Experimental investigation on partial replacement of cement by oyster shell in plain concrete

[1] Abhijeet B. Moghe, [2] G. D. Dhawale, [3] Rutuja K. Kakpure,
[1]P. G. Student of structural Engineering BDCE, Sevagram, Wardha [2]professor of Civil Engineering Department, BDCE, Sevagram, Wardha, [3]Asst.Professor of Civil Engineering Department, BDCE, Sevagram, Wardha.

Abstract: In this day and age we are in front of most complex safety problems connected to environment. Many things which are made-up for our comfortable life are accountable for polluting environment due to offensive waste management technique. The present exploration assesses the merging of oyster shell in concrete. The consequence of oyster shell as fractional replacement of cement on the compressive strength (primary) of concrete has been investigated. Globally, over 150 countries produce cement and/or clinker, the primary input to cement. In 2001, the United States was the world's third largest producer of cement (90 million metric tons (MMT)), behind China (661 MMT) and India (100 MMT). This work reports an experimental procedure to investigate the effect of using oyster shell powder as partial replacement of cement. Tabby is a type of concrete made by burning oyster shells to create lime, then mixing it with water, sand, ash and broken oyster shells. Tabby was used by early Spanish settlers in present-day North Carolina and Florida, then by English colonists primarily in coastal South Carolina and Georgia. Oyster shell as a alternate for straight cement with partial replacement using M25 grade concrete The main objective is to support the use of these outwardly waste products as a construction material.

Index Terms- **oyster shell, tabby, compressive, flexural , tensile strength.**

I. INTRODUCTION

Concrete is one of the two most used structure materials in construction. In order to reduce reliance of raw material in concrete producing, the green concrete had been promoted. Green concrete is the concrete that had been produced using recycle or wasted natural materials. One of the ways to produce green concrete is by using modified cement. Cement is the second largest volume materials used by human being after water. Cement plays the role of a binder, a substance that sets and hardens and might bind alternative materials along. During production of cement and hydration process of cement, the amount of CO2 emitted by the industry is nearly 900 kg of CO2 for every 1000 kg of cement produced. This CO2 production causes serious environmental damages. The sea shells are high potential materials to become partial cement replacement and filler in concrete. The calcium carbonate (CaCO3) in the sea shells is more than 90% and is similar to contain of calcium carbonate in the limestone dust that been used in the Portland cement production. Impressively, the crystal structures of seashells are largely composed of calcite and aragonite, which have higher strengths and density than limestone powder. Also, the particle sizes of seashells are between 36µm to 75µm and are similar to the particle size of Portland cement. Due to the physical and chemical properties of conch and oyster shells, they may be a suitable substitute for cement and aggregates. The crushed shells would be beneficial to the waste industry along with the construction industry. When the shells get crushed they can be substituted for all different types of concrete constituent depending on the size of the specimen. Oyster shells are a viable option because they contain a large amount of calcium carbonate. This can help improve the strength in the concrete. Also the calcium carbonate can help improve resistance against heat and chemicals. The shells may increase strength in the concrete due to the uniquely weaved pattern they Shellfish shells have gained interest in studies revolving around recycled concrete aggregate. The reason why shellfish shells and other seashells are part of this study is because they are easily obtainable from the seafood industry and they have mechanical and chemical properties that make them attractive to the construction industry. After preliminary research, the shells that were chosen are oyster and conch shells. Other shells that could have been used were various types of mussel shells or clam shells. These were selected off of their physical properties as well as their availability. Oysters have high calcium carbonate content and also contain rare impurities that improve strength as well. Oyster shells have been used throughout history to help aid in construction. Quicklime is obtained from oyster shells when the CaCO3 in the shell is heated at an excess of 2000°F or about 1100°C and converted to calcium oxide (CaO), otherwise known as lime. This lime is then used in mortar mixtures and is called tabby. Tabby used in construction has been found commonly in Muslim territories such as Cordoba and Seville in the 15th century for military structures. Perhaps the most common tabby constructed buildings are 11th century British Castles. For example the Wareham Castle, in Dorset, England was found in ruins, but was excavated in the 1950s, revealing that tabby was used for much of the mortaring.

Table 1.1 Chemical composition of oyster-shell

Sr. No.	Composition	River Oyster	Sea Oyster
1	$CaCO_3$	95.994	89.56
2	SiO_2	1.283	4.04
3	MgO	0.68	0.649
4	Al_2O_3	0.40	0.419
5	SrO	0.35	0.33

6	P_2O_5	0.206	0.204
7	Na_2O	0.98	0.98
8	SO_3	0.724	0.724

Table 1.2 Physical properties of oyster shell

Sr. No.	Color	Ceramic White
1	Specific gravity	1.74
2	Colour	White Powder
3	$CaCO_3$	92.13

Shells are currently taking up a large volume in landfills. If they are used in concrete mixes they will have a positive environmental impact. This is beneficial for the industry especially since many admixtures like fly ash are scrutinized for their potential negative environmental impact. Shells can be considered into the aggregate category as well as cement. The shells are a cheaper way to increase the strength of concrete by providing a substance for the cement past to bond to. Shellfish shells gain their strength from a nacre layer that has a crystalline structure in the form of calcium carbonate.

- **OBJECTIVES**

➢ Objectives for the project work are as follows:

1. Investigation on the concrete mixes containing 5%, 10% and 15% of shell as partial replacement of cement to evaluate the mechanical properties of concrete such as compressive strength, tensile splitting strength, and flexural strength characteristics.
2. Evaluating and studying the effect of varying percentages of shell and comparing the results with normal concrete without any replacements.
3. Performing the slump test and analyzing the difference of slump for different % of shell to obtain the workability of the concrete with partially replacements.

2. LITERATURE REVIEW

.**Experimental study on partial replacement of coarse aggregate by seashell & partial replacement of cement by fly ash** Yamuna Bharathi in 2016. This research helps to access the behavior of concrete mixed with seashell and determination of optimum percentage of combined mixture which can be recommended as suitable alternative construction material in low cost housing delivery especially in coastal areas and near fresh water where they are found as waste. Seashell is mainly composed of calcium and the rough texture makes it suitable to be used as partial coarse aggregate replacement which provides an economic alternative to the conventional materials such as gravel. Experimental studies were performed on conventional concrete and mixtures of seashell with concrete. The percentage of seashell is varied from 3% to 11%. Also the cement is replaced for 25% of fly ash. The mechanical properties of concrete such as compressive strength, tensile strength, flexural strength, and workability are evaluated. The laboratory tests (Compressive strength test, Split Tensile strength test, Flexural strength test, workability) were carried out on concrete with replacement of seashell and fly ash. The mechanical behavior of concrete with varying percentage (0 to 11%) of seashell and 25% of fly ash are studied by repeating the procedure.

An Effect on Oyster Shell Powder's Mechanical Properties in Self Compacting Concrete S.Abinaya and S.Prasanna venkatesh 2016 Oyster shell were collected from river and sea & it produced to powder from In this study, pozzolonic replaced with various percentages by oyster shell powder and the fresh and hardened properties of cement concrete were studied. In this study, cement content in the SCC mix is replaced with various percentage of 0%, .2.5%, 5%, 7.5%, 10% and 20% of oyster (River and Sea) shell powder is used and the fresh and hardened properties of cement concrete were studied. It is observed that can be effectively used as a mineral additive in SCC. The Mix Design for concrete M25 grade is being done as per the Indian Standard Code IS: 10262-2009.Specimens (cube &cylinders) were cast to study the strength properties such as compressive strength (3, 7 , 14 and 28 days), split tensile strength (28 days), Flexural Strength (28 days) and durability aspects such as water absorption (28 days). Water Binder ratio was maintained at 0.40. Test results was indicate that concrete containing oyster shell power to an extent of 5% shows better strength characteristics when compared to the concrete with 0% of oyster shell power, whereas concrete with oyster shell power of 5% replacement shows optimum results better durability characteristics than the other percentage replacements of oyster shell power. In this study ,it has been found that with the increase in various percentage of replacement river and oyster shell powder, hence if we increase the sea and river oyster shell powder replace of pozzolanic properties fly ash .so optimum percentage increase the river and sea oyster shell powder we have a better workable concrete is 5%.The result of the mechanical properties (compressive, split and flexure strength) have shown significant performance difference and the higher compressive strength has been obtained for oyster shell powder replacement level could be of optimum consideration for flow ability, mechanical properties study.

Developing Concrete using Sea Shell as a Fine Aggregate Ms. V. Mohanalakshmi and Ms. S. Indhu, **2017,** the author have replaced the sea shell after grinding it to the maximum size of 4.75 mm. The IS 10262-2009 was followed for the mix design of M20 grade concrete after that optimization of cement is done. Sea shell which is used in concrete confirming to the zone II as per IS 383-1970. Then cubes were casted for the 5 parts of partial replacement as 20%, 40%, 60 %, 80%, and 100 %. All the specimens are used for 7 & 28 days and tested for compressive, flexural and split tensile strength .We have observed the maximum strength is obtained for 80% replacement of sea shell. 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 20%, 40%, 60%, and 80%, after that there is fall in strength in the 100% replacement. The maximum percentage of successful replacement is found in 80% which mark the maximum strength value in all three forms of strength (viz) compression, split-tensile, flexural. 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 conclude that 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 conclude that seashell increase the strength to maximum extend.

Mechanical properties of seashell concrete Monita Oliviaa and Lita Darmayantia **2015,** in this research, the ground cockle seashell was used as a partial cement replacement. The ground seashells were prepared by burning, crushing, grinding and filtering the cockle using no #200 sieve. The mechanical properties studied were compressive strength, splitting tensile strength, flexural strength and modulus of elasticity of seashell concrete. These properties were compared with those of a control Ordinary Portland Cement (OPC) concrete. Based on the trial mixes using the ground seashell with proportion of 2, 4, 6 and 8% by weight of cement, the optimum compressive strength was achieved for the mix that replaced cement by 4%. The seashell concrete yielded less compressive strength and modulus elasticity compared to the OPC concrete. It is noted that the tensile strength and flexural strength were higher than those of the OPC concrete, which is advantageous to increase concrete tension properties. 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**.**

Parametric Study on Concrete by Partial Replacement of Aggregates with Sea Shells and Coconut Shells Jay Kumar Patel, Dr. D.L. Shah and Prof. T.N. Patel, **2016,** This paper critically reviews the current state of knowledge and technology of using sea shells and coconut shells to concrete. Detailed review on the various preparation techniques and the resulting properties of sea shells and coconut shells are presented and the effects of sea shells and coconut shells on the fresh and hardened concrete properties are discussed in this paper. The effect of sea shells and coconut shells on workability, plastic shrinkage, and compressive strength, splitting tensile strength, flexural strength, crack behavior and dry shrinkage is discussed in this paper. Pull-out behavior of the coconut shell in the concrete are also reviewed. Finally, some applications of the sea shells and coconut shells concrete are discussed. This paper has presented the current state of knowledge of using sea shells and coconut shells in concrete. It also reviews the reinforcing effects of coconut shells in concrete, environmental benefits and applications of sea shells and coconut shells concrete. The sand substitution by crushed seashells has slightly decreased the fluidity of mortars and increases the bulk density. The Drying shrinkage increased, Elastic modulus decreased with SR of OS increase. Use of sea shells did not show negative influence on freezing and thawing; improve the chemical attack resistance and permeability resistance. OS did not cause reduction in the compressive strength of concrete at age 28 days and development of compressive strength was faster as SR of OS increased. If the percentage of coconut shell decreases, density and compressive strength of concrete is increases and vice-versa. Coconut shells were more suitable than palm kernel shells when used as substitute for conventional aggregates in concrete production. Bond strength of coconut shell concrete is higher than that of the conventional concrete. Coconut shell concrete led to reduce plastic shrinkage cracking and more deflection compared to conventional concrete. Also coconut shell concrete gives warning before its failure compared to conventional concrete. The flow ability of mortars based 100% of seashells, was better and is suitable for a fluid concrete (as a self-compacting concrete). Coconut shell concrete is able to achieve its full strain capacity under flexural loadings.

Suitability of Periwinkle Shell as Partial Replacement for River Gravel in Concrete Olufemi Isaac and Joel Manasseh, **2009,** In this paper the Physical and mechanical properties of the shells and well-graded river gravel were determined and compared. Concrete cubes were prepared using proportions of 1:0, 1:1, 1:3, 3:1 and 0:1 periwinkle shells to river gravel by weight, as coarse aggregate. Compressive strength tests were carried out on the periwinkle gravel concrete cubes. The bulk density of the periwinkle shells was found to be 515 kg/m3 while that for river gravel was 1611 kg/m3. The aggregate impact values for periwinkle shells and river gravel were 58.59 % and 27.1 % respectively. Concrete cubes with periwinkle shells alone as coarse aggregate were lighter and of lower compressive strengths compared to those with other periwinkle: gravel properties. The 28-day density and compressive strength of periwinkle were 1944 kg/m3 and 13.05 N/mm2 respectively. Density, workability and the compressive strength of periwinkle concrete increased with increasing inclusion of river gravel. From this study, it can be concluded that periwinkle shells can be used as partial replacement for river gravel in normal construction works especially in places where river gravel is in short supply and periwinkle shells are readily available. The study could lead to the following conclusions:

- ✓ Periwinkle shells can be used as a lightweight aggregate in concrete works. Its bulk density of 515 kg/m3 resulted in concrete with lower weight. Hence lower dead loads in concrete construction.
- ✓ The workability of periwinkle-gravel concrete is reduced with increasing content of periwinkle shells and the strength development in periwinkle-gravel concrete is similar to those of conventional gravel concrete.
- ✓ The foregoing suggests that periwinkle shells can be used as a partial replacement for river gravel in normal construction works especially in places where gravel is in short supply and periwinkle shells are readily available. This will help in reducing the threat these shells pose to our environment since their decaying rate is insignificant.

Experimental study on partial replacement of Cement with egg shell powder and silica fume M. Parkas and N. Partha, **2017** the goal of this investigation work is to use the egg shell powder, silica fume as a limited additional of cement. Egg shell powder is replaced by 5%, 10% and 15% in addition with the silica fume by 2.5%, 5%, and 7.5% of weight of cement. An experimental research demonstrates the strength features such as split tensile strength, compressive strength, and flexural strength test of egg shell based concrete were investigated. It

is found the strength of the concrete rises with the adding of egg shell powder and silica fume and finally the comparison is made for the egg shell and silica fume added strength of concrete. The objectives of all the tests are to find the mechanical properties the concrete (Grade M30) with Egg Shell Powder and Silica fume as the replacement of cement. The strength properties such as compressive strength and split tensile strength test results are presented in the tabular form and also in graphical form for better understanding. The results are analyzed, compared between the various mix proportions. Compressive strength is by far the maximum important possessions checked for the concrete and even more vital in high performance concrete. Uniaxial compression test is carried out on the specimen (150×150×150 mm cubes) at various days to check the development of compressive strength due to effect of curing. It is clear that cement replaced with egg shell powder up to 15 per cent shows the increase in compressive strength compared with the controlled concrete cubes. Also silica fume added up to 7.5 per cent with the weight of cement along with the egg shell powder results increase in compressive strength. Since the addition of Silica fumes doesn't make any broad changes to the Concrete strength, Flexural and Split tensile tests are performed with the plain Egg shell mix only. The comparison of compressive strength for conventional mix and all other eggshell and silica fume concrete mix with different percentage is also done as shown in Figure Under uniaxial compression the blows are about parallel to the practical load but some blows form at a position to the applied load. The similar cracks are triggered by a localized tensile stress in a standard to the compressive load and the motivated cracks occur due to collapse caused by the growth of shear planes. It should be noted that the cracks have formed in two planes equivalent to the load and that the specimen fragments into column type trashes. The results of compressive strength obtained for all types of specimens by conducting compressive test and the results.

The compressive strength of the concrete with egg shell powder as cement replacement material increases up to 15 percent without silica fume, Addition of silica fume also improves the strength but in inexpensive point of view only the egg shell powder replacement is sufficient enough for getting higher strength. The split tensile strength of the egg shell powder concrete decreases with the addition of egg shell powder. This can be increased if the concrete is used with reinforcement. The flexural strength of the egg shell concrete increases with the addition of egg shell powder up to 15 percent. The egg shell powder surrounding the surface of the mix, May increases the Carbonation process and may reduce the Permeability in the long run. Hence a detailed study of Carbonation process in the mix is needed.

Feasibility of Pulverized Oyster Shell as a Cementing Material Chou-Fu Liang and Hung-Yu Wang, **2013** this research intends to study the cementing potential of pulverized oyster shell, rich in calcium, when mixed with fly ash and soil. Cylindrical compacted soil and cubic lime specimens with different proportions of the shells and fly ash are made to study the strength variance. Soil, which is classified as CL in the USCS system, commercialized pulverized oyster shell, F-type fly ash, and lime are mixed in different weight percentages. Five sample groups are made to study the compressive strength of soil and lime specimens, respectively. The lime cubes are made with 0.45W/B ratio and the cylindrical soils are compacted under the standard Procter compaction process with 20% moisture content. The results show that increment of shell quantity result to lower strength on both the soil and lime specimens. In a 56-day curing, the compressive strength of the lime cubes containing fly ash increases evidently while those carrying the shell get little progress in strength. The soil specimens containing fly ash gradually gain strength as curing proceeds. It suggests that mixtures of the shell and fly ash do not process any Pozzolanic reaction nor help to raise the unconfined strength of the compacted soil through the curing. Standard moulds were not used for the compaction. However, the test result shows that the compaction is reasonable, and the specific weight of compacted soil suggests consistency of soil result. Therefore, the compaction selected for this study is feasible. The addition of pulverized oyster shells improves the optimal moisture content in the soil; that is, it decreases the sensitivity of soil to moisture content. However, at a specific weight of 2.2, the pulverized oyster shells do not improve the maximum dry density of the soil when added. The market available pulverized oyster shells used in the study do not improve the compression strength of compacted soil in the experiment, and the drop of compression strength grows increasingly clear with the increase of addition. The test result suggests neither significant Pozzolanic reaction between the pulverized oysters shells used and the fly ash nor improvement of soil strength by adding both pulverized oyster shells and flyash. The application of lime is a common and viable practice in soil stabilization and Pozzolanic reaction with fly ash. However, the strength improvement in compacted soil and lime blocks using lime-rich pulverized oyster shells perhaps is limited to the fineness and activity of pulverization, soil type, and aggregates. The same conditions do not apply to all test configurations. It is probably feasible to use pulverized oyster shells for their lime-rich nature in soil stabilization or in reaction with fly ash. However, the study did not yield the expected compressive strength increase in both compacted soil and lime blocks. How to improve the practicality of using pulverized oyster shells in soil stabilization remains to be investigated. The soil used in this study does not expand, resulting in lack of expected outcome. A test conducted on expandable clay may be considered to determine the suitability of pulverized oyster shells.

Characterization of Calcium Carbonate Obtained from Oyster and Mussel Shells and Incorporation in Polypropylene Michele Regina Rosa, Santos Blazers and Daniela**, 2012** this work has as its main objective to obtain calcium carbonate from mussel and oyster shells and used as filler in polypropylene compared their properties with polypropylene and commercial calcium carbonate composites. The shellfish was milling and heated at 500 °C for 2 hours. The powder obtained from shellfish were characterized by scanning electron microscopy (SEM), X-ray fluorescence, particle size distribution and abrasiveness and compared with commercial $CaCO3$ and mixed with polypropylene. The thermal and mechanical properties of polypropylene with $CaCO3$ obtained from oyster and mussel shells and with commercial $CaCO3$ were analyzed. The results showed that $CaCO3$can be obtained from oyster and mussel shell and is technically possible to replace the commercial $CaCO3$ for that obtained from the shells of shellfish in polypropylene composites. The results of this study showed that $CaCO3$ can be obtained from oyster and mussel shells, since both have a similar amount of CaO to commercial $CaCO3$. The differences in particles size and distribution of particle size observed are due to the milling conditions used and firing conditions of calcinations that it was kept constant. Analyzing the tensile and impact test results, we can conclude that the composites with commercial $CaCO3$ and mussel or oyster shells were similar, despite the great difference in particle size and distribution of particle size. For an amount of 10% load in the PP, there was no significant change in the mechanical properties, which makes this project technically feasible.

Experimental analysis on strength and durability of concrete by partially exchanging fine aggregate with oyster shell Shahnawaz Alam, Joonaith Veda and Thavasumony Dhasan **2018,** This project deals with the experimental analysis on strength and durability of concrete by partially exchanging fine aggregate with oyster shell which is an illegitimately disposed waste from oyster farm places. To pursue for a chance to recover the waste as building ingredients, crushed oyster-shell were partially substituted for fine aggregate. Based on this experimental study, it is concluded that the mix can be made by replacing oyster shell for fine aggregate without decreasing strength.20% of replacement of oyster shell for fine aggregate has produced maximum compressive strength. The comparative with ordinary concrete with oyster shell replaced concrete gave better performance in strength. Thus the study gave the results in increasing the strength of the concrete by replacing the oyster shell for fine aggregate. I Now-a-days the cost of sand and demand for sand is increasing rapidly. This will reduce the availability of sand and cause the scarcity of sand in future. Also the test result concluded that the partial replacement of sand with oyster shell in concrete gives high compression strength than the ordinary concrete. Hence the demand for sand can be reduced.

Review on seashells ash as partial cement replacement Wan Ahmad and Bin Wan Mohammad **2017** This review paper emphasis on various sea shells ash such as cockle, clam, oyster, mollusk, periwinkle, snail, and green mussel shell ash as partial cement replacement and its objective is to create sustainable environment and reduce problems of global warming. This study includes previous investigation done on the properties of chemical and mechanical such as specific gravity, chemical composition, compressive strength, tensile strength and flexural strength of concrete produced using partial replacement of cement by seashells ash. Results show that the optimum percentage of seashells as cement replacement is between 4 – 5%.From this review, we can say that the development of sea shell ash as partial cement replacement could be produce as a cement-like material where the particle size will be the same or finer than cement. Concrete with seashells as cement replacement will produce better concrete in term of chemical composition, specific gravity, compressive strength, flexural strength and tensile strength. It could be investigated by using difference types of sea shells to reduce environmental issues. Implicitly, this effort will create better benefit in future economic value to the local community and industries and also, provide better solution in concrete technology. Good values on developing the future of concrete industry should be expend through quality research among industry players and higher learning institutions to involve all parties into sustainable situation. Besides that, collaboration with local authorities through regulations and laws will create better opportunity to stake holders to come up with programs on waste minimization and utilization. Therefore, utilizing of waste materials such as sea shell in developing green concrete should be explored, expended and supported through focus researches. Development of green concrete should be proved through performance on hardened state and fresh state to understand the behavior of each material either in long or short term effect.

- **METHODOLOGY**

It is the method followed to perform the experiment. In this section we have made step wise procedure to perform experiment which is briefly described as follows:

A. Collection of material
B. Testing of material (Physical and Chemical)
C. Mix design
D. Batching of material (volume batching / weight batching)
E. Mixing
F. Casting of concrete cube,cylinder,beam
G. Testing
H. Compilation Of Result Of Testing
I. Conclusion

5.1 CHARACTERISTIC STRENGTH

The compressive strength of concrete is given in terms of the characteristic compressive strength of 150 mm size cubes tested at 28 days (fck). The characteristic strength is defined as the strength of the concrete below which not more than 5% of the test results are expected to fall. This concept assumes a normal distribution of the strengths of the samples of concrete.

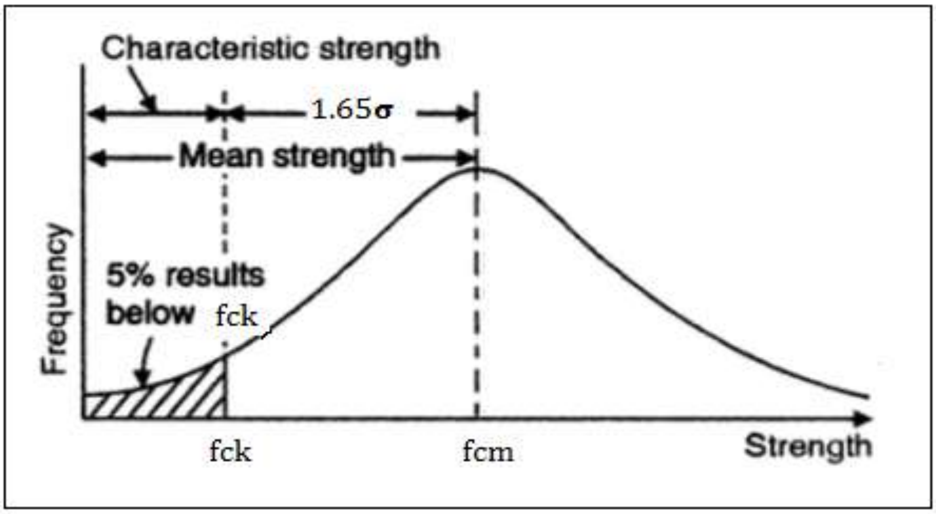

Fig 5.3.1: Normal Distribution curve on test specimens for determining compressive strength

Target strength for mix proportioning

$$\mathbf{f'ck = fck + 1.65\ s}$$

Where**,**

f′ck = Target Average compressive strength of 28 Days, fck = compressive strength of 28 Days,

Tolerance factor = 1.65

S = Standard deviation, S =4 n/mm2, from IS 456; 2013, table no 8

Standard deviation can increase by +1 if your site management is not good.
Therefore, target strength = 25 + 1.65 x 4 =31.6 N/mm2.
So, tested concrete cube compressive strength must be 90% of 33.25 N/mm2 = 29.93 N/mm2.

5.3.1 Selection of water-cement ratio

Water cement ratio depends on exposure condition, from table 5, IS 456: 2000, Maximum water-cement ratio = 0.50 (Page no 20) Based on experience, adopt water-cement ratio = 0.50-0.05 = 0.45, IS 10262; 1982 for accurate reducing factor.

5.3.2 Selection of water content

From table 2, as per IS10262:2009

Maximum water content =186 liters, for 20mm aggregate and 25-50 slump range

As per IS 10262-2009, clause 4.2

We can increase 3% for every additional 25 slump.

Estimated water content for 100-125 mm slump as per IS10262:2009

= 186+ (186 X 6%)

=197 Ltr

5.3.3 Calculation of cement content

Water cement ratio = 0.45 and Water content = 197 Ltr.

Cement content = 197 ÷ 0.45 = 437.78 Kg/m3

Adopted cement content is 437.78 Kg/m3 (450 < 437.78 > 300) Kg/m3, hence safe.

So, final water cement ratio = 197/437.78 = 0.45

5.3.4 Proportion of volume of coarse aggregate and fine aggregate content

From table No 3of IS code 10262-2009, volume of coarse aggregate consequent to 20 mm size aggregate and fine aggregate zone II for water cement ratio of 0.45 = 0.63.

Actual water cement ratio = 0.45

volume of coarse aggregate = 0.63

The Volume of fine aggregate content = 1 − 0.63 = 0.37

5.3.5 The mix calculations per unit volume of concrete shall be as follows:

I.) Volume of concrete = 1m^3

(A) Volume of cement $= \frac{\text{Mass of cement}}{\text{specific gravity of cement}} \text{ x } \frac{1}{1000}$

$= \frac{438}{3.15} \text{ x } \frac{1}{1000}$ = 0.139m3,

(B) Volume of water $= \frac{\text{Mass of Water}}{\text{specific gravity of water}} \text{ x } \frac{1}{1000}$

$= \frac{197}{1} \text{ x } \frac{1}{1000}$ = 0.197 m3

(C) Volume of all aggregate = [1-(A+B)]

= [1- (0.139+0.197)]

= 0.664 m3

(E) Mass of coarse aggregate (CA) = E x volume of coarse aggregate x Specific gravity of coarse Aggregate x 1000 = 0.664 x 0.37 x 2.61 x 1000

= 1179.66 Kg

(F) Mass of natural fine aggregate = E x volume of fine aggregate x Specific gravity of fine Aggregate x 1000 = 0.664 x 0.37 x 2.61 x 1000

= 641.22 Kg

5.3.6 Materials required for each casting of M25 grade concrete

Volume calculations:

Volume of 1 cube = 3.375 × 10^{-3} m^{3},

Volume of 1 beam=0.0156 m^3

And

Volume of 1 cylinder = 1.6 x 10^{-3} m^3

Total volume to be filled with concrete = (3.375 × 10^{-3} x numbers of cube + 0.0156 x no. of beam casting + 1.6 x 10^{-3} m3 x Numbers of cylinders)

Table No 5.3.1 Final Mix Proportion in Laboratory

SR NO.	Materials	Quantity (Kg/m3)	Proportion
1	Cement	437.78	1
2	Natural Sand	641.22	1.46
4	Coarse aggregate	1178.66	2.69
5	Water	197	0.45

Table No 5.3.2 Mix Combinations Model Nomenclatures

Sr. No.	Model Name	Replacement
1.	P-100	Control Mix
2.	OSP-5-95	5% oyster shell powder replacement of cement (95% cement + 5% OSP)
3.	OSP-10-90	10% oyster shell powder replacement of cement (90% cement + 10% OSP)
4.	OSP-15-85	15% oyster shell powder replacement of cement (85% cement + 15% OSP)

4. RESULTS

Compressive Strength Result:

The compressive strength measurement of the concrete samples was done as per IS 516: (1959) standard practiced. The test was conducted on the three samples of each composition and the average value of all is evaluated by a sample of each composition as the result compressive strength.The compressive strength values of different compositions of Dolomite powder and Cement.

$$\text{Compressive strength} = \frac{Load}{\text{Area}}$$

Load =P KN

Area = 150 × 150 mm^2

Table No. 6.1.1 Observation of Compressive Strength:

Days	**Average Compressive strength**		
Mix proportions	**Days (N/mm^2)**	**Days(N/mm^2)**	**Days(N/mm^2)**
OSP-0-100C	21.86	29.30	32.83
OSP-5-95C	23.05	31.30	33.10
OSP-10-90C	24.50	32.90	34.90
OSP-15-85C	24.90	33	34.20

From the experimental results it is clear that Compressive strength of the M25 Concrete mix when cement is substituted with Oyster shell powder 5 to 10%, then the strength is increased compared with conventional concrete. But in case of 15% the compressive strength is found to not increasing too much up to 7 day and 14 day but its start reducing after 28 day slightly

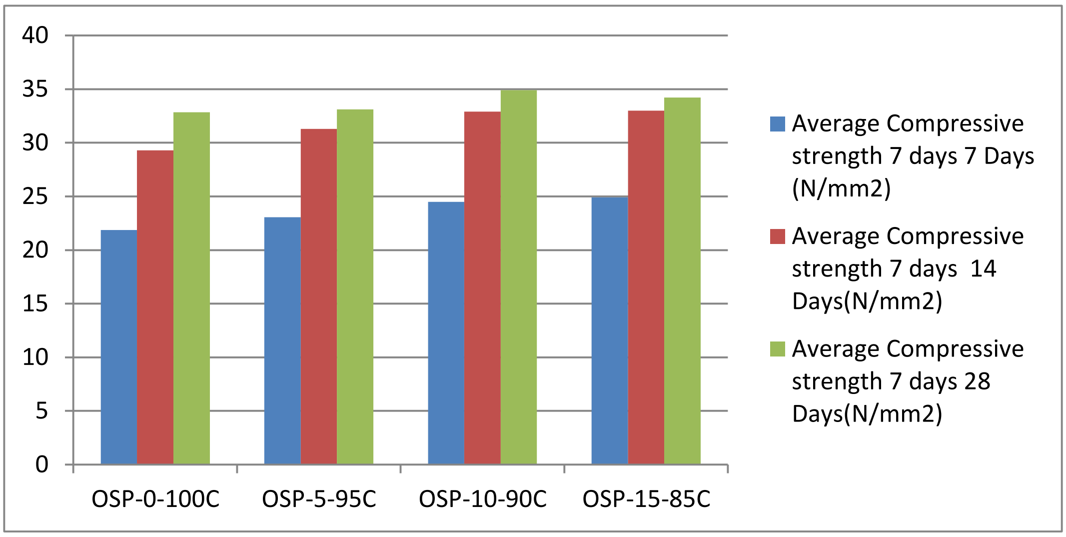

Fig. 6.1.1 Comparison of Average Compressive strength

6.2 Split Tensile Test Result:

It is impossible to test the direct tensile strength of concrete because of during the direct tensile strength test there is always some eccentricity present and also the grip problem for concrete also arise so to determine the direct tensile strength of concrete some indirect methods are adopted in which split tensile strength test is one of the important methods. It is a well-known indirect test method for determining the strength of concrete. The test consists of applying compressive load on the concrete cylinder sample place with axis horizontal between the platens by two opposite generators due to application of line loading a fairly uniform tensile stress is induced over nearly two-third of the loaded diameter and due to this tensile stress the specimen finally fails by splitting along the loaded diameter.

The magnitude of tensile stress (T) acting uniformly to the line of action of applied loading is given by formula.

$$T = \frac{2\mathrm{P}}{\pi \mathrm{DL}}$$

Table No. 6.2 Observation of Split Tensile Strength:

Days	**Average Tensile strength**		
Mix proportions	**Days (N/mm^2)**	**Days(N/mm^2)**	**Days(N/mm^2)**
OSP-0-100C	1.6	2.1	2.9
OSP-5-95C	1.60	2.4	2.9
OSP-10-90C	1.82	2.2	3.6
OSP-15-85C	1.60	2.1	2.60

Split tensile strength of concrete specimen with sand and cement (control specimen) 28 days was found to be 2.9 N/mm^2.From the experimental results it is clear that Split Tensile strength of the M25 Concrete mix when cement is substituted with oyster shell powder 5% to10%, then the strength is increased compared with conventional concrete. Oyster shell powder is substituted with cement 15% the compressive strength is found to be reducing.

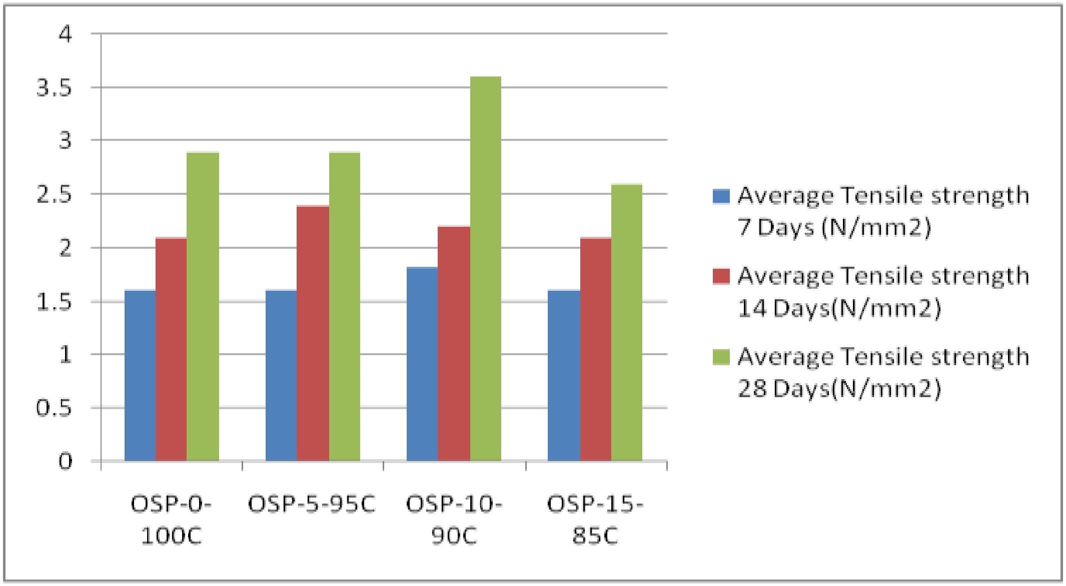

Fig 6.2 Comparison of Split tensile strength

6.3 Flexural Strength Result:

The flexural strength is one of the measures of the tensile strength of concrete. This method is generally used for a measure of an unreinforced concrete beam or slab to resist failure in bending. The flexural strength is expressed as modulus of rupture and it is measured by ASTM machine. Basically 2 types of ASTM machine

1) ASTM C78 – Third point loading System
2) ASTM C 293 - Center point loading system

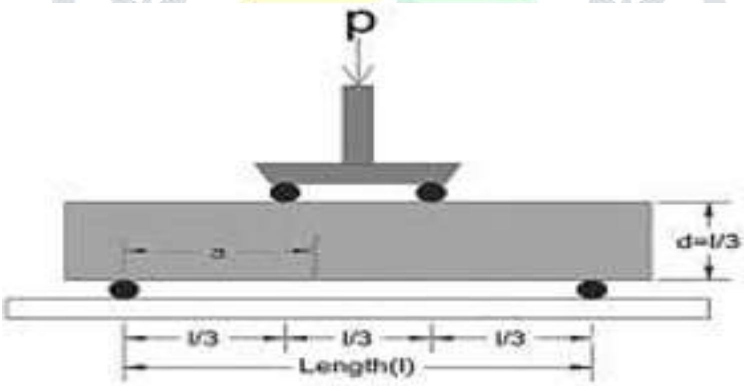

Table No. 6.3 Observation of Flexural Strength :

Days	**Flexural strength**		
Mix proportions	**Days (N/mm^2)**	**Days(N/mm^2)**	**Days(N/mm^2)**
OSP-0-100C	1.95	2.6	3.9
OSP-5-95C	2.2	3.4	4.10
OSP-10-90C	2.55	3.19	3.90
OSP-15-85C	2.45	3.10	3.70

Flexural strength of concrete specimen with sand and cement (control specimen) 28 days was found to be 3.9 N/mm^2. From the experimental results it is clear that Flexural strength of the M25 Concrete mix when cement is substituted with oyster shell powder 5%, then the strength is increased compared with conventional concrete. But in case of 10 % and 15 % it shows that flexural strength is start to reduce as compare to conventional concrete.

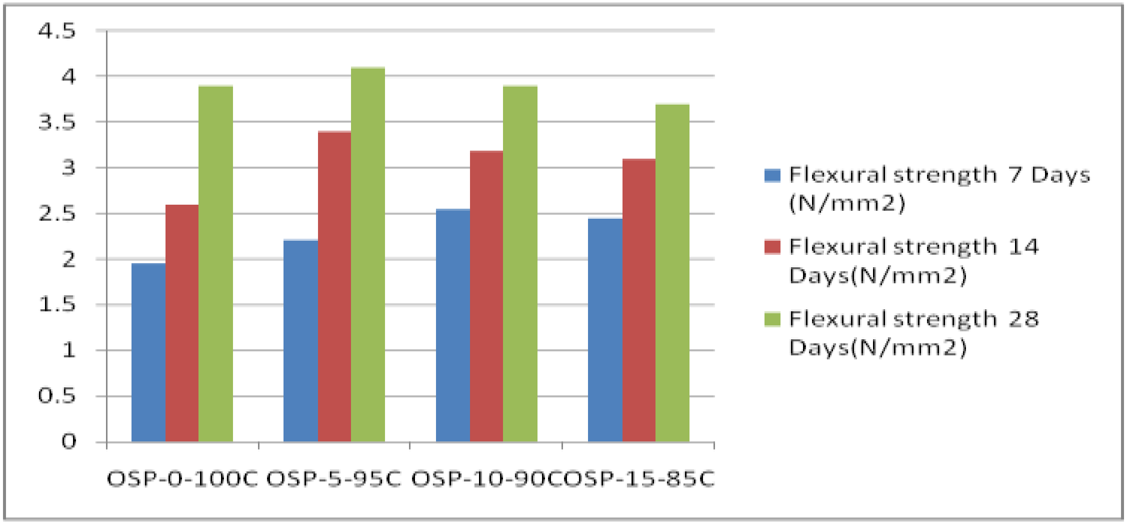

Fig 6.3 Comparison of Flexural strength

5- CONCLUSION:-

Replacement of oyster shell powder with cement found to improve the strength of concrete.

1. The replacement of oyster shell powder with cement found to be increase in strength with 5% and 10% replacement than conventional concrete.
2. The 10 % replacement of oyster shell powder with cement not increase the strength much more
3. It is observed that the strength of concrete with 15% replacement is starting to reduce after 28 days.
   As per above result it is clear that the material which is replaced by cement has less component of silica and high of lime due to which the material on getting hydrated provide less variation in increase of strength.

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