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Efficacy of Admixtures on Compressive Strength of Concrete

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Abstract:- This report investigates the impact of reducing cement proportion in concrete by adding varying percentage of silica fume and glass fibre. The aim is to evaluate the compressive strength of modified concrete mix with varying percentage. The experiment involved varying levels of cement replacement with silica fume and the addition of glass fibre to determine the optimal combination for enhancing concrete performance. Testing methodologies included compressive strength tests of concrete cube. The results provide insights into the feasibility and effectiveness of utilizing silica fume and glass fibre to improve the strength characteristics of concrete while reducing cement content, contributing to sustainable and durable construction practices.

Keywords:- *M20 Grade Concrete, Silica Fume, Glass Fibre, Cement Reduction, Compressive Strength.*

I. INTRODUCTION

Concrete is one of the most widely used construction materials due to its durability, strength, and versatility. The strength of concrete primarily depends on its constituent materials, including cement, aggregates, water, and additives. Among these, cement plays a crucial role in determining the strength and performance of concrete. The M20 grade concrete, characterized by a mix ratio of 1:1.5:3 (cement: sand: aggregate) and a compressive strength of 20 MPa (megapascals), is commonly used in various construction applications. In recent years, there has been growing interest in reducing the cement content of concrete mixtures while maintaining or even enhancing their strength properties. One approach to achieving this is by incorporating supplementary cementitious materials (SCMs) such as silica fume and reinforcing agent like glass fibre as shown in figure (1) and figure (2).

Fig 1: Glass Fibre

Fig 2: Silica Fume

➢ *Aim*

The aim of this project is to replace cement proportion by silica fume & by glass fibre in M20 grade concrete cubes and also to check the compressive strength compared with conventional concrete cubes.

➢ *Objectives*

Investigate the impact of reducing cement proportion on the strength of M20 grade concrete. Assess the effectiveness of silica fume as a partial replacement for cement. Also evaluate the effects of glass fibre in M20 grade concrete. Analyse the combined influence of silica fume and glass fibre on concrete strength. Compare the mechanical properties of modified M20 grade concrete with conventional M20 grade concrete.

II. METHODOLOGY

➢ *Selection of Materials*
➢ *Testing of Materials*
➢ *Making Mix Proportion*
➢ *Concrete Mixing*
➢ *Moulding, Unmoulding*

➢ *Material Selection:*

- Cement: Portland Pozzolana Cement (PPC) 43 grade.
- Aggregates: Coarse and fine aggregates conforming to relevant standards.
- Admixtures: Silica fume and glass fibre to replace a proportion of cement.

➢ *Testing of Materials:*

Specific gravity of fine aggregate and coarse aggregate, (density of cement is given on cement bag).

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➢ *Mix Design:*

Concrete mix ratio is 1:1.6:3.5 for all mixes and water cement ratio is 0.55. Conducted according to relevant standards (e.g., IS 10262:2019, IS 456: 2000).

➢ *Concrete Mixing:*

Batches prepared with varying proportions of cement, silica fume, and glass Fibre. Uniform mixing ensured to maintain consistency as shown in figure (3).

Fig 3: Concrete Mixing

➢ *Moulding and Unmoulding:*

Filled the mould by material and tamped properly to do not occur any voids and mould put on vibration table for few minutes After 24 hours cubes get unmoulded as shown in figure(4).

Fig 4: Moulding and Unmoulding

III. RESULTS

In order to compare the results acquired by testing of concrete cubes of varying the percentage of silica fume and glass fibre added. The concrete cubes were tested after 7, 14 and 28days of curing by compression testing machine as shown in figure (5) and (6) respectively. Compressive strength test results for concrete samples prepared with replacement of cement by silica fume and glass fibre with varying percentage is shown in below tables such as (1),(2) and (3) respectively. Comparisons between compressive strength of concrete without and after added silica fume and glass fibre as shown in table (4) and (5) respectively.

- Size of concrete cube mould =**150×150×150**mm.
- Mix design ratio = **1: 1.6: 3.5**

Fig 5: Compressive Strength Test of Cube

Fig 6: Compression Testing Machine

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➢ *Test Results for Compressive Strength (Average of 3 Cubes Per Days)*

Table 1: For Conventional Concrete Cubes

Sr. No.	Days	Compressive Strength (MPa)
1	7 days	15.25
2	14 days	24.44
3	28 days	27.40

Table 2: For Concrete Cubes with Silica Fume

Percentage%	Days	Compressive Strength (MPa)
5%	7 days	23.99
	14 days	29.99
	28 days	38.45
7.5%	7 days	17.55
	14 days	26.88
	28 days	33.11
10%	7 days	23.99
	14 days	25.99
	28 days	41.11

Table 3: For Concrete Cubes with Glass Fibre

Percentage%	Days	Compressive Strength (MPa)
1%	7 days	18
	14 days	25.23
	28 days	29.33
2%	7 days	16.33
	14 days	26.54
	28 days	30.22
3%	7 days	16.66
	14 days	26.87
	28 days	29.33

Table 4: Increased Compressive Strength (MPA) for 5%, 7.5% and 10% Silica Fume

Used percentage (%)	Days	% increase
5%	7 days	57.31
	14 days	22.70
	28 days	40.32
7.5%	7 days	15
	14 days	9.99
	28 days	20.84
10%	7 days	57.31
	14 days	6.35
	28 days	50

Table 5: Increased Compressive Strength (MPA) for 1%, 2% and 3% Glass Fibre

Used percentage (%)	Days	% Increase
1%	7 days	18
	14 days	3.24
	28 days	7
2%	7 days	7
	14 days	8.60
	28 days	10.30
3%	7 days	9.25
	14 days	9.95
	28 days	7

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IV. CONCLUSION

It has been observed that, by adding silica fume and glass fibre in traditional concrete increase the compressive strength. However, it also increases the workability of concrete and reduces the water absorption capacity. Hence, increases the life of concrete.

Reduction in specific weight of concrete has been also observed.

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