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An Experimental Study on Compressive Strength of M30 Concrete Using Seashell Powder and Eggshell Powder as a Partial Replacement of Fine Aggregate in Comparison with Conventional Concrete

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Abstract

The objective of the research is to compare seashell and eggshell based powder M30 concrete and conventional concrete on the compressive strength. In this study, a total of 18 samples were divided into two groups and prepared for data collection. One is made with ordinary concrete, and the other with seashells and eggshells-based powder M30 concrete. To perform the independent sample t-test, SPSS (Statistical Package for the Social Sciences) software, version 21, was used. The seashell and eggshell based powder M30 concrete sample has a mean compressive strength of 38.00 N/mm^2, whereas the conventional concrete test sample has a mean characteristics compressive strength of 33.73 N/mm^2. Independent samples t-test is performed to analyze the results. When a significant difference is found between the two groups in an independent sample t-test and the G-power is 80% and $p = 0.053$ ($p > 0.05$), the independent sample t-test is run for both groups is not statistically significant. The standard deviation is 2.90452, 5.81220, and the standard error is 0.68460, 1.36995, with the mean value being 33.7294, 36.8378. From the experimental study results, it could be found that the seashell and eggshell based powder M30 concrete has more compressive strength than traditional concrete.

Keywords

Seashell powder, Eggshell powder, Cement, Fine aggregate, Sustainable infrastructure, Compressive strength, M30 grade, Conventional concrete.

Introduction

The advancement of a nation or a nation relies upon innovation, yet in addition on a framework. The framework is known to be supported by concrete. Materials such as cement, aggregates (fine and coarse) with water forms concrete [1]. Concrete is broadly utilized all through the world. Concrete creation goes from the world's complete carbon dioxide. Thus, concrete creation isn't harmless to the ecosystem, and concrete is the costliest material in the structure of cement and, in this manner, uneconomical [2]. Finding alternative materials is crucial to making the development industry eco-friendly and financially viable. The collection of waste is rapidly growing due to the tremendous increase. Collection of waste material is expanding quickly in light of the fact that tremendous development in the populace is giving a source to it, and this makes emergency removal of waste. One arrangement of this emergency lies in reusing waste materials in line with some helpful items [3]. The substantial is around the world a significant development material which is utilized in the development of different constructions from old opportunities to work today and remain supported in future. Population development, urbanization, globalization, and ecological contamination are a few elements that are answerable for social and monetary change of the general public. Natural contamination causes serious harm to human development on the earth and to tackle this issue, the idea of green concrete is arising these days [4].

Seashell powder and eggshell powder concrete are the subject of much research over the last five years, with approximately 168 articles in Google Scholar and 90 in the American Concrete Institute. Concrete made with eggshell powder shrinks. Mechanical characteristics of high-strength concrete that uses fly ash and eggshell powder to partially replace cement.

An experiment to replace traditional coarse aggregate in M40 grade concrete made with river sand with eggshell powder [5]. Thus, the development business is as of now searching for appropriate waste that will altogether diminish concrete use and eventually lessen development costs. Squander from modern and rural fields, for example, copper, slag, quarry dust, rice husk debris, eggshell powder, seashell powder are a reason for reusing and ecological perils [6]. Selecting seashell powder makes use for waste materials and calcium-advanced eggshell powder are poultry squander with practically a similar synthetic organization as limestone [7]. Cement may benefit by using eggshell powder waste instead of ordinary lime or concrete since it limits the amount of concrete used, protects regular lime, and makes use of waste. Eggshell powder is a decent gas pedal for concrete fasteners [8]. The eggshell powder and limestone are practically the same in synthetic nature. To this end, we can limit the utilization of concrete and garbage removal [9]. Different scientists use eggshell powder as a substitute for concrete. Present exploration examined the new and solidified attributes of cement containing eggshell powder [10]. The utilization of eggshell powder debris in substantial creation decreases the expense of unrefined substances and also adds to the development business [11]. Eggshell powder additionally adds to the development industry which tends to be lessened in development spending plans with high strength sturdiness of the substantial. In this manner, eggshell powder can be relevant to the decreased expense of development material and deliver another natural substance for advancement in the development business. To compare seashell and eggshell powder concrete with conventional concrete using M30 grade concrete. Nano eggshell and seashell powder were also employed in various applications [12].

Materials and Method

To determine the characteristic compressive strength of the concrete specimen, 150 mm cubic standard specimen was engaged since the nominal size of aggregates used in this study is of 20 mm. Experiments were conducted in two groups, one group of the concrete specimens was made using conventional concrete of M30 grade in accordance with IS regulations, whereas the other groups used M30 concrete with cement, aggregate, and water additions of 15% seashell powder and 25% eggshell powder. Figure 1 shows the seashell and figure 2 shows the seashell powder. Figure 3 and figure 4 show the eggshell and eggshell powder, respectively.

The G-power has computed the sample size and found that each group has 18 samples, allowing for a total of 36 tests to be run. The SPSS (version 21) program can be used to perform statistical analysis on comparative research. Figure 5 shows the mixing of concrete. Figure 6 weighing of concrete.

Figure 1: Collection of seashells.

Figure 2: Seashell powder.

Figure 3: Collection of eggshells.

Figure 4: Eggshell powder.

Figure 5: Mixing of concrete.

Figure 6: Weighing of concrete cube.

For group 1, batching and manual mixing of the required ingredients are employed to make the concrete for the sample specimen. Regular M30 grade concrete is added directly and uniformly. Three equal-height layers of this concrete were poured into the molds, and each layer was tamped 25 times. Figure 7 shows the casting of cube molds. To eliminate cavities from the specimen, vibration is also applied during the casting process. The specimens were stored for curing at room temperature for 28 days following sample preparation. Similar to how the sample size was determined, the G-power determined that each group had 18 samples, allowing for the execution of 36 tests. The statistical analysis for the comparative research can be done using the SPSS (version 21) tool. The identical procedures were followed for group 2, with the sole exception that during the concrete mixing process, eggshell powder was added in proportion to the volume of cement Figure 8 presents experimental test setup by using universal testing machine.

The compressive strength of 18 samples in group-1 specimens, or traditional self-healing specimens, was determined after testing. Similar to this, the compressive strength of 18 specimens of group 2's seashell powder and eggshell powder concrete specimens was determined.

Figure 7: Casting of concrete cubes.

Statistical analysis

The compressive strength grade of the concrete, water cement days of curing, and analytical differences factors were independent variables used in the study, which was conducted using SPSS (version 21) software. To determine the study's analytical differences variable, independent sample t-tests were used. This program also calculated the compressive strength's standard deviation and standard error of the mean. When a significant difference is found between the two groups in an independent sample t-test and the G-power is 80% and $p = 0.053$ ($p > 0.05$), the independent sample t-test is run for both groups is not statistically significant. Figure 9 displays the SPSS statistical analysis bar chart. The compressive strength of eggshell and seashell addition concrete is compared to conventional concrete.

Results

Comparatively, the compressive strength of concrete made with seashell and eggshell based powder M30 concrete was 38.00 N/mm^2, whereas conventional concrete had a mean

Figure 8: Experimental test setup by using universal testing machine.

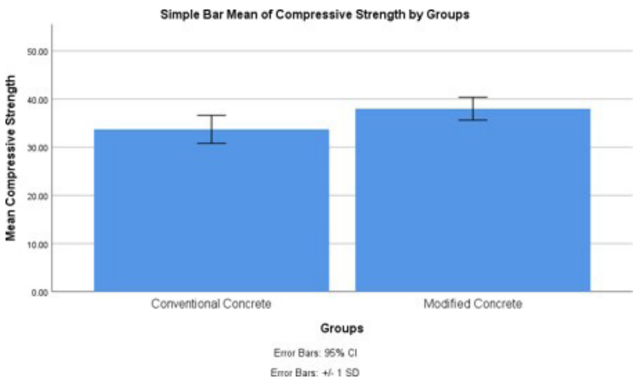

Figure 9: Bar chart shows the X-axis group statistics of conventional concrete and modified concrete. and the Y-axis is about the mean compressive strength of M30 grade concrete and the standard deviation +/-1 and the confidence interval (CI) is about 95%.

compressive strength of 33.73 N/mm^2. The standard deviation is 2.90452, 5.81220, the mean value is 33.7294, and the standard error is 0.68460, 1.36995. The compressive strengths of standard concrete are shown in table 1, while those of modified concrete are shown in table 2. Table 3 displays the results of the independent t-test using SPSS. Group statistics are displayed in table 4. The SPSS carried out has a significance of 0.053 ($p > 0.05$). This shows that there is a not statistically significant difference between the two groups considered in this study. Standard error 0.68460, 1.36995.

Discussion

The accompanying perceptions were produced using the test directed [8]. The concrete's compressive strength increased at all times of relieving when compared to the control concrete's compressive strength, even with a concrete mix that substituted 15% seashell powder and 25% eggshell powder for the concrete at halfway the levels recommended by the manufacturer. Experimental investigation of the effectiveness of a self-compacting concrete mix employing admixtures in comparison to conventional concrete is presented [13] an experimental evaluation of the effects of fly ash on eggshell powder-based concrete. Experiment with eggshell powder and some micro silica to make concrete.

The utilization of eggshell powder debris in substantial creation decreases the expense of unrefined substances and

Table 1: Result of compressive strength of the conventional concrete (M30 grade).

S. No.	Weight (Kg)	Compressive strength (N/mm^2)
1	8.145	30.18
2	8.443	41.07
3	8.327	33.60
4	8.649	30.00
5	9.163	31.71
6	8.987	30.91
7	8.568	31.79
8	8.247	32.22
9	8.699	32.98
10	8.184	33.64
11	9.012	34.35
12	8.445	35.05
13	8.765	35.75
14	9.187	36.46
15	8.543	31.79
16	8.217	32.22
17	9.199	38.57
18	8.932	34.84
Mean average		**33.73**

Table 2: Result of compressive strength of seashells and eggshells-based powder M30 concrete.

S. No.	Weight (Kg)	Compressive strength (N/mm^2)
1	8.145	36.49
2	8.443	37.60
3	8.327	38.89
4	8.649	36.09
5	9.163	38.58
6	8.987	41.07
7	8.568	35.07
8	8.247	37.47
9	8.699	38.89
10	8.184	42.00
11	9.012	38.89
12	8.445	34.76
13	8.765	34.84
14	9.187	42.84
15	8.543	35.33
16	8.217	37.96
17	9.199	38.89
18	8.932	38.40
Mean average		**38.00**

Table 3: Statistical analysis of comparison of conventional concrete and eggshell powder concrete. Mean value is 33.7294, 36.8378, the standard deviation is 2.90452, 5.81220, and standard error is 0.68460, 1.36995.

	Groups	N	Mean	Std. deviation	Std. error mean
Values	Conventional concrete	18	33.7294	2.90452	0.68460
	Seashell and eggshell powder concrete	18	36.8378	5.81220	1.36995

also adds to the development business [14]. Eggshell powder additionally adds to the development industry which tends to

Table 4: Independent sample t-test t is performed for the two groups for significant difference observed for strength in an independent sample t-test with p = 0.053 as it is (p > 0.05). Hence it is not statistically significant.

Test for equality of variances			T-test for equality of means						
Assumptions	F	Sig.	t	df	Sig. (2-tailed)	Mean difference	Std. error difference	95% CI of the difference	
								Lower	Upper
Equal variance assumed	0.772	0.386	-2.030	34	0.053	-3.10833	1.53148	-6.22068	0.00402
Equal variance not assumed	-	-	-2.030	24.992	0.053	-3.10833	1.53148	-6.26253	0.04587

be lessened in development spending plans with high strength sturdiness of the substantial [15]. In this manner, eggshell powder can be relevant to the decreased expense of development material and deliver another natural substance for advancement in the development business [16]. To compare eggshell powder concrete with conventional concrete using M30 grade concrete.

Conclusion

The compressive strength of seashell and eggshell based powder M30 grade concrete increased by 4.27 N/mm^2 on average when compared to conventional concrete, according to a comparative analysis. Hence as per compressive strength result seashell powder and eggshell mixed concrete can achieve good results.

Acknowledgements

None.

Conflict of Interest

None.

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