Experimental Study on Partial Replacement of Fine Aggregate with Quarry Dust and Coarse Aggregate with Bamboo in Concrete

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Abstract **- Concrete is the most utilized development material transversely the world. Normally accessible stream sand is the generally utilized as a fine total in numerous nations. The greater necessity for concrete has caused this normal to river sand asset to get debilitates. The consumption of stream sand in abundance has shown exceptionally clear natural effects, on the opposite side, creation of extremely immense measure of quarry dust is being delivered during the method involved with quarrying and its prompting numerous ecological issues. It is important to do the examination on distinguishing the plausibility of utilizing elective waste materials like quarry dust and bamboo. In this paper the usage of bamboo and quarry dust on M30 concrete was studied. The level of bamboo added by 5, 7.5, 10, 12.5 and 15%, as substitution of coarse total utilized in concrete. Bamboo substitution in volume shows great outcomes on compressive and split tensile strength with control concrete. Essentially, the level of quarry dust by weight was added in 10, 20, 30 and 40% individually the fine total substitution in concrete. From this test results it is seen that supplanting coarse total with upto 12.5% of bamboo acceptable outcome when contrasted and regular cement for 7 and 28 days. Subsequently the utilization of quarry dust and bamboo as trade for fine and coarse in concrete is decreasing the ecological squanders which represent a troublesome issue in its removal.**

Index Terms **- Bamboo, Coarse aggregate, Fine aggregate, Quarry dust.**

1.INTRODUCTION

Concrete is a world wide material used since it is good in compression. The ingredients utilized in developing concrete includes river sand and coarse aggregate from the natural resources. Since continues depletion of natural resources leads to the short fall of materials which leads to utilize the waste material and save guard our environment to the next generation. Dust from quarry becomes waste material when extracting coarse aggregate and quarry dust utilized as alternative to river sand which reduces air pollution. Bamboo is available and can be grown used as substitute for coarse aggregate. In this present investigation is to study the effect of partial replacement of coarse aggregate by fine aggregate by quarry dust with 0, 10 20, 30,40% and bamboo with 5, 7.5, 10, 12.5 and 15% respectively. The mechanical properties were evaluated from using bamboo and quarry dust.

1.2 ALTERNATIVE MATERIALS TO SAND

Some of the alternative materials like crushed rock material, M-sand, fly ash and sea sand are found out in order to replace the natural sand. Boulders of rock are crushed to small pieces in crushers to obtain different sizes of metal like 40, 20, 10 and 4.75 mm and the powder residue of size less than 4.75 mm. The powder is the unwanted material called as quarry dust and this is dumped like heap of mountain near crusher units which creates environmental pollution. It is used as filler to spread over newly laid bituminous road

surface. If it is effectively used in concrete as an alternate material to sand, it helps to reduce environmental pollution. Its cost is less when compared to river sand. M-sand, the manufactured sand is prepared by washing quarry dust, dried and then sieved through 4.75 mm sieve. The particles having size in between 4.75 mm to 150 microns is called as M-sand. It is costlier than quarry dust but cheaper than river sand.

Fly ash generated and sintered ash from pulverized coal burner is an important aggregate. Large quantities of this industrial by-product are derived from pulverized coal operated boilers of thermal stations. These ashes are extensively used by the building industry. Ash as pozzolana is used for cellular and other types of concrete as mineral admixtures. Fly ash also used as fine aggregate as a partly replacement material. Among the above alternative materials to sand, quarry dust is preferred for this study

2 PRESENT STUDY OBJECTIVE AND SCOPE

1. To study the behaviour of concrete replacing sand by quarry dust partly or fully as fine aggregate and bamboo as coarse aggregate.
2. To analyze the possibility of its use, tests on workability and strength were analysed.

3. MATERIAL PROPERTIES

3.1 Ordinary Portland Cement

Ordinary Portland cement are used for the study by evaluating the physical properties in the laboratory. The properties of cement are presented in Table 1.

Table 1. Properties of cement

S.No.	Property	Cement (53
1	Specific gravity	3.15
2	Consistency	36%
3	Initial setting time	48 min
4	Final setting time	521 min

3.2 Fine aggregate

Natural sand is used as a fine aggregate and its properties are presented in table 2.

Table 2: Physical properties of fine aggregates

S.No.	Characteristics	Value
1	Type	Natural sand
2	Specific gravity	2.53
3	Fineness modulus	2.60
4	Grading zone	Zone II

3.3 Quarry dust

The crushed rock particles having size below 4.75mm is defined as fine aggregate. It is further classified into coarse, medium and fine. The size of grains from 4.75mm to 2mm is known as coarse, 2mm to 0.425mm as medium and 0.425 mm to 0.075 mm defined as fine. Tests were conducted to determine specific gravity, density and void ratio using the equations of specific gravity. The physical properties of quarry dust are presented in table 3.

Table 3: Physical properties of the quarry dust

S. No	Properties	Aggregate
1	Specific gravity	2.57
2	Fineness modulus	2.41

3.4 Coarse aggregate

The physical properties of coarse aggregate are presented in table 4.

Table 4: Physical properties of the recycled and natural coarse aggregate

S. No	Properties	Aggregate
1	Specific gravity	2.98
2	Water absorption (%)	1.70
3	Fineness modulus	6.36

3.5 Water

Potable water was used in the manufacture of concrete.

3.6 Bamboo plant

Bamboo is a tall grass that grows quickly and is usually woody are shown in Fig 1. The culms of bamboo should be seasoned and divided before use. Before used, the culms should be seasoned to preserve the sweetness of the bamboo and to reduce insect attacks on the bamboo. Hand knives are used to split or cut the bamboo culms. The bamboos employed in this study were moso bamboo, which was split into required proportions.

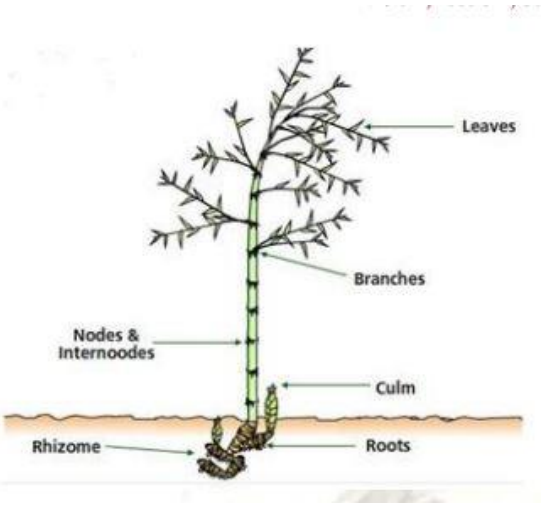

Figure: 1 Bamboo Plant

4. EXPERIMENTAL STUDY

The experimental study on the feasibility of using quarry dust to replace sand in concrete and bamboo fibres are the coarse aggregate replacements for M-30 grade of concrete. The mix is 1: 1.14: 2.49 with water cement ratio of 0.40. The preparation of concrete mix in figure 2.

Figure: 2 Preparation of concrete mix

4.1 Compressive Strength

The compressive strength is conducted for the cast specimen in cube of 150mm. The casted specimen cured in water tank and tested to evaluate the strength at 7 and 28 days. The test results are furnished in table 5 to 7. Figure 3 represents the testing of specimen in compression testing machine.

Figure: 3 Testing of concrete cube

Table 5. Fine aggregate partial replacement of quarry dust

S.No.	Percentage of quarry dust	Compressive	
		7 Days	28 Days
1	0 %	27.33	39.50
2	10%	29.17	41.98
3	20%	31.17	45.12
4	30%	34.24	48.09
5	40%	31.33	46.09

Table 6. Partial replacement of coarse aggregate with bamboo chips

S.No.	Percentage of bamboo chips	Compressive	
		7 Days	28 Days
1	5%	27.85	40.25
2	7.5 %	28.91	41.37
3	10%	28.27	41.83
4	12.5%	30.31	42.04
5	15 %	28.58	41.49

Table 7. Combination of 30% QD +12.5% BAM

S.No.	Combined	Compressive	
		7 Days	28 Days
1	0%	27.33	39.50
2	30% QD + 12.5%	34.55	49.37

4.2 Split tensile strength

The split tensile strength is conducted for the cylinder of size 150mm diameter and height 300m. The casted specimen cured in water tank and tested to evaluate the strength at 7 and 28 days. The test results are furnished

in table 8 to 10. Figure 4 represents the testing of specimen in universal testing machine.

Table 8. Split tensile strength at 7 and 28 days

S.No.	Percentage of quarry dust	Split tensile strength,	
		7 Days	28 Days
1	0 %	2.60	3.83
2	10 %	2.79	4.06
3	20%	2.97	4.30
4	30 %	3.30	4.69
5	40 %	2.89	4.14

Table 9. Split tensile strength at 7 and 28 days (Bamboo)

S.No.	Percentage of bamboo	Split tensile strength,	
		7 Days	28 Days
1	5 %	3.83	3.88
2	7.5 %	4.06	4.04
3	10%	4.30	4.14
4	12.5 %	4.69	4.83
5	15 %	4.14	4.10

Table 10. Combination of 30% QD +12.5% BAM

S.No.		Combined	Split tensile	
			7 Days	28 Days
1		0%	2.60	3.83
2		30% QD + 12.5%	3.06	4.38

5. CONCLUSIONS

1. The compressive strength for conventional concrete at 7 and 28 days are 27.33 and 39.50N/mm2
2. The split tensile strength for conventional concrete at 7 and 28 days are 2.60 and 3.83N/mm2
3. The percentage of quarry dust at 10, 20, 30 and 40% for compressive strength at 7 days are 29.17, 31.17, 34.24 and 31.33N/mm2 respectively.
4. The percentage of quarry dust at 10, 20, 30 and 40% for compressive strength at 28 days are 41.98, 45.98, 48.09 and 46.09N/mm2 respectively.
5. The percentage of quarry dust at 10, 20, 30 and 40% for split tensile strength at 7 days are 2.79, 2.97, 3.30 and 2.89N/mm2 respectively.
6. The percentage of quarry dust at 10, 20, 30 and 40% for split tensile strength at 28 days are 3.83, 4.06, 4.30, 4.69 and 4.14N/mm2 respectively.
7. The percentage of bamboo chips at 5, 7.5, 10, 12.5 and 15% for compressive strength at 7 days are 27.85, 28.27, 28.91, 30.31 and 28.58N/mm2 respectively.
8. The percentage of bamboo chips at 5, 7.5, 10, 12.5 and 15% for compressive strength at 28 days are 40.25, 41.37, 41.83, 42.04 and 41.49 N/mm2 respectively.
9. The percentage of bamboo chips at 5, 7.5, 10, 12.5 and 15% for split tensile strength at 7 days are 3.83, 4.06, 4.30, 4.69 and 4.14N/mm2 respectively.
10. The percentage of bamboo chips at 5, 7.5, 10, 12.5 and 15% for split tensile strength at 28 days are 3.83, 4.04, 4.14, 4.83 and 4.10N/mm2 respectively.
11. The percentage of combination of 30% quarry dust and 12.5% bamboo chips for compressive strength at 7 and 28 days are 34.55 and 49.37N/mm2.
12. The percentage of combination of 30% quarry dust and 12.5% bamboo chips for split tensile strength at 7 and 28 days are 3.06 and 4.38N/mm2.

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