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An Experimental Investigation on the Steel Fiber Concrete by Partial Replacement of Tio_2 and Quartz Powder

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Abstract: *K Concrete is a building material widely used in the world for every construction project, and this construction projects consists of every possible challenge in terms of durability, exposure to various reactive substances and at a place where concrete needs to be high strength. the concrete is a mixture which is of heterogeneous aimed to solidify and produce strength based on the quality and composition of materials used in the concrete. in this study we are performing an experimental investigation to see whether there is any possible increase in the strength of nominal concrete to change to high strength concrete, In order to achieve this high strength we have used materials like steel fibres, TiO_2 as partial replacement for cement, quartz powder as partial replacement of fine aggregate. We have performed several tests on materials, fresh concrete, and hardened concrete. We have also reviewed the previous works of the researches performed on the similar projects with the related materials. we have used a varied percentages of material ratios as 10%, 20%, 30%, 40%, 50% of quartz powder partially replacing fine aggregate, and 0%, 0.5%, 1.0%, 1.5% of TiO_2 as partial replacement of cement, and 0%, 0.5%%, 1%, 1.5%, 2% of steel fibres addition to concrete.*

Keywords: Ground Granulated Blast Furnace Slag, Titanium Dioxide, Compressive, Split Tensile Strength

I. INTRODUCTION

Concrete is a material used for construction and for production and utilization of this material there are some standards are there first of all the concrete consists of materials like cement, coarse aggregate, fine aggregate, water and admixtures. The combination of these constituents will form concrete. The ordinary concrete consists of these regular materials will form concrete with moderate strength but for some exceptional cases the concrete needed to be high strength, in-order to achieve this high strength concrete there will be an addition of contents with partial replacement of the constituents of concrete. The high strength obtaining concrete may contain one or many additional contents intended to make concrete high strength. Such materials are of steel fibres, TiO_2, quartz powder. Use of the high strength concrete is most raising solution nowadays constructional challenges of nominal concrete. Usage of TiO_2 partial replacement of cement will result in high strength of concrete and it acts as an agent to collect poisonous agents or harmful gases. Usage of steel fibres will tend to provide more strength than conventional concrete. Usage of quartz powder partially replacing the fine aggregate will result in the closure of voids and providing better compact concrete content.

II. OBJECTIVES

1. To Optimize the usage of cement with TiO_2
2. To study the behaviour of concrete with steel fibres.
3. To study the strength properties of concrete at a combination of TiO_2, steel fibres &quartz powder.

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III. MATERIALS

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%

3.1 Tio_2

The titanium dioxide is a naturally occurring chemical which is of a composition of titanium and oxygen. It is an inorganic compound. This material gives great flexural strength and it also gives white color to the concrete.

3.2 Steel Fibers

Steel fibres are the steel bits of steel used as additional agents in the concrete to get strength the diameter of these fibres are 3 to 6 mm dia and their length is of 4 to 6 mm and these are of various types they are hooked fibers, crimped and twisted rolled fibers.

3.3 Quartz Powder

Quartz is a crystalline compound when crushed it will produce white colored powder which is of rough texture and its chemical formulae is of SiO_2 as of natural silica and when this compound is added in the concrete will give additional high strength to concrete acting as void filling agent and strength gaining agent.

IV. EXPERIMENTAL RESULTS

4.1 Compressive 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.

Table 2: Compressive strength of concrete with quartz powder as partial replacement of fine aggregate in concrete

S. No	%Of quartz powder	Compressive Strength, N/mm²		
		28 Days	56Days	90days
1	0%	37.25	40.32	43.31
2	10%	38.24	41.64	44.65
3	20%	39.28	42.42	45.77
4	30%	40.01	43.29	45.60
5	40%	40.89	44.28	47.78
6	50%	40.50	43.90	47.24

Table 3: Compressive strength of concrete with steel fibers in concrete

S. No.	%of steel fibres	Compressive Strength, N/mm²		
		28 Days	56Days	90days
1	0%	37.25	40.32	43.31
2	0.5%	41.93	45.49	48.88
3	1%	45.48	49.31	53.09
4	1.5%	49.75	53.82	57.94
5	2%	48.23	52.28	56.13

Table 4: Compressive strength of concrete with Tio_2 in concrete

S. No.	% of TiO_2	Compressive Strength, N/mm²		
		28 Days	56 days	90 days
1	0%	37.25	40.32	43.31
2	0.5%	41.75	45.14	48.54
3	1%	43.17	46.88	50.32
4	1.5%	42.68	46.26	49.92

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Table 5: Split tensile strength of concrete with quartz powder as partial replacement of fine aggregate in concrete

S. No	%Of quartz powder	Split tensile Strength, N/mm²		
		28 Days	56Days	90days
1	0%	3.72	4.09	4.33
2	10%	3.78	4.08	4.39
3	20%	3.82	4.14	4.46
4	30%	3.96	4.29	4.61
5	40%	4.12	4.51	4.82
6	50%	4.01	4.34	4.69

Table 6: Split tensile strength of concrete with steel fibers in concrete.

S. No	%Of steel fibres	Split tensile Strength, N/mm²		
		28 Days	56Days	90days
1	0%	3.72	4.09	4.33
2	0.5%	4.18	4.53	4.85
3	1%	4.47	4.85	5.21
4	1.5%	5.02	5.52	5.86
5	2%	4.69	5.10	5.48

Table 7: Split Tensile strength of concrete with Tio_2 in concrete.

S. No.	%Of Tio_2	Split tensile Strength, N/mm²		
		28 Days	56Days	90days
1	0%	3.72	4.09	4.33
2	0.5%	4.04	4.36	4.67
3	1%	4.24	4.62	4.94
4	1.5%	4.11	4.45	4.78

Table 8: Compressive strength of Concrete with QP, HSF &TiO_2

S. No	QP + TiO_2+HSF	Compressive Strength, N/mm²		
		28 Days	56Days	90days
1	0%	37.25	40.32	43.31
2	40%QP+1%Tio_2+1.5%HSF	54.54	58.91	63.61

Table 9: Split strength of Concrete with QP, HSF &TiO_2

S. No.	QP + TiO_2+HSF	Split tensile Strength, N/mm²		
		28 Days	56Days	90days
1	0%	3.72	4.09	4.33
2	40%QP+1%Tio_2+1.5%HSF	5.47	6.03	6.39

V. CONCLUSION

In this study, the concrete ingredients like cement are partially replaced by TIO_2 and fine aggregates is partially replaced by quartz powder and addition of steel fibers to concrete respectively. Quartz powder varied different percentages of 0 %, 10%, 20%,30%,40%, 50% .and TIO2 is varied with different percentages of0%,0.5%,1%,1.5%, and hooked steel fibers varied with percentages of 0%, 0.5%, 1%, 1.5%, 2%.

- At 40% partial replacement of quartz powder with fine aggregate the compressive strength of concrete at 28,56 and 90 days are 40.89, 44.28 and 47.78 N/mm^2.
- At 40% partial replacement of quartz powder with fine aggregate the split tensile strength of concrete at 28,56and 90 days are4.12, 4.51 and 4.82 N/mm^2.
- At 1% partial replacement of titanium dioxide with cement the compressive strength of concrete at 28,56 and 90 days are 43.17,46.88and 50.32 N/mm^2.
- At 1% partial replacement of titanium dioxide with cement the split tensile strength of concrete at 28,56 and 90 days are 4.21,4.62and 4.94 N/mm^2.

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- At 1.5% addition of hooked steel fibers to concrete the compressive strength of concrete at 28,56 and 90 days is 49.75,53.82 and 57.94 N/mm^2.
- At 1.5% addition of hooked steel fibers to concrete the split tensile strength of concrete at 28,56 and 90 days is 5.02, 5.56 and 5.86 N/mm^2.
- By the combination of 40% quartz powder +1% Tio_2+1.5% steel fibers with concrete the compressive strength of concrete at 28,56 and 90 days are and 54.54, 58.91, 63.61N/mm^2.
- By the combination of 40% quartz powder +1% Tio_2+1.5% steel fibers with concrete the split tensile strength of concrete at 28,56 and 90 days are 5.47, 6.03 and6.39 N/mm^2.

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