# Experimental Study on Seashell as a Fine Aggregate & Fly Ash as Cement in Concrete

G.janarthanana[1], N.Moorthyb[2]
[1]*PG student (Structural Engineering), Department of Civil Engineering, Paavai Engineering College, Pachal*
[2]*Assistant Professor, Department of Civil Engineering, Paavai Engineering College, Pachal*

***Abstract*- This paper reports the exploratory study on the suitability of the sea shells and fly ash as partial replacement for in concrete. This has necessitated research into alternative materials of construction and analyzing tensile and compressive strength characteristics of concrete produced using by sea shells as substitutes for conventional fine aggregate with partial replacement using M25 grade concrete. Sieve analysis is carried out from various fine aggregates (FA) and coarse aggregates (CA) samples and the sample which suits the requirement is selected. Fly ash will be used to replace cement by weight and by volume respectively. The Fine aggregate is partial replacement with 0%, 15%, 30%, 45%,60% and 75% by seashells. Specific gravity tests are will be carried out for fine aggregate.The water cement ratio is maintained for this mix design is 0.45. Compacting factor test will be carried out on fresh concrete while Compressive Strength test will be carried out on hardened 150mmX150mm concrete cubes after 7 and 28 days curing in water. The compacting factor of the volume batched concrete produced by volume replacement of sand by seashell is higher than that produced by weight replacement.**

**Index terms- sea shell, fly ash, partial replacement**

## INTRODUCTION

Concrete is unique among major construction materials because it is designed specifically for civil engineering projects. All along in india, we have been using natural sand and gravel in concrete manufacturing.

Sand Researchers world over are in continuous search for the alternatives to sand. Fine aggregate is one of the important constituents of concrete and mortar in construction industry. River sand is becoming a scarce material. Sand mining from our rivers has become objectionably excessive. It has now reached a stage where it is killing all our rivers day by day. So sand mining has to be discouraged so as to save the rivers.

As natural sand deposits become depleted near some areas of metropolitan growth, the use of alternatives to sands as a replacement fine aggregate in concrete is receiving increased attention. As a solution for this, various alternatives are explored and used in many parts of the world. Other alternatives for river sand are by-products from cement industry and reusing construction.

There are three types of ash produced by thermal power plants, viz. fly ash, bottom ash, and pond ash. Fly ash is collected by mechanical or electrostatic precipitators from the flue gases of power plant.

Various alternatives are explored and used in many parts of the world:

- Manufactured Sand(M Sand)
- Processed Quarry Dust
- Processed Crushed Rock Fines (CRF)
- Offshore Sand
- Dune Sand
- Washed Soil (Filtered Sand)
- Fly Ash/ Bottom Ash/Pond Ash
- Slag Sand
- Copper Slag Sand
- Construction Demolition Waste
- Powdered Glass
- Aluminum saw mill waste
- Granite Fines/Slurry and Many More.

## PROPERTIES OF MATERIALS

### SEASHELL AS FINE AGGREGATE:

Seashells are hard protective coat created by living organisms in sea, these seashells are exoskeletons of an invertebrate composed as calcium carbonate and calcium. Shells are very often washed up onto a beach empty and clean, as the animal living inside that seashell is dead. There are more than 50,000 varieties of seashells present in nature. Seashells are used in various ways as currency in history , tools, horticulture, religion and spirituality, musical instruments, personal adornment, crafts and art, architectural decoration etc. . Beach combers pick empty seashells very often, majority of seashells are offered for sale commercially. The sea shells into fine powder and mixed in concrete as chemical admixture, as sea shells contain calcium these may help in increasing strength of concrete and also reduces the temperature emitted due to exothermal reaction in concrete. As there are very less study related to sea shells this paper helps in using sea shells as chemical admixtures if necessary.

The seashells collected must be collected carefully with specific thickness and size. These shells must be crushed by hammering and powdered as seashells are made of calcium it's difficult to make it into fine powder so as to use it as admixture. The powder must be fine and uniform without lumps and large pieces. The colour of powder varies depending on the shells we have chosen to crush.

CONDUCTIVITY TEST FOR SEA SHELL:

To find salinity in the sea shell, conductivity is measured by a probe, which applies voltage between two electrodes. The drop in voltage is used to measure the resistance of the water, which is then converted to conductivity. Conductivity is reciprocal to resistance and is measured in the amount of conductance over a certain distance. The conductivity unit has been called "mho" because it is the inverse of "ohm", the resistance unit.

REASON OF SEASHELL USED IN CONCRETE:

Seashell is a waste obtained from Gummidi poondi at Sunambukulam which is near Pulicat lake, formed as the result of disintegration of dead animals. Seashell consists of three layers outer, intermediate and inner layer Outer layer is made up of calcite material whereas inner layer is otherwise known as nacre which is made up of calcium carbonate. Since 95% of calcium carbonate present in seashell, it has the strength nearly equal to fine aggregate. The seashells of 20 mm size were sieved and used.

FLY ASH AS CEMENT:

Fly ash, the fine particulate waste material produced by pulverized coal-based thermal power station, is an environmental pollutant, it has a potential to be a resource material. It is nowadays used in cement, concrete and other cement based applications in India.

CLASSIFICATION OF FLY ASH:

According to IS 3812-1981, there are two grades of Fly Ash

1. Grade I fly ash, which are derived from bituminous coal having fractions $SiO_2+Al_2O_3+Fe_2O_3$ greater than 70 %.
2. Grade II Fly ash, which are derived from lignite coal having fractions $SiO_2+Al_2O_3+Fe_2O_3$ greater than 50 %.

ASTM C618 specified two categories of fly ash, Class C and Class F depending on the type of coal and the resultant chemical analysis.

Class C fly ash, normally produced from the combustion of lignite or sub bituminous coals, contains CaO higher than 10 percent and possesses cementitious properties in addition to pozzolanic properties.

Class F fly ash, normally produced from the combustion of bituminous or an anthracite coal contains CaO below 10 percent and possesses pozzolanic properties.

Classification, based on the boiler operations is classified with two distinct identities: Low temperature(LT) fly ash, Generated out of combustion temperature below 900o C High temperature(HT) fly ash, Generated out of combustion temperature below 1000o C .

This threshold temperature demarcates the development of meta kaolinite phases in the case of LT and the same constituents form as reactive glassy phases in the case of HT fly ash. LT fly ash hence preferred for precast building materials such as bricks/blocks. However the higher ignition loss, of the order of 4-8 percent makes the fly ash less desirable for cement and concrete applications. In contrast, the initial pozzolanic reaction is slow in HT fly ash, which is accelerated with age. This property together with a relatively low ignition loss makes HT

fly ash more suitable for use in cement and concrete industries.

COLOUR OF FLY ASH:

Fly ash can be tan to dark gray, depending on its chemical and mineral constituents. Tan and light colours are typically associated with high lime content. A brownish colour is typically associated with the iron content. A dark gray to black colour is typically attributed to an elevated unburned content. Fly ash colour is usually very consistent for each power plant and coal source.


Typical ash colours.

REASON OF FLYASH USED IN CONCRETE:

In concrete mix, when water and cement come in contact, a chemical reaction initiates that produces binding material and consolidates the concrete mass. The process exothermic and heat is released which increases the temperature of the mass When fly ash is present in the concrete mass, it plays dual role for the strength development. Fly ash reacts with released lime and produces binder as explained above and render additional strength to the concrete mass. The un- reactive portion of fly ash act as micro aggregates and fills up the matrix to render packing effect and results in increased strength. The large temperature rise of concrete mass exerts temperature stresses and can ead micro cracks. When fly ash is used as part of cementations material, quantum of heat liberated is low and staggers through pozzolanic reactions and thus reduces micro-cracking and improves soundness of concrete mass.

## PRELIMINARY TESTS ON MATERIALS

CEMENT:

1. Fineness Test
2. Consistency Test
3. Initial And Final Setting Time Of Cement

FINE AGGREGATE:

1. Specific Gravity Test
2. Fineness Modulus Test

COARSE AGGREGATE:

- Specific Gravity Test
- Fineness Modulus Test

## FINENESS TEST ON CEMENT

This test is carried to check the proper grinding of cement. It may be notes that the finer cement has the quicker action with water and gain early strength. weight 100 gm of cement and take it on a standard sieve IS sieve NO.9 (90μ). Break down the air set lumps in the sample with fingers. Continuously sieve the sample giving circular and vertical motion for a period of 15 minutes. Weight the residue left on the sieve. The residue retained on IS sieve number 9 should not be greater then 10%.

Fineness = ( weight of residue/ weight of sample)

= (2/100) x 100

=2 % (allowed %=10).

## FINENESS MODULUS TEST ON FINE AGGREGATE

Fine aggregate with rounded particle shape and smooth flexure requires less mixing water in concrete and therefore were preferred. It is having fineness modulus of 2.60 and it corresponds to grading zone III of is: 383-1970 grading requirement. The specific gravity of fine aggregate is 2.60. .Quantity taken is 1000 gms.

The sieve test satisfied zone II of IS 383-1970.

Fineness modules of fine Aggregate = (cumulative % of soil retained/100)

= 306.6/100

= 3.0

## CONCRETE MIX DESIGN AND QUANTITY OF MATERIALS

GENERAL

In this chapter the design mix for the study will be prepared and discussed. Design procedure from “recommended guidelines for concrete mix design” (IS102262-1982,IS456-2000). The Process of selecting suitable ingredients of concrete and

determining their relative amounts with the objective of producing a concrete of required strength, durability, and workabilitity as economically as possible is termed the concrete mix design. The proportioning of ingredients of concrete is governed by the required performance of concrete in two states namely plastic and hardened states.

The variations in cost of materials arise from the fact that the cement is several times costly than the aggregates, thus the aim is to produce as learn a mix as possible.from the technical point of view the rich mixes may lead to high shrinkage and cracking in structural concrete, and evolution of high heat of hydration in mass concrete which may cause cracking.

The actual cost of concrete is related to the cost of materials required for producing a minimum mean strength called characteristic strength that is specified by the designer of structure. This depends on the quality control measures, but there is no doubt that the quality controls adds to the cost of concrete. The extent of quality control is often an economic compromise and depends on size and type of job.

## REQUIREMENTS OF CONCRETE MIX DESIGN

The requirements which from the basis of selection and proportioning of mix ingredients are:

- The minimum compressive strength required from structural consideration.
- The adequate workability necessary for full compaction with the compacting equipment available.
- Maximum water cement ratio and maximum cement content to give adequate durability for particular site conditions.
- Maximum cement content to avoid shrinkage, cracking due to temperature cycle in mass concrete.

For the design of concrete mix, the following information is required:

- Grade of concrete
- Degree of workability
- Type of cement
- Minimum cement content
- Maximum water cement ratio
- Type of aggregates
- Maximum nominal size of aggregate
- Type of admixtures, if required
- Level of quality assurance
- Exposure condition
- Method of placing
- Degree of supervision

## CONCLUSION:

In this study, the effect of replacing cement by ground seashell on the mechanistic properties of concrete was examined. Replacement of the cement with the ground seashell led to a decrease of compressive strength of seashell concrete compared with the control OPC concrete. The tensile and flexural strength of the seashell concrete were higher than the control concrete. The Young's Modulus of Elasticity of seashell concrete increased with the age of concrete. It can be concluded that the concrete containing ground seashell yielded relatively better tension properties, but lower compressive strength and modulus of elasticity than the control concrete.

The project of replacement of sea shell as fine aggregate have finally resulted in the increase in the strength of concrete to a high extend. The strength increase is found not only in compression but it follows the same in split-tensile and in flexural strength. The gradual increase in strength is observed in all the 15%, 30%, 45%, and 60%, after that there is fall in strength in the 75% replacement. The maximum percentage of successful replacement is found in 60% which mark the maximum strength value in all three forms of strength (viz) compression and split tensile. This increase in strength clearly shows us the sea shell starts to react with the others ingredients of concrete which there by increase in the heat of hydration in concrete as far seen from basics of concrete technology.

We concluded that the addition of sea shell increases strength in all replacement and we wish further studies on the durability of the concrete on the combination of partial replacement of fly ash or cement and the partial replacement of sea shell for fine aggregate is needed, due to fact of less calcium carbonate in fly ash from our studies and experiment, we finally concluded that the seashell to give increase the strength up to 60%.

REFERENCES

[1] Adewuyi, A. P., Adegoke, T. 2008. Exploratory Study Of Periwinkle Shells As fine Aggregate In Concrete Works. Journal of Applied Sciences Research, 4(12): 1678-1681.

[2] Adewuyi A. P. and Adegoke T. 2008. Exploratory Study of Periwinkle Shells as fine Aggregate in Concrete Works. Journal Science Resources. 4(12): 1678- 1681.Shetty M.S. "Concrete Technology heory and Practice" S.Chand& Company New Delhi.

[3] Exploratory Study of Periwinkle Shells as fine Aggregates in Concrete Works" A. P. Adewuyi and T. Adegoke -ARPN Journal of Engineering and Applied Sciences, December 2008.

[4] Hogendom, Jan and Johnsom Marion: The Shell Money of the Slave Trade. African Studies Series 49, Cambridge University Press, Cambridge, 1986.

[5] Kamang, E. E. and O. F. Job (1997).The relationship between the strength and non-destructive parameters of periwinkle shell concrete.African Journal of Natural Sciences, 1:96-100.

[6] Abbott, R. Tucker, 1986, Seashells of North America, St. Martin's Press, New York. Osadebe, N. N., and O. M. Ibearugbulem (2009).Application of scheffe's simplex model in optimizing compressive strength of periwinkle shell granite concrete.The Heartland Engineer, 4 (1): 27 – 38.

[7] Poutiers,J.M.(1998). Gastropads in: FAO Species Identification Guide for Fishery Purpose: The living resources of the Western central Pacific Voume 1. Seaweeds, corals, bivalves and gastropods. Rome,FAO 1998. Page 503.