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AN EXPERIMENTAL DEMONSTRATING OF FIBER REINFORCED CONCRETE FOR FLEXURAL STRENGTH

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ABSTRACT:
Fibers have played a leading role for a stretched time in a variety of applications for their extraordinaryexplicit strength and modulus. They can be effectively precise cracking and use the concrete with crack free and also increase the overall properties like compressive, ductility, flexural, quality of the concrete. This paper compacts with the properties of accumulation of various proportions of polypropylene fiber for diverse grades on the properties of concrete. An experiential modeling of fiber reinforced concrete (polypropylene fiber) was carried out to explore its effects on flexural strength. By using the values of different papers on polypropylene fibers the empirical equation was determined by validation; for flexural strength. Papers on polypropylene fibers are used in this data modeling. Polypropylene fibres are tough but have low tensile strength and modulus of elasticity. Polypropylene is a synthetic hydrocarbon polymer, the fiber of which is made using extrusion processes by hot drawing the material through a die. Its use enables reliable and effective utilization of intrinsic tensile and flexural strength of the material along with significant reduction of plastic shrinkage cracking and minimizing of thermal cracking.
Keywords: *polypropylene fibers, strength properties, concrete specimens.*

1. INTRODUCTION

Fiber-reinforced concrete (FRC) is concrete containing fibrous material which increases its structural integrity. It contains short discrete fibers that are uniformly distributed and randomly oriented. Fibers include steel fibers, glass fibers, synthetic fibers and natural fibers – each of which lend varying properties to the concrete. In addition, the character of fiber-reinforced concrete changes with varying concretes, fiber materials, geometries, distribution, orientation, and densities. Steel fibre is one of the most commonly used fibres. Generally round fibres are used. The diameter may vary from 0.25 to 0.75mm.The steel fibre sometimes gets rusted and lose its strength. But investigations have proved that fibres get rusted only at surfaces. It has high modulus of elasticity. Use of steel fibres makes significant improvements in flexure, impact and fatigue strength of concrete. It has been used in various types of structures. Glass fibre is a recently introduced fibre in making fibre concrete. It has very high tensile strength of 1020 to 4080Mpa. Glass fibre concretes are mainly used in exterior building façade panels and as architectural precast concrete. This material is very good in making shapes on the front of any building and it is less dense than steel. Use of carbon fibre is not a developed process. But it has considerable strength and young's modulus. Also investigations have shown that use of carbon makes the concrete very durable. The study on the carbon fibres is limited. Mainly used for cladding purpose. Natural fibres are low cost and abundant. They are no hazardous and renewable.

In this composite material, short discrete fibers are randomly distributed trough out the concrete mass. The behavioral efficiency of this composite material is far superior to that of plain concrete and many other construction materials of same cost. Due to this benefit, the use of FRC has steadily increased during last two decades and its current field of application includes airport and highway pavements, earthquake resistant and explosive resistant structures, mines and tunnel linings, bridge deck overlays, hydraulic structures, rock slope stabilization. Extensive research work on FRC has established that the addition of various types of fibers such as steel, glass, synthetic and carbon, in plain concrete which improves strength, toughness, ductility, and post cracking resistance, etc.

2. FRC DESIGN MODEL:

It is concrete containing fibrous material which increases its structural integrity. It contains short discrete fibers that are uniformly distributed and random oriented. Fibers include steel fibers, glass fibers, synthetic fibers and natural fiber. Within these different fibers that character of fiber reinforced concrete changes with varying concretes, fiber materials, geometries, distribution, orientation and densities.

Use of Fibers:

Over the past 40 years, a number of applications have been recommended for the use of fiber reinforced concrete including road and floor slabs, refractory materials and concrete products

3. DATA MODELLING:

These are the values for data modeling of polypropylene fibers those consists of different variables i.e., concrete strength, aspect ratio, volume fiber, tensile strength of fiber.

Compressive strength at 0%fiber	Aspect Ratio	Volume of fibers	Tensile strength	Flexural strength
46.3	0	0	0	5.75
46.3	857	0.2	1700	6.3
46.3	857	0.25	1700	6.8
46.3	857	0.3	1700	7.1
46.3	857	0.5	1700	7.36
46.3	857	1	1700	7.62
46.3	857	1.5	1700	8.37
36.5	0	0	0	3.84
36.5	0	0	0	4.94
38.28	0	0	0	5.84
38.28	600	0.01	1700	5.78
38.28	600	0.02	1700	5.12
38.28	600	0.03	1700	6.8
38.1	0	0	0	3.7
38.1	0	0	0	3.5
38.1	857.1	0.1	2500	3.8

38.1	857.1	0.2	2500	3.95
38.1	857.1	0.3	2500	4.15
23.93	0	0	0	3.312
23.93	0	0	0	2.86
23.93	0	0	0	3.86
23.93	857.1	0.03	2500	3.06
23.93	857.1	0.03	2500	3.696
23.93	857.1	0.03	2500	4.006
23.93	857.1	0.06	2500	3.296
23.93	857.1	0.06	2500	3.7
23.93	857.1	0.06	2500	3.968
23.93	857.1	0.1	2500	3.548
23.93	857.1	0.1	2500	4.018
23.93	857.1	0.1	2500	4.43
36.6	0	0	0	3.52
36.6	857.1	0.03	1700	4.08
41.5	0	0	0	4.12
41.5	857.1	0.03	1700	4.78
47.92	0	0	0	4.72
47.92	857.1	0.03	1700	5.52
54.18	0	0	0	5.42
54.18	857.1	0.03	1700	6.23
41	857	1.5	1100	5.46
41	857	1.5	1100	5.37
41	857	1.5	1100	5.62
41	857	2	1100	5.49
41	857	2	1100	6.4
41	857	2	1100	6.56
27.9	0	0	0	3.95
27.9	857.1	0.5	2500	7.82
27.9	857.1	0.75	2500	8.16
27.9	857.1	1	2500	8.95
27.9	857.1	1.25	2500	8.93
55	0	0	0	7.15
55	857.1	0.5	1700	8.45
55	857.1	1	1700	9.75
55	857.1	1.5	1700	8.75
55	857.1	2	1700	7.35
39.7	0	0	0	4.2

39.7	857.1	1	1700	3.3
27	420	0.5	550	5.75
27	420	1	550	6.25
27	420	1.5	550	6.85
27	420	2	550	7.1
39	0	0	0	4.05
39	750	0.4	400	4.945
39	750	0.8	400	5.915
39	750	1	400	6.225
39	750	1.5	400	7.28

4. RESULTS AND DISCUSSIONS

The experimental values are taken from various research papers from various journals; and the values analyzed by using regression and Mat Lab is used to minimize the errors and the programming is shown below

4.1 Input Values:

4.1.1. Com. Strength at 0%fiber:

46.3,46.3,46.3,46.3,46.3,46.3,46.3,36.5,36.5, 38.28,38.28,38.28,38.28,38.1,38.1,38.1,38.1, 38.1,23.93,23.93,23.93,23.93,23.93,23.93, 23.93,23.93,23.93,23.93,23.93,23.93,36.6,36 .6,41.5,41.5,47,92,47.92,54.18,54.18,41,41,4 1,41,41,41,27.9,27.9,27.9,27.9,27.9,55,55,55 ,55,55,39.7,39.7,27,27,27,27, 39,39,39,39,39

4.1.2 Aspect Ratio:

0,857,857,857,857,857,857,0,0,0,600,600,60 0,0,0,857.1,857.1,857.1,0,0,0,857.1,857.1,85 7.1,857.1,857.1,857.1,857.1,857.1,857.1,0, 857.1,0,857.1,0,857.1,0,857.1,857,857,857,8 57,857,857,0,857.1,857.1,857.1,857.1,0,857. 1,857.1,857.1,857.1,0,857.1,420,420,420,42 0,0,750,750,750,750.

4.1.3 Volume Fraction:

0,0.2,0.25,0.3,0.5,1,1.5,0,0,0,0.01,0.02,0.03, 0,0,0.1,0.2,0.3,0,0,0,0.03,0.03,0.03,0.06,0.06 ,0.06,0.1,0.1,0.1,0,0.03,0,0.03,0,0.03,0,0.03, 1.5,1.5,1.5,2,2,2,0,0.5,0.75,1,1.25,0,0.5,1,1.5 ,2,0,1,0.5,1,1.5,2,0,0.4, 0.8,1,1.5.

4.1.4 Tensile strength:

0,1700,1700,1700,1700,1700,1700,0,0,0,170 0,1700,1700,0,0, 2500,2500,2500,0,0,0,2500,2500,2500,2500, 2500,2500,2500,2500, 2500,0,1700,0,1700,0,1700,0,1700,1100,110 0,1100,1100,1100,1100,0,2500,2500,2500,2 500,0,1700,1700,1700,1700,0,1700,550,550, 550,550,0,400,400, 400,400.

4.2 Output Values:

4.2.1 Flexural strength:

5.75,6.3,6.8,7.1,7.36,7.62,8.37,3.84,4.94,5.8 4,5.78,5.12,6.8,3.7,3.5,3.8,3.95,4.15,3.312,2. 86,3.86,3.06,3.696,4.006,3.296,3.7,3.968,3.5 48,4.018,4.43,3.52,4.08,4.12,4.78,4.72,5.52, 5.42,6.23,5.46,5.37,5.62,5.49,6.4,6.56,3.95,7 .82,8.16,8.95,8.93,7.15,8.45,9.75,8.75,7.35,4

.2,3.3,5.75,6.25,6.85,7.1,4.05,4.945,5.915,6.225,7.28

4.3 Equation:

The equation flexural strength for polypropylene fiber reinforced concrete:

com.strength at 0%fiber	Ar	Vf	tensile strength	flexural strength	Result	Difference	% Error
39.00	0.00	0.00	0.00	4.05	4.22	0.17	4.21
36.50	0.00	0.00	0.00	3.84	3.95	0.11	2.86
23.93	0.00	0.00	0.00	2.86	2.59	-0.27	-9.42
41.50	0.00	0.00	0.00	4.12	4.49	0.37	8.99
47.92	0.00	0.00	0.00	4.72	5.18	0.47	9.85
39.70	0.00	0.00	0.00	4.20	4.29	0.10	2.29
27	420	0.5	550	5.75	5.31	-0.44	-7.63
27.00	420.00	1.00	550.00	6.25	6.077	-0.17	-2.78
27.00	420.00	1.50	550.00	6.85	6.84	-0.01	-0.13
27.00	420.00	2.00	550.00	7.10	6.41	-0.69	-9.69

"Flxstr: 0.1446*Cs-0.002*Ar+1.68*Vf+0.001Tst"

4.4 Figures of Mat Lab output:

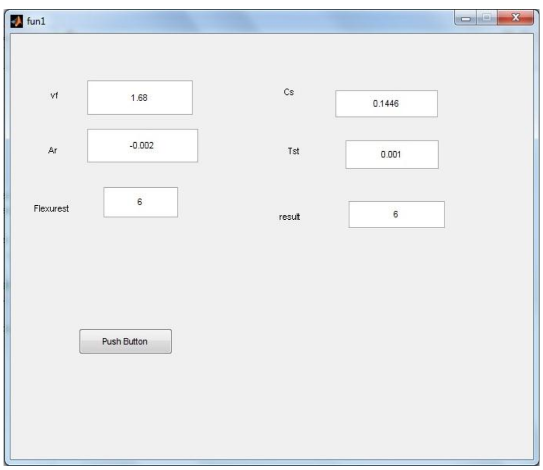

Figure4.1. Push button

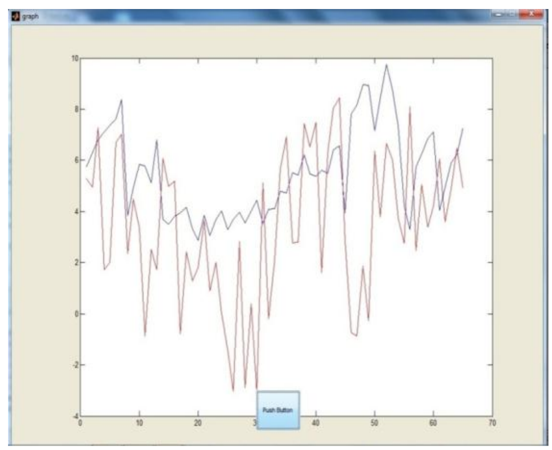

Figure4.2. Comparison between experimental and formulated values

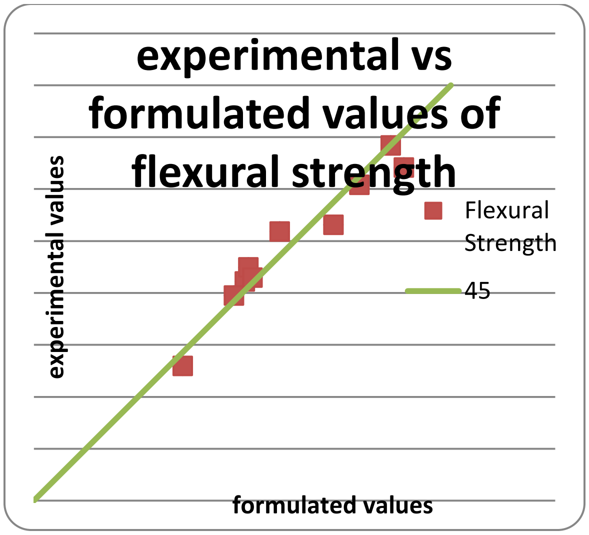

Fig.4.3 Comparsion between Experimental and Formulated values of flexural strength

4.5 Discussions:

From the above comparison graph the results obtained from the experimental and formulated are scattering nearer to 45˚ line.

5. CONCLUSIONS:

This project work is done to obtain empirical relationship between mix proportion, aspect ratio, volume of fiber, tensile strength and flexural strength, for polypropylene fiber reinforced concrete and the relation is

"Flxstr:0.1446*Cs-0.002*Ar+1.68*Vf+0.001Tst"

This equation checked with the experimental values and the percentage error is within the limit (-/+10%).

So, we are concluding that the equation of flexural strength is satisfying all aspect requirements.

By using this equation the value of flexural strength is directly find out without conducting experiments.

SCOPE FOR FURTHER STUDY:

There is more scope for expanding for more work and the error between the experimental and formulated values can reduced.

By considering more constraints the formulation can be more accurately and the error can be minimized.

There is scope to finding equitation for polypropylene in other aspects like compressive strength, split tensile strength and ductility.

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