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PERIWINKLE SHELLS AS CONCRETE AGGREGATES

NIGERIAN BUILDING AND ROAD RESEARCH INSTITUTE

FOREWARD

The research work done on periwinkle shells and presented in this publication was undertaken in the Materials and Research Division of the Federal Ministry of Works and Housing in 1968. This work evoked a high degree of enthusiasm in all the members of the Material and Research Division involved in materials testing. As a result when this paper was first presented by Dr. Y. O. Beredugo for publication, it was decided that the publication should be deferred until the one year compressive strength test results were available. It would then be possible to describe the engineering properties of periwinkle shells concrete with a high degree of confidence. This caution appeared justified at the time because some investigators had reported a marginal fall in the one year compressive strength of conventional concrete when compared to the ninety one-day strength.

Subsequent events have now confirmed that the report on the research project should have been published at that time, perhaps in a different form. When the one year results became available, Dr. Beredugo had gone abroad for further post-graduate studies and his absence naturally led to a delay in arranging the publication of a paper on the project. Meanwhile the two-year results for water-cement ratio of 0.50 were obtained. The results were significantly lower than those for the ninety one-day and one year compressive strength. The logical reaction was to initiate a new series of tests. This was not readily possible because Dr. Beredugo, the principal investigator, was away and there was no competent supporting staff to continue the research. As a result work on periwinkle shells in the Federal Ministry of Works and Housing ceased in spite of good intentions to continue with it. Eventually the Federal Ministry of Works and Housing was reorganised in 1976 and the Materials and Research Division of the Ministry became part of the enlarged Civil Engineering Services Division, apparently with less emphasis on research. The present writer was duly seconded to the Nigerian Building and Road Research Institute to establish it from scratch.

Notwithstanding, the set back just described, considerable interest continued to be shown in periwinkle shells. Professor C. O. Oragun referred to it in his paper entitled "The relevance to structural design of some properties of engineering materials" at the 1979 Annual Conference of the Nigerian Society of Engineers. In the Conference on Materials Testing, Control and Research (February 1984) held in Port Harcourt, Dr. T. M. Oguara presented a paper, "Suitability of periwinkle shells as construction aggregate", based on the first phase of his research project on these materials. During the discussion of Dr. Oguara's paper, reference was naturally made to Dr. Beredugo's previous work on this subject by the present writer and finally, though reluctantly, by Dr. Beredugo himself. In view of the great interest shown by most of the participants in Dr. Beredugo's work, it was decided that his 1968/69 paper should be published as early as possible and widely circulated. This paper is hereby published in its original form with only minor editing with regard to dates and names of organisations mentioned in the paper. The Imperial Units of the original paper have been retained because conversion to metric units would have led to approximations and replotting of all the graphs. Instead conversion factors have been provided in the report for easy use.

The two-year strength compressive strength have been included in Fig. 6A. The significant difference between this set of results and that of the ninety one-day strength strongly suggests that tests to examine the behaviour of periwinkle shell concrete at one year, two years and above is necessary. It is hoped that current investigators will take up this challenge. On the other hand, the fact, that many buildings built with periwinkle shells concrete over the past twenty years or so in the Niger Delta appeared to have shown no sign of instability, has encouraged us to present Dr. Beredugo's paper in its original form without any alteration.

It is hoped that this publication will provide an adequate and reliable background information on a local material which is still actively in use in the building industry in the lagoonal riverine areas of Nigeria.

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Director.

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SUMMARY

Large quantities of periwinkles occur in the lagoons and mudflats of the Niger Delta and Badagry. They are used as coarse aggregates in these areas where gravels are not available. The physical and mechanical properties of the periwinkle shells are determined and the properties of the concrete made with these shells are considered. The preliminary results indicate that periwinkle shell concrete may be regarded as light-weight concrete.

PERIWINKLE SHELLS AS CONCRETE AGGREGATES

Introduction:

The Periwinkle is a small greenish blue marine snail of the Littorinae family which is widely distributed in the littoral drift sand banks of both the Pacific and Atlantic Oceans. In the lagoons and mudflats of the Niger Delta between Calabar in the East and Badagry in the West are found two species of Periwinkles-Tympanostomus and Pachmellania which are a delicacy of the riverine people. Over the years, large quantities of the calcareous top-shaped shells, with their characteristic spiral cavities formerly occupied by the periwinkles, have accumulated in many places, and have become valuable sources of coarse aggregates for concrete in areas where there are neither stones nor gravels.

So far the use of periwinkle shells as coarse aggregates has been based on trial and error methods devised by "Village" brick-layers. Thus there appears to be a necessity to assess the value of periwinkle shells as coarse aggregates. This paper describes the preliminary results which have been obtained.

Physical and Mechanical Properties of Periwinkle Shells:

Tests have been carried out to determine the grading, aggregate crushing value, Los Angeles Abrasion Value, Specific gravity, Water absorption value, Bulk density and Percentage Voids of the Periwinkle Shells.

Concrete-Making Properties:

The materials used in making the concrete cubes for testing are:—

Coarse Aggregates: Periwinkle Shells obtained from stockpiles at Ajegunle and Surulere. (See Table 1 for properties).

Fine Aggregates : Fine lagoon sand, Bulk density 97.0 lb/ft³ (loose), 106 lb/ft³ (rodded) Specific gravity 2.65, grading Zone 3 (BS. 882: 1201 (1954) (See fig. 1).

For mix design only: Ogun River sharp sand Bulk density 94.5 lb/ft³ (loose) specific gravity 2.63, grading Zone 2 (BS.882: 1201 (1954) (See fig. 1).

Cement : Ordinary portland cement-Elephant Brand. Complying with BS.12 (1958).

Water : Normal Tap water.

The sand and the periwinkle shells were air dried by spreading them in the laboratory for at least 48 hours before using them.

In the first series of tests a nominal mix of 1:1½:3 by volume (equivalent to mix proportions of 1:1.62:1.13 by weight) was designed for volume batching at water/cement ratios of 0.35, 0.40, 0.45, 0.50 and 0.60 determined on a weight basis. Eighteen 6 inch cubes were prepared at each water/cement ratio for testing at 1, 3, 7, 28, 91 and 365 days.

In the second series of tests, a nominal mix of 1:1.22:2.91 by volume (equivalent to mix proportions of 1:1.32:2.1 by weight) was designed for weigh batching at the same water/cement ratios as in the first series of tests. Twelve 6 inch cubes were prepared at each water/cement ratio for testing at 1, 3, 7 and 28 days.