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Research Paper

Characterization of a Periwinkle Shells Concrete for Infrastructure

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ABSTRACT: *Indifferent disposal of periwinkle shells (PS) is contributing to environmental dreadful conditions in spite of high cost of producing infrastructure. This study considered using PS as partial replacement of granite in concrete production as a possibility of providing healthy environment as well as durable infrastructure. Also, cements 42.5N and 32.5N tagged B and E respectively were employed in the production of normal and periwinkle shells concretes independently. Aggregates cement relationship of 3:1 with constant w/c ratio of 0.45 concrete mixes were produced leading to production of 480 specimens. The experiments involved replacing granite with PS in lieu of 0%, 5%, 10% and 15% by volume leading to eight batches of fresh concretes and workability determination. Rectangular pavers, I-pavers, Z-pavers and cubes of normal and PS concretes were produced. Compressive strengths and densities of the concrete specimens were determined individually after curing in order of 7, 14, 28, 56 and 91 days. Workability experimental results gave the higher the amount of periwinkle the lower the values of slump and compaction factor. Also, the higher value of granite replaced by PS the lower the compressive strength. PS concrete employing B cement has higher compressive strength than normal concrete using E cement. All cubes produced both for normal and PS concretes in this study at 28 days satisfied minimum standard specification of 40 N/mm² for rigid pavement. Z-paver gave optimal strength of the three pavers with 49 N/mm² and 41 N/mm² at 15% of PS replacement of B and E cements respectively for flexible pavement*

KEYWORDS: *Flexible Pavement, Pavers, Periwinkle Shells, Rigid Pavement, Cube*

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I. INTRODUCTION

Periwinkle (Tympanotonus fuscatus) shells generated as waste majorly along the coastal regions do contribute to dreadful conditions of such environments due to their haphazard disposal. Improper management of these periwinkle shells leads to blockage of drainages in particular closed ones thereby resulting to environmental flooding.

According to Aimikhe and Lekia [1] pollution prevention is a process that helps protect the environment whilst conserving and protecting natural resources. They claimed that pollution control ultimately translates waste management and environmental cost related to public and environmental healthy situations. They further claimed that pollution prevention amounts to controlling, treating, and disposing waste effectively.

Utilizing periwinkle shells that are wastes for the development of value-added products such as concretes is a valuable strategy. The valuable strategy includes sustainable resource management, reduced waste storage, reduced material costs, and wealth creation; Jović et al. [2].

Aimikhe and Lekia [1] as well claimed that using locally sourced waste shells as a partial or complete replacement for concrete aggregates can help reduce the production cost of concrete. They as well claimed that the system can as well mitigate environmental degradation, and improve waste management for sustainable development. Agbede and Manasseh [3] concluded on suitability of periwinkle shells as partial replacement for river gravel in concrete. They made it obvious that periwinkle shells can be used as partial replacement in normal construction works. They resolved specifically that in places where gravel is in short supply and periwinkle shells are readily available, concrete could be made economically. Ettu et al. [4] resolved on a reinvestigation of the prospects of using periwinkle shell as partial replacement for granite in concrete. They claimed that the reduced density of concrete produced when granitic chippings are partially replaced with periwinkle shells resulted in lower self-weight of structure. Also, that it is particularly beneficial in coastal communities where the soils have relatively low bearing capacities. Falade et al. [5] studied behaviour of lightweight concrete containing periwinkle shells at elevated temperature and submitted on its properties. They concluded that lightweight concrete containing periwinkle shells would only be suitable for structures that will be subjected to temperature less than 300°C.

Concrete can be produced by constituents that include water, cement, chemical admixture, fine aggregate, coarse aggregate, mineral admixture by mix ratios or mix designs. Also, concrete can as well be produced wholly or by partially replacing coarse aggregate such as granite with periwinkle shells. Akiije and Adebiyi [6] claimed that highway pavement such as road, tunnel, airstrip, railway, parking lots and other similar areas must have surfacing with durable materials.

The aim of this study is to identify the effectiveness of periwinkle shells by partially replacing granites in concrete at optimal use of same for infrastructural development. The main objectives of this study are to determine: (1) The chemical and compound compositions of the B42.5N and the E32.5N cements used. (2) Properties of the fresh and hardened concrete of normal and periwinkle shells concrete using both B42.5N and the E32.5N cements individually. (3) An optimum amount of periwinkle shells for use in concretes production in lieu of infrastructural developments. The scope of work included production of normal and periwinkle concretes. Making individual concrete samples of cubes, Z-shape pavers, I-shaped pavers and rectangular pavers. Testing the concretes at fresh states for workability by slump and compaction test devices. Testing each water cured hardened concrete samples as scheduled for 7, 14, 28, 56 and 91 days for compressive strength.

II. MATERIAL AND METHOD

The materials used as well as the methods employed for this study are as expressed in this section.

2.1. Concrete Material Constituents

Water, cement, sand, granite and periwinkle shells were the concrete material constituents that we employed in this study for the production of normal and periwinkle shell concretes. The constituents collected were tested appropriately for physical and chemical properties according to each material relevant standard specification methods.

Water: The water found in the laboratory was used for the individual concrete mixture. The water was suitable for human consumption for being sourced from the municipal water. The water was also used for cleaning the equipment used for concrete production and testing.

Cement: we made use of 50 kg per bag of cement B of 42.5N and cement E of 32.5N. Each cement bulk density, specific gravity, fineness, initial setting time, final setting time, chemical and compound composition properties were verified. These properties were determined according to standard methods (ASTM C114 [7]; ASTM C191 [8]). Also, the chemical analysis of the two brands of cement were tested separately in accordance to ASTM C114 [7].

Aggregates: Granite, periwinkle shells and sand aggregates used were separately air dried in bits inside the laboratory before use. In accordance to AASHTO T 27 [9], both granite and sand aggregates used were subjected to gradation, coefficient of uniformity and coefficient of curvature through laboratory tests. Also, the sand used was tested according to ASTM C128 [10] for moisture content, relative density, dry density and absorption values. Fine and granite used were separately tested for the bulk densities in accordance to AASHTO T 19 [11]. The moisture content, specific gravity, dry density and absorption of the granite were tested in accordance to ASTM C127 [12]. The standard specification methodology as described by Los Angeles abrasion test was employed in the laboratory to determine granite abrasion value in accordance to ASTM C 131 [13]. In accordance to ASTM C33/C33M [14], the granite used was tested for the determination of its crushing and impact values.

2.2. *Concrete Constituents Proportioning by Absolute Volume Method*

Both normal and periwinkle shells concretes produced in this study employed absolute volume method of mix proportioning. Equation 1 was used for the development of the normal concrete mix proportioning whilst Equation 2 was used for periwinkle shells concrete mixes.

Weight and Absolute volume method of Concrete Gambhir [15] and Akiije [16] is given.

$$\text{Volume} = V_{nc} = \frac{w}{S_w} + \frac{c}{S_c} + \frac{fa}{S_{fa}} + \frac{ca}{S_{ca}} = 1 \tag{1}$$

Weight and Absolute volume method of Periwinkle Shells Concrete is defined.

$$\text{Volume} = V_{psc} = \frac{w}{S_w} + \frac{c}{S_c} + \frac{fa}{S_{fa}} + \frac{ca}{S_{ca}} + \frac{ps}{S_{ps}} = 1 \quad (2)$$

Where;

V_{nc} = Absolute Normal Concrete Volume, m³;

V_{psc} = Absolute Periwinkle Shells Concrete Volume, m³;

w = Weight of Water, kg; ca = Weight of Cement;

fa = Weight of Fine Aggregate, kg; ca = Weight of Coarse Aggregate, kg;

ps = Weight of Periwinkle Shells, kg; S_w = Specific Gravity of Water;

S_c = Specific Gravity of Gravity of Cement; S_{fa} = Specific Gravity of Fine Aggregate;

S_{ca} = Specific Gravity.

Concrete constituents proportioning by weight and absolute volume method are illustrated in Table 1.

Table 1: Concrete constituents proportioning by weight and absolute volume method

Concrete types for 43NB and the 33NE	Water (kg/m³)	Cement (kg/m)³	fa (kg/m³)	ca (kg/m³)	ps (kg/m³)	Total (kg/m³)
Normal Concrete BNC1 or ENC1	240	534	534	1068	0	2376
PS Concrete BPSC2 or EPSC2	240	534	534	1008	40	2356
PS Concrete BPSC3 or EPSC3	240	534	534	949	80	2337
PS Concrete BPSC4 or EPSC4	240	534	534	890	120	2318

2.3. Concrete Production and Testing

The proportioning of each mixture was carried out using a 50 kg of either B or C cements along with the other constituents of concrete as shown in Table 2.

Fresh concrete production was carried out by the use of a concrete mixing machine for both fresh normal and periwinkle shells concretes. Workability of each fresh concrete produced were examined at the point of pouring the fresh concrete by both slump and compacting factor tests. Concrete specimens were also immediately cast per each batch of production of 15 specimens each of R-pavers, I-pavers, Z-pavers and cubes. Eight batches were carried out leading to a production of 480 specimens.

Table 2: Concrete constituents proportioning according to AASHTO T 23 [17]

CONCRETE LABELS	WC	Water kg	Cement kg	Fine Agg. kg	Granite kg	Deducted granite kg (Vol)	Added PS kg (Vol)
BNC1 or ENC1	0.45	11.25	50	50	100	0 (0%)	0 (0%)
BPSC2 or EPSC2	0.45	11.25	50	50	95	5 (5%)	3.73 (5%)
BPSC3 or EPSC3	0.45	11.25	50	50	90	10 (10%)	7.45 (10%)
BPSC4 or EPSC4	0.45	11.25	50	50	85	15 (15%)	11.18 (15%)

2.4. Harden Concrete Specimens Curing and Compression Tests

24 hours after casting, each batch of the hardened specimens were demoulded for curing according to AASHTO T 23 [17](2018). They were as well cured inside clean and clear water tank at the laboratory pending the various compression testing days. Specimens cast were subjected to compression test individually based upon schedule of water curing by 7, 14, 28, 56 and 91 days. Hydraulic compression testing machine powered with electricity was employed to testing and determining the compressive strength of both cube models and paver samples individually. During testing, three similar specimens were considered for crushing and the average value was considered as the compressive strength. The compressive strength for each specimen was calculated by the Equation 3.

$$\text{Compressive strength, } F = \frac{P}{A}. \quad (3)$$

Where,

F = Compressive strength, N/mm²; P = Maximum applied load, mm²; A = Cross sectional area, mm²

III. RESULTS AND DISCUSSIONS

A quest for substituting conventional coarse aggregates with other materials in the production of concrete has been emphasized of which periwinkle shells have been considered in this study. The results and discussions of the study upon normal and periwinkle shells concrete are considered as following. Table 3 shows results of the results of the compound composition of the two cements as carried out in the laboratory according to ASTM C1356 [18] standard specifications. It is obvious in Table 3 that 32.5 N cement satisfied the standard specification than 42.5 N cement regarding Tricalcium silicate $(CaO)_3.SiO_2$ and dicalcium silicate $(CaO)_2.SiO_2$. Table 4 also shows physical properties of the cement values as obtained in the laboratory. As exhibited in Table 4, the values of physical properties of the cement used were in conformity to their related standard specifications.

Table 3: Chemical compound composition of B and E brands of cement

Chemical Compound Composition	Cement Chemist Notation (CCN)	Cement B Value (%)	Cement E Value (%)	ASTM C1356 [18] Spec. (%)
Tricalcium Silicate ($(CaO)_3.SiO_2$)	C_3S	80.59	46.16	45 - 75
Dicalcium Silicate ($(CaO)_2.SiO_2$)	C_2S	3.49	13.58	7 - 32
Tricalcium Aluminate ($(CaO)_3.Al_2O_3$)	C_3A	7.71	10.98	0 - 13
Tetracalcium Aluminoferrite ($(CaO)_4.Al_2O_3\ Fe_2O)_3$)	C4AF	11.07	7.57	0 - 18

Table 4: Physical properties of the cement ***of B and E brands of cement***

Cement Physical Properties	Cement B Value	Cement E Value	Specifications	Standards
Fineness (% on 45 µm)	6	4	10	ASTM C786 [19]
Specific gravity	3.15	3.15	3.13-3.15	ASTM C188 [20]
Bulk density (kg/m³)	1440	1440	1440	ASTM C29 [21]
Standard consistency (%)	27	28	25-35	ASTM C187 [22]
Initial setting time (min)	115	122	≥ 30	ASTM C191 [8]
Final setting time (min)	246	258	≤ 600	ASTM C191 [8]
Loss on ignition (%)	0.04	0.05	0.04-0.05	ASTM D7348 [23]
Insoluble residue (%)	0.03	0.03	0.02-0.04	ASTM C465 [24]

3.1 Aggregate Properties

Table 5 is showing the properties of the materials used. Also, Figure 1 is showing the aggregate gradation charts of fine aggregate while Figure 2 shows the coarse aggregate of granite grade size 9.5 mm gradation chart. Although the coefficient of uniformity (Cu) of fine aggregate is 2 that is less than 6 but the coefficient of curvature (Cc) is 1.28 that is higher than 1. The inference is that the sand used is well graded. The coefficient of uniformity (Cu) of the granite is 1.5 that is less than 4 and the coefficient of curvature (Cc) is 0.96 which is less than 1. Thus, the implication is that the 9.5 mm granite used is uniformly graded. The fineness modulus of sand used is 2.8 which is within the range of 2.6 to 2.9 and it is a medium sand of which it is to give optimum concrete density and strength. The fineness modulus of 9.5 mm granite used is 1.99 which is not within the range of 5.5 to 8.0 whilst 6 would give optimum concrete density and strength. However, since sand used is well graded and when it is combined in the concrete production will definitely give good concrete. The values of the densities of sand, granite and periwinkle aggregates used are respectfully 1,670 kg/m³, 1,700 kg/m³and 1,353 kg/m³. The values of the specific of sand, granite and periwinkle aggregates used are respectfully 2.67, 2.70 and 2.1. Since the density and the specific gravity of PS are lower when compared to those of sand and granite made the concrete produced to be of lower density and strength. Figure 3 is showing samples of both 9.5 mm size granite and periwinkle shells used.

Table 5: Properties of fine, coarse and periwinkle shells aggregates

Properties	Fine aggregate	Coarse aggregate	Coarse aggregate
Aggregates	Sand	Fine Gravel	Periwinkle shells
Maximum size of the aggregate (mm)	4.75	9.5	9.5
Fineness modulus (%)	2.8	2	-
Bulk density (kg/m³)	1670	1700	1353
Specific gravity	2.67	2.7	2.1
Coefficient of uniformity (Cu)	2.0	2.67	-

Coefficient of curvature (Cc)	1.28	0.97	-
Maximum percentage of bulking (%)	18.9	-	-
Corresponding moisture content (%)	2.32	-	-
Water absorption (%)	2.15	0.08	-

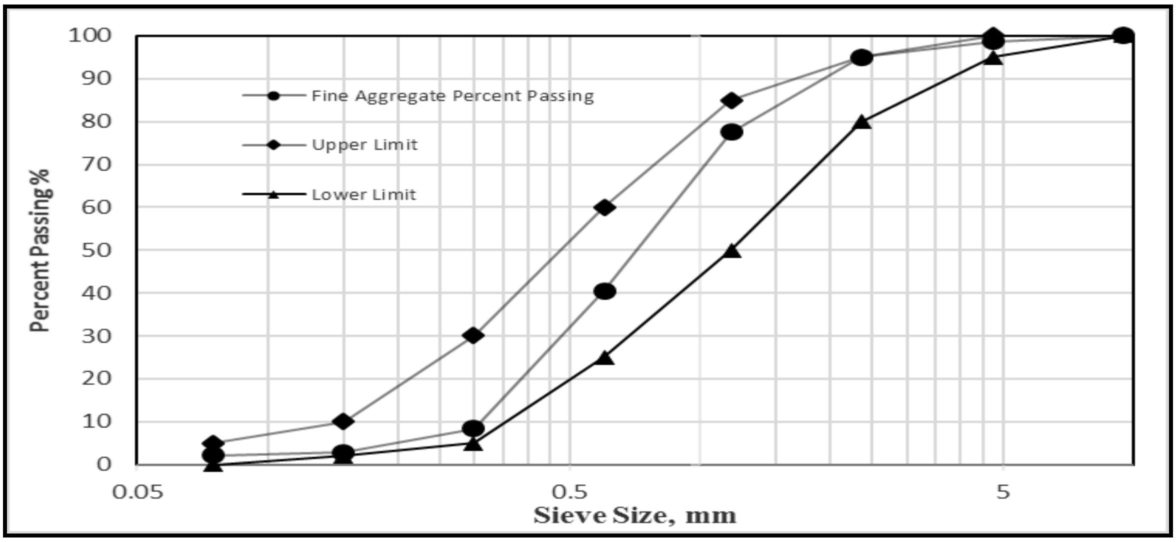

Figure 1: Fine aggregate gradation chart

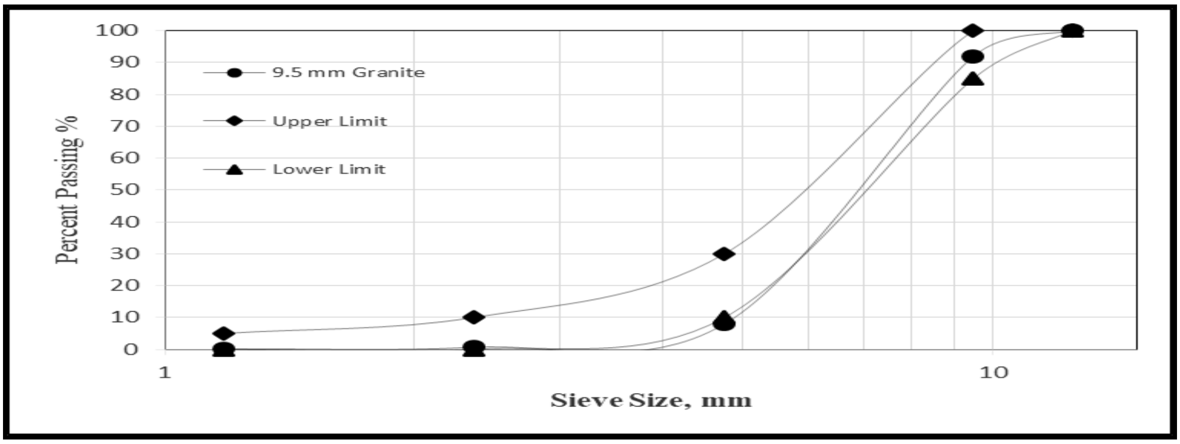

Figure 2: 9.5 mm size granite gradation chart

Figure 3: 9.5 mm size granite and periwinkle shells samples

3.2 Fresh Concrete Properties

Table 6 is showing slump values and compaction factors of normal and periwinkle shells concretes using B and E cements individually. The normal and periwinkle shells concrete slump values and compaction factors made of B cement are higher in amount than those of same made of E cement. This could be attributed to the fact that the value of the fineness of E cement is higher than that of B. Also in Table 6, the concrete workability values of both slumps and compaction factors are decreasing as periwinkle shells are increasing. The phenomenon can be attributed to the fact that as the periwinkle shells are increasing their surface area is increasing leading to increase in amount of water requirement. For both normal and periwinkle shells concrete of B cement, the slump value varies from 65 to 88 while the compaction factor varies from 0.91 to 0.93 thus indicating medium level degree of workability. Also, considering same for concrete made of E cement, the slump value varies from 30 to 42 while the compaction factor varies from 0.86 to 0.89 showing low degree of workability.

Table 6: Properties of fresh normal and periwinkle shells concretes

S/No	Specimen label	W/C	PS %	Slump (mm)	Degree of Workability	Compaction Factor, CF	Degree of Workability
1	BNC1	0.45	0	88	Medium	0.93	Medium
2	BPSC2	0.45	5	87	Medium	0.92	Medium
3	BPSC3	0.45	10	70	Medium	0.91	Medium
4	BPSC4	0.45	15	65	Medium	0.91	Medium
5	ENC1	0.45	0	42	Low	0.89	Very low
6	EPSC2	0.45	5	40	Low	0.88	Very low
7	EPSC3	0.45	10	35	Low	0.87	Very low
8	EPSC4	0.45	15	30	Low	0.86	Very low

3.3 Hardened Concrete Properties

Results of both normal and periwinkle water cured concrete specimens' compressive strengths using both B and E cements separately are shown in Figures 4 to 7. Each of the eight types of concrete specimens developed included BNC1, BPSC2, BPSC3 and BPSC4 of B cement. Other concrete types included ENC1, EPSC2, EPSC3 and EPSC4 of E cement. Of the four figures, each line diagram in them is showing the trend of concrete compressive strength development at a higher rate for day 7 to day 14. It is as well followed by a high rate concrete development for day 14 to day 28. However, a low rate of development for day 28 to day 56 followed by a lower rated development of concrete compressive strength for day 56 to day 91.

Also for each line diagram, the trend of the compressive strength developed is that the higher the curing day the higher the concrete compressive strength. Each figure is also indicating that the compressive strengths of B cement concretes are higher than those of E cement concretes. This is of course for cement B is of 42.5 N while that of cement E is of 32.5 N.

Also, comparing compressive strengths of rectangular R-paver, I-paver, Z-paver and cube samples, cubes specimens produced by B cement gave the highest values of them all. The compressive strength of Z-pavers is the highest of the three types of paver specimens. I-pavers are having the higher values compressive strength than those of R-pavers.

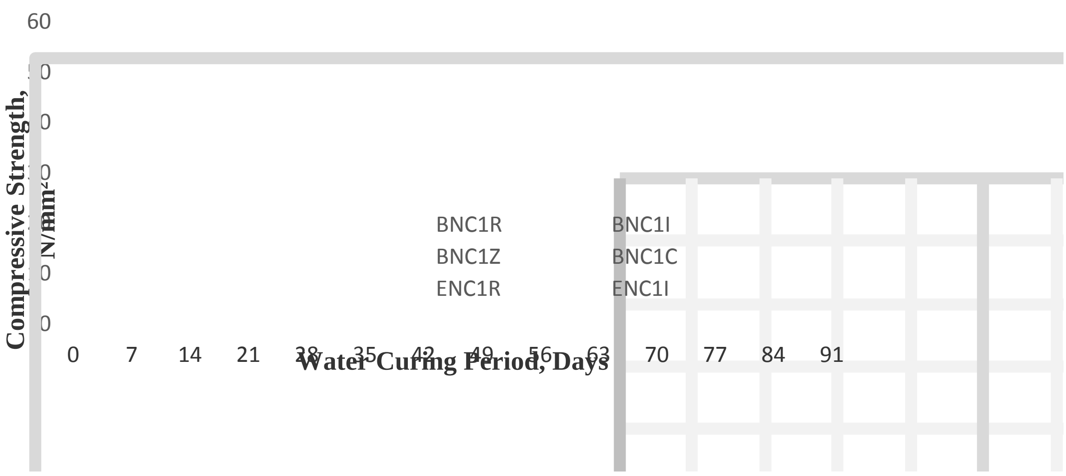

Figure 4: Compressive strength-water curing period effect for normal concrete

However, one can see in Figure 8 that the cube compressive strength of concrete with 5% PS using type B cement has higher value than that of normal concrete using cement type E. This can be vivid by looking through labels ENCI and BPSC2 of Figure 8. The phenomenon is obvious in Figure 9 by label of '28 Days Cubes' bar chart. This phenomenon resulted upon the choice of cement based at the same rate of value that brought a tangible economic advantage of lowering the cost of roads and buildings construction.

Tables 7 through 10 are showing concrete compressive strength of the specimens developed in this study for 28 days curing in water storage tank. The specimens are tagged BNC1, ENC1, BPSC2, EPSC2, BPSC3, EPSC3, BPSC4 and EPSC4 for both B and E cements. Interpretation, implication, importance and relevance of this study results are based upon AASHTO T 23 [17] as discussed in Tables 7 through 10.

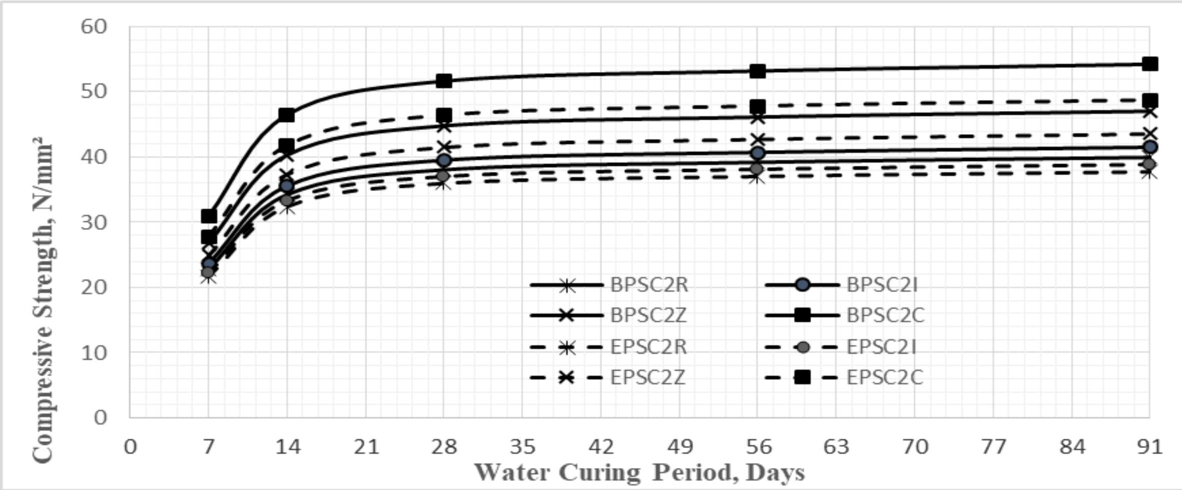

Figure 5: Compressive strength-water curing period effect @ 5% periwinkle shells concrete

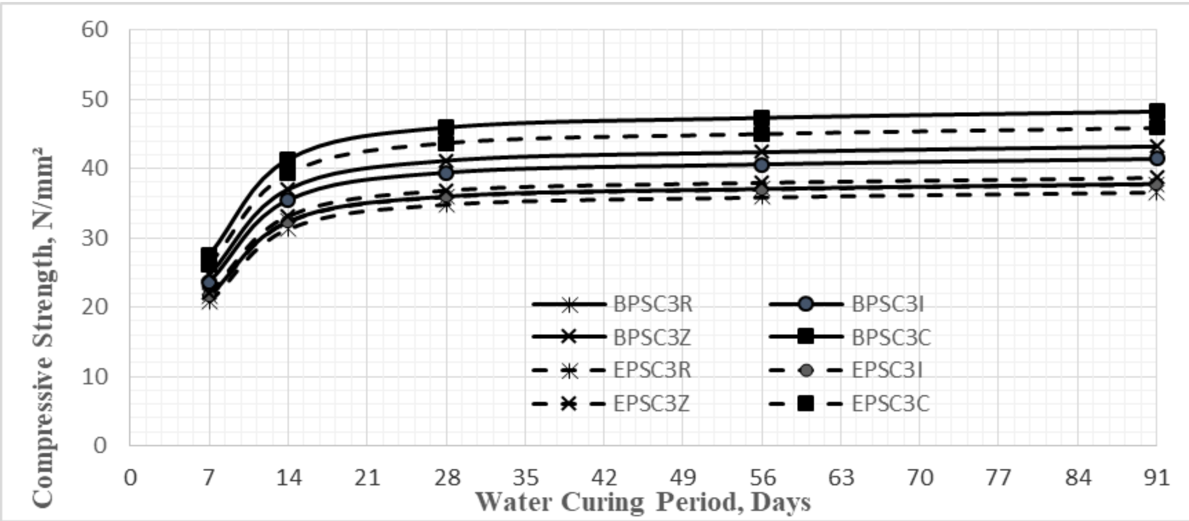

Figure 6: Compressive strength-water curing period effect @ 10% periwinkle shells concrete

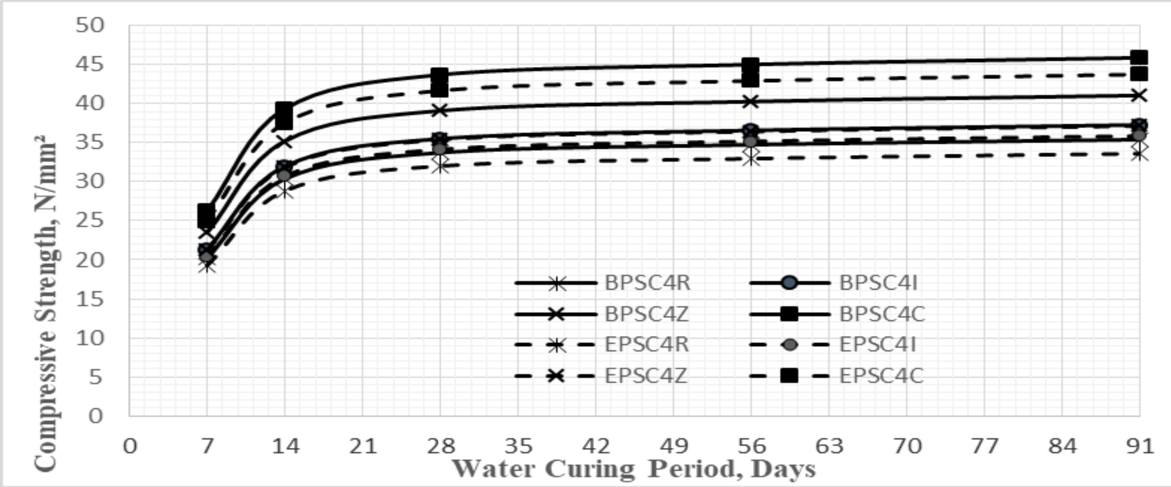

Figure 7: Compressive strength of specimens at 28 days water curing

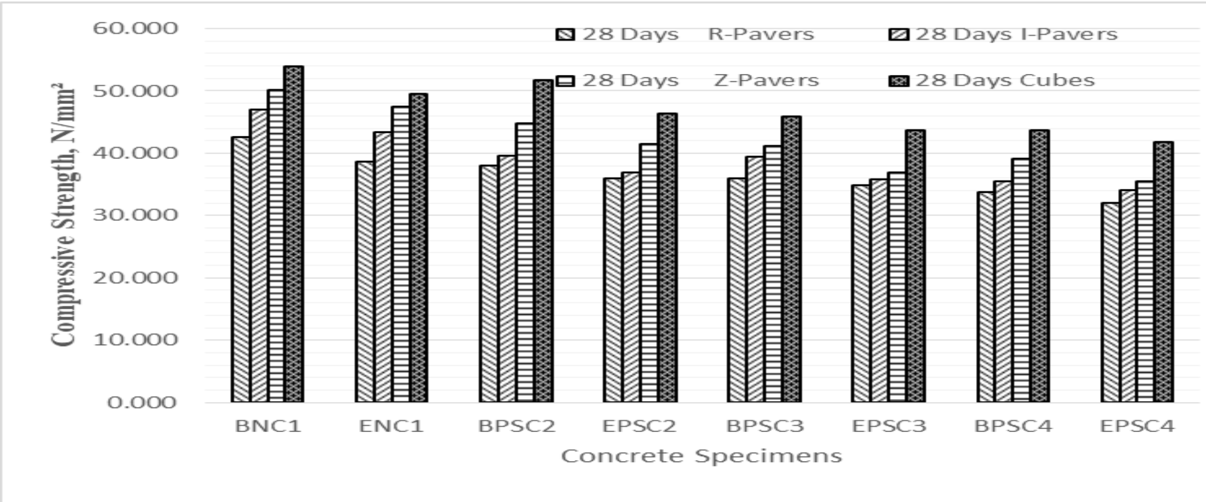

Figure 8: Compressive strength of specimens at 28 days water curing

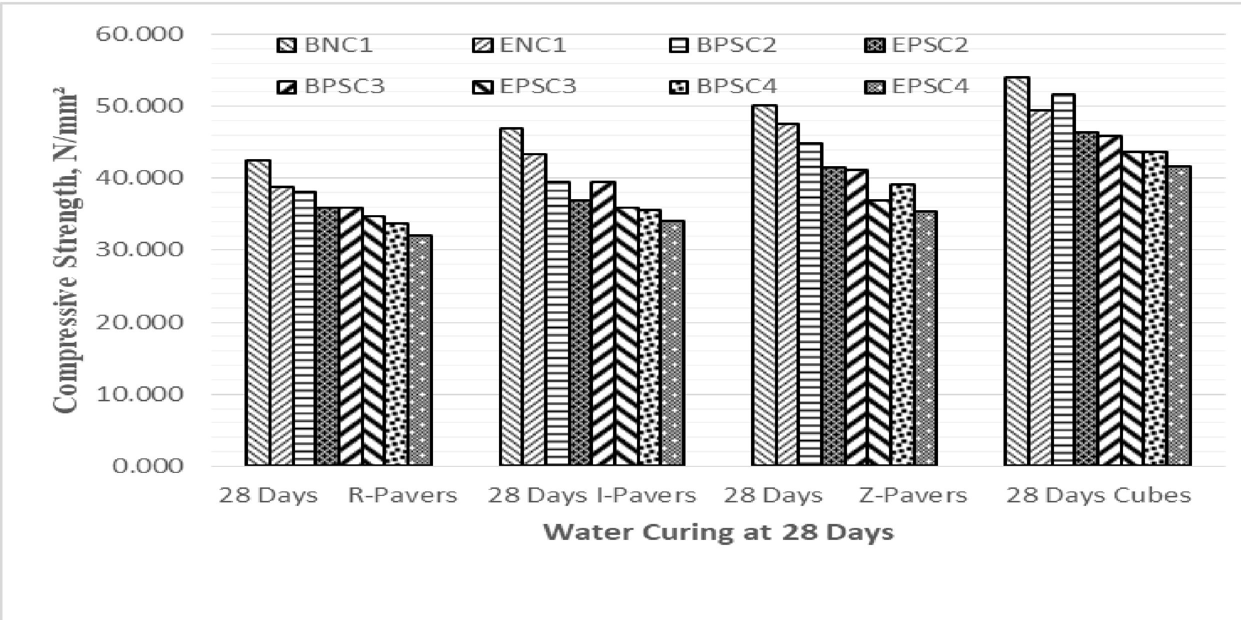

Figure 9: Compressive strength of specimens at 28 days water curing

Table 7: Characteristics of 28 days cubes compressive strength for normal and PS concretes

	28 Days Cubes Strength N/mm^2	PS replac-ement in %	Interpretation, implication, importance and relevance of results based upon AASHTO T 23 [17] test that provides the comprehensive strength of concrete 28 Days Cubes
BNC1	54	0	BNC1 and BPSC2 cubes satisfied 50 N/mm^2 compressive strength which is of high-strength concrete grade quality. The concrete strength is satisfactory for placement in a harsh condition where aggressive chemicals or where high level of abrasion is present. ENC1, EPSC2, BPSC3, EPSC3, and BPSC4 cubes satisfied 45 N/mm^2 compressive strength which is of standard concrete grade by quality. The concrete strength is satisfactory for placement in an exposed rural areas and of heavy-duty construct\ion. EPSC4 cubes satisfied 40 N/mm^2 compressive strength which is of standard concrete grade by quality. They are useful for highway pavements, drives, paths and footings.
ENC1	49	0	
BPSC2	52	5	
EPSC2	46	5	
BPSC3	49	10	
EPSC3	46	10	
BPSC4	45	15	
EPSC4	44	15	

Table 8: Characteristics of 28 days Z-paver compressive strength for normal and PS concretes

	28 Days Z-Pavers Strength N/mm^2	PS replac-ement in %	Interpretation, implication, importance and relevance of results based upon AASHTO T 23 [17] test that provides the comprehensive strength of concrete 28 Days Z-Pavers
BNC1	50	0	BNC1 Z-Pavers satisfied 50N/mm^2 compressive strength which is of high-strength concrete grade quality. They are useful for flexible pavement of very heavy traffic category. They are also satisfactory for placement in a harsh condition where aggressive chemicals or where high level of abrasion is present. ENC1, EPSC2 and EPSC3 Z-Pavers satisfied 45N/mm^2 compressive strength which is of standard concrete grade by quality. They are useful for flexible pavement of heavy traffic category. Also, they are satisfactory for placement in an exposed rural areas and of heavy-duty construct\ion. BPSC4 and EPSC2 satisfied 40N/mm^2 compressive strength which is of standard concrete grade quality. They are useful for flexible pavement of medium traffic category. EPSC4 and EPSC3 satisfied 30N/mm^2 compressive strength which is of standard concrete grade quality. They are useful for flexible pavement of light traffic category
ENC1	48	0	
BPSC2	49	5	
EPSC2	41	5	
BPSC3	47	10	
EPSC3	33	10	
BPSC4	43	15	
EPSC4	32	15	

Table 9: Characteristics of 28 days I-pavers compressive strength for normal and PS concretes

	28 Days I-Paver Strength N/mm^2	PS replac-ement in %	Interpretation, implication, importance and relevance of results based upon AASHTO T 23 [17] test that provides the comprehensive strength of concrete 28 Days I-Pavers
BNC1	47	0	BNC1 and BPSC2 I-Pavers satisfied 45N/mm^2 compressive strength which is of standard concrete grade by quality. They are useful for flexible pavement of heavy traffic category. Also, they are satisfactory for placement in an exposed rural areas and of heavy-duty construct\ion. ENC1 satisfied 40N/mm^2 compressive strength which is of standard concrete grade quality. They are useful for flexible pavement of medium traffic category. EPSC2, BPSC3 and BPSC4 satisfied 35N/mm^2 compressive strength which is of standard concrete grade quality. They are useful for flexible pavement of medium traffic category. EPSC3 and EPSC4 satisfied 30 N/mm^2 compressive strength which is of standard concrete grade quality. They are useful for flexible pavement of non- traffic category.
ENC1	43	0	
BPSC2	45	5	
EPSC2	38	5	
BPSC3	37	10	
EPSC3	27	10	
BPSC4	35	15	
EPSC4	25	15	

Table 10: Characteristics of 28 days R-pavers compressive strength for normal and PS concretes

	28 Days R-Paver Strength N/mm^2	PS replac-ement in %	Interpretation, implication, importance and relevance of results based upon AASHTO T 23 [17] test that provides the comprehensive strength of concrete 28 Days R-Pavers
BNC1	45	0	BNC1 R-Pavers satisfied $45N/mm^2$ compressive strength which is of standard concrete grade by quality. They are useful for flexible pavement of heavy traffic category. Also, they are satisfactory for placement in an exposed rural areas and of heavy-duty construct\ion. BPSC2 and ENC1 satisfied $40N/mm^2$ compressive strength which is of standard concrete grade quality. They are useful for flexible pavement of medium traffic category. EPSC2, BPSC3, EPSC3 and BPSC4 satisfied $35N/mm^2$ compressive strength which is of standard concrete grade quality. They are useful for flexible pavement of medium traffic category. EPSC4 satisfied 30 N/mm^2 compressive strength which is of standard concrete grade quality. They are useful for flexible pavement of non- traffic category.
ENC1	40	0	
BPSC2	41	5	
EPSC2	36	5	
BPSC3	39	10	
EPSC3	31	10	
BPSC4	37	15	
EPSC4	29	15	

IV. CONCLUSIONS

The effectiveness of periwinkle shells (PS) in lieu of 0%, 5%, 10% and 15% when used to partially replace 9.5 mm size granite in the production of concrete has been studied. Rectangular R-pavers, I-pavers, Z-pavers and cubes of normal and PS concretes were produced using aggregates cement ratio of 3:1 with constant w/c ratio of 0.45.

Based upon the gradation results, the sand used is well graded but the granite used is not and yet the combination of the two constituents gave useful quality concrete. For fresh concrete, the higher the amount of PS the lower the values of slump and compaction factor. The presence of periwinkle with lowest values of density and specific gravity brought about reduced strength of periwinkle shells concrete.

Compressive strengths of specimens at 28 days of water tank curing of 54 N/mm^2 to 25 N/mm^2 were achieved in the course of this study. Concretes of cement B produced with 5% of periwinkle shells replacement have higher values of compressive strengths than those of normal concrete using cement E.

Both normal and periwinkle shells concrete cubes produced attained the compressive strength above 40 N/mm^2. Z-pavers only attained same with cement B usage at 10% while cement E attained it at 5%. Both I-pavers and R-pavers attained alike with cement B at 5% while cement E attained it only at normal concrete.

Normal and periwinkle shells concrete cubes and pavers with compressive strength of 40 N/mm^2 and above are employable for rigid pavements and flexible pavements respectively based on location and traffic.

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