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EXPERIMENTAL ANALYSIS OF DURABILITY OF PERVIOUS CONCRETE BY USING CRUSHED SEASHELLS

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Abstract - *Concrete is the widely used material in the world. This automatically creates a huge demand for ingredient of concrete (Fine Aggregate, Coarse Aggregate and cement). From the environment point of view, the huge extraction of the aggregate creates depletion and manufacturing of cement causes pollution. This scenario affects the world's ecological balance. As a civil engineer, we have planned to replace the river sand which is widely used in construction by sea shell. Sea shell is the dead remain of the marine organism. We 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, Permeability test and Durability test is 90days .We have observed the maximum strength is obtained for 40% replacement of sea shell. The purpose of this paper is to examine the use of a waste marine sea shell product incorporated into a concrete mix as an aggregate replacement. Utilizing shells reduces the storage of shell waste. As a final, this article shows an acceptable durability of pervious concrete with and without crushed shells for the application of low traffic load.*

Key Words: *Pervious concrete, Compressive strength, Durability, Permeability, Shell concretes.*

1. INTRODUCTION

PERVIOUS concrete is one of the chief significant rising advances for supportable offices and foundation, sustainable facilities and infrastructure. Infrastructure development across the world created demand for the construction development materials. Framework improvement over the world made an interest in development advancement materials. Cement is the chief structural building development material. Concrete is the premier civil engineering construction material. American concrete institute (ACI) committee advisory group 522 depicts pervious (permeable) concrete as a "near zero-slump, open-graded material consisting of hydraulic cement, coarse aggregate, sand replaced seashell in different mix designation for the fine aggregate, admixtures, and water".

Our concept is to sand replace the seashell that is available abundantly in the coastal area. We have replaced sea shell powder for about 20%, 40%, 60%, 80%, and 100%. Moreover river sand is a wealth we can use it but not to exploit it, which makes the future people to be without this wealth.

Seashell By-Products (SBP) are created in a significant amount in Asia (close to the seashore) and are considered as waste. This work examined to utilize SBP in pervious cement and produce significantly more earth well-disposed item, pervious solid pavers.

In Asia, India has a significant angling and shellfish cultivating industry that produces almost 8.5 million tons of shell squander every year (FAO, 1998). These exercises create thousand of a huge amount of seashell result to release, as they are considered as a waste. For the occasion, a few endeavours have been made in India to reuse them as a dirt conditioner or creature's sustenance yet none of them fulfillment as far as practical and included worth reusing. The most widely recognized technique for dealing with this waste is landfill transfer, expanding the natural effect.

While pervious cement has been utilized and fusing SBP in traditional cement have been examined already, the utilization of SBP in pervious cement is simply starting to be investigated. Joining SBP in pervious cement is as yet a generally new thought, and the practicality of SBP in pervious cement is still under scrutiny.

1.1 TYPES OF CRUSHED SHELL

Different types of seashells are used for this research mainly are names as below as.

1. CRepidula (CR)
2. Scallop (SC)
3. Queen Scallop (QS)
4. Oyster shell (OS)
5. Periwinkle

These seashells are very abundant on the Andhra Pradesh and Chennai coasts of India. They were gathered from fish organizations and exposed to various arrangements, for example, crushing and screening nearby to acquire the division 2/4 mm. Without a doubt, through past examination, the portion 2/4 mm is ideal to have a trade-off between the compressive quality and porousness to the water of pervious cement. The squashed shells are

principally framed from the calcium carbonate, in this way the particular gravity of squashed shells is comparable or somewhat lighter to that of the common totals.

1.2 IMPORTANCE OF RESEARCH

We are mainly concentrated on the eco friendly materials uses to aggregates for the construction. Infrastructure development and small area driveways are used these constructions. One more major problem solves the land wastage by the seashell wastage dump yards.

1.3 AIMS AND OBJECTIVES

Use of pervious cement in asphalts principally centers on storm water ascendency for the most part in urban zones where the shortage of land is high gear. Porous asphalt permits water from precipitation and another witness to freedom chit through it and accordingly lessens the spillover from a site which last outcomes in the energize of land water and increment the level.

2. LITERATURE REVIEW

Numerous specialists have considered the designing properties of seashell total and seashell fiery debris in the ongoing past.

3. MATERIALS AND PROPERTIES

This chapter briefly describes the final results of the properties of all materials used in this project. The IS codes (Indian Standard) important practice considered for all tests in the reference and all test on materials were performed by the code system is pertinent and rules.

3.1 CEMENT

There are numerous components relies on the quality of cement wherein the quality of the bond is the profitable contemplations. The utilization of 53 Grade OPC is favored as it was seen from the past records of concretes accessible in the market. In that fundamental compound constituents of concrete are C3A, C3S, C2S.

The properties of the concrete are explicit gravity of 3.04, Normal consistency of 28%, Initial setting time and last setting time of 27 min and 535 min separately.

3.2 FINE AGGREGATE

The material which is for the most part made out of silica and it is a dormant or artificially inert material which should go through 4.75mm IS sieve. The waterway sand which we use is from common deterioration of rocks and which has been kept by operators of enduring like the stream as a rule. The sieve examination for fine total communicated a fineness modulus of 2.36. The particular gravity of fine total is 2.59.

3.3 COARSE AGGREGATE

Coarse total will comprise of normally happening material, for example, rock or coming about because of the breaking down of rocks. The molecule is more noteworthy than 4.75mm the total which we have utilized is of the greatest size of about 20mm and it is fit as a fiddle. The coarse total utilized in the solid blend is of ostensible size of 20 mm total with a particular gravity is 2.7. The size of totals utilized is 20mm and the grain size of sand utilized is of zone2.

3.4 WATER

Typical faucet water was utilized to blend the solid with a water-concrete (water-cement ratio) proportion of 0.45 acquired from droop test.

3.5 SEASHELL-BY-PRODUCTS

Seashell is additionally referred to just as a shell, is a hard, defensive external layer made by a creature that lives in the ocean. The shell is a piece of the body of the creature. Void seashells are regularly discovered appeared on shorelines by drifters. The shells are vacant in light of the fact that the creature has kicked the bucket and the delicate parts have been eaten by another creature or have spoiled out. The term seashell more often than not alludes to the exoskeleton of an invertebrate (a creature without a spine). Most shells that are found on shorelines are the shells of marine mollusks, incompletely in light of the fact that a large number of these shells bear superior to different seashells.

Fig: Seashells before Crushing

Fig: Seashells after Crushing

The seashell By-items (SBP) that was utilized for this exploration was included ruler scallop that was progressively squashed and sieved to acquire the portion 2/4mm and fine totals utilizing. It is noticed that there is no cleaning venture to expel the polluting influences, as needs

are, the natural issue and chloride particles substance is high, the molecule sizes dispersion of squashed ruler scallop.

3.6 MIX COMPOSITION AND SPECIMEN PREPARATION

When the fundamental tests are performed and checked for the nature of the material, giving of shape such a role as the 3D square, shaft, the chamber is the following procedure. The molds are thrown for various extents, for example, customary concrete, 20%, 40%, 60%, 80% and 100% fine total supplanted seashell concrete. In light of the structure blend, the required amount of the material for the various sorts of form is taken and cement is made for the water-concrete proportion of 0.45. In the wake of blending the solid flawlessly and after that the solid is put in the molds and took into consideration the setting. Later they are Demoulded and set in the restoring tank for the relieving procedure to occur.

Aggregate of 15x15x15cm was thrown for every blend and the new solid test were done so as to hoist the impacts of the expansion of the SBP into the pervious solid blend. The cast cubic was remolded 24hours in the wake of throwing. So, all things considered they were set to fix in wet conditions for 28days.

4. EXPERIEMENTAL PROGRAM

We have maintained the various types of mix designation casting moulds calculated the compressive test, permeability test and durability tests.

Fig: Compressive strength using UTM Machine

Fig: Casting the Cubes

The compressive quality is estimated on the cubic 15x15x15 cm examples as per the European standard EN 12390. Tests were tried for the compressive quality at 28 days of age. These tests were performed utilizing a consistent stacking of 0.06 MP.S-1. The revealed outcome is normal of three to five tests.

Fig: Compressive test on cubes

All through the compressive quality testing it very well may be seen that the PCP2-20 examples expanded a lot of solidarity when contrasted with the control blend. This was likely because of the abatement of the void substance of these examples. In spite of the conservativeness of blends diminishes somewhat by including 20% of SBP, this doesn't consider the nearness of concrete and water. Maybe, the nearness of these components will improve the smallness of the blend at 20% SBP.

Fig: After testing on the compressive test on moulds

The SBP is delicate than the common total. Indeed, the protection from fracture of characteristic total acquired through the Los Angeles test is 11 which contrasted and 15 if there should arise an occurrence of SBP. The substitution of the total with SBP can increment with the all-out porosity. Truth be told, the characteristic rock has a round shape that permits an ideal pressing level of the blend. On the other hand, the SBP has the level shape, when joined, they assume a job as a divider, will forestall the methodology of characteristic totals and aggravate the granular game plan, in this manner diminish the conservativeness. For affirming this perception, conservativeness trial of molecule parts on the shaking table has been utilized to decide the pressing of a blend of SBP and common total.

Fig: Permeability test working on lab

5. RESULTS AND DISCUSSIONS

5.1 COMPRESSIVE TEST

The compressive quality is estimated on the cubic 15x15x15 cm examples as per the European standard EN 12390. Tests were tried for the compressive quality at 28 and 90 days of age.

compressive strength test			
S.NO	Mix Designation	28days	90days
1.	M0	36.2	38.5
2.	M1	43.8	45.5
3.	M2	48.0	49.2
4.	M3	42.4	44.2
5.	M4	37.5	39.5
6.	M5	27.5	29.0

Pressing degree diminished with an expanded level of SBP in the blend. The SBP is pads, the flakiness file of normal totals 4/6.3mm is 20.1 rather than 98.4 for the instance of SBP 4/6.3mm. These qualities were resolved through the European standard EN 933-03. Consequently the surface territory of SBP is more prominent than that of common total. As a result, with a similar measure of bond glue, the covering of bond glue around the grains of the common rock and SBP for SBP cement is increasingly slight, most likely the rock isn't completely secured.

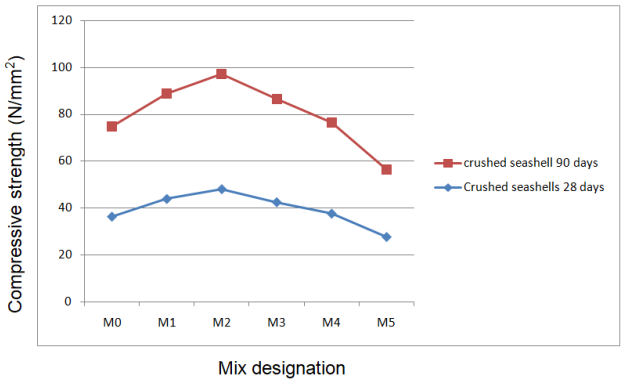

Fig: The Strength Comparison of Normal concrete and various types of mix proportion on crushed seashells.

M_0 = Normal concrete (conventional concrete)

M_1 = Cement, Sand 80%, Coarse aggregate and Replaced 20% of sand with Crushed Seashells

M_2 = Cement, Sand 60%, Coarse aggregate and Replaced 40% of sand with Crushed Seashells

M_3 = Cement, Sand 40%, Coarse aggregate and Replaced 60% of sand with Crushed Seashells

M_4 = Cement, Sand 20%, Coarse aggregate and Replaced 80% of sand with Crushed Seashells

M_5 = Cement, Coarse aggregate and Replaced 100% of sand with Crushed Seashells

We have observed the mix proportions, we got maximum compressive strength at M2, i.e. M_2 = Cement, Sand 60%, Coarse aggregate and Crushed Seashells 40%.

5.2 DURABILITY TEST

To check durability of pervious concrete mix, Cubes of size 15cmX15cmX15cm was casted using different mix proportion. Next After 24 hours the specimens will remove from the mould and subjected to water curing for 28 days. The specimens were taken out from the curing tank and initial weight was taken. After this step, cubes was immersed in sea water for 28 days and again weighted and then weight in loss was calculated.

Durability test in Acid			
S.NO	Mix Designation	28days	90days
1.	M0	34	37
2.	M1	42	44
3.	M2	46	48.5
4.	M3	41.5	43
5.	M4	37	38
6.	M5	26.5	28

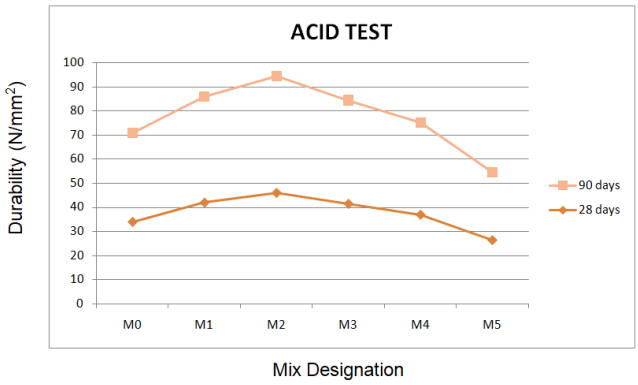

Fig: The Strength Comparison of Normal concrete and various types of mix proportion on crushed seashells test in Acid.

Durability test in Base			
S.NO	Mix Designation	28days	90days
1.	M0	38	36
2.	M1	44.2	43
3.	M2	49.3	47.2
4.	M3	42.3	42.2
5.	M4	38	37
6.	M5	28.2	27.5

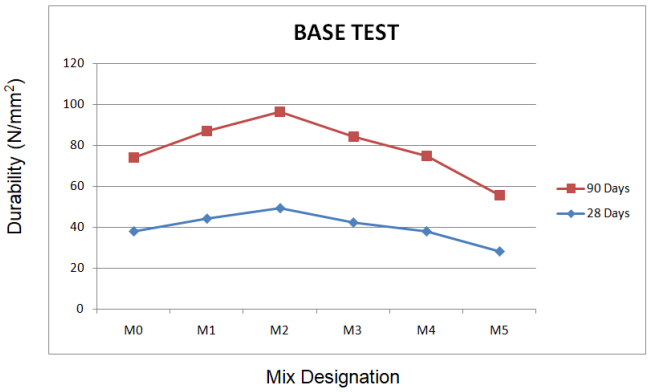

Fig: The Strength Comparison of Normal concrete and various types of mix proportion on crushed seashells test in Base.

5.3 PERMEABILITY TEST

The penetrability coefficient of the pervious cement is essential to guarantee legitimate structure and work for porousness asphalt. Furthermore, water ought to be completely penetrated when it downpours, paying little heed to how substantial the precipitation is. The penetrability to the water of pervious cement with or without squashed shells fluctuates somewhere in the range of 2.2 and 3.4 mm.s-1.

It very well may be seen that the variety of the pervious solid penetrability is exponentially corresponding to the porosities.

S.NO	Mix Designation	Permeability test (mm/sec)
1.	M0	$5.37x10^{-3}$
2.	M1	$4.04x10^{-3}$
3.	M2	$3.73x10^{-3}$
4.	M3	$5.96x10^{-3}$
5.	M4	$6.34x10^{-3}$
6.	M5	$7.37x10^{-3}$

Graph (E) Permeability Test

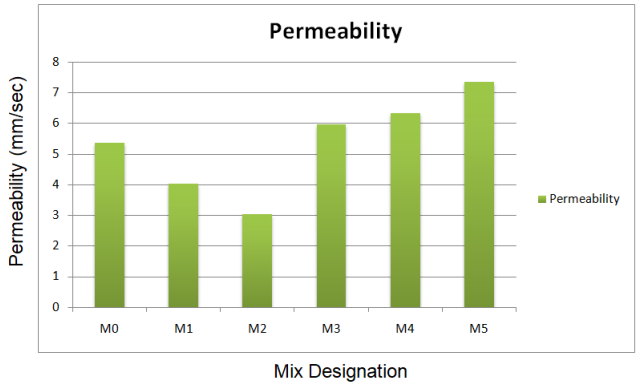

Fig: The Permeability and various types of mix proportion on crushed seashells.

6. CONCLUSION

In this investigation, seashells were utilized as a total to make pervious cement. The investigation focuses on

the toughness of pervious cement from the squashed shells (Crepidula, scallops, and ruler scallop).

Pervious cements produced using the squashed shells have lower mechanical quality than control pervious cement without shells. In addition, the pervious cement with shells is generally utilizable for applications, for example, low-traffic stopping territories.

Draining of pervious cements rapidly happens after contact with the filtering arrangement; the nearness of the shells seems to impact the amount of filtering calcium. For sure, the calcium carbonate in the shells separates in demineralised water to discharge calcium.

The squashed shells are more delicate than the regular totals.

The significant natural issue and pollutions of shells can upset the hydration procedure or cause deformities of grip between the squashed shells particles and the concrete glue. Along these lines, they can create auxiliary imperfections in the bond glue.

Eastern Oyster shells were gathered, cleaned and squashed, at that point their properties broke down for molecule size, explicit gravity, thickness and retention, and unit weight.

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