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STRENGTH STUDIES ON JUTE FIBRE CONCRETE WITH ADMIXTURES ALCCOFINE AND METAKAOLIN WITH M30 GRADE OF CONCRETE

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***Abstract*:** Present days the construction activities increased day by day. Concrete technology upgrading has harmed the environment to a greater level. Concrete is one such basic component that has always undergone continuous improvement in order to improve the strength properties by adding various admixtures. The strength of concrete is improved by substituting Alccofine and Metakaolin for cement and adding jute fibres to the mix. Jute fibers are added in concrete to improve strength without any environmental effect. In this experimental investigation 1% of jute fiber added by the volume of concrete. The partial replacement of cement with Metakaolin and Alccofine with percentages of 3, 6, 9, 12, 18 and 0.3, 0.6, 0.9, 1.2, 1.5 respectively. The mechanical properties are determined for 28, 56 and 90 days. The maximum UPV found to be 4760N/mm^2 for 28 days by adding 1% jute fibers and partial replacing of Alccofine-1203 (1.2%) and Metakaolin (12%).

Key words: Alccofine 1203, Jute fiber, Metakaolin.

1. INTRODUCTION

Concrete is one of the most commonly used construction materials. It's made up of fine aggregate, coarse aggregate, water, and other materials. Global warming is caused by a variety of factors, including CO_2 from cement. Cement manufacturers can assist reduces CO_2 emissions by optimising their manufacturing processes. In the manufacturing of concrete, supplemental cementing elements such as fly ash, blast-furnace slag, natural pozzolans, and biomass ash polymers can be used to reduce cement content. In addition, the chemical and agricultural process sectors generate huge amounts of industrial by-products each year, causing pollution and raising the cost of disposal for the industry. The usage of these materials not only helps to get them into cement, concrete, and other building materials, but it also helps to lower cement and concrete manufacturing costs. It also provides a number of indirect advantages, including as lower landfill costs, energy savings, and pollution reduction. Additionally, their utilisation may enhance the microstructure and mechanical qualities of concrete, which are difficult to achieve with only normal Portland cement.

2. OBJECTIVES

a. To determine the compressive and split tensile strength for conventional concrete
b. To determine the compressive and split tensile strength and by adding 1% jute fibers and partial replacing of Alccofine-1203 (0.3-1.5%) with incremental of 0.3 and Metakaolin (3-12%) with incremental of 3%.
c. The UPV value for determined with and without jute fiber, Alccofine and metakaolin.

3. MATERIALS

3.1 Cement

The Portland Cement 53 grades are presented in Table 1.

Table 1. Properties of cement

Property	Cement (53 grade)
Specific gravity	3.15
Consistency	36%
Initial setting time	68 min
Final setting time	508 min

3.2 Fine aggregates

River sand is used as a fine aggregate (zone-II). The pebbles are entirely eliminated using sieve analysis and its properties are presented in table 2.

Table 2. Physical properties of fine aggregates

Characteristics	Value
Type	Natural sand
Specific gravity	2.48
Fineness modulus	2.57
Grading zone	Zone II

3.3 Coarse aggregate

Stones which are obtained from crushing of gravel are used as coarse aggregate. The maximum size of coarse aggregate is limited to 20mm. The aggregates are added strength to the composition. The coarse aggregates are crushed from natural rocks, so the all properties like hardness, stability are derived from parent rock and the 12.5 mm aggregates are used. The physical properties of natural coarse aggregate are presented in table 3.

Table 3. Physical properties of coarse aggregate

Properties	Natural aggregate
Specific gravity	2.56
Water absorption (%)	1.89

3.4 Water

Water is most important material in construction for mixing of cement mortar and curing. The water gives the binding matrix in between cement and aggregates. The pH range of surface water must in between 6.5 to 8.5 and ground water is 6 to 8.5.

3.5 Metakaolin

Metakaolin is a new type of clay that has been produced in recent years. It's manufactured by heating kaolin to a specific temperature. Because of its pozzolanic characteristics, metakaolin is frequently utilised as a concrete ingredient, replacing a portion of the cement content.

3.6 Alccofine 1203

Alccofine 1203 particle size significantly smaller than cement, fly ash and other similar materials. Alccofine 1203 is a supplemental cementitious ingredient that can be used in high-performance concrete to replace silica fume. It's made from materials used in the iron ore industry. Alccofine has a higher percentage of alumina and silica content in its chemical composition.

3.7 Jute fibres

The most affordable natural fibre is jute, which has the biggest manufacturing volume. These fibres are taken from the stem's ribbon. The plant constituents cellulose and lignin with the majority of jute fibres. Jute fibre has been shown in recent study to slow the hardening of concrete and increase its resistance to cracking. The use of tannin as an additive improves the workability of jute fibre reinforced concrete mixtures. The current work was reduced to a length of 15mm.

4. RESULTS AND DISCUSSIONS

4.1 Compressive strength test

Compression test was conducted on the cast specimen of 150mm cubes. The cured specimen was tested to evaluate compressive strength at 28, 56 and 90 days and their results are furnished in table 4.

Table 4. Compressive strength at 28, 56 and 90 days

Type of Mix	Compressive strength, N/mm^2		
	28 days	56 days	90 days
0% MK+ 0% AF+ 0% JF	38.85	41.99	45.10
3% MK+ 0.3% AF+ 1% JF	43.40	46.95	50.46
6% MK+ 0.6% AF+ 1% JF	47.05	50.97	59.27
9% MK+ 0.9% AF+ 1% JF	49.7	53.97	62.95
12% MK+ 1.2% AF+ 1% JF	52.14	56.78	66.31
18% MK+ 1.5% AF+ 1% JF	50.07	54.57	58.57

4.2 Spilt tensile strength test

The cylinder specimen has a diameter of 150 mm and a length of 300 mm and the results are furnished in table 5.

Table 5. Split tensile strength at 28, 56 and 90 days

Type of Mix	Split tensile strength, N/mm^2		
	28 days	56 days	90 days
0% MK+ 0% AF+ 0% JF	3.76	4.06	4.36
3% MK+ 0.3% AF+ 1% JF	4.30	4.65	5.00
6% MK+ 0.6% AF+ 1% JF	4.63	5.01	5.39
9% MK+ 0.9% AF+ 1% JF	4.92	5.36	5.75
12% MK+ 1.2% AF+ 1% JF	5.20	5.66	6.08
18% MK+ 1.5% AF+ 1% JF	5.05	5.50	5.89

Table:6 UPV strength result at 28 days

Type of Mix	UPV strength, m/s
	28 days
0% MK+ 0% AF+ 0% JF	4250
3% MK+ 0.3% AF+ 1% JF	4396
6% MK+ 0.6% AF+ 1% JF	4480
9% MK+ 0.9% AF+ 1% JF	4583
12% MK+ 1.2% AF+ 1% JF	4760
18% MK+ 1.5% AF+ 1% JF	4607

5. CONCLUSION

1. The compressive strength for conventional concrete is 38.85, 41.99 and 45.10N/mm^2 at 28, 56 and 90 days.
2. The compressive strength was found to be 52.14, 56.78 and 66.31N/mm ^{2} for 28, 56 and 90 days by adding 1% jute fibers and partial replacing of Alccofine-1203 (1.2%) and Metakaolin (12%) respectively.
3. For nominal concrete the split tensile strength was found to be 3.76, 4.06 and 4.36N/mm ^{2} at 28, 56 and 90 days.
4. The maximum split strength was found to be 5.20, 5.66 and 6.08N/mm^2 for 28, 56 and 90 days by adding 1% jute fibers and partial replacing of Alccofine-1203 (1.2%) and Metakaolin (12%) respectively.
5. Both the tensile and compressive strength values decreased in the combination of 18% MK+ 1.5% AF+ 1% JF.
6. The UPV value for nominal concrete was found to be 4250m/s at 28 days.
7. The maximum UPV was found to be 4760m/s for 28 days by adding 1% jute fibers and partial replacing of Alccofine-1203 (1.2%) and Metakaolin (12%).

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