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Elastic Crumb Rubber Concrete (ECRC)-I

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Abstract:-**This research paper is presented after observing a lots of waste generated by rubber industries and especially tire industries. This paper also focuses on the idea to analyze the properties of concrete when rubber waste is introduced in mix design as replacement of coarse and fine aggregates in different percentages so that concrete components can survive more influentially under the effect of seismic energy. In this research fine aggregates and coarse aggregates are replaced by crumb rubber in varying proportions of 5% , 10% and 15% and standard tests like compressive strength , Flexural tensile test to find for the desirable percentage of addition of rubber . Results will reveal the Desirable percentage in which rubber is to be added without compromising compressive strength and flexural strength. For this percentage elasticity of rubber concrete will analyzed as future scope of this research paper.**

Keywords: Sustainable concrete, crumb rubber, strength of concrete, toughness of concrete, ductility of concrete

INTRODUCTION:

On the daily basis a lot of waste is generated by rubber industries among which tier industries are on lead Waste production on large scale is very difficult to handle and decomposition of such waste products will generate pollution on large scale .Construction industry provides an efficient solution for this problem by accumulating such a large waste into mass volume of concrete in varying proportions. In such a way not only waste reduces but also provides a new design mix with enhance properties of elasticity on construction sites. Such type mix design is capable of absorbing more energies under effect of seismic effect. This research helps to analyze the efficiency of such concrete mix design by performing various tests.

Mix Design:

Crumb rubber concrete (CRC) is a special design mix with modified mechanical properties in order to improve the seismic response of behavior. This approach is attained by varying three different percentages of rubber i.e. 5%, 7.5 % and 10% with fine aggregate. Value of percentage replacement higher than 10 % has exponentially decreased the value of strength which has already been proved in various research papers which is also not a practically accepted value for construction on sites. The aim of accepting these three percentages in order to compensate the loss of strengths with appreciable increase in value of elasticity of concrete which can be used in less bearing components of structures and thus increasing an average elasticity of entire structure. Constituents of Mix design includes cement of type 1, coarse aggregates, fine aggregates and crumb rubber .Crumb rubber is further produced in two various sizes as coarse and fine crumb rubber. Coarse crumb rubber is of bulk weight 0.54g/cm^3 used as replacement of coarse aggregate while fine crumb rubber of bulk weight 0.45g/cm^3 as fine aggregate replacement .The images of coarse and fine crumb rubber is illustrated as follows:

Fig 1. Coarse Crum Rubber Aggregates

Fig 2. Fine Crumb Rubber Aggregates

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Mix design is prepared with a target strength of 28MPa (approximate) for which corresponding values of various materials are considered as given in table below:

Table 1: Batching Report for Materials used in Mix Design (in Kilograms)

S.No.	Material	Percentages/Variations			
		0%	5%	7.50%	10%
1	Cement(kg)	355 Kg	346.06 Kg	341.63 Kg	319.44 Kg
2	Fine aggregate	738 Kg	719.55 Kg	710.33 Kg	664.2 Kg
3	Coarse aggregate	1223 Kg	1192.42 Kg	1177.14 Kg	1100.7 Kg
4	Water	170 Kg	166.11 kg	163.98 Kg	153.33 Kg
5	Fine crumb Rubber	0 Kg	18.45 Kg	27.67 Kg	36.9 Kg
6	Coarse Crumb Rubber	0 Kg	30.57 Kg	45.86 Kg	61.15 Kg

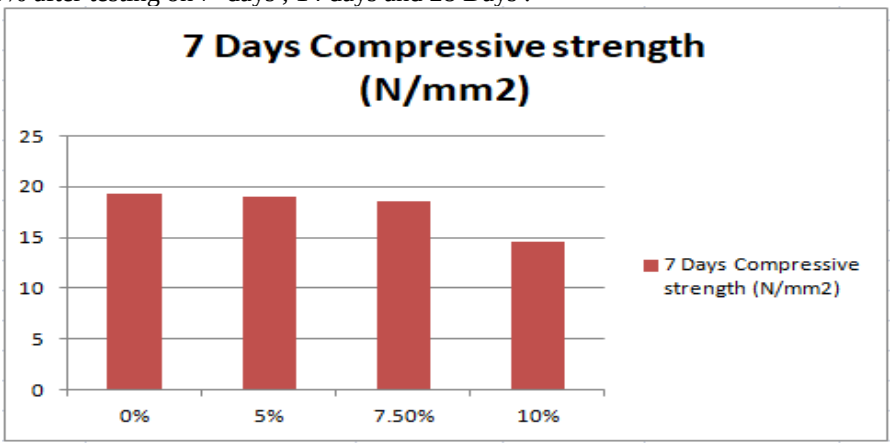
The table represents various proportions of rubber replacement i.e. 0%, 5%, 7.5% and 10% by coarse and fine aggregate in which respective percentage is equally divided on the corresponding weights of aggregates in kg .As shown in table replacing percentage of 5%, 7.5% and 10% is divided as 2.5%, 3.75% and 5% respectively each on weights of fine and coarse aggregates and replaced by percentage weight of fine rubber crumbs and coarse rubber crumbs. Cube moulds of standard size 150 mm x 150 mm are used for testing of rubber concrete.

COMPRESSIVE STRENGTH TEST

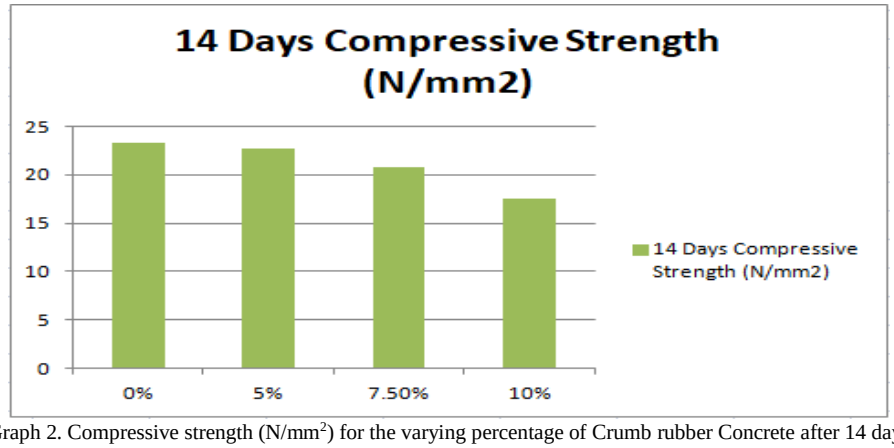
Table 2: Compressive strength (N/mm^2) for 0%, 5%, 7.5% & 10% Crumb Rubber Concrete

S.no.	Sample	Compressive strength (N/mm2)		
		7 Days	14 Days	28 Days
1	0%	19.35	23.25	28.6
2	5%	19.02	22.75	28.02
3	7.50%	18.5	20.8	27.25
4	10%	14.5	17.55	25.5

The above table depicts the values of compressive strength test (N/mm^2) for various proportions of crumb rubber concrete i.e. 0% , 5% , 7.5% and 10% after testing on 7 days , 14 days and 28 Days .



Graph 1. Compressive strength (N/mm^2) for the varying percentage of Crumb rubber Concrete after 7 days



Graph 2. Compressive strength (N/mm^2) for the varying percentage of Crumb rubber Concrete after 14 days

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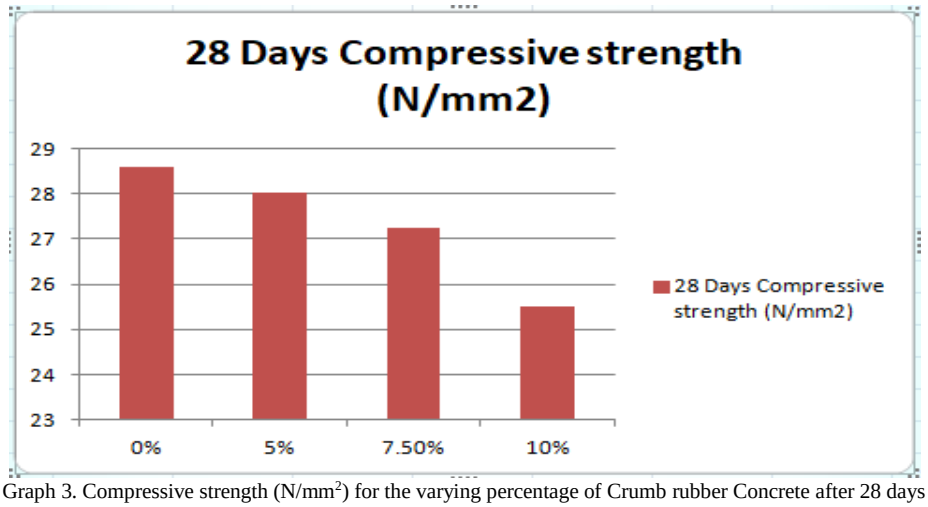
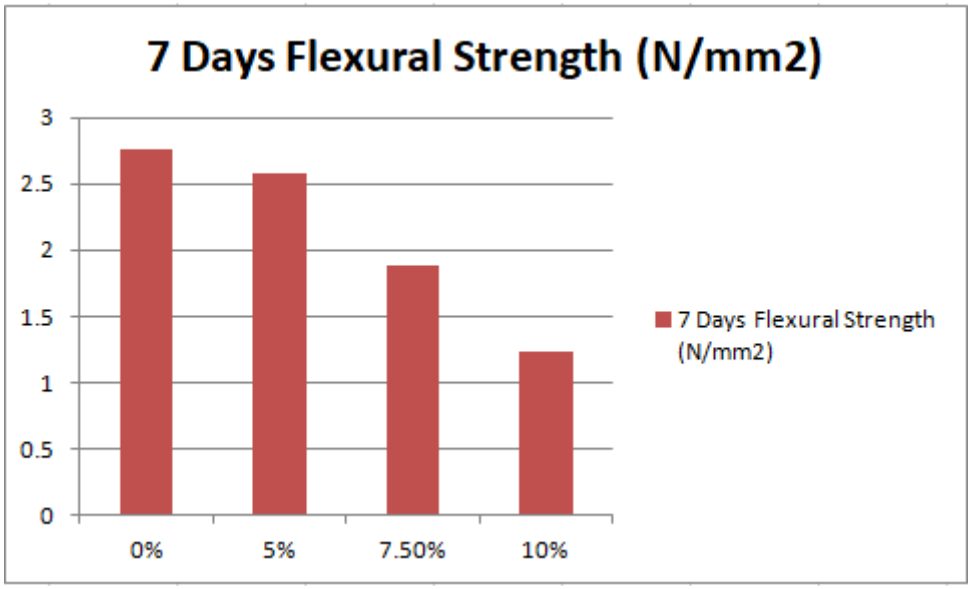


Graph 3. Compressive strength (N/mm^2) for the varying percentage of Crumb rubber Concrete after 28 days

FLEXURAL STRENGTH TEST

Table 3: Flexural strength (N/mm^2) for 0%, 5%, 7.5% & 10% Crumb Rubber Concrete

S.no.	Sample	Flexural strength (N/mm2)		
		7 Days	14 Days	28 Days
1	0%	2.76	3.53	4.75
2	5%	2.58	3.01	5.13
3	7.50%	1.89	2.21	5.41
4	10%	1.24	2.04	6.02



Graph 4. Flexural strength (N/mm^2) for the varying percentage of Crumb rubber Concrete after 7 days

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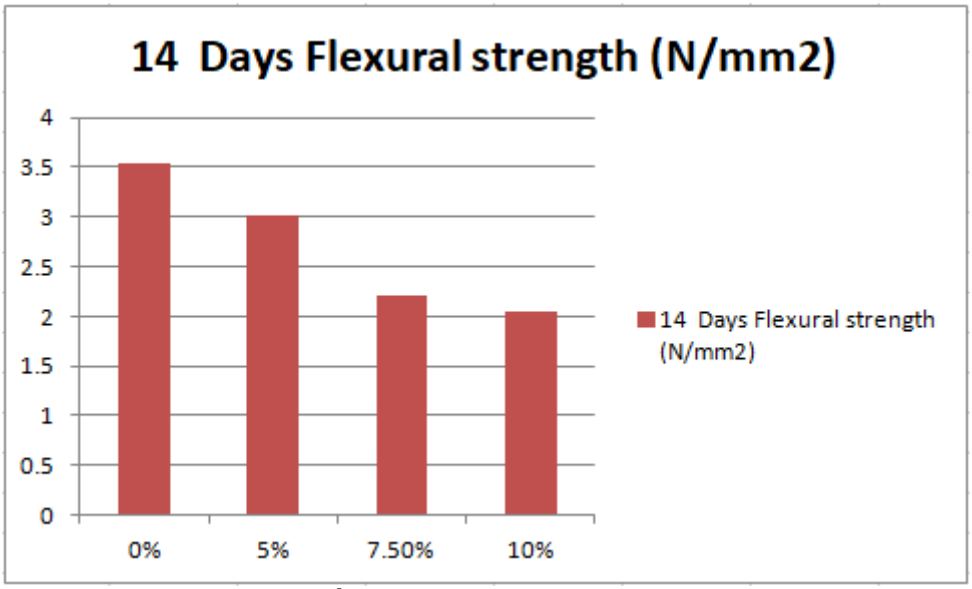
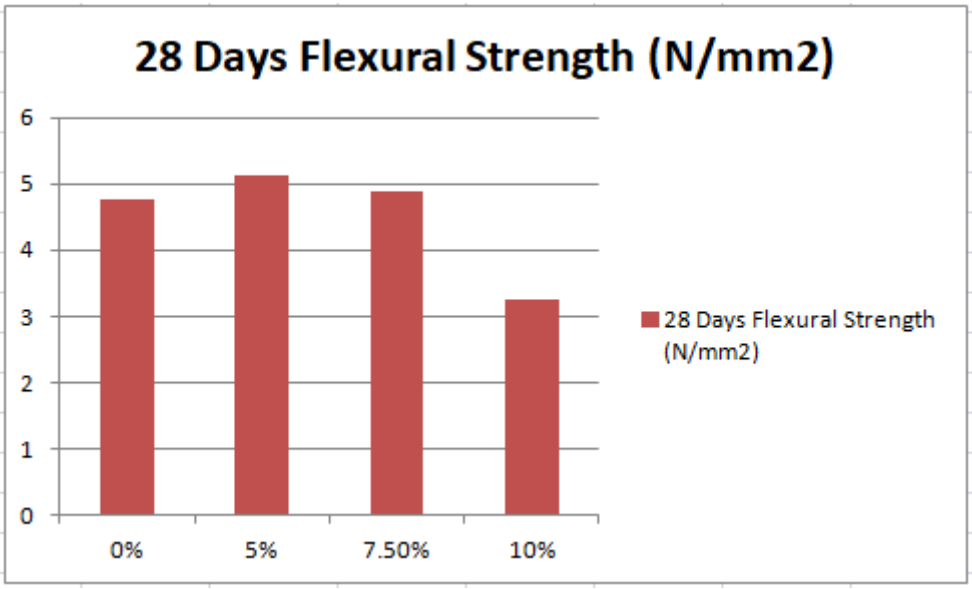


Graph 5. Flexural strength (N/mm^2) for the varying percentage of Crumb rubber Concrete after 14 days



Graph 6. Flexural strength (N/mm^2) for the varying percentage of Crumb rubber Concrete after 28 days

RESULTS

From the observation of above tests it shows compressive strength has declined as on replacement of rubber content in small percentages i.e. 5%, 7.5%. A respective decline of 2.02% for 5% addition and 4.72% for 7.5% after 28 days curing but on high percentages of 10% replacement compressive strength declines by 10.8% with respect to compressive strength strength of mix design with 0% rubber content after a time period of 28 days curing .

While for flexural strength test results reveal that on 5% replacement of rubber aggregates flexural strength increases by 8% , for 7.5% replacement strength increases by 13.8% and for higher percentages of replacement 10% strength increases by 26.7% with respect to flexural strength of mix design with 0% rubber content after a time period of 28 days curing.

Table 4: Percentage decrease in Compressive strength (N/mm^2) for 5% , 7.5% & 10% Crumb Rubber Concrete w.r.t 0% Rubber concrete

S.no.	Rubber percentages	Percentage Decrease in Compressive strength (N/mm2)		
		7 Days	14 Days	28 Days
1	5%	1.75%	2.15%	2.02%
2	7.50%	4.39%	10.53%	4.72%
3	10%	25.06%	24.51%	10.83%

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Table 5: Percentage decrease in Flexural strength strength (N/mm^2) for 5% , 7.5% & 10% Crumb Rubber Concrete w.r.t 0%Rubber concrete

S.no.	Rubber percentages	Percentage Increase in Flexural strength (N/mm2)		
		7 Days	14 Days	28 Days
1	5%	6.52%	14.73%	8%
2	7.50%	31.50%	37.39%	13.89%
3	10%	55.07%	42.20%	26.73%

Table 5: Percentage difference in Flexural strength (N/mm^2) And compressive strength for 5% , 7.5% & 10% Crumb Rubber Concrete w.r.t 0% Rubber concrete

S.no.	Rubber percentages	Percentage Flexural Strength - Percentage Compressive strength		
		7 Days	14 Days	28 Days
1	5%	4.77%	12.58%	6%
2	7.50%	27.11%	26.86%	9%
3	10%	30.01%	17.69%	16%

CONCLUSIONS:

From the above results conclusion lies that for 5% replacement there is an average difference of 6% in values of flexural strength and compressive strength after 28 days or full maturity while for 7.5% replacement of rubber there is an average difference of 9% in values of flexural strength and compressive strength after 28 days or full maturity . therefore these two percentages can opted for future elastic analysis of crumb rubber concrete and thereby improving elasticity of concrete.

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