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An Experimental Study on Green Concrete

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Abstract: In this research replacement of cement with silica fume which is finer than cement yields higher strength and durability to the concrete structure. Steel fibers are used to enhance strength properties and ductility of concrete. The coarse aggregate replaced partially with the demolished waste aggregate of 50%. Cement with silica fume added in different percentages of 5, 10, 15 and 20%. Strength tests are conducted at 7 and 28 days for hardened concrete to evaluate the strength such as compressive and spilt tensile. The partial replacements of 10-15% of combined use of silica fume and fly ash allowed increasing the strength parameters.

Keywords: compressive strength, demolished waste aggregate, silica fume, split tensile strength test.

I. INTRODUCTION

Green Concrete is the revolutionary topic in the history of concrete industry, this was first invented in Denmark in year 1998. Green concrete is the type of concrete which is much like the conventional concrete but the production of such concrete requires minimum amount of energy and causes least harm to environment. It is a concept of using eco-friendly materials in concrete, to make the system more sustainable. Green concrete is very often and also cheap to produce, because for example, waste products are used as a partial substitute for cement, charges. The size of construction industry all over the world is growing at faster rate. The huge construction growth boosts demand for construction materials. Aggregates are the main constituent of concrete. Due to continuously mining the availability of aggregates has emerged problems in recent times. To overcome this problem, there is need to find replacement to some extent. Nowadays, there is a solution to some extent and the solution is known as “Green Concrete”. It is a concept of thinking environment into concrete considering every aspect from raw materials manufacture over mix design to structural design, construction, and service life.

Inorganic residual products like stone dust, crushed concrete, marble wastes are used as green aggregates in concrete. Further, by replacing cement with fly ash, micro silica in larger amounts, to develop new green cements and binding materials, increases the use of alternative raw materials and alternative fuels by developing or improving cement with low energy consumption. Considerable research has been carried out on the use of various industrial by-products and micro-fillers in concrete. The main concern of using pozzolanic wastes was not only the cost effectiveness but also to improve the properties of concrete, especially durability.

II. OBJECTIVES

The objectives of this study are as follow

- To determine the optimum percentage of silica fume.
- To evaluate the compressive and split tensile strength of casted specimens with optimum percentage with and without recycled aggregate

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III. MATERIALS

The properties of cement, fine and coarse aggregate are presented in Table 1.

Table 1. Properties of cement

S. No.	Property	Cement (53 grade)
1	Specific gravity	3.15
2	Fineness	7.81
3	Consistency	33%
4	Initial setting time	42 min
5	Final setting time	510 min

3.1. Silica fume:

It has also known as micro silica, it is an ultrafine powder collected as a by-product of the silicon and ferrosilicon alloy production and consist of spherical particles with an average particle diameter of 150mm. the main field of application is as pozzolanic material for high performance concrete. Silica fume, is used as an artificial pozzolanic admixture. It is a material resulting from reduction of quartz with coal in an electric arc furnace in the manufacture of silicon or ferrosilicon alloy. Chemical composition of silica fume Contains more than 90 percent silicon dioxide other constituents are carbon, Sulphur and oxides of aluminum, iron, calcium, magnesium, sodium and potassium.

Table 2.Physical Properties of Silica Fume:

S.No	Properties	Silica fume
1	Specific Gravity	2.24
2	Specific Surface Area	26810 m^2/kg

3.2 Demolished waste aggregate:

The concrete aggregate that contains 95% of crushed concrete is called as recycled concrete aggregates. The construction and demolition waste in its original state consists of wood, gypsum, plastics and many contaminating materials, that have to be removed because of its usage in concrete manufacture.

3.3 Concrete Mix Design

The mix proportion for M30 grade of concrete is 1:1.86:3.44 with water cement ratio 0.45.

IV. EXPERIMENTAL INVESTIGATIONS

4.1 Compressive strength results

The compressive strength conducted in compression testing machine for the cast and cured specimens and the results are furnished in Table 3.

Table 3: Compressive strength of concrete Percentage of silica fume + 50%demolished waste aggregate

S.No	Mix indication	Compressive strength N/mm^2	
		7 days	28 days
1	M1(0% SF+50%DA)	25.20	38.5
2	M2(5% silica fume +50% DA)	27.90	42.14
3	M3(10% silica		44.61

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	fume+50% DA)	28.83	
4	M4(15% silica fume+50% DA)	29.91	46.00
5	M4(15% silica fume+50% DA)	27.12	41.72

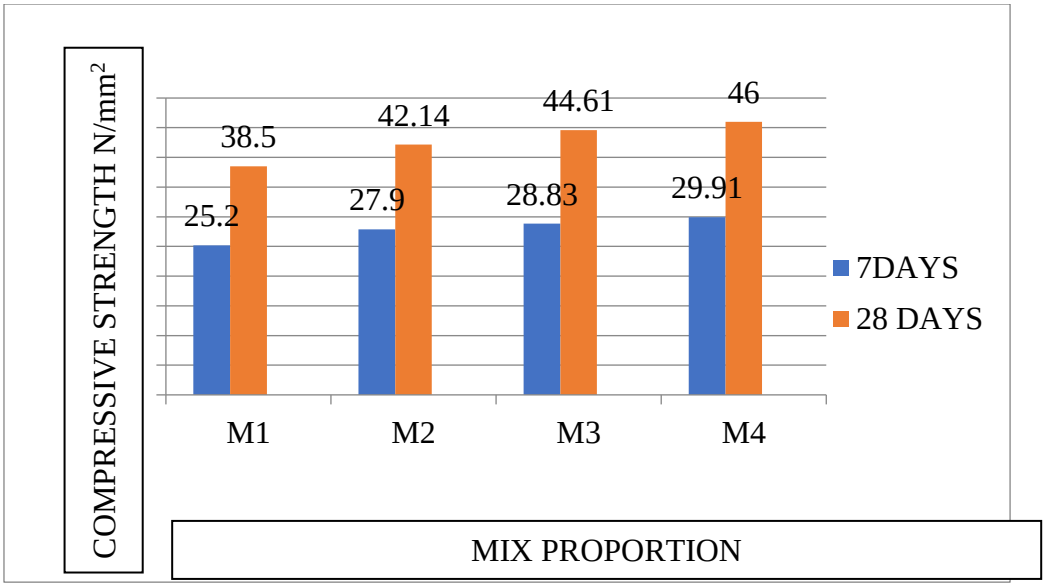

Figure 1: Compressive strength of concrete percentage of silica fume + 50% demolished waste aggregate

4.2 Split tensile strength results

The split tensile strength conducted for the cast and cured specimens and the results are furnished in Table 4.

Table 4: Split tensile strength of concrete Percentage of silica fume + 50% demolished waste aggregate

S.No	Mix indication	Split tensile strength, N/mm^2	
		7 days	28 days
1	M1(0% SF+50%DA)	2.26	3.46
2	M2(5% silica fume +50% DA)	2.51	3.80
3	M3(10% silica fume +50% DA)	2.59	4.02
4	M4(15% silica fume +50% DA)	2.69	4.14
5	M5(20% silica fume +50% DA)	2.44	3.76

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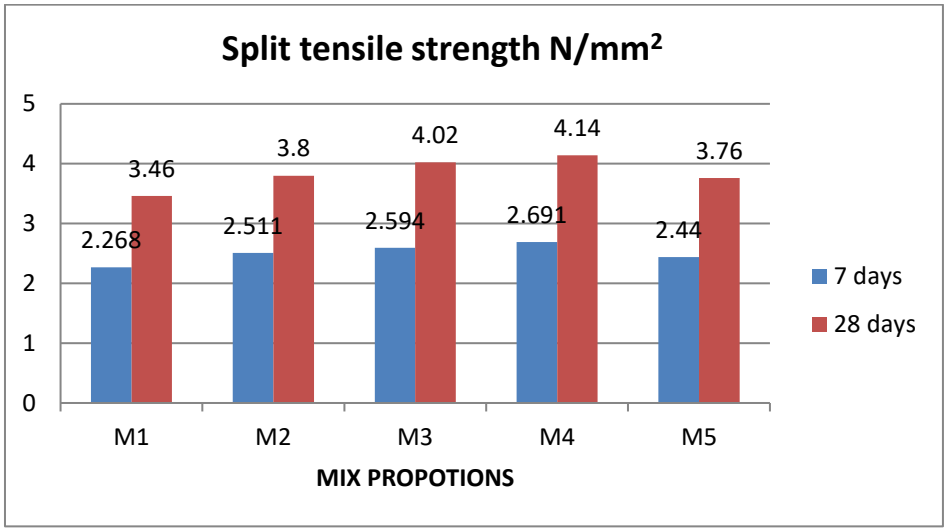

Figure 2: Split tensile strength of concrete Percentage of silica fume + 50% demolished waste aggregate

V. CONCLUSION

1. The compressive strength for M30 grade concrete by using 15% SF and 50% DA at 7 is 29.91N/mm^2.
2. The compressive strength for M30 grade concrete by using 15% SF and 50% DA at 28 days is 46N/mm^2.
3. The split tensile strength for M30 grade concrete by using 15% SF and 50%DA at 7 days is 2.69N/mm^2.
4. The split tensile strength for M30 grade concrete by using 15% SF and 50% DA at 28 days is 4.14 N/mm^2.
5. Addition of 50% demolished waste paves the way for sustainable development.

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