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An experimental study on partial replacement of cement with silica fume and fine aggregates with marble powder in concrete

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Abstract
Silica fume is used as a replacement of cement in concrete and fine aggregate are partially replaced with marble powder. Silica fume is a byproduct of producing silicon mental is generated by industries as waste material. Silica Fume is a great potential for the utilization in concrete as replacement as cement. The silica fume is replaced by 15% proportion. The Fine aggregate are replaced by marble powder 15%, 30%, 45%. The use of Silica fume in the construction would result in the reduction of cost of the material. Also, the usage of Silica Fume results in reduction of emission of harmful gases such as carbon dioxide, carbon mono oxide, etc.
M25 grade of concrete is produced by partially replaced cement, fine aggregate with silica fume and marble powder respectively. Cubes and cylinders were casted and their compressive strength and split tensile were evaluated at 7, 14 and 28 days by replacing 15% of silica fume and 15%, 30%, 45% of marble powder respectively. This type of replaced concrete is an alternative to reduce the weight of concrete and to reduce the cost of concrete.

Keywords: silica fume, marble powder, compressive strength, split tensile strength

Introduction

1. Silica Fume

Silica Fume is generally a byproduct of silicon metal which is obtained from the furnaces of silicon or alloys of silica fume is used in concrete to increase its strength, properties. Silica Fume also improves compressive strength of the concrete and abrasion resistance. Addition of silica fume to reinforced concrete also reduces permeability and protects it from getting corroded especially in coastal regions and salt water bridges.
Silica fume is rich in silica percentage which helps in increasing the compressive strength of the concrete. It also helps in reduction of cracks. Silica fume is mainly used in the construction of parking structure, bridges, etc.

2. Marble powder

Marble powder is generally obtained from shaping and cutting of marbles. Addition of marble powder increases the strength of the concrete to a great extent. Marble powder can be used as a replacement for the both cement and fine aggregates. Marble powder can be used in bricks manufacturing, road construction etc.

Objective

The main objective of this project:

- To study the effect of partial replacement of cement with silica fume and fine aggregates with marble powder.
- Comparison of compressive strength with replacement of cement with silica fume and fine aggregates with marble powder and normal concrete.
- To know the strength variations with the use of silica fume in concrete.

Methodology

The methodology, we adopted in order to conduct this experiment is shown in figure 1.

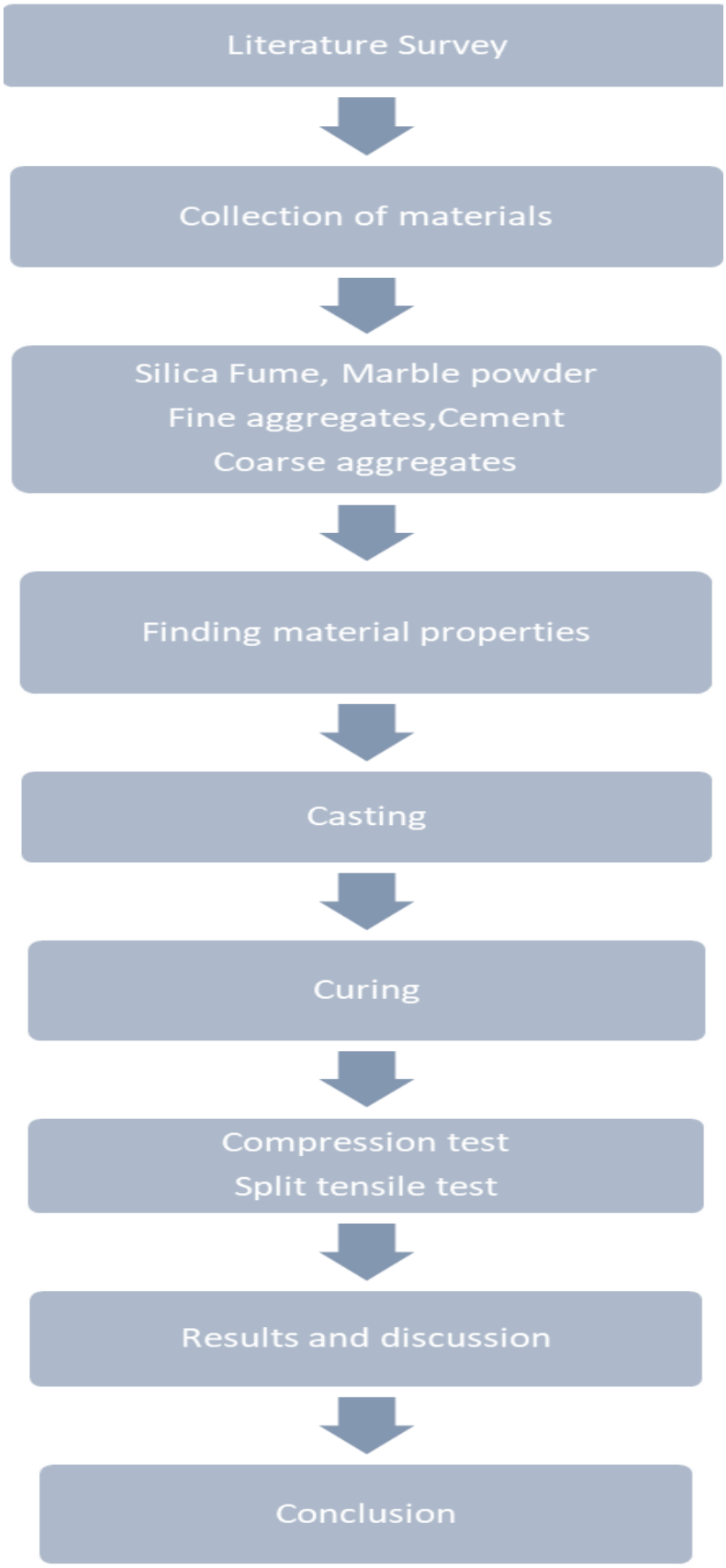

Fig 1: Methodology flow chart

Materials

1. Cement

In this study, Ordinary Portland cement 53 grade was used. Different tests were conducted on Cement and Fine aggregate and the test results are tabulated in table I & II respectively.

Table 1: Physical Properties of the OPC 53 grade cement

Sl. No	Physical Properties	Test results
1	Fineness	97%
2	Specific gravity	3.10
3	Initial setting time	35 minutes
4	Final setting time	580 minutes

2. Fine aggregate

Table 2: Test results on Fine aggregate

Sl. No	Properties	Test results
1	Specific gravity	2.633
2	Fineness modulus	2.28

3. Silica fume

Silica fume is a byproduct of silicon metal which is obtained from the furnaces of silicon or alloys of silicon as shown in figure 2. Specific gravity of silica fume is 2.2.

Fig 2: Silica fume

4. Marble powder

Marble powder is generally obtained from cutting and curing of marbles. Specific gravity of marble powder is 2.7. Figure 3 represents the pictorial representation of marble powder.

Fig 3: Marble powder

Result and discussions

1. Compressive strength results

The compressive strength test results for different mix proportions were conducted on 150x150x150mm specimens and result values are tabulated below in table III for different days.

Table 3: Compressive Strength of Specimens 7, 14 days & 28 days

Sl. No	Type of Concrete	Age	Compressive Strength (N/mm^2)			Avg Comp St. (N/mm^2)
			I	II	III	
1	Normal Concrete (NC)	7	18.1	17.2	20.4	18.5
		14	19.5	22.7	23.5	23.2
		28	31.5	32.1	30.6	31.4
2	SF 15% + MP15%	7	19.5	20.8	21.3	20.5
		14	23.2	24.8	26.2	24.7
		28	33.5	34.8	32.3	33.5
3	SF 15% + MP30%	7	17.3	20	18.6	18.6
		14	25.3	23.5	20	22.9
		28	24.4	23	22.2	23.2
4	SF 15% + MP45%	7	15.1	20.8	17.7	17.8
		14	20.8	22.2	20	21
		28	25.3	19.1	24	22.8

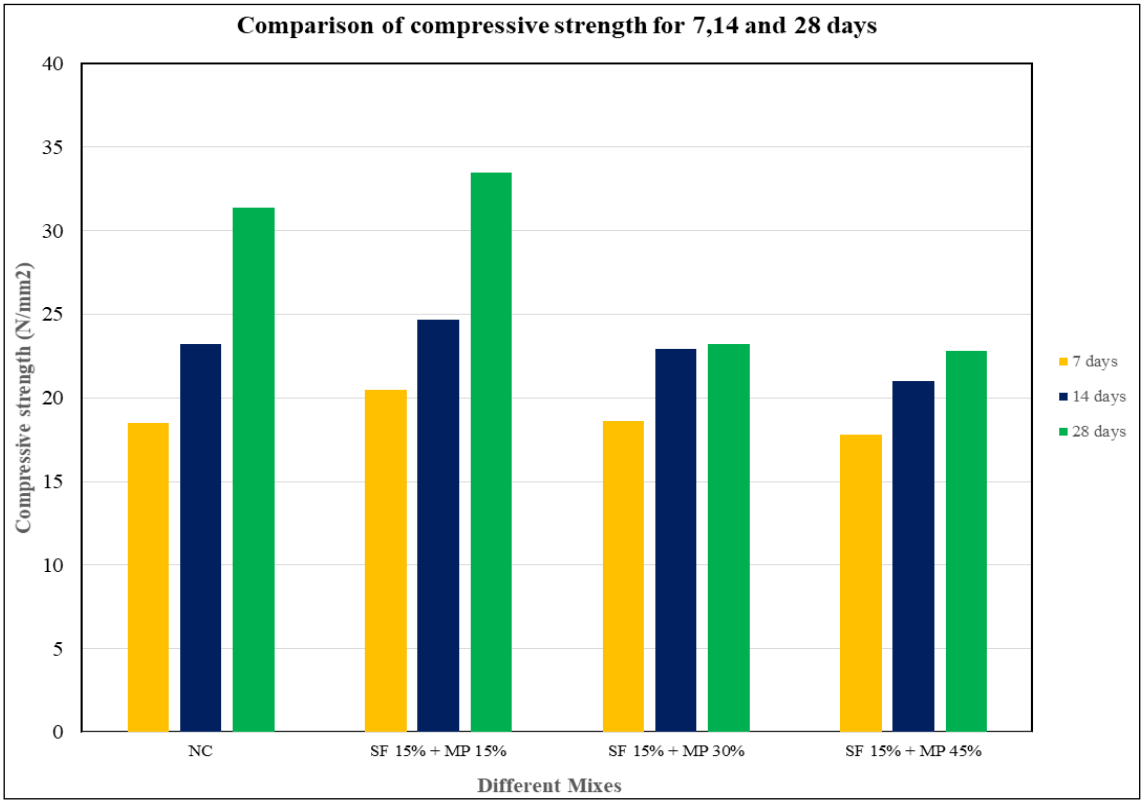

Fig 4: Compressive Strength variation

From figure 4, it is clear that the maximum compressive strength is obtained by 15% SF&MP after 7 days is 20.5 N/mm^2, after 14 days is 24.7 N/mm^2, after 28 days is 33.5 N/mm^2. The minimum compressive strength obtained by 15% SF & 45% MP after 7 days is 17.8 N/mm^2, after 14 days is 21 N/mm^2, after 28 days is 22.8 N/mm^2. So, the graph gradually decreases from 15% of MP replacement to 45% of MP. Also, from the graph we conclude that as the percentage of marble powder increases there is constant decrease in variation of compressive strength after 28 days.

2. Split tensile strength results

All the split tensile strength tests were conducted on 300mm x 150mm specimens for 28 days and the results are tabulated in table IV for different proportion mixes.

Table 4: Split tensile Strength of Specimens 7, 14 days & 28 days

Sl. No.	Percentage of silica fume	Percentage of marble powder	Specimens		Split tensile strength (N/mm^2)
			I	II	
1	0%	0%	4.10	4.40	4.25
2	15%	15%	3.53	3.39	3.46
3	15%	30%	2.68	2.11	2.39
4	15%	45%	1.98	1.55	1.76

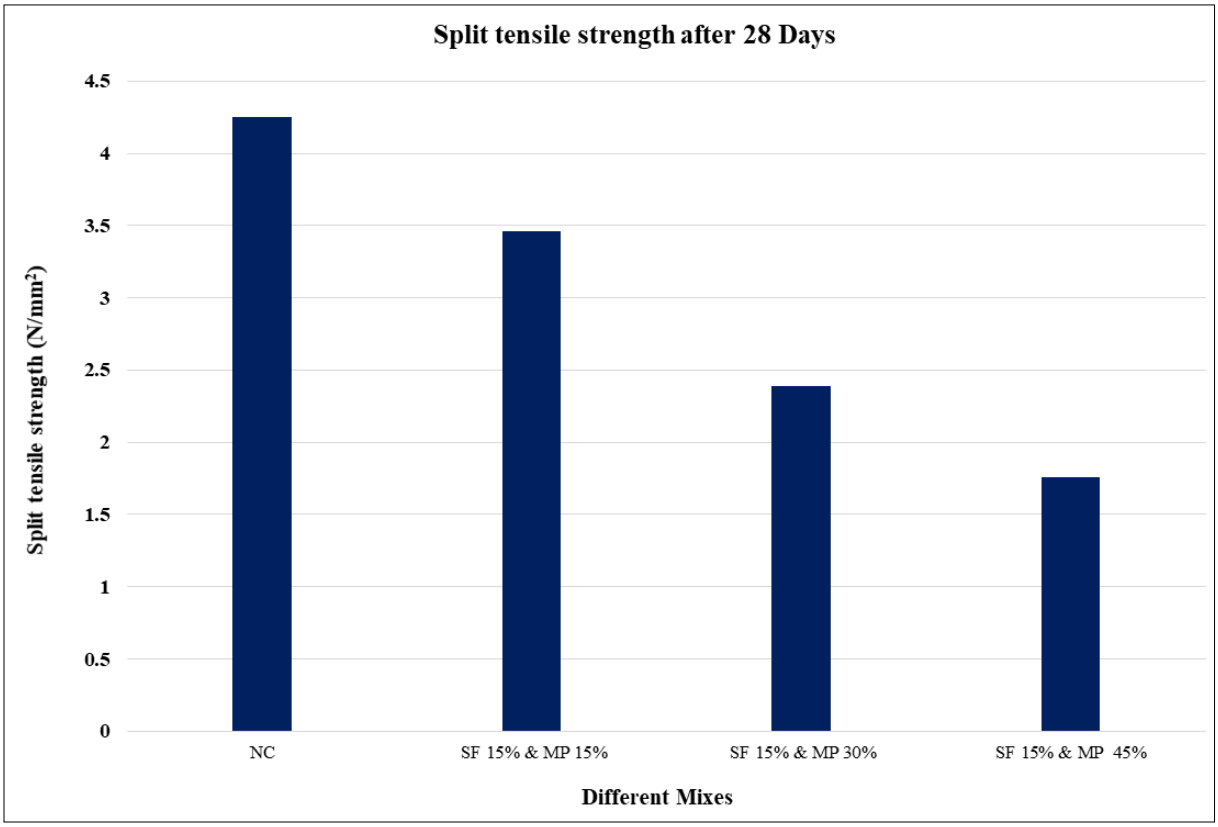

Fig 5: Tensile strength variation

From the figure 5, it is clear that the maximum tensile strength obtained after 28 days is 4.25 N/mm^2 with 0% MP replacement and the minimum is 1.76 N/mm^2 with 45% MP replacement. So, from the graph we conclude that as the percentage of marble powder increases the split tensile strength decreases after 28 days. There is a gradual decrease in tensile strength with increase in replacement of marble powder.

Conclusion

- The strength of the concrete is higher when the marble powder is added up to 15%. After that the strength gradually decreases.
- The average compressive strength increases by 4.76% from 0% to 15% of replacement and decreases by 32% from 15% to 45% of marble powder with constant silica fume after testing for 7, 14 and 28 days.
- The split tensile strength decreases by 41% with increase in marble powder percentage with 15% silica fume tested after 28 days.
- It is observed that maximum compressive strength is obtained at 28 days by replacing 15% silica fume and 15% of marble powder.
- Average compressive strength decreases moderately with increase in percentage of marble powder replacement after 14 and 28 days.
- The split tensile strength after 28 days decreases with increases in percentage of marble powder.

References

1. IS 456:2000 Indian Standard Code of plain and Reinforced concrete code of practice, Bureau of Indian standards, New Delhi.
2. IS 383-1970 Specifications for coarse and fine aggregates from Natural sources for concrete, Bureau of Indian Standards, New Delhi.
3. Nanabala Jyosthna. “Partial replacement of cement by using silica fume in concrete” International research journal of engineering and technology (IRJET), 2021, 8(6). ISSN: 2395-0072.
4. Lakshmi HS. “Partial replacement of fine and coarse aggregates by using marble powder” International journal of advance research in science and technology (IJARSE), 2017, 6(7). ISSN: 2319-8346.
5. Yash liladia. “Partial replacement of cement by using silica fume in concrete” International research journal of engineering and technology (IRJET), 2020, 7(2). ISSN: 2395-0056.
6. Selva priya R. “An experimental study on partial replacement of cement with silica fume” International research journal of multidisciplinary technovation (IRJMT), 2019, 1(6), ISSN: 2482-1040.
7. Arjun kumar. “An experimental study on partial replacement of cement with silica fume” International journal of advance research (IJAR), 2016, 4(7), ISSN: 2320-5407.

8. Satish kumar L. “Partial replacement of fine aggregates with marble powder on concrete” Anveshana’s international journal of research in engineering and applied sciences (AIJREAS), 2017, 2(2), ISSN: 2455-6300.
9. Mohammed mohiuddin ejaz. “Partial replacement of fine aggregate by marble powder” International journal of scientific & research (IJSER), 2019, 10(12), ISSN: 2229-5518.
10. Supriya Deshpande, Rashmi GS. “Study of Pavement Grade Concrete with Partial Replacement of Cement by Marble Dust and M-Sand as Fine Aggregate” International Research Journal of Engineering and Technology (IRJET), 2020, 7(5), e-ISSN: 2395-0056, p-ISSN: 2395-0072.
11. Gopi R, Mrs Kaleeswari G, Dr Dhanalakshmi G. “Study on Marble Powder as Partial Replacement of Cement in Concrete” Global Research and Development Journal for Engineering, 2017, 2(7), ISSN: 2455-5703.
12. Dr Krishna Rao B. “Study on Marble Powder as Partial Replacement of Cement in Normal Compacting Concrete” IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE),2016:13(4):3:01-01.
13. Vijaya Kumar YM, Shruti D, Tharan SN, Sanjay SR, Sricharan PM “Partial Replacement of Cement to Concrete by Marble Dust Powder” International Journal of Modern Trends in Science and Technology (IJMTST), 2016, 2(5), ISSN: 2455-3778.