Reconnaissance of Strength Characteristics of Recron Polyester Fiber Recycled Aggregate Concrete

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Abstract- In some countries it is a standard alternative for both construction and maintenance, particularly where there is a shortage of construction aggregate. The benefits and weaknesses of using recycled aggregate in concrete have been broadly studied .The use of recycled aggregate generally increases the drying shrinkage and creep and decreases the compressive strength and modulus of elasticity of concrete compared to those of natural aggregate concrete . The undesirable effects of recycled aggregate on concrete quality limit the use of this material in structural concrete. However, the weaknesses of using recycled aggregate can be mitigated by incorporating a certain amount of fly ash into the concrete mixture since fly ash is known to be able to reduce the creep and drying shrinkage of concrete.

INTRODUCTION

The recycling of Construction and Demolition Wastes has long been recognized to have the potential to conserve natural resources and to reduce energy used in production. In some countries it is a standard alternative for both construction and maintenance, particularly where there is a shortage of construction aggregate. The benefits and weaknesses of using recycled aggregate in concrete have been broadly studied .The use of recycled aggregate generally increases the drying shrinkage and creep and decreases the compressive strength and modulus of elasticity of concrete compared to those of natural aggregate concrete . The undesirable effects of recycled aggregate on concrete quality limit the use of this material in structural concrete. However, the weaknesses of using recycled aggregate can be mitigated by incorporating a certain amount of fly ash into the concrete mixture since fly ash is known to be able to reduce the creep and drying shrinkage of concrete.

Recycled Aggregate

Recycling is the act of processing the used material for use in creating new product. The usage of natural aggregate is getting more and more intense with the advanced development in infrastructure area. In order to reduce the usage of natural aggregate, recycled aggregate can be used as the replacement materials. Recycled aggregate are comprised of crushed, graded inorganic particles processed from the materials that have been used in the constructions and demolition debris. These materials are generally from *Experimental Studies*

Recycled Coarse Aggregate Buildings, roads, bridges, and sometimes even from catastrophes, such as wars and earthquakes. There are many advantages through using the recycled aggregate. The advantages that occur through usage of recycled aggregate are listed below. a) Environmental Gain b) Cost c) Job Opportunities d) Sustainability e) Market is wide.

NECESSITY AND OBJECTIVES OF THE WORK

Concrete is the most common material in the world because it construction combines very good mechanical and durability workability and relative low cost. properties, However, cement production emits greenhouse gases, mainly CO_2, being responsible for about 5% of global anthropogenic emissions in the world . Since 1 kg of cement CO_2 produces approximately 1 kg of CO_2, the use of low emission replacement pozzolans as cements possibilities to greenhouse.

The application of recycled aggregate in concrete production brings positive effects of the environment; hence it reduces the problems associated to their distraction disposal. Regarding their use as aggregate additive, mineral admixtures affect the performances of paste, mortar and concrete owing to both physical and chemical effects. Therefore it is possible to recycled aggregate in concrete additive and replacement material to improve quality and reduce cost of pozzolonic construction material.

REVIEW ON RECYCLED AGGREGATE

Suraya Hani Adnan et al (2007) [16] investigated the effects of various percentages (0%, 25%, 50%, 75%, and 100%) of Recycled Aggregate (RA) on compressive strength of Recycled Aggregate Concrete (RAC) and to determine the performance of a concrete. RA is used to replace natural aggregate (NA) as coarse aggregate in concrete mixes. This research also covered RAC mixtures at different water-cement ratio (0.4, 0.5, and 0.6). It was found that RAC had lower compressive strength compared to Natural Aggregate Concrete (NAC). At the age of 28 days, RAC with water-cement ratio 0.4 had the highest strength.

Chen W.F., and Drucker 1969 [4] reported the solution for the bearing capacity of square blocks is used to predict the bearing capacity. A Mohr-Coulomb failure surface in compression and small tension is utilized. An upper bound of the average bearing capacity was suggested an equation.

EXPERIMENTAL INVESTIGATION

The methodology involves evaluation of partial replacement of recycled aggregate at different percentages in cement, study of compressive strength, Split tensile strength & durability at different ages of concrete cured. The compressive strength, Split tensile strength & durability of concrete will be arrived after analyzing the results of strength tests (Compression test, Split tensile strength test and durability test).

Experimental Investigation

The details of experimental investigations are as follows.

MATERIALS USED

1. Cement
2. Fine aggregate
3. Coarse Aggregate
4. Recycled aggregate
5. Water

MATERIAL PROPERTIES

Cement

Cement is a material that has cohesive and adhesive properties in the presence of water. Such cements are called hydraulic cements.

These consist of primarily silicates and aluminates of lime obtained from limestone and clay. There are different types of cements, out of which OPC is used.

Ordinary Portland Cement (OPC) is the basic Portland cement and is best suited for use in general concrete construction. It is of three types 33 grade, 43 grade, and 53grade. One of the important benefits is the faster rate of development of strength. Ordinary Portland Cement (OPC) available in the market conforming to IS 12269-1987 was used for casting the specimens. The cement using is 53 Grade.

Chemical composition (%) of cement

Composition	Opc-53 Grade
Sio_2	21.52
Al_2o_3	6.16
Fe_2o_3	4.60
Cao	63.36
Mgo	0.83
So_3	1.87
IR	1.30
Loss of ignition	1.64

Aggregates

Aggregate properties greatly influence the behaviour of concrete, since they occupy about 80% of the total volume of concrete. The aggregate are classified as

(1) Fine aggregate

(2) Coarse aggregate

Sieve Analysis of Fine Aggregate

The wt of sand is taken =1000 grams

S.NO.	I.S. Sieve No.	Weight retained(gm)	%Weight retained	Cumalative % retained	% passing
1	40mm	0	0	0	100
2	20mm	0	0	0	100
3	10mm	0	0	0	100
4	4.75mm	21	2.1	2.1	97.90
5	2.36mm	65	6.5	8.6	91.40
6	1.18mm	180	18	26.6	73.4
7	600 µ	278	27.8	54.4	45.6
8	300 µ	280	28	82.4	17.6
9	150 µ	176	17.6	100	0
Total				274.1	

$$\text{Fineness modulus of sand} = \sum \frac{\text{cumulative percent retained}}{100}$$
$$= 274/100 = 2.74$$

Conforming to **Zone II** (I.s:383-1970)

Properties of Fine Aggregate

S.NO.	Property	Test Result
1	Specific Gravity	2.59
2	Bulk density(Kg/m^3)	1543 (loose state) 1705 (dry rodded)
3	Fineness Modulus	2.81
4	Zone	2

Coarse aggregate

The coarse aggregate are granular materials obtained from rocks and crushed stones. They may be also obtained from synthetic material like slag, shale, fly ash and clay for use in light weight concrete. Also in case of coarse aggregate maximum 20mm sized coarse aggregate is suitable for concrete work. But where there is no restriction, 40mm or large size may be permitted.

Table 3.6 Sieve Analysis Of Coarse Aggregate

The wt of coarse aggregate is taken = 5000 grams.

S.NO.	I.S. Sieve No.	Weight retained(gm)	CumalativeWt retained(gm)	Cumalative % retained	% passing
1	40mm	0	0	0	100
2	20mm	877	877	17.54	82.46
3	10mm	4085	4962	99.24	0.76
4	4.75mm	38	5000	100	0
5	2.36mm	0	5000	100	0
6	1.18mm	0	5000	100	0
7	600	0	5000	100	0
8	300	0	5000	100	0
9	150	0	5000	100	0
			Total	716.78	

$$\text{Fineness modulus of coarse aggregate} = \sum \frac{\text{cumulative percent retained}}{100}$$

$$= \quad 716.78/100 = \mathbf{7.17}$$

Properties of Coarse Aggregate

S.NO.	Property	Test Result
1	Bulk density(kg/m^3)	1468 [loose state] 1675 [dry rodded]
2	Specific Gravity(G)	2.81
3	Fineness Modulus	7.17

Obstacles in Use of RCA

The acceptability of recycled aggregate is impeded for structural applications due to the technical problems associated with it such as weak interfacial transition zones between cement paste and aggregate, porosity and transverse cracks within demolished concrete, high level of sulphate and chloride contents, impurity, cement remains, poor grading, and large variation in quality.

Although, it is environmentally & economically beneficial to use RCA in construction, however the current legislation and experience are not adequate to support and encourage recycling of construction & demolished waste in India. Lack of awareness, guidelines, specifications, standards, data base of utilization of RCA in concrete and lack of confidence in engineers, researchers and user agencies is major cause for poor utilization of RCA in construction. If the Govt wishes these obstacles can easily be removed.

Shows the Reliance Recron Polyester Fibre

Water

Clean potable water is used for mixing concrete. Water used for mixing and curing should be clean and free from injurious amounts of oils, acids, alkalis, salts, sugar, organic materials or other substances that may be deleterious to concrete and steel.

MIX DESIGN PROCEDURE:

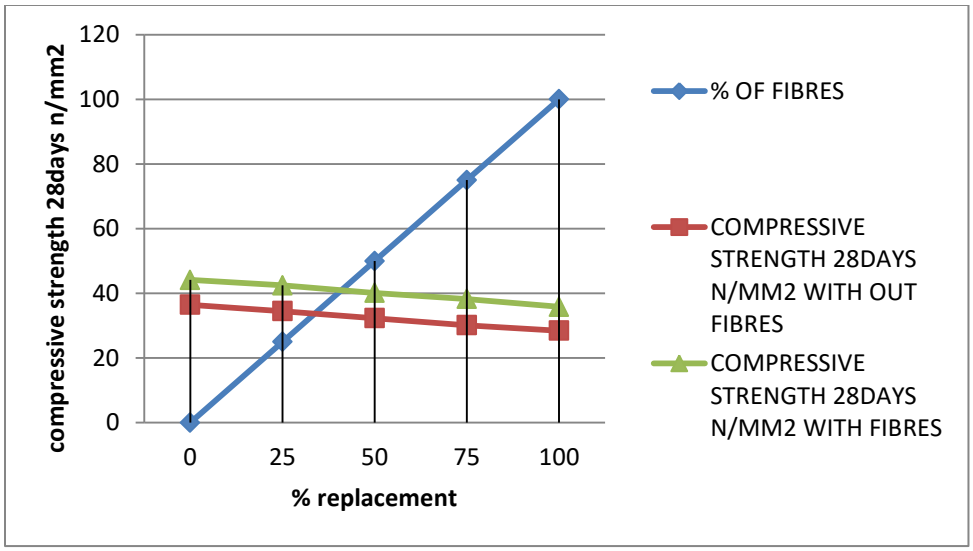
In the present investigation mix proportioning is done using IS10262:2009 method for, M 40 grade concrete. The resulting mixes are modified after conducting trials at the laboratory by duly following the Indian standards guidelines to achieve following mix proportion by weight.

Design stipulations:

i)	Characteristic compressive strength required in the field at 28 days.	:	40 MPa
ii)	Maximum size of aggregate	:	20 mm
iii)	Degree of workability	:	100mm slump
iv)	Degree of super vision	:	Good
v)	Type of exposure	:	Severe

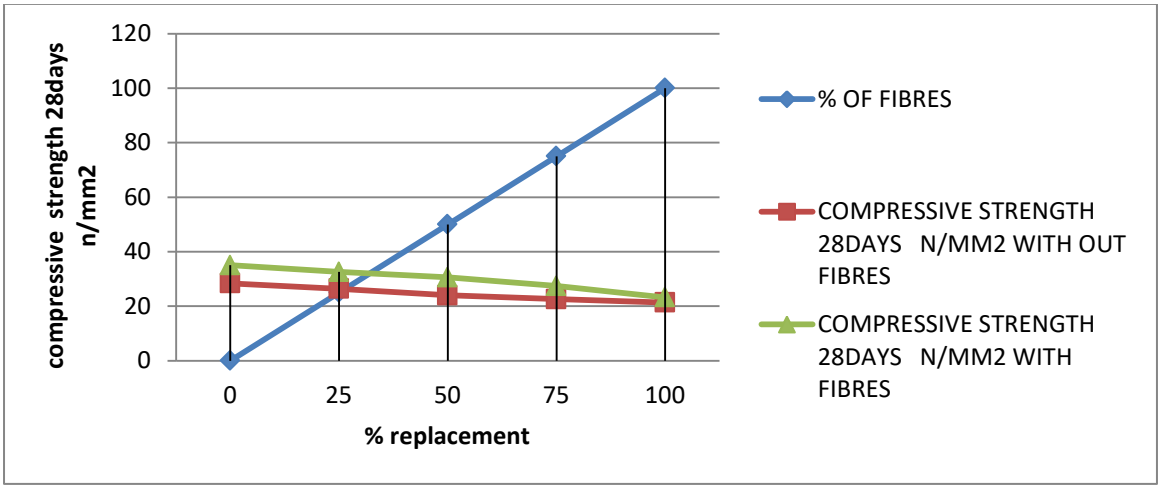
COMPRESSIVE STRENGTH

% OF FIBRES	COMPRESSIVE STRENGTH 28DAYS N/MM2 WITH OUT FIBRES	COMPRESSIVE STRENGTH 28DAYS N/MM2 WITH FIBRES
0	36.45	44.12
25	34.49	42.45
50	32.34	40.15
75	30.12	38.25
100	28.45	35.85



COMPRESSIVE STRENGTH CYLINDER

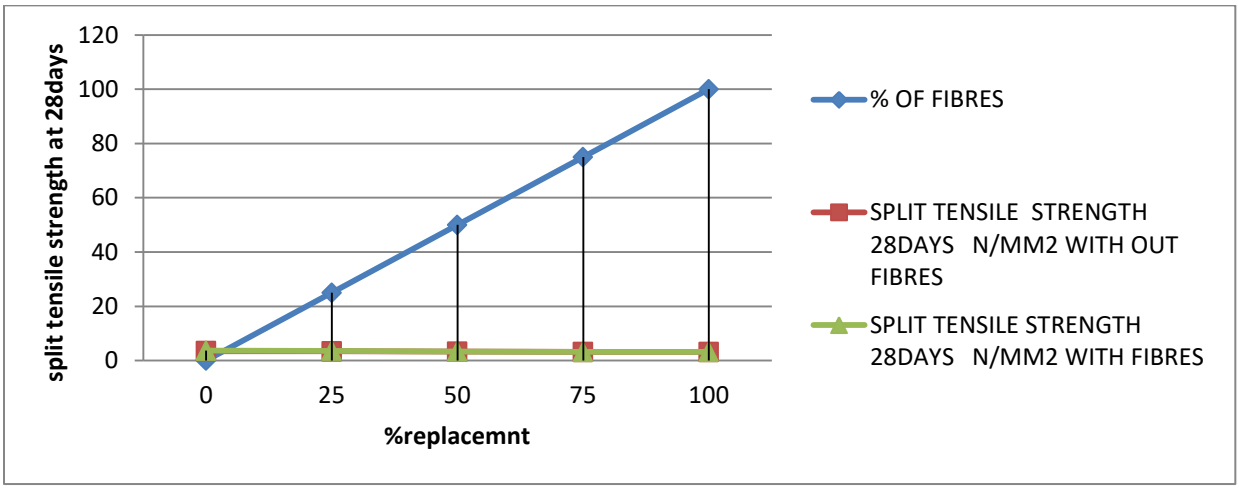
% OF FIBRES	COMPRESSIVE STRENGTH 28DAYS N/MM2 WITH OUT FIBRES	COMPRESSIVE STRENGTH 28DAYS N/MM2 WITH FIBRES
0	28.37	35.01
25	26.38	32.55
50	24.01	30.55
75	22.55	27.37
100	21.37	23.24



SPLIT TENSILE

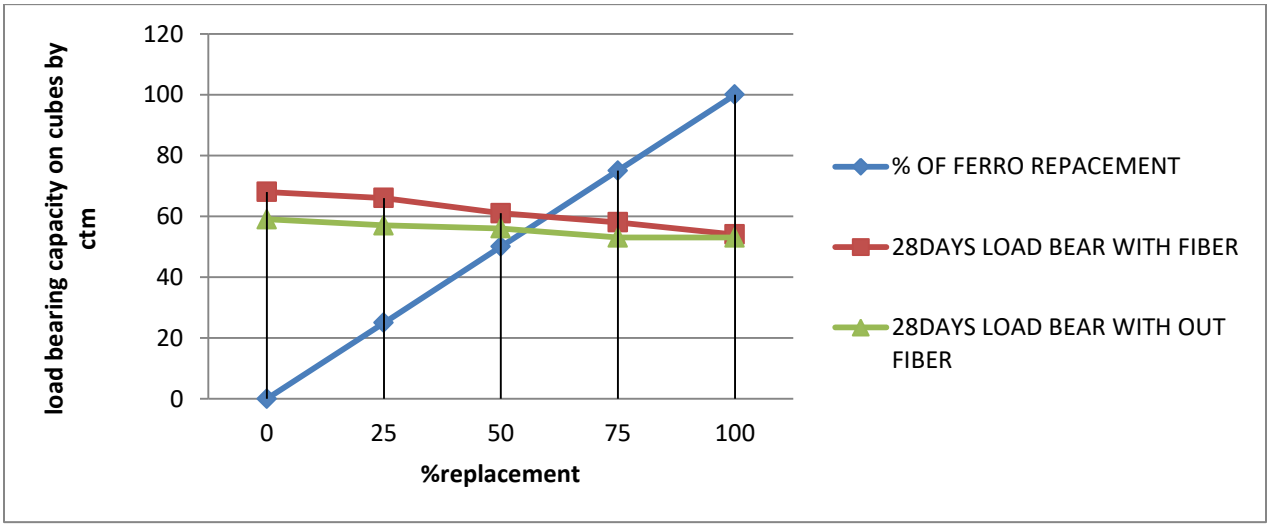
% OF FIBRES	SPLIT TENSILE STRENGTH 28DAYS N/MM2 WITH OUT FIBRES	SPLIT TENSILE STRENGTH 28DAYS N/MM2 WITH FIBRES

0	3.5	3.66
25	3.42	3.58
50	3.3	3.34
75	3.2	3.2
100	3.17	3.17



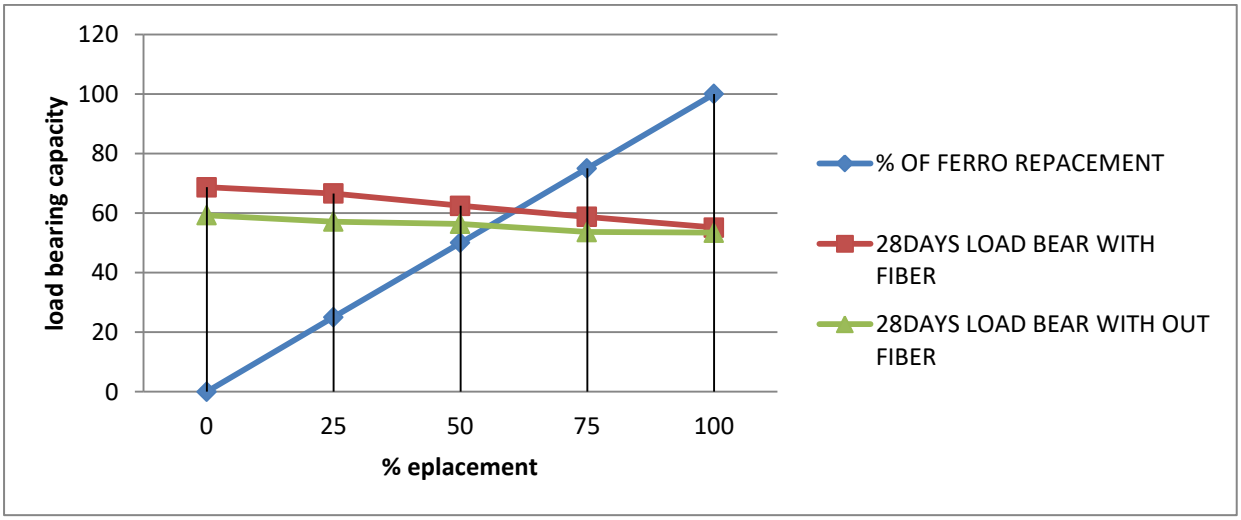
LOAD BEARING CAPACITY ON CUBES BY CTM

% OF FERRO REPACEMENT	28DAYS LOAD BEAR WITH FIBER	28DAYS LOAD BEAR WITH OUT FIBER
0	68	59
25	66	57
50	61	56
75	58	53
100	54	53



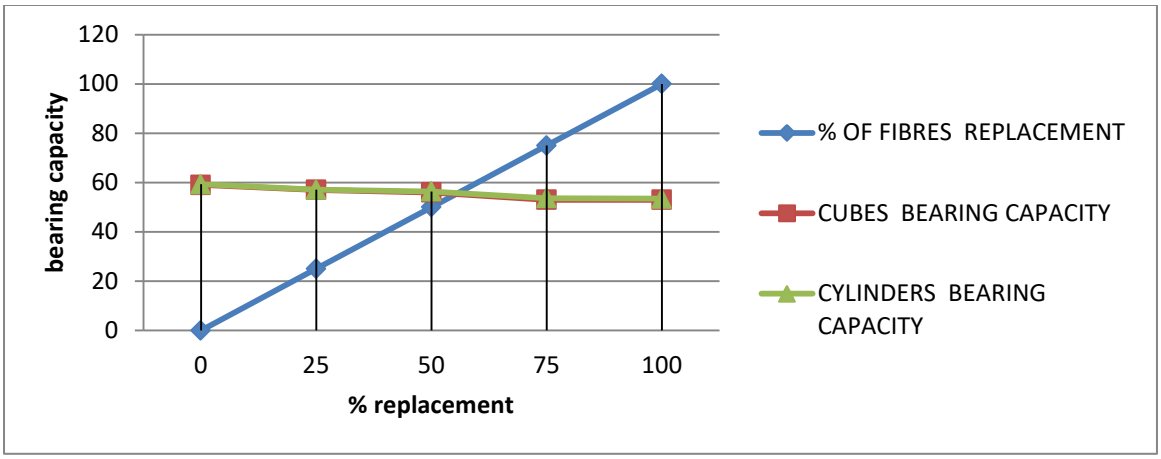
LOAD BEARING CAPACITY TEST ANALYTICAL METHOD

% OF FERRO REPACEMENT	28DAYS LOAD BEAR WITH FIBER	28DAYS LOAD BEAR WITH OUT FIBER
0	68.66	59.26
25	66.57	57.1
50	62.45	56.35
75	58.74	53.62
100	55.13	53.42



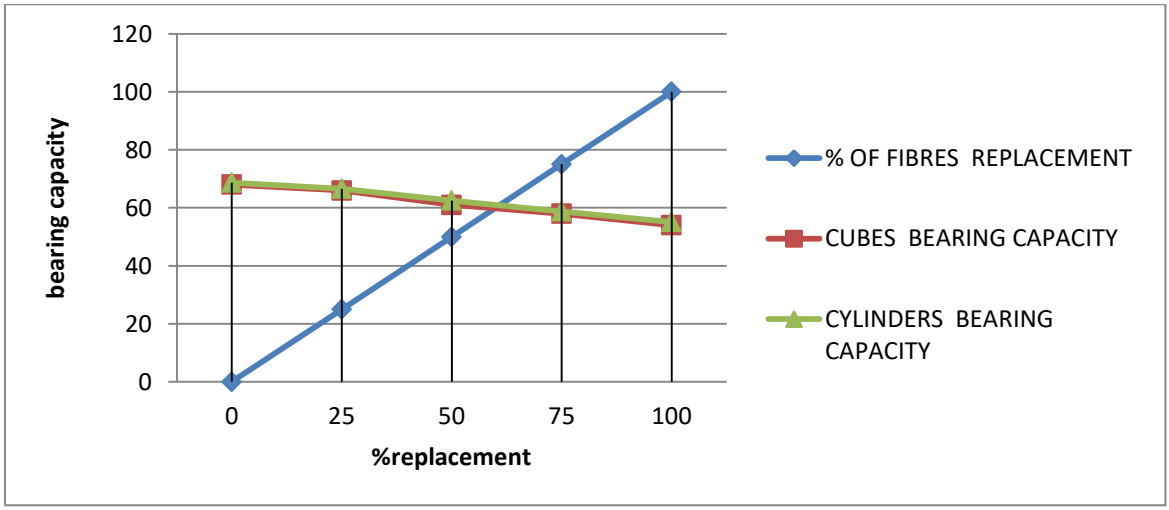
CUBES BEARING CAPACITY MECHANICAL METHOD COMPARISION WITH ANALYTICAL METHOD WITH OUT FIBER AT 28 DAYS

% OF FIBRES REPLACEMENT	CUBES BEARING CAPACITY	CYLINDERS BEARING CAPACITY
0	59	59.26
25	57	57.1
50	56	56.35
75	53	53.62
100	53	53.42



CUBES BEARING CAPACITY MECHANICAL METHOD COMPARISION WITH ANALYTICAL METHOD WITH AT 28 DAYS

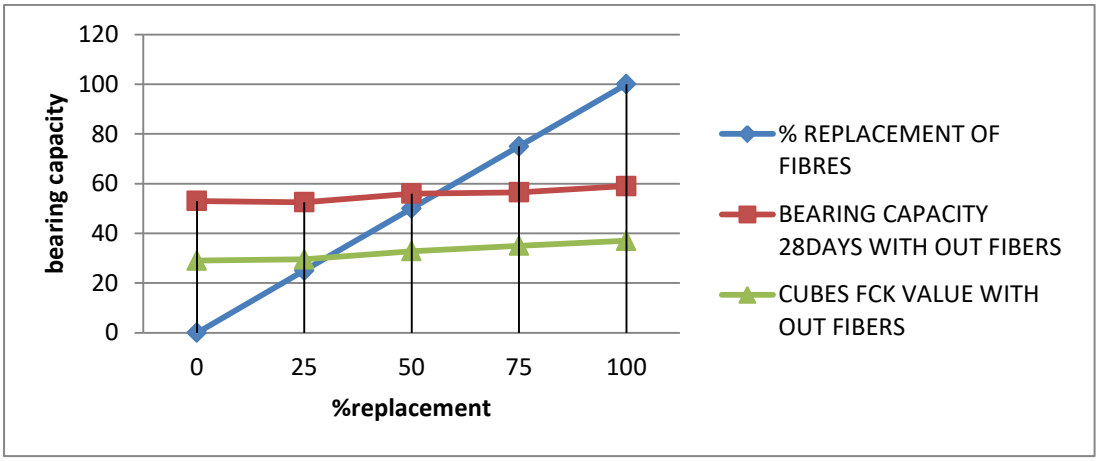
% OF FIBRES REPLACEMENT	CUBES BEARING CAPACITY	CYLINDERS BEARING CAPACITY
0	68	68.66
25	66	66.57
50	61	62.48
75	58	58.74
100	54	55.13



UNLOADED /LOADED AREA RATIO OF BEARING CAPACITY STRENGTH WITH OUT FIBRES AT 28 DAYS

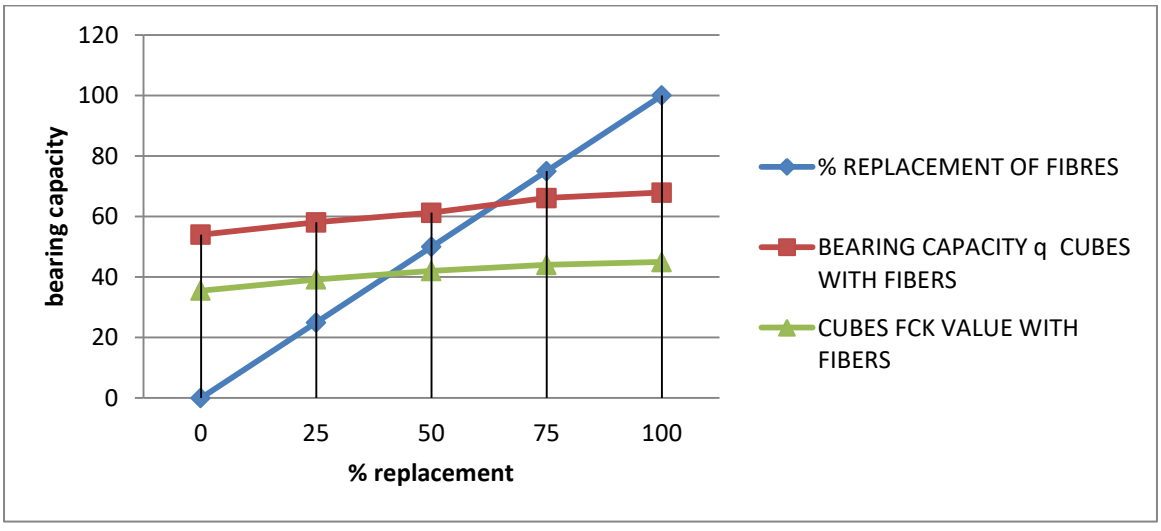
% REPLACEMENT OF FIBRES	BEARING CAPACITY 28DAYS WITH OUT FIBERS	CUBES FCK VALUE WITH OUT FIBERS
0	53	28.98
25	52.5	29.5

50	56	32.8
75	56.5	35
100	59	37



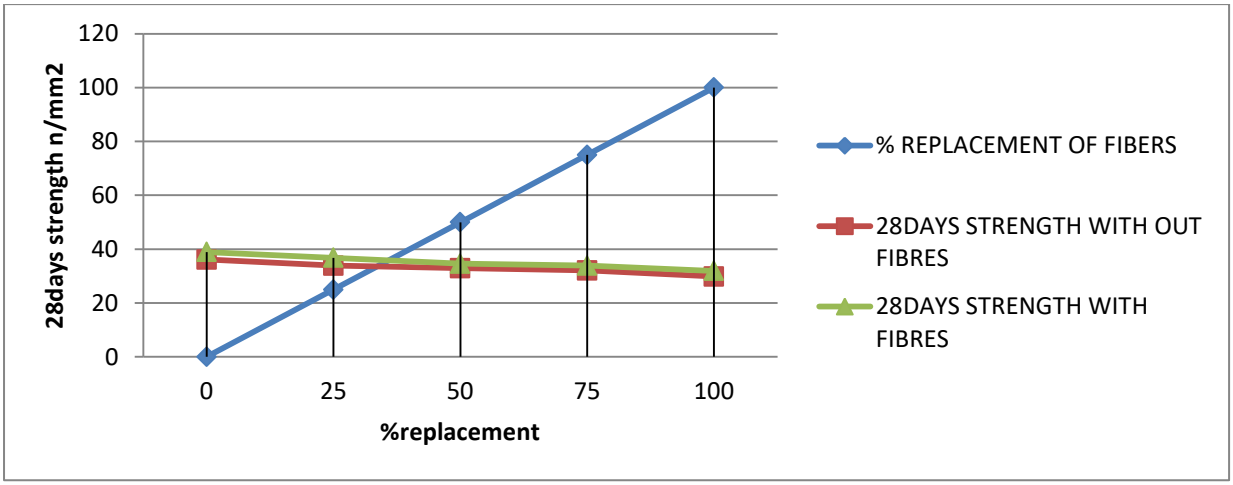
UNLOADED /LOADED AREA RATIO OF BEARING CAPACITY STRENGTH WITH FIBRES AT 28 DAYS

% REPLACEMENT OF FIBRES	BEARING CAPACITY q CUBES WITH FIBERS	CUBES FCK VALUE WITH FIBERS
0	54	35.5
25	58.05	39.2
50	61.25	42.01
75	66.125	44.025
100	67.92	44.95



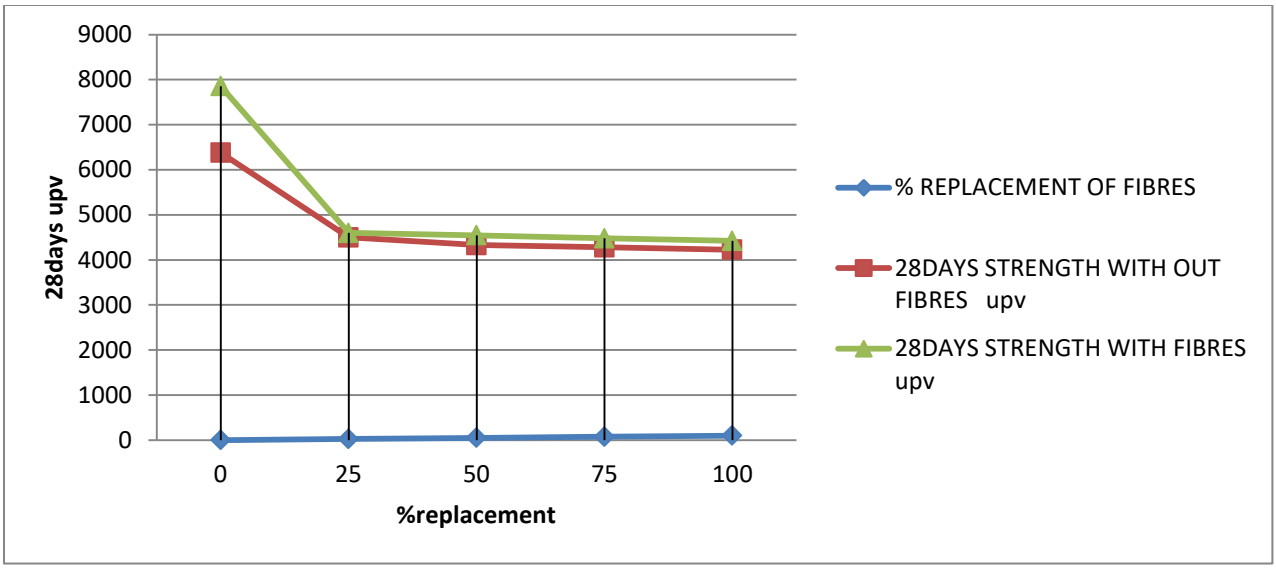
REBOUND HAMMER TEST RESULT

% REPLACEMENT OF FIBERS	28DAYS STRENGTH WITH OUT FIBRES	28DAYS STRENGTH WITH FIBRES
0	36.17	38.92
25	33.87	36.78
50	32.92	34.58
75	32.12	33.87
100	29.84	31.94



ULTRASONIC PULSE VELOCITY TEST RESUTS

% REPLACEMENT OF FIBRES	28DAYS STRENGTH WITH OUT FIBRES upv	28DAYS STRENGTH WITH FIBRES upv
0	6378	7855
25	4500	4600
50	4328	4545
75	4278	4478
100	4228	4422



CONCLUSION

- All the mixes attained the target mean strength. Cube Strength of RAC is about with and with out fibers 44.12 MPa to 28.45 MPa with the replacement percentage in the range of 0 to 100.
- Concrete made with 100% replacement of conventional coarse aggregates with recycled coarse aggregate had 35.85MPA compressive strength, than conventional concrete compressive strength 44.12MPA at 28 days with fiber
- Concrete made with 100% replacement of conventional coarse aggregates with recycled coarse aggregate had 28.45MPA compressive strength ,than conventional concrete compressive strength 36.45MPA at 28 days with out fiber
- Compressive strength (cylindes 15diax30cm) Concrete made with 100% replacement of conventional coarse aggregates with recycled coarse aggregate had 21.37MPA compressive strength ,than conventional concrete compressive strength 28.37MPAat 28 days with out fiber
- Compressive strength (cylindes 15diax30cm) Concrete made with 100% replacement of conventional coarse aggregates with recycled coarse aggregate had 23.24MPA compressive strength, than conventional concrete compressive strength 35.01MPAat 28 days with fiber
- Split tensile strength Concrete made with 100% replacement of conventional coarse aggregates with recycled coarse aggregate had 3.17 MPA strength ,than conventional concrete 3.66MPA at 28 days with fiber
- Split tensile strength Concrete made with 100% replacement of conventional coarse aggregates with recycled coarse aggregate had 3.12MPA strength ,than conventional concrete 3.5 MPA at 28 days with out fiber
- Load bearing capacity on cubes by ctm achives load at 28days with fiber and with out fiber 0% is 68 and 59 ,100% is 54 and 53 respectively
- Load bearing capacity on cubes by analytical method achives load at 28days with fiber and with out fiber 0% is 68 .66and 59 .26,100% is 55.13 and 53.42 respectively
- Cubes bearing capacity mechanical method compaision with analytical method with out fibers at 28 days cubes is fibers 0% is 59 and 100% is 53 , and cylindes is fibers 0% is59.26 and 100% is 23.42

- Cubes bearing capacity mechanical method compaision with analytical method with fibers at 28 days cubes is fibers 0% is 68 and 100% is 54 , and cylindes is fibers 0% is68.66 and 100% is 55.13
- Unloaded /loaded area ratio curve of bearing capacity strength with out fiber cubes fck value is 0% is 28.98 and 100% is 37
- Unloaded /loaded area ratio curve of bearing capacity strength with fiber cubes fck value is 0% is 35.5 and 100% is 44.95
- Rebound hammer test value achives at replacement of fiber at 25% is 33.87 at 28days with out fiber
- Rebound hammer test value achives at replacement of fiber at 25% is 36.78 at 28days with fiber Ultrasonic pulse velocity value 0% and 100% is 6378 and 4228 at 28days with out fiber , Ultrasonic pulse velocity value 0% and 100% is 7855and 4422at 28days with fiber

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