STUDY OF PARTIAL REPLACEMENT OF CEMENT AND FINE AGGREGATE BY STONE DUST IN CONCRETE

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ABSTRACT-Concrete is a versatile widely used construction material. Ever since concrete has been accepted as a material for construction, researchers have been trying to improve its quality and enhance its performance. Recent changes in construction industry demand improved durability of structure. For construction the concrete is essential. It contain the natural material as sand .There are research on the partial replacement of the natural sand by the different material as fly ash and any other material which shows the same property. The mix design is use for the casting of the cube and for the partial replacement of the cement and sand with the stone dust is use M25 grade mix design. We are replacing the natural sand with stone dust which is passing through 4.75 mm IS sieve and retained on 90 micron IS sieve with increasing percentage 10%, 20%, 30%, etc. similarly the cement is replacing with stone dust which is passing through IS 90 micron sieve with increasing percentage 5%, 10%, 15%, etc. the stone dust with the various percentages to increase. The strength of the concrete is increase in the percentage of 5%, 10%, 15%. The strength is increase by the 20%.

KEYWORDS: Stone Dust, 4.75mm IS Sieve, 90 Micron IS Sieve, M25 grade Concrete, etc.

1. INTRODUCTION

Concrete is commonly used construction material due to its ease of availability, suitability, rigidity and durability. It generally consists of binding material, Fine aggregate, coarse aggregate and required quantity of water, where sand is normally used as Fine aggregate. The concrete is useful materials in the construction industry. It is not only used in building construction but also in other areas like roads, bridges, harbors, and many more. It is comparatively economical, easy to make offers continuity solidity and indeed it lays the role of developing and improving or modern life. It is a composite material which is made up of cement, sand, aggregate and water. The fresh concrete can be mould into any desire shape. Due to rapid growth of construction activity, the available sources of natural sand are getting exhausted. Hence conservation of natural resources is great challenge for civil engineers since construction activities cannot be diminished as it is intimate able. The only way is to search an alternatives material which can fully or partially replaced naturally available material in construction. Stone dust is such an alternative material which can be effectively being used in construction as partial replacement of natural sand. This is a waste product obtained from aggregate crushing plant. Stone dust is well appropriate in terms of strength and economy over normal sand for medium grade concrete 40 percent Fine aggregate can be effectively replaced with stone dust.

The compressive strength of concrete mix had increased by 22% with the use of crusher dust at 40% replacement of natural sand. The present study aimed to utilizing stone dust as Fine aggregate in concrete in place of natural Fine aggregate. For that an experimental program was carried out to study the suitability and potential use of stone dust as partial replacement of Fine aggregate in concrete. To accomplish this concrete cubes were cast for different replacement level at an interval of 10 percent to determine compressive strength of concrete at different level of Fine aggregate with stone dust. The study shows that compressive strength of concrete made using stone dust as Fine aggregate replacement having greater value in comparison of conventional concrete.

2. OBJECTIVES OF EXPERIMENTAL WORK

- To find the optimum percentage of replacement of natural sand with stone dust at which maximum strength is obtained.
- To find the optimum mix design with regards to the amount of water, stone dust and cement ratio.
- To conduct compression test and control concrete on standard IS specimen size (150x150x150 mm).
- To study in detail about presence of stone dust in concrete.
- To provide economical construction material and strength to concrete.

3. METHODOLOGY

1.Cement

Portland Pozolana cement of 53 grade (IS: 12269-1987), Specifications for 53 Grade has been used in the study. It was procured from a single source and stored as per IS: 4032 – 1977. Care has been taken to ensure that the cement of same company and same grade is used throughout the investigation. The cement thus procured was tested for physical properties in accordance with the IS: 12269 – 1987.

2.Aggregate

Fine and coarse aggregates make up the bulk of a concrete mixture. Sand, natural gravel and crushed stone are used mainly for this purpose. The size distribution of the aggregate determines how much binder is required. Aggregate with a very even size distribution has the biggest gaps whereas adding aggregate with smaller particles tends to fill these gaps. The binder must fill the gaps between the aggregate as well as pasting the surfaces of the aggregate together, and is typically the most expensive component.

3.Stone Dust

The Stone dust used in the investigation is obtained from stone crusher plant near Sawangi, Aurangabad. The stone dust is used in two sizes i.e. stone dust passing through 90 micron IS sieve for replacement of cement and stone dust passing through 4.75 mm IS sieve and retained on 90 micron IS sieve for replacement of fine aggregate.

4.Mix Design

In this experiment we select the grades of concrete M25. The mix design was carried out as per IS: 10262-2009. The trials have been prepared and finally we find for M25 grade was design for this experiment having the mix proportion 1:1.67:2.30 and the water cement ratio is 0.46. All locally available materials are used during the preparation of the mix proportion.

5.Compressive Strength Tests

The compressive strength tests were done by using the cubic specimen of sizes 150x150x150 mm. The moulds are confirming to the IS specification. For each test three specimens were taken and their average value is considered. The load should be applied gradually at the rate of 140 kg/cm2 per minute till the specimens fails. The load at the failure divided by area of specimen gives the compressive strength of concrete. The cubes were tested at 7, 14 and 28 days of curing.

4. RESULT

Compressive Strength

Table 1 Replacement of 5% Cement and 10% Fine Aggregate

Sr. No.	Age in Days	Wt. of Cube (gm)	Compressive Strength			Density of Concrete	Mean (KN/mm^3)
			Load(KN)	IN (N/mm2)	Mean		
1	7	8751	274	12.16	13.99	25.44	25.54
		8705	340	15.13		25.30	
		8902	330	14.67		25.88	
2	14	8654	476	21.16	21.34	25.15	24.94
		8535	510	22.67		24.81	
		8552	454	20.19		24.86	
3	28	8497	818	36.37	38.42	24.70	24.81
		8520	877	38.98		24.76	
		8586	898	39.90		24.96	

The above table shows the replacement of 5% cement and 10% Fine aggregate. The compressive strength of the M25 grade concrete is given as for the 7 day curing the strength is 13.99 N/mm2. For the 14 day curing the strength is given 21.34N/mm2 .For the 28 day curing the strength given is 38.42 N/mm2. The density of concrete is 24. 81 KN/mm^3.

Table 2 For Replacement of 10% Cement and 20% Fine Aggregate

Sr.No.	Age in Days	Wt.of Cube (gm)	Compressive Strength			Density of Concrete	Mean (KN/mm^3)
			Load(KN)	IN (N/mm2)	Mean		
1	7	8555	251	11.16	12.67	24.87	25.06
		8564	274	12.19		24.89	
		8743	330	14.65		25.41	
2	14	8576	454	20.16	20.33	24.93	25.05
		8620	431	19.16		25.06	
		8660	488	21.67		25.17	
3	28	8400	840	37.35	36.56	24.42	24.67
		8312	814	36.16		24.16	
		8748	814	36.16		25.43	

The above table shows the replacement of 10% cement and 20% Fine aggregate. The compressive strength of the M25 grade concrete is given as for the 7 day curing the strength is 12.67 N/mm2. For the 14 day curing the strength is given 20.33 N/mm2. For the 28 day curing the strength given is 36.56 N/mm2. The density of concrete is 24. 67 KN/mm^3.

Table 3 For Replacement of 15% Cement and 30% Fine Aggregate

Sr.No.	Age in Days	Wt.of Cube (gm)	Compressive Strength			Density of Concrete	Mean (KN/mm^3)
			Load(KN)	IN (N/mm2)	Mean		
1	7	8516	285	12.67	11.60	24.75	24.65
		8332	25	11.16		24.22	
		8594	247	10.98		24.98	
2	14	8543	435	19.34	18.22	24.83	24.79
		8472	435	19.34		24.63	
		8568	386	17.17		24.90	
3	28	8628	679	30.16	29.11	24.42	25.08
		8773	668	29.67		25.50	
		8485	619	27.49		24.66	

The above table shows the replacement of 15% cement and 30% Fine aggregate. The compressive strength of the M25 grade concrete is given as for the 7 day curing the strength is 11.60 N/mm2. For the 14 day curing the strength is given 18.22 N/mm2. For the 28 day curing the strength given is 29.11 N/mm2. The density of concrete is 25. 08 KN/mm^3.

Table 4 For Replacement of 20% Cement and 40% Fine Aggregate

Sr.No.	Age in Days	Wt. of Cube (gm)	Compressive Strength			Density of Concrete	Mean (KN/mm^3)
			Load(KN)	IN (N/mm2)	Mean		
1	7	8265	175	7.78	7.22	24.02	24.48
		8552	157	6.98		24.86	
		8448	155	6.89		24.56	
2	14	8487	319	14.16	12.27	24.67	24.99
		8530	263	11.67		24.79	
		8780	247	10.98		25.52	
3	28	8508	477	21.19	20.03	24.73	24.77
		8588	420	18.67		24.96	
		8470	455	20.23		24.62	

The above table shows the replacement of 20% cement and 40% Fine aggregate. The compressive strength of the M25 grade concrete is given as for the 7 day curing the strength is 7.22 N/mm2. For the 14 day curing the strength is given 12.27 N/mm2. For the 28 day curing the strength given is 20.03 N/mm2. The density of concrete is 24.77 KN/mm^3.

Table 5 Compressive Strength with Variation of Replacement of Material

Sr. No.	Material Replacement	Compressive Strength In N/mm^3
1	5% cement and 10 % fine aggregate	38.42
2	10% cement and 20 % fine aggregate	36.56
3	15% cement and 30 % fine aggregate	29.11
4	20% cement and 40 % fine aggregate	20.03

The above table shows that the result of compressive strength of concrete with partial replacement of stone dust for 7, 14 and 28 days for M-25 concrete. The following graph shows the graphical representation of compressive strength of concrete of M25 grade.

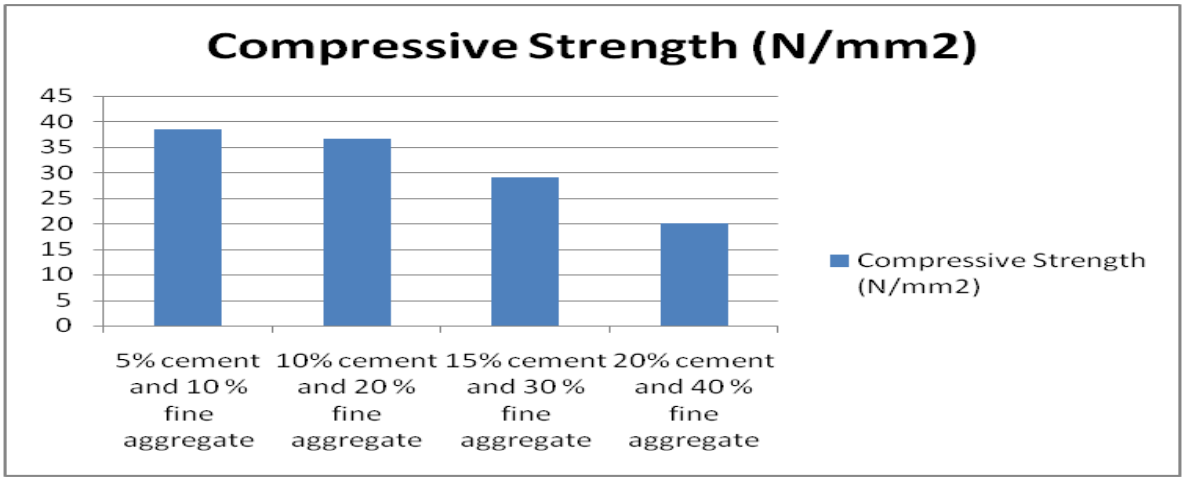

Fig. 1 Graphical Representation of Compressive Strength of Concrete

5. CONCLUSION

From the about experiments following conclusions are observes:

1. As per the experimental studies the concrete can be partial replace by cement and sand with stone dust.
2. The increase in compressive strength up to the15% cement and 30% fine aggregate will increase the value of compressive strength and after that the value is decrease.
3. The optimum percentage of stone dust that can be replaced with 15% of cement and 30% of fine aggregate.

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