considered more economical since it offers optimum utilization, noting that it is commonly available but considered an industrial waste.

REFERENCES

[1] Jackson. N. (1981). Civil engineering materials. Macmillan Press Ltd, London.

[2] Rocco, C.G and Elices M. (2009). Effect of aggregate shape on the mechanical properties of simple concrete. Engineering Fracture Mechanics, 76 (2), 286-298.

[3] Nwofor, T.C. & Eme D.B. (2010). Stability of concrete work with partial substitute of rice husk ash (RHA) for cement in Nigeria. Journal of Chemical, Mechanical and Engineering Practice, 1(2&3), 42-47.

[4] Sule S. & Nwofor, T.C. (2011). Analytical models for the prediction of mechanical properties of rice husk ash concrete. International Journal of Current Research, 3(11), 368-370

[5] Nwofor, T.C. & Sule, S. (2012). Stability of groundnut shell (GSA)/ordinary Portland cement (OPC) concrete in Nigeria. Advances in Applied Science Research, 3(4), 2283-2287.

[6] Nwofor, T.C. & Sule, S. (2012). Investigating geometric characteristics of cement concrete materials. International Journal of Innovative Research in Advanced Engineering, 1(9), 74-82

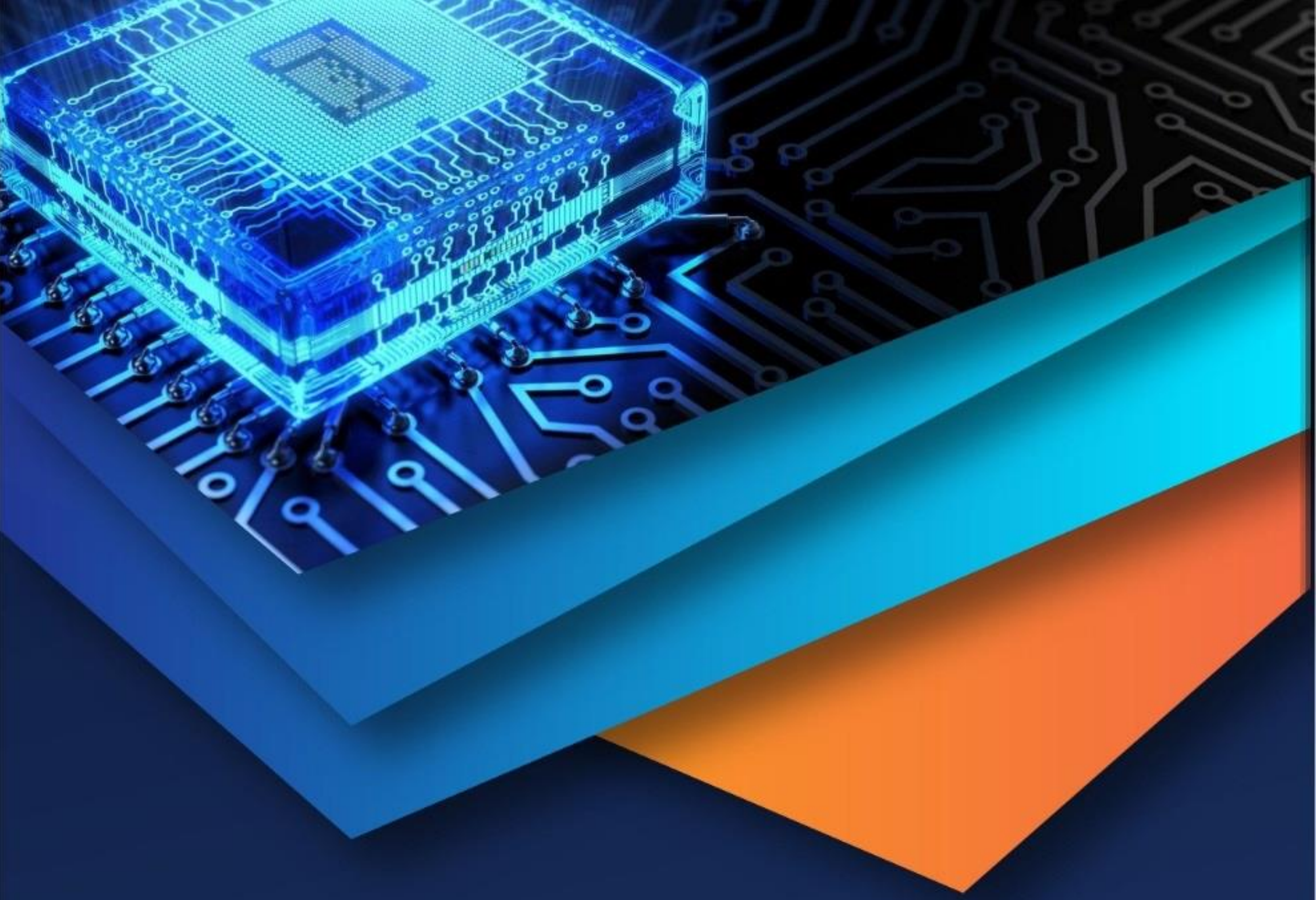
[7] Nwofor, T.C., Sule, S. & Eme, D.B. (2015). A comparative study of the methods of concrete mix design using crushed and uncrushed coarse aggregates. International Journal of Scientific and Engineering Research, 6(8), 1182-1194.

[8] Sule, S., Nwofor, T.C. & Onwuka, D.O. (2015). Probabilistic risk assessment of concrete component of an existing building. International Journal of Scientific and Engineering Research, 6(5), 1668-1673.

[9] Neville, A.M. (1996). Properties of concrete. John Wiley & Sons Inc, Fourth edition, New York

[10] Wills, M.H. (1967). How aggregate particle shape influence concrete mixing water requirement and Strength. Journal of Mater, 2 (4), 101-111.

[11] Hewlett, P.C. (1998). Chemistry of cement and concrete, John Wiley & Sons Inc, Fourth Edition, New York, 1998.



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY