INVESTIGATING THE INFLUENCE OFRIVER SAND AND CRUSHED SANDON THE STRENGTH GAIN FOR M30 GRADE OF CONCRETE

Abstract

Concrete is a widely used construction material and the quality of its constituents significantly affects its overall strength and durability. Traditional concrete production involves the use of natural crushed sand as a fine aggregate. However, the availability of crushed sand has been diminishing due to environmental concerns and excessive mining. This has led to an increasing interest in using alternative materials, such as river sand in concrete production. This research provides a concise overview of a study focused on the compressive strength of concrete when crushed sand is replaced with river sand. The objective of this research was to investigate the impact of replacing crushed sand with river sand on the compressive strength of concrete, with the aim of addressing a current research gap in the field. The research gap identified in this study is the limited understanding of how replacing crushed sand with river sand affects the compressive strength of concrete. This knowledge gap necessitates the investigation of this relationship, as it has significant implications for the construction industry and the development of sustainable concrete production practices. The main aim of this project is to analyze the compressive strength characteristics of concrete by replacing crushed sand with river sand. A comprehensive experimental program was designed and executed, involving the preparation and testing of concrete specimens with varying proportions of river sand as a replacement for crushed sand. The compressive strength of these specimens was then evaluated using standardized testing methods. The results of the study

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revealed valuable insights into the effects of replacing crushed sand with river sand on the compressive strength of concrete. The findings provide a basis for optimizing concrete mix designs and improving the utilization of alternative materials in concrete production. In conclusion, this research project contributes to the existing knowledge by filling the research gap regarding the influence of replacing crushed sand with river sand on the compressive strength of concrete. The rate of gain of strength of river sand concrete is constant throughout between 7 days to the 21 days of curing. The findings offer valuable guidance for engineers, researchers and industry professionals involved in concrete production, enabling them to make informed decisions and promote sustainable practices in construction.

Keywords: Compressive Strength, Crushed Sand, River Sand and Replacement.

I. INTRODUCTION

Concrete, a widely used construction material, is composed of cement, aggregates, water, and other additives. Aggregates play a crucial role in determining the strength and durability of concrete. The two most commonly used types of aggregates are river sand and crushed sand. River sand is traditionally used as a fine aggregate in concrete production, while crushed sand, obtained by crushing rocks, has gained popularity as an alternative. The selection of appropriate aggregates is essential to ensure the desired properties and performance of concrete. The M30 grade of concrete refers to a mix design where the compressive strength of the concrete after 28 days of curing is targeted at 30 MPa. Achieving the desired strength requires careful consideration of the aggregate characteristics, as they significantly influence the overall quality of the concrete. This experimental investigation aims to analyze and compare the impact of river sand and crushed sand as fine aggregates in the production of M30 grade concrete. The study seeks to evaluate the mechanical properties, such as compressive strength, tensile strength, and flexural strength, as well as other relevant properties like workability and durability. By systematically studying the effects of using river sand and crushed sand in M30 grade concrete, this research aims to provide valuable insights into the performance and suitability of these two types of aggregates. The findings can aid engineers, architects, and construction professionals in making informed decisions regarding aggregate selection for specific construction projects. The aim of this project is to conduct an experimental investigation to evaluate and compare the impact of river sand and crushed sand as fine aggregates in the production of M30 grade concrete. The study aims to analyze the mechanical properties, workability, and durability characteristics of the concrete mixtures containing these two types of aggregates. By achieving this aim, the project aims to provide valuable insights and recommendations for the selection and optimization of fine aggregates in M30 grade concrete, benefiting the construction industry and facilitating informed decision-making in concrete construction projects.

The objectives adopted to achieve the aim of this project are as follows:

1 To investigate the influence of river sand and crushed sand on the compressive strength of M30 grade concrete.
2 To analyze the impact of different fine aggregates on the workability of concrete mixtures.
3 To provide recommendations and insights regarding the most suitable type of fine aggregates for M30 grade concrete based on the experimental findings.

II. METHODOLGY

In the experimental investigation on the impact of river sand and crushed sand in M30 grade concrete, several tests are conducted to characterize the properties of the materials involved. These tests are crucial for understanding the behavior and suitability of the sands in concrete production. The following tests are typically performed:

1. **Sieve Analysis of Coarse Aggregates:** This test determines the particle size distribution of the coarse aggregates. The aggregate is passed through a series of sieves with different mesh sizes, and the percentage of material retained on each sieve is determined.

2. **Specific Gravity of Cement:** This test determines the specific gravity of cement, which

indicates its density compared to water. It is usually measured using a specific gravity bottle or a pycnometer.

3. **Specific Gravity of Coarse Aggregate:** The specific gravity of coarse aggregate is determined to understand its density in relation to water. This test helps in assessing the quality and suitability of the aggregate for concrete production.

4. **Water Absorption Test on Coarse Aggregate:** This test measures the amount of water absorbed by the coarse aggregate. It provides insights into the porosity and moisture content of the aggregate, which can influence the water-cement ratio and workability of concrete.

5. **Specific Gravity of Crushed Sand:** The specific gravity of crushed sand is determined to assess its density compared to water. This property helps in understanding the quality and characteristics of crushed sand as a fine aggregate in concrete.

6. **Water Absorption of Crushed Sand:** This test measures the water absorption capacity of crushed sand. It determines the amount of water absorbed by the fine aggregate, which can affect the overall water-cement ratio and workability of concrete mixtures.

7. **Specific Gravity of River Sand:** The specific gravity of river sand is determined to evaluate its density relative to water. This test provides insights into the quality and suitability of river sand as a fine aggregate in concrete production.

8. **Water Absorption of River Sand:** This test measures the water absorption capacity of river sand. It helps in understanding the amount of water that the fine aggregate can absorb, which can impact the water-cement ratio and workability of concrete.

These tests are essential in characterizing the physical properties of the coarse aggregate, crushed sand, and river sand, which are crucial components in concrete production. The results obtained from these tests contribute to a comprehensive understanding of the materials and facilitate the formulation of optimized concrete mix designs.

III. RESULTS & DISCUSSION

The compressive strength values obtained from the three-day, seven-day, fourteen-day, twenty-one day, and twenty-eight day compressive tests were recorded for both the river sand and crushed sand concrete cube samples simultaenously. The average compressive strength were calculated for each set of samples. The data were analyzed to compare the strength development and assess the influence of the different sands on the concrete's compressive strength. Based on the three-day compressive test results, the compressive strength performance of the river sand and crushed sand concrete samples can be evaluated. The findings will provide valuable insights into the early strength development and suitability of these sands in M30 grade concrete. The results will contribute to further discussions on the impact of the sand type on the concrete's overall strength characteristics and assist in making informed decisions regarding material selection in concrete production.

1. Results for Compressive Strength using River Sand:

- **Three Day Compressive Strength:** In Table 1, the compressive strength of each individual concrete sample containing river sand is presented. The samples, labeled as Sample 1, Sample 2, Sample 3 were subjected to the three-day compressive test. The compressive strength values of each sample, expressed in megapascals (MPa), are listed in the corresponding column. To determine the average compressive strength of the river sand concrete samples, the values were summed and divided by the total number of samples tested. The tabulated data provides a quantitative representation of the compressive strength results for the river sand concrete samples. This information serves as a basis for comparing the performance of the concrete mix incorporating river sand and for further analysis and interpretation in the context of the experimental investigation

Table 1: Three Day Compressive Strength using River Sand

Sample	Weight (kg)	Load (N)	Area (mm^2)	Compressive Strength (N/mm^2)	Average Value (N/mm^2)
1	8.500	427	150 x 150	18.97	18.92
2	8.475	411	150 x 150	18.26	
3	8.500	440	150 x 150	19.55	

- **Seven Day Compressive Strength:** In Table 2, the compressive strength of each individual concrete sample containing river sand is tabulated after seven days of testing. The samples, labeled as Sample 1, Sample 2, Sample 3 were subjected to the compressive strength test at the end of the seven-day curing period. The values of the compressive strength for each sample, measured in megapascals (MPa), are presented in the corresponding column. The tabulated data provides a quantitative representation of the compressive strength results for the river sand concrete samples at the seven-day mark. This information allows for a comparison of the strength development over time and provides insights into the performance of the concrete mix incorporating river sand. The average compressive strength value is essential for evaluating the overall strength characteristics and further analysis of the concrete samples in the context of the experimental investigation.

Table 2: Seven Day Compressive Strength using River Sand

Sample	Weight (kg)	Load (N)	Area (mm^2)	Compressive Strength (N/mm^2)	Average Value (N/mm^2)
1	8.750	689	150 x 150	30.62	29.73
2	8.480	678	150 x 150	30.13	
3	8.445	640	150 x 150	28.44	

- **Fourteen Day Compressive Strength:** In Table 3, the compressive strength of each individual concrete sample containing river sand is tabulated after fourteen days of

testing. The samples, labeled as Sample 1, Sample 2, and Sample 3 were subjected to the compressive strength test at the end of the fourteen-day curing period. The values of the compressive strength for each sample, measured in megapascals (MPa), are presented in the corresponding column. The tabulated data provides a quantitative representation of the compressive strength results for the river sand concrete samples at the fourteen-day mark. This information allows for tracking the strength development over time and evaluating the performance of the concrete mix incorporating river sand. The average compressive strength value is essential for assessing the overall strength characteristics and further analysis of the concrete samples in the context of the experimental investigation.

Table 3: Fourteen Day Compressive Strength using River Sand

Sample	Weight (kg)	Load (N)	Area (mm^2)	Compressive Strength (N/mm^2)	Average Value (N/mm^2)
1	8.830	535	150 x 150	23.77	30.08
2	8.540	735	150 x 150	32.66	
3	8.405	761	150 x 150	33.82	

- **Twenty-One Day Compressive Strength:** In Table 4, the compressive strength of each individual concrete sample containing river sand is tabulated after twenty-one days of testing. The samples, labeled as Sample 1, Sample 2, and Sample 3 were subjected to the compressive strength test at the end of the fourteen-day curing period. The values of the compressive strength for each sample, measured in megapascals (MPa), are presented in the corresponding column. The tabulated data provides a quantitative representation of the compressive strength results for the river sand concrete samples at the fourteen-day mark. This information allows for tracking the strength development over time and evaluating the performance of the concrete mix incorporating river sand. The average compressive strength value is essential for assessing the overall strength characteristics and further analysis of the concrete samples in the context of the experimental investigation.

Table 4: Twenty-One Day Compressive Strength using River Sand

Sample	Weight (kg)	Load (N)	Area (mm^2)	Compressive Strength (N/mm^2)	Average Value (N/mm^2)
1	8.835	700	150 x 150	31.11	30.54
2	8.550	675	150 x 150	30.00	
3	8.490	687	150 x 150	30.53	

- **Twenty-Eight Day Compressive Strength:** In Table 5, the compressive strength of each individual concrete sample containing river sand is tabulated after twenty-eight days of testing. The samples, labeled as Sample 1, Sample 2, and Sample 3 were subjected to the compressive strength test at the end of the fourteen-day curing period. The values of the compressive strength for each sample, measured in megapascals

(MPa), are presented in the corresponding column. The tabulated data provides a quantitative representation of the compressive strength results for the river sand concrete samples at the fourteen-day mark. This information allows for tracking the strength development over time and evaluating the performance of the concrete mix incorporating river sand. The average compressive strength value is essential for assessing the overall strength characteristics and further analysis of the concrete samples in the context of the experimental investigation.

Table 5: Twenty-Eight Day Compressive Strength using River Sand

Sample	Weight (kg)	Load (N)	Area (mm^2)	Compressive Strength (N/mm^2)	Average Value (N/mm^2)
1	8.775	912	150 x 150	40.53	35.65
2	8.545	695	150 x 150	30.88	
3	8.680	800	150 x 150	35.55	

2. Results for Compressive Strength using Crushed Sand:

- **Three Day Compressive Strength:** In Table 6, the compressive strength of each individual concrete sample containing crushed sand is presented. The samples, labeled as Sample 1, Sample 2, Sample 3 were subjected to the three-day compressive test. The compressive strength values of each sample, expressed in megapascals (MPa), are listed in the corresponding column. To determine the average compressive strength of the river sand concrete samples, the values were summed and divided by the total number of samples tested. The tabulated data provides a quantitative representation of the compressive strength results for the river sand concrete samples. This information serves as a basis for comparing the performance of the concrete mix incorporating river sand and for further analysis and interpretation in the context of the experimental investigation

Table 6: Three Day Compressive Strength using Crushed Sand

Sample	Weight (kg)	Load (N)	Area (mm^2)	Compressive Strength (N/mm^2)	Average Value (N/mm^2)
1	8.690	472	150 x 150	20.97	21.07
2	8.475	411	150 x 150	18.26	
3	8.500	440	150 x 150	19.55	

- **Seven Day Compressive Strength:** In Table 7, the compressive strength of each individual concrete sample containing crushed sand is tabulated after seven days of testing. The samples, labeled as Sample 1, Sample 2, Sample 3 were subjected to the compressive strength test at the end of the seven-day curing period. The values of the compressive strength for each sample, measured in megapascals (MPa), are presented in the corresponding column. The tabulated data provides a quantitative representation of the compressive strength results for the river sand concrete samples

at the seven-day mark. This information allows for a comparison of the strength development over time and provides insights into the performance of the concrete mix incorporating river sand. The average compressive strength value is essential for evaluating the overall strength characteristics and further analysis of the concrete samples in the context of the experimental investigation.

Table 7: Seven Day Compressive Strength using Crushed Sand

Sample	Weight (kg)	Load (N)	Area (mm^2)	Compressive Strength (N/mm^2)	Average Value (N/mm^2)
1	8.800	690	150 x 150	30.66	22.84
2	8.505	383	150 x 150	17.02	
3	9.165	469	150 x 150	20.84	

- **Fourteen Day Compressive Strength:** In Table 8, the compressive strength of each individual concrete sample containing crushed sand is tabulated after fourteen days of testing. The samples, labeled as Sample 1, Sample 2, and Sample 3 were subjected to the compressive strength test at the end of the fourteen-day curing period. The values of the compressive strength for each sample, measured in megapascals (MPa), are presented in the corresponding column. The tabulated data provides a quantitative representation of the compressive strength results for the river sand concrete samples at the fourteen-day mark. This information allows for tracking the strength development over time and evaluating the performance of the concrete mix incorporating river sand. The average compressive strength value is essential for assessing the overall strength characteristics and further analysis of the concrete samples in the context of the experimental investigation.

Table 8: Fourteen Day Compressive Strength using River Sand

Sample	Weight (kg)	Load (N)	Area (mm^2)	Compressive Strength (N/mm^2)	Average Value (N/mm^2)
1	8.770	608	150 x 150	27.02	29.62
2	8.635	539	150 x 150	23.95	
3	8.955	853	150 x 150	37.91	

- **Twenty-One Day Compressive Strength:** In Table 9, the compressive strength of each individual concrete sample containing crushed sand is tabulated after twenty-one days of testing. The samples, labeled as Sample 1, Sample 2, and Sample 3 were subjected to the compressive strength test at the end of the fourteen-day curing period. The values of the compressive strength for each sample, measured in megapascals (MPa), are presented in the corresponding column. The tabulated data provides a quantitative representation of the compressive strength results for the river sand concrete samples at the fourteen-day mark. This information allows for tracking the strength development over time and evaluating the performance of the concrete mix incorporating river sand. The average compressive strength value is essential for

assessing the overall strength characteristics and further analysis of the concrete samples in the context of the experimental investigation.

Table 9: Twenty-One Day Compressive Strength using River Sand

Sample	Weight (kg)	Load (N)	Area (mm^2)	Compressive Strength (N/mm^2)	Average Value (N/mm^2)
1	8.865	1019	150 x 150	45.28	36.89
2	8.575	678	150 x 150	30.13	
3	9.025	794	150 x 150	35.28	

- **Twenty-Eight Day Compressive Strength:** In Table 10, the compressive strength of each individual concrete sample containing crushed sand is tabulated after twenty-eight days of testing. The samples, labeled as Sample 1, Sample 2, and Sample 3 were subjected to the compressive strength test at the end of the fourteen-day curing period. The values of the compressive strength for each sample, measured in megapascals (MPa), are presented in the corresponding column. The tabulated data provides a quantitative representation of the compressive strength results for the river sand concrete samples at the fourteen-day mark. This information allows for tracking the strength development over time and evaluating the performance of the concrete mix incorporating river sand. The average compressive strength value is essential for assessing the overall strength characteristics and further analysis of the concrete samples in the context of the experimental investigation.

Table 10: Twenty-Eight Day Compressive Strength using River Sand

Sample	Weight (kg)	Load (N)	Area (mm^2)	Compressive Strength (N/mm^2)	Average Value (N/mm^2)
1	8.555	703	150 x 150	31.24	39.13
2	8.615	907	150 x 150	40.31	
3	8.630	1032	150 x 150	45.86	

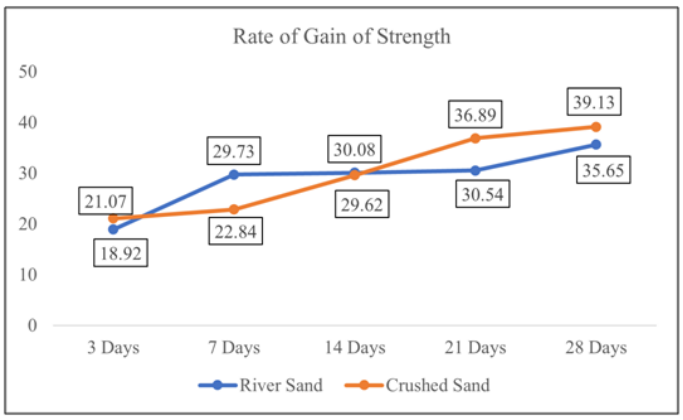

Figure 1: Compressive Strength comparison of River sand and Crushed Sand

IV. CONCLUSIONS

The compressive strength of concrete samples containing river sand at three days is observed to be less than that of concrete samples containing 11.36% fine aggregate. This indicates that the fine aggregate concrete, which includes a higher proportion of fine aggregates, demonstrates greater strength development at the early age of three days compared to the concrete with river sand.

The compressive strength of concrete samples containing river sand at seven days is observed to be greater than that of concrete samples containing 30.17% crushed sand. This indicates that the river sand concrete, with a higher proportion of river sand as fine aggregate, exhibits superior strength development at the seven-day mark compared to the concrete with crushed sand.

The compressive strength of concrete samples containing river sand at fourteen days is observed to be higher than that of concrete samples containing 15.53% crushed sand. This indicates that the river sand concrete, which includes a higher proportion of river sand as fine aggregate, exhibits greater strength development at the fourteen-day mark compared to the concrete with crushed sand.

The compressive strength of concrete samples containing river sand at twenty-one days is observed to be lower than that of concrete samples containing 20.79% crushed sand. This indicates that the fine aggregate concrete, which includes a higher proportion of fine aggregates, exhibits greater strength development at the twenty-one-day mark compared to the concrete with river sand.

The compressive strength of concrete samples containing river sand at twenty-eight days is observed to be lower than that of concrete samples containing 9.76% crushed sand. This indicates that the fine aggregate concrete, which includes a higher proportion of fine aggregates, exhibits greater strength development at the twenty-eight-day mark compared to the concrete with river sand.

The rate of gain of strength for concrete samples containing crushed sand gradually increases from day one to the end of the curing period. This indicates that the concrete exhibits a progressive strength development over time.

The rate of gain of strength for concrete samples containing river sand remains relatively constant between the 7th and 21st day of the curing period. This suggests that the concrete demonstrates a consistent and steady rate of strength development during this specific timeframe. This constant rate of gain of strength during the 7th to 21st day of curing can be attributed to the continuous hydration process of cement and the ongoing formation and maturation of the cementitious matrix. The particle characteristics and distribution of river sand contribute to a stable and consistent packing arrangement within the concrete, which promotes uniform strength development over time.

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