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CHANGE IN STRENGTH PARAMETERS BY ADDITION OF Tio_2 & Sio_2 NANO-PARTICLES IN CONCRETE

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ABSTRACT: The recent researches on Nano materials and nano technologies have highlighted the potential use of these materials in various fields such as medicine, construction, automobile industry, etc., this is due to special characteristics of materials at the nano scale. Building materials domain can be one of the main beneficiaries of the researches, with applications that will improve the characteristics of concrete and steel, glass and insulating materials. Improving the material resistance and increasing of their durability will reduce environmental pollution by reducing the carbon footprint of the building. Based on the previous study we have conducted the following tests on concrete consisting of Nano particles i.e., Compressive strength of cubes and cylinders, Split tensile strength of cylinders and Flexural strength of beams. In this study by using nano particles (silica dioxide and titanium dioxide) which leads to densifying of the micro and nanostructure resulting in improved mechanical properties. In this study we have added 0.1, 0.125, 0.25, 0.5, 0.75 and 1.0 percentage of Sio_2 and Tio_2. The addition of Sio_2 and Tio_2 in different percentages, improves strength properties of concrete.

Keywords*:* Nano materials , Nano particles , pozzolana, Duro concrete Mix Design

INTRODUCTION:

This standard lays down the recommended procedure for designing concrete mixes for general types of construction using the concreting materials normally available. The design is carried out for a desired compressive strength and workability of concrete, using continuously graded aggregates. This standard does not include the design of concrete mixes for flexural strength or when gap-graded aggregates or various admixtures and pozzolana are to be used. All requirements of IS : 456-1978 and IS : 1343-1980 in so far as they apply, shall be deemed to form part of this standard except where otherwise laid down in this standard.

Water to cement ratio (W/C ratio) is the single most important factor governing the strength and durability of concrete. Strength of concrete depends upon W/C ratio rather than the cement content. Abram's law states that higher the water/cement ratio, lower is the strength of concrete. As a thumb rule every 1% increase in quantity of water added, reduces the strength of concrete by 5%. A water/cement ratio of only 0.38 is required for complete hydration of cement. (Although this is the theoretical limit, water cement ratio lower than 0.38 will also increase the strength, since all the cement that is added, does not hydrate) Water added for workability over and above this water/cement ratio of 0.38, evaporates leaving cavities in the concrete. These cavities are in the form of thin capillaries. They reduce the strength and durability of concrete. Hence, it is very important to control the water/cement ratio on site. Every extra lit of water will approx. reduce the strength of concrete by 2 to 3 N/mm^2 and increase the workability by 25 mm. As stated earlier, the water/cement ratio strongly influences the permeability of concrete and durability of concrete. Revised IS 456-2000 has restricted the maximum water/cement ratios for durability considerations by clause 8.2.4.1, table 5.

Trail No	Empty Weight of Bottle(W1)	Weight of Bottle + Dry aggregates (W2)	Weight of bottle + aggregates + water (W3)	Weight of bottle + water	Specific gravity
1	660	1080	1738	1442	3
2	660	1090	1738	1442	3.2
3	660	1095	1730	1442	3.4
				Avg.	**3.2**

Cement is the core material in concrete, which acts as a binding agent and imparts strength to the concrete. From durability considerations cement content should not be reduced below 300Kg/m^3 for RCC. IS 456 –2000 (Refer annexure VI page 78 of Duro concrete Mix Design Manual) recommends higher cement contents for more severe conditions of exposure of weathering agents to the concrete. It is not necessary that higher cement content would result in higher strength. In fact latest findings show that for the same water/cement ratio, a leaner mix will give better strength. However, this does not mean that we can achieve higher grades of concrete by just lowering the water/cement ratio. This is because lower water/cement ratios will mean lower water contents and result in lower workability. In fact for achieving a given workability, a certain quantity of water will be required. If lower water/cement ratio is to be achieved without disturbing the workability, cement content will have to be increased. Higher cement content helps us in getting the desired workability at a lower water/cement ratio. In most of the mix design methods, the water contents to achieve different workability levels are given in form of empirical relations. Water/cement ratios required to achieve target mean strengths are interpolated from graphs given in IS 10262 Clause 3.1 and 3.2 of Duro concrete.

Observations:

Record of Observations of Coarse Aggregates

Table:1

S.No	**% of T0.io2**	**Split Tensile Strength (Mpa)**			
		7days	Average	28days	
1	0	0.86	0.91	1.74	1.79
		0.98		1.78	
		0.90		1.86	
2	0.1	0.99	1.02	1.87	1.89
		1.16		1.82	

		0.92		1.98	
3	0.5	1.20	1.12	2.05	2.05
		1.16		2.16	
		1.02		1.95	
4	1.0	1.13	1.21	2.16	2.18

Table: 2

Results and discussions:

S.NO	% of Chemical added SiO_2 (%)	Workability		
		Slump Cone (mm)	Compaction Factor	Vee-bee Consistometer (Sec)
1	0	70	0.9	4
2	0.1	75	0.9	4
3	0.125	75	0.92	4
4	0.25	80	0.93	5
5	0.5	80	0.93	5
6	0.75	80	0.94	5
7	1.00	85	0.94	5

Table: 3

S.No	MIX PROPORTION	W/C	NANO SiO_2 (%)	NANO TiO_2 (%)	NO.OF CUBES
1	M20	0.48	0.10	0.10	9
2	M20	0.48	0.125	0.125	9
3	M20	0.48	0.25	0.25	9
4	M20	0.48	0.50	0.50	9

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5	M20	0.48	0.75	0.75	9
6	M20	0.48	1	1	9

- Studied the variation of compressive Strength of concrete with Nano-particles Tio2 & Sio2.
- Studied the variation of Flexural and Split Tensile Strength of concrete with Nano-particles Tio2 & Sio2.

Table: 4

S.NO	% of Chemical added TiO_2 (%)	Workability		
		Slump Cone (mm)	Compaction Factor	Vee-bee Consistometer (Sec)
1	0	72	0.9	4
2	0.1	74	0.91	4
3	0.125	74	0.91	4
4	0.25	78	0.92	5
5	0.5	80	0.92	5
6	0.75	80	0.93	5
7	1.00	85	0.93	5

Table: 5

S.No	% of Sio2	Compressive Strength (Mpa)					
		3days	Average	7days	Average	28days	Average
1	0	O9.33	9.18	18.4	18.23	28	27.93
		8.66		18.8		27.1	
		9.55		17.5		28.7	
2	0.1	11.5	11.55	23.33	23.03	35.0	34.72
		11.77		22.72		34.66	
		11.4		23.04		34.50	
3	0.125	10.75	11.20	22.01	21.45	33.0	33.06
		11.62		20.98		33.25	
		11.24		21.37		32.94	
4	0.25	10.69	10.49	21.4	21.18	32.09	32.34
		10.24		21.0		32.37	
		10.54		21.16		32.58	

5	0.5	10.43	10.40	21.97	20.99	31.30	31.47
		10.11		20.58		31.57	
		10.67		20.43		30.81	
6	0.75	11.08	10.23	20.35	20.21	31.29	31.22
		10.80		20.03		31.66	
		10.39		20.26		31.47	
7	1.0	9.93	9.76	19.86	19.51	29.82	29.86
		9.79		19.48		29.4	
		9.58		19.21		30.37	

Table: 6

S.No	% of Sio2	Flexural Strength (Mpa)			
		7days	Average	28days	
1	0	0.42	0.34	1.28	1.29
		0.28		1.36	
		0.32		1.24	
2	0.1	0.40	0.40	1.25	1.30
		0.35		1.35	
		0.45		1.30	
3	0.5	0.45	0.46	1.40	1.40
		0.45		1.45	
		0.46		1.35	
4	1.0	0.60	0.48	1.45	1.41
		0.45		1.45	
		0.40		1.35	

Table: 7

S.No	% of Sio2	Flexural Strength (Mpa)			
		7days	Average	28days	
1	0	0.42	0.34	1.28	1.29
		0.28		1.36	
		0.32		1.24	
2	0.1	0.40	0.40	1.25	1.30
		0.35		1.35	
		0.45		1.30	
3	0.5	0.45	0.46	1.40	1.40
		0.45		1.45	

		0.46		1.35	
4	1.0	0.60	0.48	1.45	1.41
		0.45		1.45	
		0.40		1.35	

Table: 8

S.No	% of Sio2	Split Tensile Strength (Mpa)			
		7days	Average	28days	
1	0	0.86	0.91	1.74	1.79
		0.98		1.78	
		0.90		1.86	
2	0.1	1.11	1.21	2.01	2.07
		1.20		1.95	
		1.33		2.25	
3	0.5	1.27	1.24	2.29	2.33
		1.34		2.53	
		1.11		2.07	
4	1.0	1.39	1.29	2.45	2.55
		1.22		2.67	
		1.26		2.53	

Table: 9

S.No	% of Tio2	Compressive Strength (Mpa)			
		7days	Average	28days	
1	0	20.32	20.84	32.18	31.82
		21.4		31.5	
		20.8		31.8	
2	0.1	21.62	21.48	33.86	33.09
		22.18		33.05	
		20.66		32.38	
3	0.5	21.65	21.82	36.33	36.07
		22.35		35.76	
		21.95		36.12	
4	1.0	21.86	22.06	38.07	37.86
		22.20		37.82	

		22.14		37.70	

Table:10

S.No	% of Tio2	Compressive Strength (Mpa)					
		3days	Average	7days	Average	28days	Average
1	0	9.33	9.18	18.4	18.23	28	27.93
		8.66		18.8		27.1	
		9.55		17.5		28.7	
2	0.1	11.09	10.66	20.82	20.51	30.20	31.17
		10.6		20.49		31.82	
		10.31		20.24		31.5	
3	0.125	10.42	10.71	22.2	21.72	33.27	32.23
		10.15		21.56		31.62	
		9.87		21.42		30.90	
4	0.25	11.49	10.85	22.0	21.84	34.49	34.12
		10.76		21.48		34.02	
		10.58		21.72		33.87	
5	0.5	12.06	11.72	20.33	22.73	36.20	36.12
		11.64		20.58		36.53	
		11.48		20.82		35.65	
6	0.75	12.27	11.8	23.46	22.92	36.82	36.73
		11.63		22.71		36.45	
		11.50		22.59		36.93	
7	1.0	12.6	12.24	23.47	23.27	37.80	37.63
		12.14		23.07		37.41	
		12.0		23.29		37.7	

Table:11

Conclusion:

By making the water cement ratio as 0.48, the 28 days compressive strength of concrete at different% of nano silica and nano titanium has been achieved as 3 – 5 times of conventional concrete. The present generations of cement based materials provides an economical option to add several alternative materials currently in use although several projects have been carried out to demonstrate the usefulness of these materials, research is still needed to update current code requirements, quality assurance procedures and design process to safely utilize these new materials to their ultimate potential.

We are making a point and that the setting time should be increased for concrete than that for ordinary concrete to have a healthy look and more strength.

- Use of IS: 10262 – 1982 code specifications helped in designing concrete mix.
- Addition of cement with nano silica &nano Titanium increase the cement.
- Cement quantity used and helped improving the ultimate compressive strength of concrete.
- Failure due to excess cement content is avoided by addition of nano materials.
- By the final mix obtained the increase in compressive strength is observed and tensile strength is not obtained.

By making the water cement ratio as 0.48, the 28 days compressive strength of concrete at different% of nano silica and nano titanium has been achieved as 3 – 5 times of conventional concrete. The present generations of cement based materials provides an economical option to add several alternative materials currently in use although several projects have been carried out to demonstrate the usefulness of these materials, research is still needed to update current code requirements, quality assurance procedures and design process to safely utilize these new materials to their ultimate potential.

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- By the final mix obtained the increase in compressive strength is observed and tensile strength is not obtained.

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