Investigate the utilization of seashells as a partial replacement of coarse aggregate in RCC concrete beams

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Abstract -In recent years, the construction industry has been challenged by an increasing demand for sustainable materials. This study explores the potential of using seashells as a partial replacement for coarse aggregate in concrete beams. Seashells are abundant and often considered waste material, making them a promising candidate for sustainable construction practices. The research involved the creation of concrete beam samples with varying percentages of seashell aggregate, ranging from 0% to 50%. Each sample was tested for compressive strength, flexural strength, and durability. Preliminary results indicate that concrete beams with up to 30% seashell aggregate maintain structural integrity comparable to traditional concrete, while also offering unique aesthetic qualities. However, samples with higher percentages of seashell aggregate showed a decrease in strength, suggesting an optimal balance must be found. This study contributes to the growing body of research on sustainable construction materials and offers a promising direction future exploration.

Keywords: Coarse aggregate, Compressive strength, Flexural strength, RCC concrete beams, Seashell.

I. INTRODUCTION

This project is about using seashells in place of some of the small stones, or ‘coarse aggregate’, that we usually use in concrete beams. We’re doing this because we want to find more environmentally friendly ways of building things. We’re testing these new concrete beams to see if they’re just as strong and long-lasting as the ones we usually make. This could be a big step towards making the construction industry more sustainable.

OBJECTIVE

1. Investigate the Feasibility: To explore the potential of using seashells as a partial replacement for coarse aggregate in concrete beams. This involves creating and testing concrete samples with varying proportions of seashell aggregate.
2. Evaluate Performance: To assess the structural properties of the seashell-infused concrete beams, including their compressive strength, flexural strength, and durability. The goal is to determine if seashell aggregate can meet or exceed the performance of traditional aggregate materials.
3. Promote Sustainability: To contribute to the development of more sustainable construction practices by reducing the reliance on traditional, non-renewable aggregate materials and promoting the use of waste materials in construction. This could potentially reduce the environmental impact of the construction industry.

II. METHODOLOGY

In this project the methodology consists of

1. Collect the necessary materials for the project. This includes seashells, cement, coarse and fine aggregates, water.
2. Prepare different concrete mixtures with varying proportions of seashell aggregate.
3. Cast the concrete mixtures into beam molds. The beams should be of a standard.
4. Allow the concrete beams to cure. The curing process usually takes about 28 days.
5. After the curing period, test the concrete beams for compressive strength, flexural strength, and durability.
6. Analyze the test results and compare with ANSYS software to determine the effect of the

seashell aggregate on the properties of the concrete.

III. MATERIALS DETAIL

The locally available construction materials such as Portland pozzolana cement, fine aggregate, coarse aggregate, water and sea shells are used for preparation of concrete. The nominal size of aggregates is 20 mm.

CEMENT:

Cement is a very important material in the construction industry. It’s a binder, which means it helps to stick other materials together. PPC, or Portland Pozzolana Cement, is a kind of cement that’s a bit different from the usual type. It’s made by mixing together a few things: a special kind of cement called Portland cement, small pieces of a material called pozzolana, and a mineral called gypsum. One of the great things about PPC is that it’s less likely to crack when it gets wet. It’s also a bit finer and less heavy than the usual type of cement, which makes it a good choice for many building projects.

FINE AGGREGATE:

Fine aggregates are small materials used in construction. These are smaller than coarse aggregates and usually pass through a 4.75 mm sieve. Sand is a common example of a fine aggregate. We use fine aggregates in things like concrete and mortar. They help to fill up the spaces between the larger coarse aggregates, like gravel or crushed stone. This makes the final product stronger and more stable. The type of fine aggregates we use can change the look of the finished concrete. For example, using white sand can give the concrete a lighter colour. This can be important for decorative concrete, like for patios or countertops.

COARSE AGGREGATE:

Coarse aggregate is the larger material used in construction. In concrete, coarse aggregate is the component that gives the mix its bulk. It’s usually made from crushed stone or gravel and it’s larger than sand, which is a type of fine aggregate. The size of the coarse aggregate can vary, but it’s generally between 9.5 mm and 37.5 mm in diameter. When we make concrete, we mix together cement, water, fine aggregate, and coarse aggregate. The cement and water form a paste that sticks everything together. The fine aggregate fills in the small gaps, and the coarse aggregate fills in the big gaps. This makes the concrete strong and stable.

WATER:

Water is like the magic ingredient in the recipe for concrete. When you mix cement with water, it starts a chemical reaction that turns the whole mixture into a hard, solid material. This reaction is what makes the concrete set and harden. The amount of water you use can also affect how strong the concrete is once it’s hardened. If you use too much water, the concrete can end up being weaker. That’s because the extra water creates tiny holes in the concrete as it dries and evaporates. These holes can make the concrete less dense and less strong.

SEASHELL:

Seashells are like little treasures from the ocean. And now, we’re finding new ways to use seashells, like in construction.

By crushing them up, we can mix them into concrete to help build stronger, more sustainable buildings.

IV.MATERIAL TEST

TEST	MATERIALS	VALUES OBTAINED
Specific Gravity	Fine aggregate	2.83
Specific Gravity	Coarse aggregate	2.75
SpecificGravity	Cement	3.16
Water absorption	Coarse aggregate	1%

IV. MIX DESIGN

Water(l/m3)	195
Cement (Kg/m3)	348
Fine aggregate (Kg/m3)	868
Coarse aggregate (Kg/m3)	1032
Mix proportion	1: 2.5: 3

Mechanical properties of concrete:

Test for compressive strength of concrete cubes

No of days	No of cylinders	Average compressive strength (N/mm2)
7th day	3	23.14
14th day	3	28.95
28th day	3	36.2

V. EXPERIMENTAL INVESTIGATION

Specimen details

The RCC concrete beam of size 700mm *150mm *150mm were casted. Specimen details are given in Table 3

BEAM NOTATION	SPECIMEN DETAIL	DIMENSION
RC - SB	Reinforced concrete solid beam	700mm *150mm *150mm
RC - SSB	Reinforced concrete seashell solid beam	700mm *150mm *150mm

Casting of beam specimen:

The beams were casted with M40 mix concrete and damping rod is used for the compaction of concrete. For an M40 mix, we need a specific ratio of cement, sand (fine aggregate), stones (coarse aggregate), and water. The 'M40' means that the concrete should have a strength of 40 N/mm² after 28 days. Once our 'concrete cake mix' is ready, we pour it into a mold shaped like a beam. We need to make sure we fill the mold evenly and get rid of any air bubbles. Then, we leave the concrete to set and harden. It usually takes about 24 hours for the concrete to set, but it needs to cure for 28 days to reach its full strength.

Testing of specimen:

The concrete beam specimens were tested under the loading equipment. One of the main tests we do is called a compressive strength test. This is like seeing how much weight the beam can carry before it starts to crack or break. We use a special machine to apply pressure to the beam and measure how much it can take. Another important test is the flexural strength test. This is like bending the beam to see how flexible it is. We support the beam at two points and then apply force in the middle to see how much it can bend before it breaks. After all the tests, we look at the results to see how well the beam has done. If it's passed all the tests, then we know we've got a good mix for our concrete. If not, we might need to change the mix and try again.

RESULT AND DISCUSSIONS

Load vs deflection character:

The load and the deflection characteristics of the beams were drawn. The deflection and load are plotted along the X axis and Y axis respectively. The load is in KN and the deflection is in mm. The load and deflection characteristics of the beam for 28th day are compared in the figure

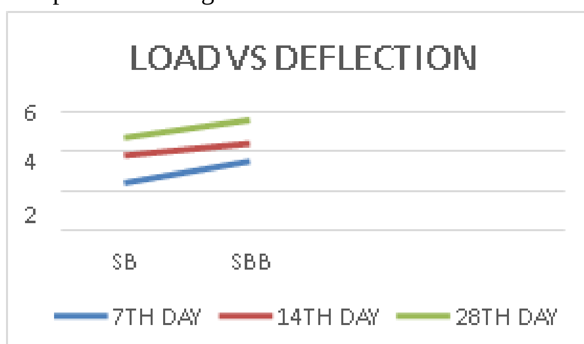
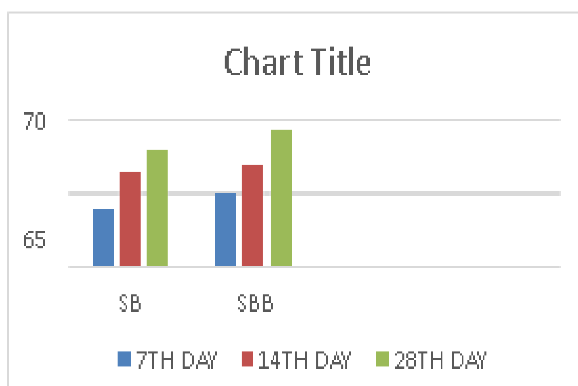


Fig 1: Comparison of load Vs deflection curves

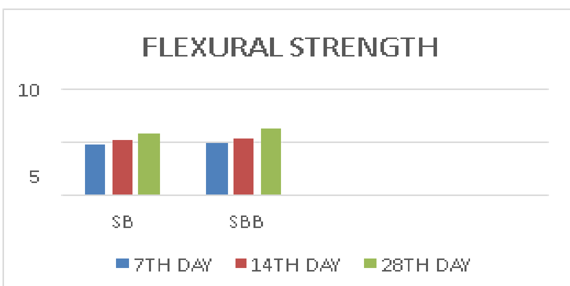
SI. No	MIX	7 Days	14 Days	28 Days
1	SB	4.77	5.2	5.9
2	SBB	4.89	5.4	6.2



Flexural strength test :
The beams tested for flexural test was conducted the following result were obtained.

Ultimate load carrying capacity of the beam:
The ultimate load carrying capacity of the beam were observed during the experiment. The ultimate load is observed and beyond this load the beams causes failure. The below table represents the ultimate load and the initial crack load occurred. The chart shows the comparison of the ultimate load at 7, 14, 28 days.

Analyzing Parameters	Ultimate load (KN) at 7th day	Ultimate load (KN) at 14th day	Ultimate load (KN) at 28th day
RC -SB	64	66.5	68
RC -SBB	65	67	69.4



FLEXURAL STRENGTH RESULT BY USINGANSYS SOFTWARE
The flexural strength test assesses how well a material can withstand bending forces. Engineers use it to understand how materials behave when subjected to loads that cause bending or flexing. By simulating this test in software like Ansys, we can predict how materials will perform in real-world scenarios
FLEXURAL STRENGTH RESULT FOR SOLID BEAM:

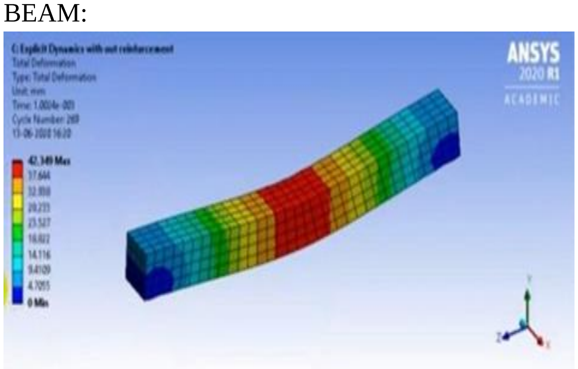
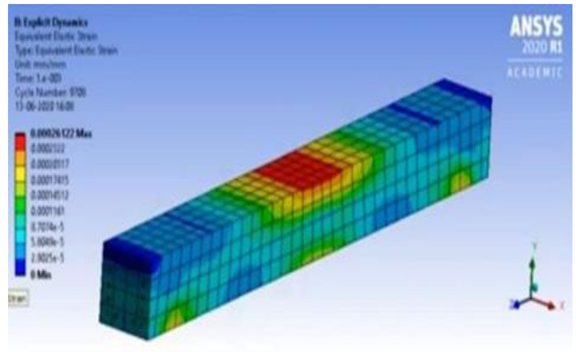


DIAGRAM TOTAL DEFORMATION



EQUIVALENT ELASTIC STRAIN DIAGRAM

VI. CONCLUSION

a. Flexural behaviour of reinforced concrete beam with partial replacement of seashell with coarse aggregate is same as that of an solid reinforced concrete beam
b. It has been observed that it doesn't require extra time and additional labour.
c. The compressive strength of the partially replaced concrete beam increased after 28 days of curing period.
d. Refincored cement concrete with 20% replacement of seashells with coarse aggregate shows better results.

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