Mechanical Properties of Concrete by using M-Sand and Basalt Fibre in Concrete

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Abstract : This paper presents the impact of the basalt fibre in concrete.Basalt fibre is a relatively new material and it is a high performance non-metallic fibre made from basalt rock melted at a high temperature. It is economical and having good strength characteristics, and also resists against temperature and alkaline environment. The Main aim of this paper is to find the compressive, flexural and split tensile strength of Concrete with M-sand and Basalt Fibre. The length of basalt fibre 12mm was used with in the range of 0.1% to 0.3%with total volume of concrete. Due to lack of river sand, it is partially replaced with M-sand by 50%and 60% in this work. This paper shows the enhancement of mechanical properties of concrete by adding Basalt fibre and partial replacement of river sand with M-sand.

Key words: Basalt fibre, compressive strength, flexural strength, split tensile strength.

I. INTRODUCTION

Concrete is very essential material on earth. In India most of the building constructed using concrete only. So there is huge demand in that component of concrete material. Concrete is made using the important components like cement, fine aggregate, coarse aggregate and water. Fine aggregate is one of the important components for making concrete. Due to environmental issues we are strictly restricted by all governments to take river sand in river beds so immediately we need alternate solution. So now a day's M- sand is easily available in market. Some of the experimental results reveal slightly greater strength of concrete using M-sand than that of river sand.[8] In addition to that normally fibres are used to increase tensile properties of the concrete. Basalt fibre is a good fibre it gives adequate tensile strength to the concrete

II. NEED FOR THIS WORK

River sand as fine aggregate in concrete becoming very scare. The cost of construction becoming uneconomical due to excessive cost of transportation from natural source. The purpose of this study is to find out the suitable material for replacement of fine aggregate in concrete and explore feasibility of utilizing the basalt fibre in the concrete.
Basalt fibre aggregate generally exhibit the potential to expand due to the presence of unhydrated free limit and. magnesium oxides which hydrate in humid environments. If such a product is used in the concrete, it enhances both the mechanical and physical properties of concrete along with its durability.

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III. MATERIAL USED

1. Cement: In the present work 53grade Ultra Tech cement was used to cast all the cubes, cylinders and beams.
2. Fine aggregate: River sand that come under Zone II was used as a fine aggregate.
3. Coarse aggregate: 20mm size was used.
4. M-sand: Sieve analysis was carried out. It also comes ZoneII. The round shape and smooth surface increase the workability of M- Sand[7]
5. Basalt fibre: 12mm length of fibre was used in this work.
6. Super plasticizer: Conplast SP430 was used.
7. Water: Tap water was used for both casting and curing.

IV. METHODOLOGY

As per IS10262 - 2009 the mix design was prepared for M-40. The mix design ratio is 1:1.33:2.47:0.40. Superplastisizer conplast sp430 was used 0.05%. Seven mixes were prepared. The mixes were control mix, Mix 1(50% m-sand 0.1% basalt fibre), Mix2 (50% m-sand 0.2% basalt fibre), Mix3 (50% m-sand 0.3%basalt fibre), Mix4 (60% m-sand 0.1% basalt fibre),Mix5 (60% m-sand 0.2% basalt fibre), Mix6 (60% m-sand 0.3% basalt fibre. Totally 42 cubes having the size of 150mmx150mmx150mm , 21 cylinders having the size of 150mm dia x300mm height, 21 beams 700mmx150mmx150mm were casted for different mix ratios.

V. RESULTS AND DISCUSSION

A.Compressive Strength

The compressive strength of concrete mixtures from M1 to M6 with control mix CM at the age of 7 and 28 days is shown in tables I and II and figures 1and 2.

Table.ICube Compressive strength of concrete mix at the age of 7 days

Sl. No	Mix Id	Cube Compressive strength of concrete mix at the age of 7 days (MPa)			
		Specimen 1	Specimen 2	Specimen 3	Average
1	CM	31.26	29.82	29.1	30.06
2	M 1	33.38	31.34	29	31.24
3	M 2	43.51	41.07	38.63	41.07
4	M 3	35.51	35.8	36.08	35.79
5	M 4	31.08	30.41	29.75	30.41
6	M 5	37.44	30.98	38.54	35.65
7	M 6	37.9	40.63	43.37	40.63

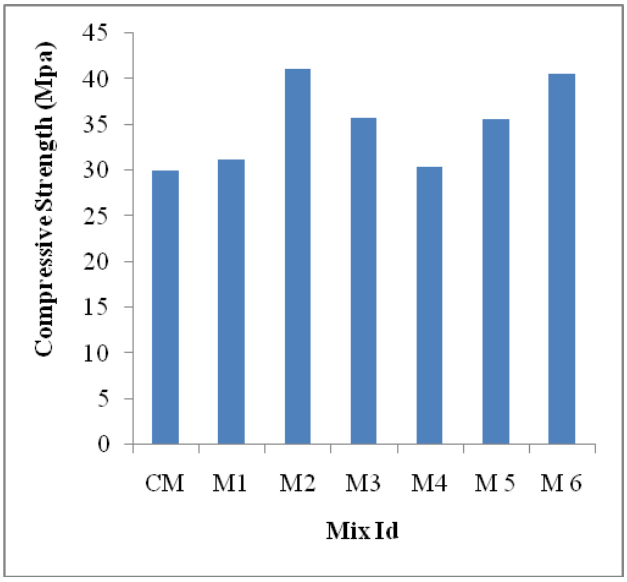

Fig.1 Average Cube Compressive strength of concrete mix at the age of 7 days

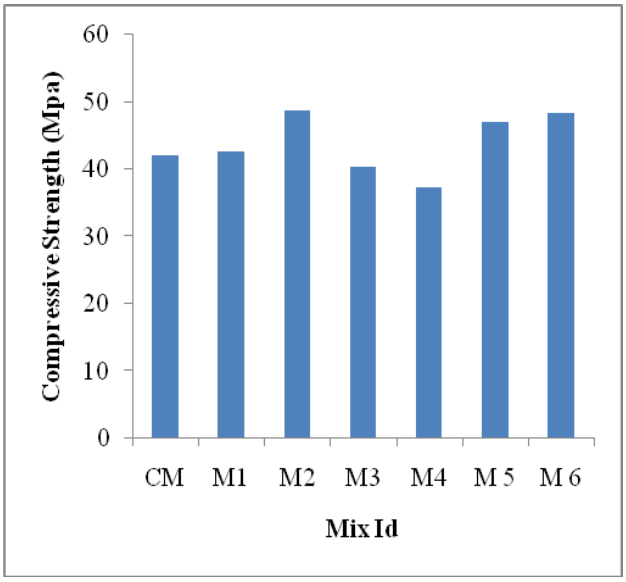

Fig 2 Average Cube Compressive strength of concrete mix at the age of 28 days

At the age of 7 days, the compressive strength of 30.06 MPa was obtained for the control mix CM. For the mix M1, M2 and M3, the compressive strength value varies from 31.24 to 41.07 Mpa at the age of 7 days. Similarly, the compressive strength values for mix M4, M5 and M6 varies from 30.41 to 40.63 Mpa. By comparing the test results, the mix M2 with 50% of River sand and 50% of M-Sand with addition of 0.2% of basalt fibre and mix M6 with 40% of River sand and 60% of M-Sand with addition of 0.3% of basalt fibre by volume of concrete gives maximum compressive strength value when compared to all other mixtures. At the age of 7 days , the rate of development of strength for mix M2 and M6 was 36.62% and 35.16% respectively, when compared to control mix CM.

Table.II Cube Compressive strength of concrete mix at the age of 28 days

Sl. No	Mix id	Cube Compressive strength of concrete mix at the age of 28 days (MPa)			
		Specimen 1	Specimen 2	Specimen 3	Average
1	CM	40.23	42.36	43.69	42.09
2	M1	43.74	42.66	41.80	42.73
3	M2	44.14	48.84	53.28	48.75
4	M3	37.74	40.40	43.06	40.40
5	M4	35.08	37.30	39.52	37.30
6	M 5	44.00	47.03	50.5	47.03
7	M 6	47.95	48.40	48.84	48.40

At the age of 28 days, the cube compressive strength for the mix M1 to M6 with control mix CM was shown in Table 2 and Figure 2. At the age of 28 days, the compressive strength of 42.09 MPa was obtained for control mix CM.

There is increment in compressive strength for the mixtures M1 to M6, when compared to control mix. The values of 42.73, 48.75 and 40.40 MPa were obtained for the mixes M1, M2 and M3 with 0.1%, 0.2% and 0.3% addition of Basalt fibre by volume of concrete with 50% replacement of river sand by M – sand respectively at the age of 28 days. When the replacement of river sand increased by 60% M-sand in concrete for the mixes M4,M5 and M6, the compressive strength value varies as 37.30,47.03 and 48.40 MPa, respectively. By comparing the test results of all mixes, M2 and M6 mix recorded maximum compressive strength value which is 15.82 and 14.99 % greater than control mix CM. By comparing results, replacement of river sand by 50%, M-sand with 0.2%, basalt Fibre and river sand by 60%, replacement by M-sand with 0.3% basalt fibre gave good compressive strength due to its well graded property and crack bridging mechanism.

B. Split Tensile Strength Of Concrete Mix At The Age Of 28 Days

The split tensile strength of concrete mixtures from M1 to M6 with control mix CM at the age of 28 days was shown in Table III and Fig 3

At the age of 28 days, the split tensile strength of 4.05 MPa was obtained for the control mix CM. For the mix M1, M2 and M3, the split tensile strength value varies from 3.46 to 3.27 Mpa at the age of 28 days. Similarly, the split tensile strength values for mix M4, M5 and M6 varies from 3.29 to 3.40 Mpa. By comparing the test results, mix M6 with 40% of River sand and 60% of M-Sand with addition of 0.3% of basalt fibre by volume of concrete gives maximum split tensile strength value when compared to all other mixtures.

At the age of 28 days, the rate of development of strength for mix M6 was 5.19% when compared to control mix CM.

Table .III Split tensile strength of concrete mix at the age of 28 days

Sl. No	Mix Id	Split tensile strength of concrete mix at the age of 28 days (MPa)			
		Specimen 1	Specimen 2	Specimen 3	Average
1	CM	3.16	3.27	3.02	3.15
2	M1	3.82	2.98	3.02	3.27
3	M2	3.05	3.84	2.96	3.28
4	M3	3.62	3.32	3.45	3.46
5	M4	3.23	3.19	3.45	3.29
6	M 5	3.43	3.15	3.62	3.40
7	M 6	4.15	4.41	4.23	4.26

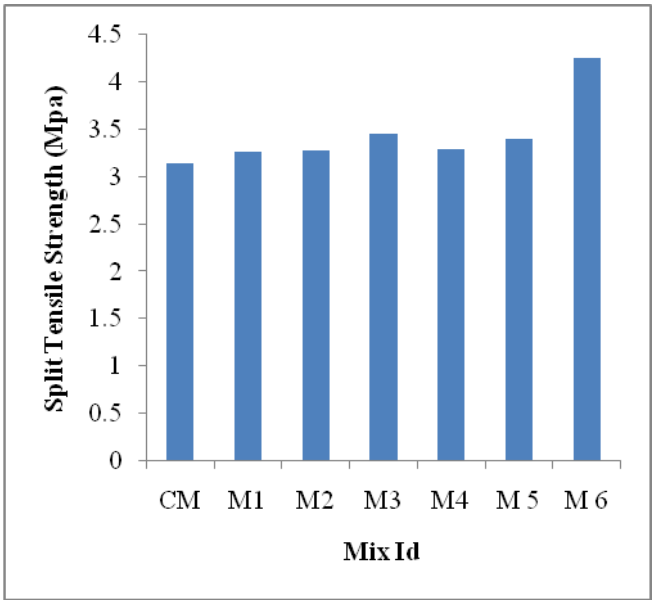

Fig.3 Average Split tensile strength of concrete mix at the age of 28 days

Table. IV Flexural strength of concrete mix at the of 28 days

Sl. No	Mix Id	Flexural strength for 28 days(MPa)			
		Specimen 1	Specimen 2	Specimen 3	Average
1	CM	2.03	1.24	1.83	1.70
2	M1	2.26	3.78	2.30	2.78
3	M2	4.33	3.10	4.84	4.09
4	M3	2.67	2.48	2.26	2.47
5	M4	2.67	2.79	2.88	2.78
6	M 5	4.33	4.13	3.93	4.13
7	M 6	4.54	4.75	4.96	4.75

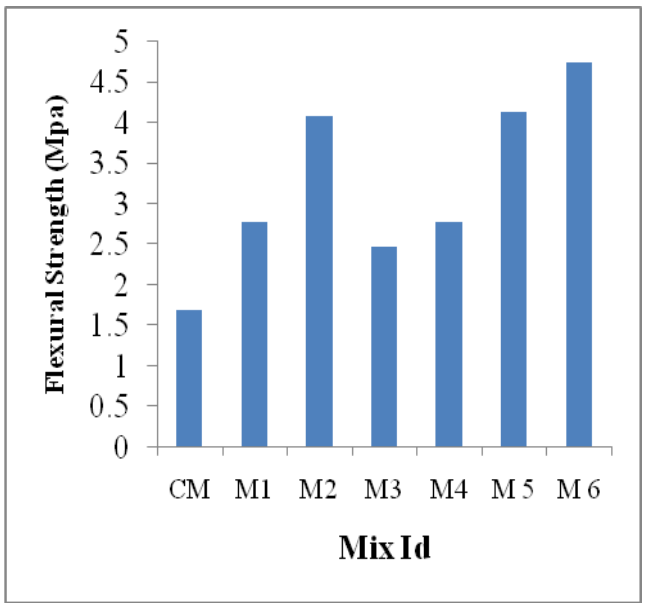

Fig.4 Average Flexural strength of concrete mix at the age of 28 days

C.Flexural Strength Of Concrete Mix At The Age Of 28 Days

The flexural strength of concrete mixtures from M1 to M6 with control mix CM at the age of 28 days was shown in Table IV and Fig 4.

At the age of 28 days, the flexural strength of 1.70 MPa was obtained for the control mix CM. For the mix M1, M2 and M3, the flexural strength value varies from 2.47 to 4.09 Mpa at the age of 7 days. Similarly, the flexural strength values for mix M4, M5 and M6 varies from 2.78 to 4.75 Mpa. By comparing the test results, the mix M5 with 60% of River sand and 40% of M-Sand with addition of 0.2% of basalt fibre and mix M6 with 40% of River sand and 60% of M-Sand with addition of 0.3% of basalt fibre by volume of concrete gives maximum flexural strength value when compared to all other mixtures. At the age of 28 days, the rate of development of strength for mix M5 and M6 was 143% and 179% respectively, when compared to control mix CM.

VI. CONCLUSIONS

Previous literatures show that 40%[6] and 50% replacement of river sand with M-sand gives good compressive strength [3]-[5] and [10] compared to conventional concrete.

From the test results the following things to be concluded

- The compressive strength development in concrete mixtures at the age of 7, M2 increases strength by 36.62% of M1, whereas partial replacement of M6 increases the strength by 35.16%.
- The compressive strength development in concrete mixtures at the age of 28days, M2 increases strength by 15.82% of M1, whereas M6 increases the strength 14.99%
- The split tensile strength increases 5.19% in M6 concrete compared to M1 at the age of 28 days
- At the age of 28 days, the flexural strength shows development of 179% in M6 compared to M1
- From the results, the optimum dosage level of basalt fibre was derived as 0.30% by volume of concrete with partial replacement of 60% M – Sand and 40% river sand(M6)
- Now a days 100% replacement of river sand with M-sand also give better strength[9].

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