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An Experimental Study on Mechanical Properties of Kevlar Fiber in Concrete

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***Abstract*— Concrete is a very hard composite building material made by mixing together cement, fine aggregate, coarse aggregate and water. It is the most popular construction material on earth. All concrete structures crack to some extent, due to shrinkage and tension. Kevlar fiber concrete (KFC) consists basically of a matrix composed of cement, sand, water, and admixtures, in which short length kevlar fibers are dispersed. Fiber Kevlar is made up with the technological advancements and development of newer materials, the strength characteristics of very fine fibers of kevlar when fibers are added to the concrete mix, it too can add the tensile loading capacity of the composite system of such newer materials must be investigated before it is practically put to use. The addition of the fibers to the concrete is not new, but, apart from studying strength characteristics using destructive testing, nondestructive testing and ultrasonic pulse velocity is also investigated.**

Keywords—Compressve strength, Kevlar fiber, Flexural strength.

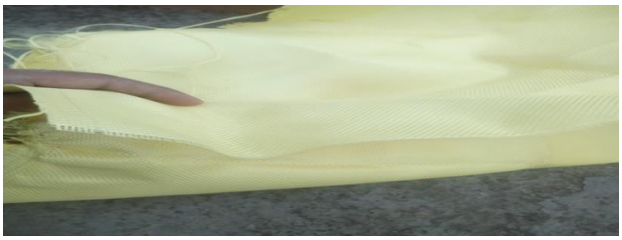
I. INTRODUCTION

Concrete is the most widely used artificial material. Concrete plays an important role in the world of civil engineering. Concrete is a hardened mass obtained from a mixture of cement, sand, gravel & water in definite proportions. These ingredients are mixed together to form a plastic mass which can be moulded in any shape. Fiber reinforced concrete (FRC) is a concrete made primarily of hydraulic cements, aggregates and discrete reinforcing fibers . FRC is a relatively new material. Kevlar fiber reinforced concrete is one of the most versatile building materials available to architects and engineers. Kevlar fiber reinforced concrete is composed principally of cement, sand and kevlar fibers, KFRC are a thin, high strength concrete with many applications in construction. Fiber in the cement based matrix acts as crack arrester, which restricts the growth of flaws in the matrix, preventing these from enlarging under load into cracks, which eventually cause failure.

II. FIBER USED

A. Kevlar fiber

Kevlar fibre is a strong light weight material and is used for the production of many products. It is strong , less brittle and its raw materials are much cheaper. Addition of these fine and closely spaced fiber to concrete provides a crack free surface & would improve its static and dynamic properties of concrete. Kevlar fiber reinforced concrete in its fresh state is stiff and hence less workable. Therefore admixtures are used for the reduction of water.



Kevlar fiber

III. METHODOLOGY

In this, an experimental program was planned to investigation strength properties of concrete with aramid fiber polymer (AFP) or Kevlar fiber reinforced. Concrete mix of the strength M25 was to be designed with varying percentages of Kevlar fiber reinforced (0%, 2%, 4%, 6%, 8%, 10% a12% and 14%).

A.Casting of Cubes

Steel moulds are used to make cubes.

PROCESS OF CUBES CASTING

The dimensions of all the specimens were identical and cross sectional dimension were 150mm X 150mm X 150mm. And we were casting the 21 cubes for 7 Days testing and 21 cubes are more casting for 28 days testing. But most of the important part in this casting of cubes in %age of the extra added material. First of the three cubes are normal casting and now next one is cubes are casting with added extra material in different %age. Like 2%, 4%, 6%, 8%, 10%, 12%, and 14% etc.

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IV. EXPERIMENTAL SETUP

Properties of concrete are tested in hardened state. In hardened state compressive strength of cubes, split tensile strength of cylinders and flexural tensile strength of cubes are tested.

A. Compressive strength of cube

Compressive strength and durability are the most important property of concrete. To check the performance of fibers on the compressive strength of concrete 150mm cubes are cast and tested. The cubes are casted at the age of 7 days, 28 days and variation are noted. IS: 516-1959, "Methods of testing for strength of concrete" strength are tested. Locally available aggregates are used and no admixtures are used. Workability of the mix are observed and no extra water are used. The size of mould are 150*150*150 mm are used. 24 numbers of cubes are casted for 7 days and 28 days.

B. Split tensile strength

Concrete is weak in tension but in rare cases it is subjected to tension. However the load at which cracking would occur is important and needs to be determined. The tensile strength of concrete is very low as compared to compressive strength. It is found to be only 10% to 15% of the compressive strength. A cylindrical concrete specimen is loaded along its length as results of the loading tensile stresses are developed along the central diameter along the lateral direction. When the limiting tensile strength is reached then specimen splits and this value can be calculated. The size of moulds is 200 mm length and 100 mm diameter is used. 24 numbers of cylinders are casted for 7 days and 28 days. The strength are tested according to IS: 516-1959.

C. Flexural strength

Flexural strength is also a measure of tensile strength of concrete. In practical, concrete may be subjected to flexural in many cases particularly in beams. Beam is a flexural member. The sizes of moulds are 500*100*100 mm is used and24 numbers of beams are casted for 7 days and 28 days and the strength are calculated according to IS: 516-1959.

Flexural strength

V. RESULTS AND DISCUSSION

Table- Compressive strength test result

% variation of Kevlar fiber	7 Days Testing	28 Days Testing
0%	19.20	29.15
2%	20.25	30.25
4%	21.35	31.50
6%	22.50	33.10
8%	24.10	34.90
10%	26.20	36.25
12%	27.33	37.95
14%	27.90	38.10
16%	27.94	38.14

TABLE – SPLIT TENSILE STRENGTH

% variation of Kevlar fiber	7 Days Testing	28 Days Testing
0%	1.86	2.83
2%	1.88	2.85
4%	1.92	2.87
6%	1.94	2.90
8%	1.96	2.94
10%	1.97	2.98
12%	1.98	3.08
14%	1.97	3.08

TABLE- FLEXURAL STRENGTH TESTING

% VARIATION OF KEVLAR FIBER	7 DAYS TESTING	28 DAYS TESTING
0%	0.90	3.10
2%	2.10	3.35
4%	2.45	3.60
6%	2.60	3.90
8%	2.84	4.30
10%	2.90	4.98
12%	2.94	5.10
14%	2.95	5.12

VI CONCLUSION

1. It is observed that the addition of Kevlar fibers in the mix, led to reduction in the bleeding of concrete.
2. With the increase in %age of kevlar fibers, the concrete mix gets harsher and less workable.
3. With increase in kevlar fiber content in concrete, the compressive strength, flexural strength and split tensile strength of concretes were found to increase.
4. There is much increase in compressive strength up to 12% ,14%,16% the rate of compressive strength is increases.
5. There is increase in split tensile strength up to 10% but After 10% there is no much increase in split tensile strength.
6. There is much increase in flexural strength up to 10% by after 10% rate of increase in flexural strength is done.

Future scope

1. To increase/changing the different percentage of kevlar fiber in a concrete mix are to be analyzed.
2. To increase the water cement ratio, concrete mix are good workable are also analyzed.
3. Other properties of kevlar fiber such as water absorption test may also analyze for the use of kevlar fiber.

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