AN EXPERIMENTAL INVESTIGATION ON THE STEEL FIBER CONCRETE BY PARTIAL REPLACEMENT OF TiO_2 AND QUARTZ POWDER USING M40 GRADE OF CONCRETE

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Abstract

Every construction project in the world uses concrete as a building material. These projects include every conceivable problem in terms of durability, exposure to different reactive substances, and at a position where concrete needs to be high strength. Based on the kind and composition of the elements employed, the concrete is a heterogeneous combination that is intended to solidify and provide strength. In this study, we are doing an experimental examination to see whether the strength of nominal concrete could possibly be increased to become high strength concrete. We used components like steel fibres, TiO2 as a partial cement substitute, and quartz powder as a partial fine aggregate replacement in order to attain this high strength. On materials, freshly-poured concrete, and hardened concrete, we've run a number of tests. We have also examined earlier studies that were conducted on projects similar to this one using relevant materials. We used a variety of material ratios, including 0 percent, 0.5 percent, 1.0 percent, 1.5 percent of TiO2 as a partial replacement for cement, and 10 percent, 20 percent, 30 percent, 40 percent, and 50 percent of quartz powder to replace some of the fine aggregate. We also added 0 percent, 0.5 percent, 1 percent, 1.5 percent, and 2 percent of steel fibres to the concrete.

Keywords: *- Steel fibre, Quartzpowder, Titanium dioxide, Compressive, Split tensile strength.*

1.Introduction

Concrete is a material in construction, and there are requirements that must be maintained in order to create and use it. Cement, fine and coarse aggregate, water, and additives make up concrete. These elements will combine to form concrete. High strength concrete were needed in a few unusual situations, so additional materials were supplied while some concrete components were partially replaced. High strength concrete is the most often used contemporary solution to the problems associated with utilising

nominal concrete in construction. In addition to serving as a poisonous agent or toxic gases collector, TiO2 applied to partially replace cement will result in concrete having a high strength. Steel fibres are frequently used to produce concrete that is stronger than conventional concrete. Using quartz powder to partially replace the fine aggregate will help to fill gaps and create better compact concrete.

2. Objectives

1. To utilise TiO2 cement as effectively as possible.
2. To investigate the effects of steel fibres on concrete behaviour.
3. To use TiO2, steel fibres, and quartz powder to examine the concrete's strength qualities.

3. MATERIALS

1.

3.1 Cement: The properties of cement are presented in Table 1.

Table 1 Physical properties of cement

S. No.	Property	Cement (53 grade)
1	Specific gravity	3.142
2	Fineness	9.75%

3.2Fine Aggregate: Concrete made of natural sand or crushed stone requires as a fine aggregate The hardened properties of the concrete are significantly influenced by the fine aggregate density.

3.3 Coarse aggregate: The aggregate which is retained over IS Sieve 4.75 mm is termed as coarse aggregate. The normal maximum size is gradually 10-20 mm as per IS 383:1970.

3.4. Water: Water is one of the most important elements in construction and is required for the preparation of mortar, mixing of cement concrete and for curing work etc. The quality of water used has a direct impact on the strength of the motor and cement concrete in the construction work.

3.5 Titanium dioxide: A naturally occurring compound made of titanium and oxygen is known as titanium dioxide. It's an inorganic substance. This substance offers concrete excellent flexural strength and gives it a white appearance.

3.6 Steel Fibers: Steel fibres are small steel particles that are added to concrete to increase its strength. They range in size from 3 to 6 mm in diameter to 4 to 6 mm in length, and they come in a variety of forms, including hooked fibres, crimped and twisted fibres, and rolled fibres.

3.7 Quartz Powder: Quartz is a crystalline substance that, when crushed, produces a white powder with a rough texture and the chemical formula SiO2, which is natural silica. When this substance is added to concrete, it increases the concrete's strength and fills in any voids.

4. EXPERIMENTAL RESULTS

4.1Compressive strength

The compressive strength conducted in compression testing machine for the cast and cured specimens and the results are furnished in table 2 to 4.

Table2:Strength of concrete with quartz powder as partial replacement of fine aggregate in concrete.

S. No.	%Of quartz powder	Compressive Strength, N/mm^2		Split tensile Strength, N/mm^2	
		7 days	28 days	7 days	28 days
1	0%	34.50	49.57	3.42	4.95
2	10%	35.27	51.24	3.83	5.60
3	20%	35.96	52.66	3.59	5.15
4	30%	36.47	53.72	3.71	5.31
5	40%	38.67	54.86	3.90	5.54
6	50%	35.67	53.32	3.38	5.27

Table 3: Strength of concrete with Tio_2 in concrete.

S. No.	%Of Tio_2	Compressive Strength, N/mm^2		Split tensile Strength, N/mm^2	
		7 days	28 days	7 days	28 days
1	0%	34.50	49.57	3.42	4.95
2	0.5%	37.91	56.08	3.69	5.43
3	1%	40.66	57.76	4.07	5.68
4	1.5%	37.99	57.14	3.67	5.50

Table 4: Strength of steel fibres in concrete.

S. No.	%Of Hooked Steel fibres	Compressive Strength, N/mm^2		Split tensile Strength, N/mm^2	
		7 days	28 days	7 days	28 days
1	0%	34.50	49.57	3.42	4.95
2	0.5%	38.69	56.32	3.80	5.61
3	1%	41.35	60.99	4.01	6.01
4	1.5%	47.34	67.25	4.75	6.79

5	2%	44.97	64.44	4.38	6.27

Table 5: Strength of Combined replacement of Tio_2,QP,HSF

S. No.	QP+Tio_2+HSF	Compressive Strength, N/mm^2		Split tensile Strength, N/mm^2	
		7 days	28 days	7 days	28 days
1	0%	34.50	49.57	3.42	4.95
2	40%QP+1%Tio_2+1.5%HSF	52.13	74.69	5.15	7.39

5.Conclusions:

1.The normal concrete compressive strength results for 7 and 28days is 34.50 N/mm^2 and 49.57 N/mm^2.

2.The normal concrete split tensile strength results for 7 and 28days is 3.42N/mm^2 and 4.95 N/mm^2.

3. The compressive strength results of 40% partial replacement of quartz powder with fine aggregate for 7 and 28days is 38.67 N/mm^2 and 54.86 N/mm^2.

4. The split tensile strength results of 40% partial replacement of quartz powder with fine aggregate for 7 and 28days is 3.90 N/mm^2 and 5.54 N/mm^2.

5.The compressive strength results of 1% partial replacement of titanium dioxide with cement for 7 and 28days is 40.66 N/mm^2 and 57.76 N/mm^2.

6. The split tensile strength results of 1% partial replacement of titanium dioxide with cement for 7 and 28days is 4.07 N/mm^2 and 5.68 N/mm^2.

7. The compressive strength results of 1.5% addition of hooked steel fibers to concrete for 7 and 28days is 47.34 N/mm^2 and 67.25 N/mm^2.

8. The split tensile strength results of 1.5% addition of hooked steel fibers to concrete for 7 and 28days is 4.75 N/mm^2 and 6.79 N/mm^2.

9. By the combination of 40% quartz powder +1% Tio2+1.5% steel fibers with concrete the compressive strength result for 7 and 28days is 52.13N/mm^2 and 74.69N/mm^2.

10. By the combination of 40% quartz powder +1% Tio2+1.5% steel fibers with concrete the split tensile strength result for 7 and 28days is 5.15 N/mm^2 and 7.39N/mm^2.

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