



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

# IJRSET

International Journal of Innovative Research in  
**SCIENCE | ENGINEERING | TECHNOLOGY**



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 10, Issue 9, September 2021

**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA

Impact Factor: 7.569

 9940 572 462

 6381 907 438

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# Experimental Investigation of Aramid Fiber Reinforced Concrete with Partial Replacements of Fine Aggregate by Dolomite Powder and Coarse Aggregate by Coconut Shell

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**ABSTRACT:** Concrete is the component which makes the civil activities ease. Cement, fine aggregate, and coarse aggregate are the key constituent of the concrete. The properties of concrete depends up on the what type of constituents are used. In this present study the using of industry product and the agricultural product is intended. The addition of aramid fiber to reinforce the concrete. Dolomite powder and the coconut shell are used as a partial replacements of aggregates. The dolomite powder and coconut shell are replaced at required portions for the requirement with constant addition of aramid fiber. The elements with the replacement materials at different percentage were prepared and compared with conventional elements. The ideal replacement of fine aggregate and coarse aggregate by dolomite powder and coconut shell respectively is obtained by observing the hardened properties of the concrete elements at 10%, 20%, 30%, and 40% of replacements.

**KEYWORDS:** Concrete, Fine aggregate, Coarse aggregate, Dolomite powder, Coconut shell, Partial replacement.

## I. INTRODUCTION

Concrete which is considered one of the important universally used for the construction in the Civil Engineering activities as material. The plain concrete is brittle in nature. One of the most heinous characteristic of plain concrete is having low tensile strength due to its brittle complex. As a result, it was necessary to reinforce the concrete structure with continuous Steel bar in a proper position which will be able to withstand tensile and also as well as share stress. Fibers are the important material which are used for reinforcing. Hence it will be called as anfiber reinforced concrete in short form FRC. The nature of the fibers are short and also as well as discontinuous in nature.

Concrete is a type of material which is composed up by mixing of aggregates, cement, and water at proper conditions. Concrete is the one of the man made material in the planet for various usages. In today's global infrastructure and construction activity development, the use of concrete is increasing at a faster rate. Increase in production of concrete the use of aggregates are at rapid rate therefore the aggregate are depleting. Due to excess use of aggregates the aggregates are depleting. Therefore the alternative materials are used for replacement of aggregates are inducing and making sustainable. Environmental and sustainability research in construction material has sparked a lot of interest around the global for good purpose. While waste generated by industrial and agricultural activates has made management and disposal issues that pose significant struggle to environmental conservation exertion, their use contributes to resource conservation and environmental protection. Instead of damping some solids waste can be reused in various applications. This can be used as alternative material for various applications in day to day life. Some products obtained by industry and agricultural which is also used as construction material. By the use of the materials in construction improve certain strength and makes economic. Therefore, dolomite powder and coconut shell are used as part replacement with the addition of fibers to give tensile characteristic in this work.

## II. LITRATURE REVIEW

Kamal.M.M et al. (2012)<sup>[1]</sup> have studied that the bond strength for self-compacting concrete mixture. All self-compacting concrete mixes comprising up to 30% dolomite powder give bond strength sufficient for design puse. The shear strength of RC beams was found to be greater than that of conventional self-compacting without dolomite



powder, according to the investigator. The concrete which will be having dolomite powder this is the important bond which will increase the strength rose as Portland cement was replaced with dolomite powder, according to the results. Amarnath et al. (2012)<sup>[2]</sup> studied the experiment conducted which will be on the properties of the consideration done on the concrete along with the consideration of the coconut shell which will be used as an aggregate replacement. The concrete is made up of coconut shell replacement to coarse aggregate at 10% and 20%. Two mix of fly ash and coconut shell was made to investigated that fly ash effect on coconut shell replaced concrete. So after this the water and as well as the cement ratio for the experiment is 0.6 maintained to all the concrete mix. The test like water absorption, moisture migration, compressive strength, splitting tensile strength are under the laboratory investigation. The major conditions is to consider the of the work such that in order provide more data and also as well as for which are required for the strength of the consideration of the coconut shell concrete which will be done at different percentages of replacements and studied the for the difference in the conditions of the transport of coconut shell replacement for coarse aggregate. The results showed that addition of coconut shell decrease the workability and the replacement for fly ash for cement increases the workability of coconut shell concrete. In fly ash mixed to the coconut shell and also as well as the concrete which is suppose to decreases the strength in the conditions of the compressive and splitting the major important tensile strength which will be having the increase in factors affecting the content which will be of the coconut shell. Thereafter, 28 days of curing the flay ash replaced for cement reduces the splitting tensile strength for coconut shell concrete. On other side fly ash replacement for fine aggregate showed no major changes in the result with coconut shell concrete.

Dewanshu et al. (2014)<sup>[3]</sup> studied that the coconut shell which will be having a partial replacement for the configuration of the coarse aggregate under the particle consideration of concrete there will be an important goal under this study in order to spread the proper awareness about the use of the coconut shell and also considering the an important part shall replacement for the concrete under the coarse aggregate/ in order to determine the proper compressive strength and also in order to decrease the percentage of the submission of the coconut shell and including percentage replacement which can be increased in order to improve the workability of the concrete. Coconut shell is an important replacement partially in order to overcome any kind of effects over the coarse aggregate in RCC concrete.

Reddy et al. (2014)<sup>[4]</sup> they studied, here the coconut shell which is used for the aggregate in the light weight aggregate for the concrete set that the presence of this for project paper is in order to increase the compressive strength and also as well and flexural strength and the properties of the concrete which is used for the partial replacement of the grade of the concrete M30 so that the study also used to demonstrate the proper use of the concrete and the enclosing the process replacement coconut shell aggregate. hence it will be helpful in order to reduce the environmental problem of solid waste which will be having the 23 % of the coarse aggregate wishes can be easily replaced by the coconut shell in order to increase the nominal mix ratio when 50% of the considered for an aggregate is replaced by the consideration of the coconut shell there will be an important properties similar to that of the lightweight of the concrete which can be also as a filler material in the consideration of the frame structures and including the thermal shielding of concrete and so on.

Ravikumar et al. (2018)<sup>[5]</sup> The feasibility of measuring and also studying the damage that happened due to fibers during the high strength over a long period under the exposure to the radiation which is to be investigated under the low excitation conditions where the technique has been utilized in order to measure the material and its important mechanical property and also considering accelerated aging experiment there will be a sample Kevlar 49 along with the continuous structure of the FRP and also Kevlar 29 continuous and also including the chopped FRP .which is exposed to the consideration of UV a radiation procedure under the usage of the calibrated lamp. A universal testing equipment which is designed for the high sensitivity dynamic measurements was used to monitor the evaluation of their mechanical properties.

Dinesh, navaneethan (2018)<sup>[6]</sup> it was studied that the experimental study on aramid fiber reinforced polymer composites. The load carrying capacity of fiber reinforced polymer composite by incorporating the aramid and cotton fiber into epoxy resin matrix. In particular, incorporated FRP composites subjected to tensile, flexure and impact loading were evaluated by monitoring the stress strain relationship. Experimental results showed that the load imposing capacity is more in aramid fiber polymer composite which compare to cotton polymer composite.

Rajashekhhar, Sachin (2019)<sup>[7]</sup> evaluated the importance of the strength and also as well as the durability study which will be done over the structure of the under the usage of the aramid fiber reinforced which is an one of the polymer. Using double wrapped aramid fiber, weight loss can be minimized by around 26% to 40% in the acid resistance test. Even after acid assault, aramid fiber wrapping increases the important parameter of the compressive strength which



will be considered for the element under the ratio of total 142% till the waiting time of the 70 days. In the test conducted for fire resistance test, the considered specimen which will under go the weight loss by the ration of the 60% when wrapped in which the aramid fiber along with consideration of the temperature increase of 200°C for 1 or 2 hours, and specimen compressive strength can be raised by 150 percent when wrapped in aramid fiber. When exposed to acid attack and heat impacts, concrete set that the presence of this for project paper is in order to increase the compressive strength and also as well and flexural strength and the properties of the concrete which is used for the partial replacement of the grade of the concrete M30 so that the study also used to demonstrate the proper use of the concrete and its important elements.

### III.METHODOLOGY

To attain the objectives of the proposed study, the following methodology is intended to be adopted are as follows.

1. Collection of materials.
2. Basic test of materials.
3. Preparation of M25 grade concrete mix design as IS 10262 (2019).
4. Casting and curing of different concrete elements.
5. Testing the hardened property of concrete.
  - Compressive strength test.
  - Flexural strength test.
  - Splitting tensile test.
6. Analysis of results.

### IV.EXPERIMENTAL RESULTS

#### TEST RESULTS OF CEMENT

The properties of cement was determined by various test conducted as per IS codal provisions is listed in a table 1.

**Table 1 Test results of cement.**

Property	Value	Standard values
Fineness (%)	3.2%	Less than 10%
Standard consistency (%)	33.0	Not specified
Initial setting time (minutes)	40	30 (minimum)
Final setting time (minutes)	460	600 (maximum)
Specific gravity	3.149	Not specified

#### TEST RESULT OF FINE AGGREGATE

The properties of fine aggregate was determined by various tests as per is codal provisions are tabulated in Table 2.

**Table 2 Test results on fine aggregate.**

Property	Value		Remark
	IS sieve designation (mm)	Percentage passing (%)	
Sieve analysis	10	100	Percentage passing for Grade Zone II
	4.75	98.5	90-100
	2.36	76.5	75-100
	1.18	69.5	55-90
	0.6	43.5	35-59
	0.3	28	8-30



	0.15	4	0-10
	Pan	0	—
Specific gravity	2.70		—
Water absorption (%)	0.5		—

**TEST RESULT OF COARSE AGGREGATE**

The properties of coarse aggregate was determined by various test conducted as per IS codal provision are tabulated in table 3.

**Table 3 Test results of coarse aggregate**

Property	Value		Remark
	IS sieve designation (mm)	Percentage passing (%)	
Sieve analysis (20mm down)	20	100	
	16	54.75	
	12.5	22.75	
	10	3.5	
	4.75	0	
	2.36	0	
	Pan	0	
	Specific gravity	2.85	
Water absorption (%)	1.06		
Bulk density (g/cm <sup>3</sup> )	1.60		

**TEST RESULTS OF DOLOMITE POWDER**

The test result of dolomite powder is given in table 4.

**Table 4 Test results of coarse aggregate**

Property	Value		Remark
	IS sieve designation (mm)	Percentage passing (%)	
Sieve analysis	10	100	Percentage passing for Grade Zone II 100
	4.75	93.6	90-100
	2.36	82	75-100
	1.18	56.8	55-90
	0.6	37.2	35-59
	0.3	18.4	8-30
	0.15	3	0-10
	Pan	0	—
Specific gravity	2.85		—



**TESTS ON COCONUT SHELL**

The test result is given in Table 5 for various test conducted on coconut shell.

**Table 5 Test results for coconut shell**

Property	Value		Remark
Sieve analysis	IS sieve designation (mm)	Percentage passing (%)	-
	20	98.4	
	16	86.2	
	12.5	74.6	
	10	8.7	
	4.75	3.10	
	2.36	0	
Pan	0		
Specific gravity	1.49		-
Water absorption (%)	23		-

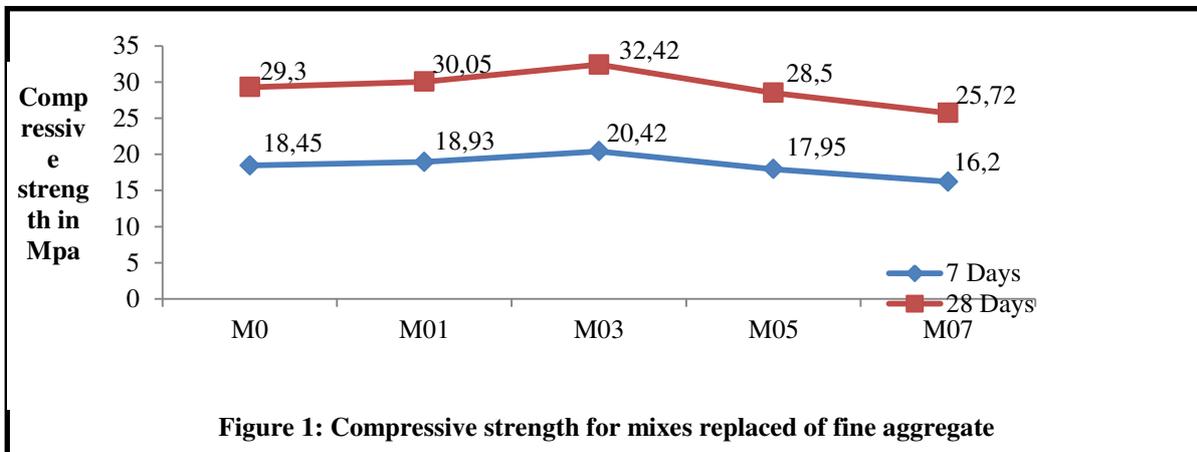
**TEST RESULTS OF HARDENED CONCRETE**

**Compressive strength test**

The compressive strength for fine aggregate and coarse aggregate replacement by dolomite powder and coconut shell respectively are tabulated and graphically represented.

**Table 6: Compressive strength test results**

Mix	Compressive strength in Mpa		Percentage replacement of fine aggregate by dolomite powder in %
	7 Days	28 Days	
M0	18.45	29.30	0
M01	18.93	30.05	10
M03	18.93	32.42	20
M05	17.95	28.50	30
M07	16.20	25.72	40

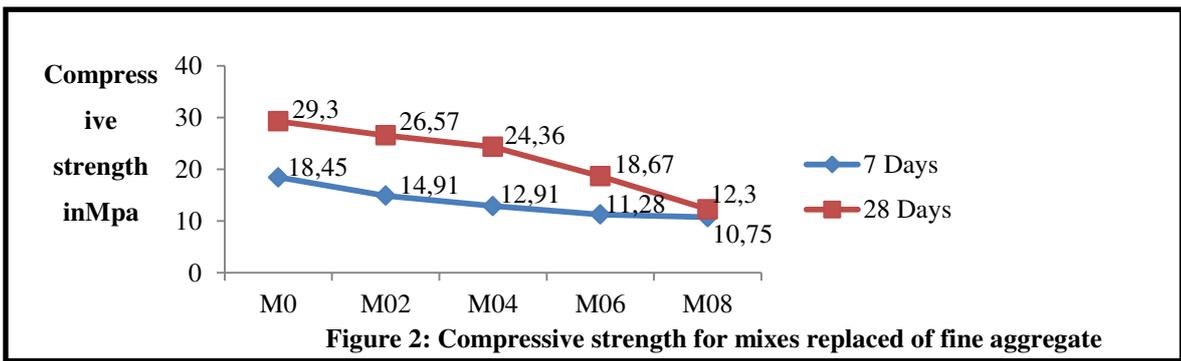


**Figure 1: Compressive strength for mixes replaced of fine aggregate**



Table 7 : Compressive strength tests

Mix	Compressive strength in Mpa		Percentage replacement of coarse aggregate by coconut shell in %
	7 Days	28 Days	
M0	18.45	29.30	0
M02	14.91	26.57	10
M04	12.94	24.36	20
M06	11.28	18.67	30
M08	10.75	12.30	40



Flexural strength test

The flexural strength for fine aggregate and coarse aggregate replacement by dolomite powder and coconut shell respectively are tabulated and graphically represented.

Table 8 : Flexural strength test results

Mix	Flexural strength in Mpa		Percentage replacement of fine aggregate by dolomite powder in %
	7 Days	28 Days	
M0	5.37	8.02	0
M01	5.89	8.80	10
M03	6.59	9.84	20
M05	4.71	7.04	30
M07	3.37	5.27	40

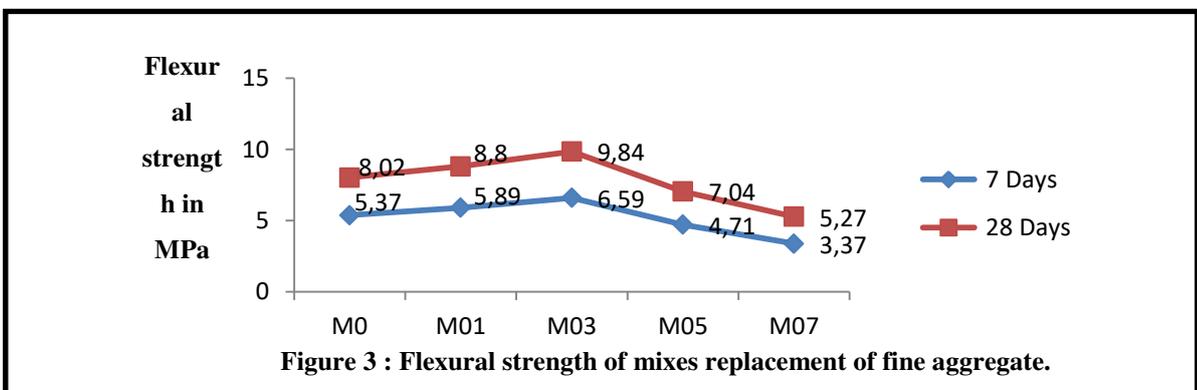




Table 9 : Flexural strength test results

Mix	Flexural strength in Mpa		Percentage replacement of coarse aggregate by coconut shell in %
	7 Days	28 Days	
M0	5.37	8.02	0
M02	4.26	9.65	10
M04	3.89	6.75	20
M06	3.22	4.24	30
M08	1.36	2.37	40

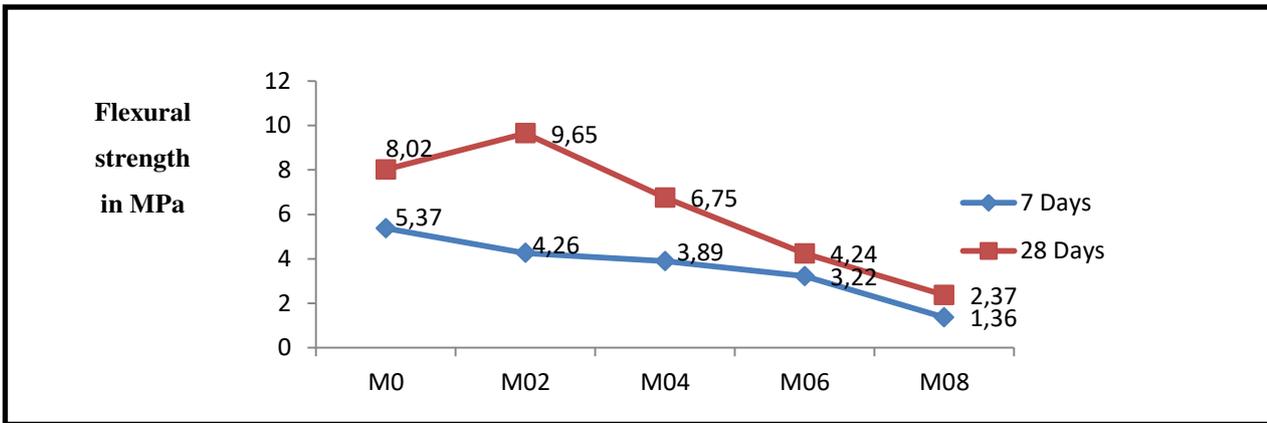


Figure 4 : Flexural strength of mixes of replacement of coarse aggregate

Splitting tensile strength test

The splitting tensile strength for fine aggregate and coarse aggregate replacement by dolomite powder and coconut shell respectively are tabulated and graphically represented.

Table 10 : Splitting tensile test results

Mix	Splitting tensile strength in Mpa		Percentage replacement of fine aggregate by dolomite powder in %
	7 Days	28 Days	
M0	2.42	4.40	0
M01	2.70	4.92	10
M03	2.88	5.25	20
M05	1.90	3.47	30
M07	1.31	2.39	40

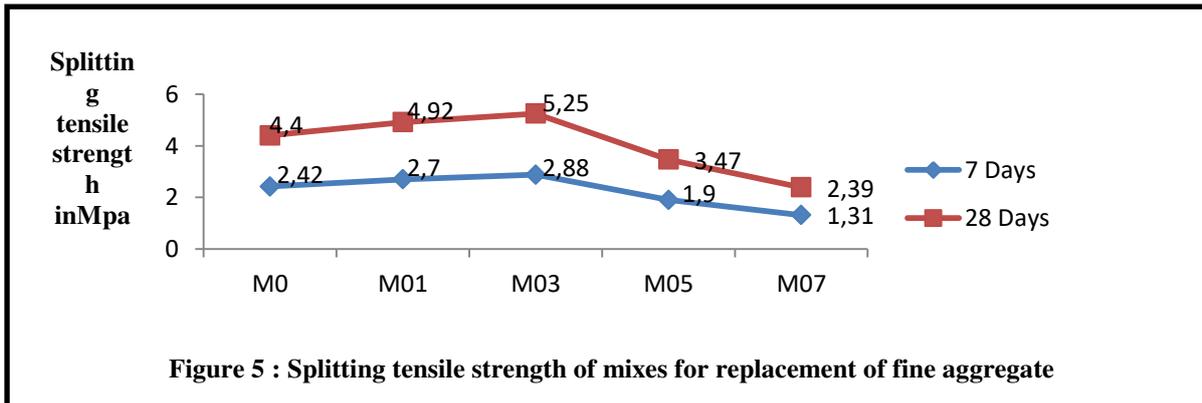
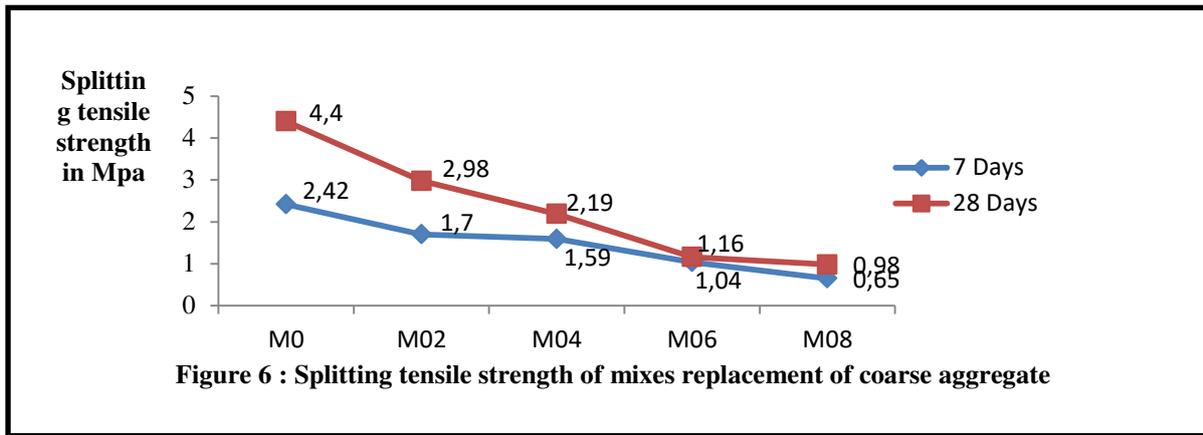


Figure 5 : Splitting tensile strength of mixes for replacement of fine aggregate



Table 11 : Splitting tensile test result

Mix	Splitting tensile strength in Mpa		Percentage replacement of coarse aggregate by coconut shell in %
	7 Days	28 Days	
M0	2.42	4.40	0
M02	1.70	2.98	10
M04	1.59	2.19	20
M06	1.04	1.16	30
M08	0.65	0.98	40



V. CONCLUSION

So finally in this current study and experiment investigated on addition of aramid fiber reinforced including the concrete under the consideration of the partial replacement of the fine aggregate consideration of the dolomite Powder and also as well as the coarse aggregate by coconut shell to understand the strength parameters of concrete design for the grade of concrete M25 according to the IS 10262:2019. Under compressive and flexural and including the splitting tensile strength of the concrete are determined under the various mixtures.

Following points were concluded at the end of the project.

1. The replacement of fine aggregate by dolomite powder increases the compressive strength of the concrete.
2. The ideal replacement percentage of fine aggregate by dolomite powder is can be replaced up to 20%.
3. At 20% replacement the maximum increase in the 28<sup>th</sup> day compression, flexural, and splitting tensile strength were found to be highest for dolomite powder replacement to fine aggregate.
4. Cost of dolomite powder is less than fine aggregate hence dolomite powder decrease the cost of concrete as well as pollution.
5. The compressive, flexural, and splitting strength values are optimal at 10% replacement of coarse aggregate by coconut shell and then decreases gradually in an interval of 10% up to 40%.

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