EXPERIMENTAL INVESTIGATION ON TIN FIBER REINFORCED CONCRETE FOR PAVEMENT APPLICATION

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ABSTRACT

This experimental investigation carried on Tin Fiber Reinforced Concrete for pavement application. Even though Concrete is having several desirable properties, its relative low tensile strength and tendency to produce small cracks leads many researchers to work on to improve these properties. The use of recycled fibers from soft drinks tin bottle waste offers additional advantages of waste reduction and resources conservation. A considerable amount of research has been directed towards studying the various properties of plain concrete as well as reinforced concrete due to the addition of steel fibres. Today the highway and transportation construction industry is in need of finding cost effective materials for improving the performance of concrete pavement structures. Hence, an attempt has been made in the present investigation to study the influence of addition of oil tin fiber can waste material as fibres with various aspect ratio keeping the dosage of fibres from 0 – 2.5% by volume of concrete. The sizes of the fibre vary from 10mm to 30mm respectively. The properties studied include compressive strength, flexural strengths and fatigue test. The study is conducted on a M30 grade concrete mix for pavement application. The test results are compared for compressive and flexural concrete strengths, with and without use of fibres of different sizes and fatigue characteristics of fibre reinforced concrete are studied and pavement design and cost analysis are done. The test results shows that tin fiber reinforced concrete is an excellent new type of composite material compared with ordinary concrete as thickness of road is reduced without affecting the load carrying capacity and is a cost effective technology.

I. INTRODUCTION

Advantage of properly prepared concrete mix is its high durability. Concrete is good in with standing harsh environmental condition, heavy loads and high temperature. the performance of concrete is mainly depend on various factors such as design of pavement, proportioning of materials, construction method etc, environmental changes in temperature and dampness make the volume of the concrete change. At the point when the concrete is restrained , these stress causes cracks in the concrete which reduces the life and performance of concrete. Thus in order to control these cracks developed due to stress fibers are used. Inclusion of fibers changes the performance of concrete, Some fibers have high value of elastic modulus therefore they contribute in improving many of the properties like impact resistance, flexural strength, tensile strength, compressive strength, fatigue resistance, ductility, shear strength and resistance against wear and abrasion. Due to this improvement in the performance fiber reinforced concrete has found special applications in hydraulic structures, airfield pavements, bridge decks, heavy duty floor (Industrial floors) and tunnel lining. Placing of concrete, compaction and curing also plays vital role in the durability of concrete pavement. Bituminous roads require regular and periodic maintenance and repairs. Further, the design life is assumed to be around ten years, after which they need up gradation and strengthening to cater for higher traffic. The current practice in India is to go in for the same basic material of construction, which is bitumen. With the advent of fast track concrete pavement technologies that allow the opening of a concrete pavement within short duration of initial paving, High Performance concrete Pavements are being used in recent years. The issue of waste disposal exists around the world, particularly in the thickly populated urban region. A large portion of the no degradable waste materials are left as stockpiles utilized as landfill material or unlawfully dumped in chose territories. Extensive amounts of this waste can't be dispensed with. In any case, the ecological effect can be diminished by making more reasonable utilization of this waste. Investigates into new and creative employments of waste materials are constantly progressing Waste utilization in concrete should be increased to accomplish cost lessening, saving in energy, resource conservation, improved concrete quality, environmental Safety and reduction in greenhouse gas discharge and for enhanced toughness and improved execution Here, it is an endeavor to utilize strands from waste cool drink and oil tins.

Need of this study:

Due to growing needs of performance and durability of concrete there has been a continuous search for upgrading properties of concrete. Fiber reinforced concrete is one of the best and economical ways of upgrading properties of concrete. Fiber reinforced concrete has more tensile strength when compared to non-reinforced concrete. It increases the concrete's durability. Fibers are usually used in concrete to control cracking due to plastic shrinkage and to dry shrinkage. They also reduce the permeability of concrete and reduce bleeding of water. To increase the tensile strength of concrete. It improves the impact strength of concrete, limits the crack growth and leads to a greater strain capacity of the composite material. For rigid pavements one of the major issues is cracking. Cracking may occur due to having low tensile strength, plastic shrinkage and dry shrinkage. We can avoid this type of problems by using fibers concrete. Because, fibers have good properties which increases the tensile strength of concrete and elasticity. We can get more tensile strength in fiber reinforced when compared to reinforced concrete and by this we can reduce the thickness of pavement and the cost of the project is reduces. The aim of this study is to make high durable structures in a economical way by using fibers in concrete.

II. LITERATURE REVIEW

[1] ***"Dayanand Kumar R, et.al, (2017)*** These people investigated on the influence of addition of soft drink can waste material as fibres with various aspect ratio keeping the dosage of fibre constant as 1% by volume of concrete. The sizes of the fibre vary from 10mm to 40mm respectively. The properties studied include compressive strength, flexural strengths and fatigue test. The study is conducted on a M40 grade concrete mix for pavement application. We noted that addition of fibers in concrete mix affects the properties of fresh concrete such as slump value, hardened concrete such as compressive strength & flexural strength. From the results obtained there was a not much difference in compression strength and flexural strength by adding the fibers in the concrete. It is observed that compression and flexural strength of specimen of aspect ratio 150is more than other specimen, compression strength and flexural strength of specimen of aspect ratio 150is 7.67 % and 11 % more than conventional concrete specimen.

[2] ***Muhammad Akram Akhund, et.al, (2017)*** these people are mainly aimed to determine the effect of soft drink tins as used fiber reinforcement on compressive strength of concrete. There were 30 cubes in total were casted by utilizing this ratio 1: 1.69: 3.15 at 0.54 w/c ratios by using a proportion of 1%, 2% and 3% by weight of cement using 0.5, 1 and 1.5 respectively. We observed that Fiber Reinforced concrete mixes can give better compressive strength then that of control concrete mix at 28 days. With the increase in the percentage and sizes of fiber the compressive strength increases of fiber made concrete mixes over control concrete mix. For higher size (1.5) and a greater percentage of the fiber (3%) can give better compressive strength than that of lower size of strips and lower percentage of the fiber.

[3] ***Imran Ali Channa, et.al, (July 2021)*** There main objective is to investigate the influence of the addition of waste materials, lik aluminium waste material, soft drink tin fibers or soft tins to improve mechanical properties of concrete and also study the strength behaviour of concrete, such as flexural strength and indirect otr spilt tensile strength. Soft tin fibers of 25.4 × 5 × 0.5 mm in size were used and added from 1 to 5% by the weight of cement with the mix design mix of 1: 1.624: 2.760 at 0.50 w/c ratio. The addition of soft drink tin fibers has improved the tensile and flexural strength of concrete. With the inclusion of soft drink tin fibers in concrete, the concrete, the concrete remained workable and workability was not affected.

[4] ***Uroosa Iqbal, et.al, (2017)*** there study is to determine the effect of soft drinks tins as used fiber reinforced on compressive strength of concrete. Total 30 cubes were cast with 1 : 1.69 : 3.15 DoE mix design at 0.54 w/c ratios. The cubes were cast using a proportion of fibers 1%, 2%,and 3% by weight of cement using 0.5, 1, 1.5 long stirrups respectively. Fiber reinforced concrete can give better compressive strength than that of control concrete at 28 days. With the increase in the percentage and sizes of fiber the compressive strength increases of fiber made concrete over control concrete.

[5] ***U. J. Ekah, et.al, (2020)*** this people worked on analysis of the mechanical Properties of Tin fibers on concrete is based on experimental investigation carried out on various percentages of Tin fiber and Concrete mixture. These tin fibers where used at ratios of 1%, 2%, 3% and 4% by weight of Cement. Test results indicate an increase in the flexural and indirect tensile strengths. On the other hand, there was a significant reduction in the compressive strength of all the samples. This reduction in compressive strength increased directly as the ratio of tin fiber additive increased.

[6] ***Indradi Wijatmiko, et.al, (2019)*** The main aim this project is to increase the strength characteristic of both compressive and flexural lightweight concrete by introducing wasted soft-drink cans as fiber reinforced. In this study cleared the effect of various fractions (10%, 15% and 20% by volume of concrete), followed by two types of fiber shape (hooked and clipped) to the lightweight concrete compressive and split tensile strength. The result showed that the introduction of 10% of fiber performed in higher tensile strength with an increase of 23%, while the hooked shape of fiber increased the compressive strength by more than 40%.

[7] ***Mohit Sihag, et.al,*** study the influence of addition of waste materials like lathe waste, soft drink bottle caps, empty waste tin, waste steel powder as a mixing material with the concrete in the percentage of maximum 1 to 1.2 % of total weight of concrete. All the scrap material mentioned above was collected and processed in to strips of approximately size of 15 to 25 mm. The geometry of waste steel fibres helps in better bonding of concrete, it also helps the fibres to act more efficiently as abridge in reducing the fracture of concrete. It also helps using attaining fibre free surface.

[8] ***Hikmatullah Aziz, et.al, (2020)*** The influence of soft drink aluminum cans fibers has been studied in different proportions and fiber length to improve the performance characteristics of the concrete. It has similar mechanical properties like steel fiber. Concrete has good characteristics in compressive strength but it is too weak in tensile strength. In these different proportions of 0.5%, 1%, 1.5%, and 2% of soft drink aluminium cans fiber by weight of cement. The experiment of compressive strength, tensile strength, and flexural strength are tested for 7 and 28 days.

Analysis of literature review:

After studying different literature reviews we observed there are some people who are used same mix proportion, percentage and same aspect ratios, but their results are different. The reasons may for this is improper mix and curing of specimens and tests on specimens may be not conducted in correct procedure. The most of the researches are done on M40 grade concrete. The 90% of the people are taking a constant either in percentage of fiber or aspect ratios of a fiber. In almost all researches 1% of fiber is used as there percentage of fiber in fiber reinforced concrete. Only few researches are used more than 1% of fibers. In all researches papers tests are conducted for 28 days only. The workability of concrete and compressive strength is varies differently with respect to change in aspect ratios of a fibers. The maximum increase in tensile strength is 15% more than conventional concrete specimen. From analyzing the literature review, we are doing a project on fiber reinforced concrete with M30 grade concrete and using 2% percentage of fiber in volume of cement. The aspect ratios are 50,100 and 150. We are like to conduct the tests for 7 days and 28 days.

III. METHODOLOGY

In this project we have used the usual materials like Cement, Fine Aggregate. Coarse Aggregate, Water. We found the necessary properties of these materials those will be required for our project.

- **Specific Gravity of Cement:**

Apparatus: Le-Chatelier flask, Kerosene oil, weighing balance, water bath.

Procedure:

1. Clean the Lechatlier flask before use. It should be free from moisture.
2. Now, take the weight of the empty flask as w1.
3. Take around 50 gm of and fill in the flask.
4. Fix the stopper on flask and weigh flask with cement as w2.
5. Now fill the kerosene in the flask up to the neck of the bottle.
6. Thoroughly mix with cement and kerosene in the flask taking care that no air bubble is left in it. Record this weight as w3.
7. Empty the flask and clean it. Now fill it with kerosene up to the neck of the bottle and record the weight as w4.

SAMPLE NO	TRAIL	INITIAEL READING V1	FINAL READING V2	VOLUME OF CEMENT V=V1+V2	SPECIFIC GRAVITY =W/V
1	1	0.5	19.5	19	3.13
1	2	0.5	19.5	19	3.11
1	3	0.8	19	18.2	3.18

Specific Gravity of Cement table

➢ **Normal Consistency of Cement:**

***Apparatus**:* Vicat's apparatus, balance, gauging trowels, measuring jars non-absorbent plates etc.

Procedure:

1. Take about 350 gm of cement and prepare a paste with a weighed quantity of water (24% by weight of cement) for the first trail.
2. The paste must be prepared in a standard manner and filled into the Vicat's mouldwithin 3 to 5 minutes.
3. After completely filling the mould shake the mould to expel the oil.
4. A standard plunger 10mm diameter and 50mm long is attached and brought down to touch the surface of the paste in the test block and quickly released allowing it to sink into the paste by its own weight.
5. Take the readings by noting the depth of penetration of the plunger.
6. Similarly conduct trails with higher and higher w/c ratio till such time the plunger penetrates for depth of 33 to 35mm from top or 5 to 7mm from the bottom.

S. No.	Quantity of Cement	Quantity of Water in %	Depth of Penetration ofthe plunger
1	320 gm	28	25
2		30	28
3		31	30
4		33	32
5		34	34

Normal Consistency of Cement table

- The Standard Consistency of the given sample Cement = 34%

- Specific gravity of cement 3.14

➢ **Initial setting of cement:**

Reference IS 4031(part-5):1996

Apparatus: Vicat's apparatus, balance, gauging trowels, measuring jars non-absorbent plates etc.

Theory:

When water is added to the cement the paste starts stiffening and gaining strength by losing its plasticity simultaneously. These two stiffening states are identified as initial and final setting times respectively. Initial setting time is defined as the time taken by a cement paste to stiffen to an extent such that the vicat's needle is not permitted to move down through the cement paste in the mould within 5+0.5mm or 5-0.5mm from the bottom of the mould. Final setting time is the time when the cement paste becomes so hard that the annular attachment to the needle under standard weight fails to leave mark on the hardened cement paste but the needle can make an impression. The following limits of properties are followed. Initial setting time not less than 30min Final setting time not more than 600 min (10 hr)

Figure 1 Vicat's apparatus

Procedure for Preparation Test Block:

1. Prepare a neat cement paste of 300 grams of Cement with 0.85 times the potable or distilled water required to give a paste of standard consistency, taking care that the time of gauging(mixing) is not less than 3 minutes, nor more than 5 min, and the gauging shall be completed before any sign of setting occurs.
2. Start a stop watch at the instant when the water is added to the cement, thoroughly mix the cement and water using gauging trowels till required consistency is attained in mixing.

3. Fill the vicat's mould which is resting on the non-porous plate with cement paste prepared till the mould completes and smoothen the surface by knife edge and level the surface to the top of the mould. The cement block thus prepared is the test block.

Observations:

- Standard consistency of the cement, p =34%
- Weight of the sample 100 gms
- Weight of water to be added = $0.85P\ 100 * W$ =28.9ml

S.No	Time (min)	Needle fails to pierce the text block (from bottom) in mm
1	5	0
2	10	1
3	15	1
4	20	2
5	25	3
6	30	3
7	35	5

Initial setting of cement is 35 minutes

➢ **Fineness of Cement:**

As per IS: 12269 – 1976 and IS 4031: 1988 Part 2

Procedure:

1. Take 100 gms of cement in the standard sieve. Break down the oil set lumps with fingers.
2. Continuously sieve the sample giving circular and vertical motion for a period of 15 minutes.
3. Weigh the residue left on the sieve. Percentage of residue left on the sieve is calculated. Bubbles, if any. Place the lid and fill the remaining gap with water and level with top of hole. Now weigh the jar, w3.
4. Empty the Pycnometer, properly clean it and then fill with water up to top of whole Again weigh the jar, w4.

Particulars	Sample
Mass of cement	100
Mass of residue sieving (gm)	3
Fineness = $\frac{\text{mass of residue}}{\text{initial weight of cement}} * 100$	3%

Fineness of Cement table

Figure pycnometer

	Sample		
	1	2	3
Weight of Pycnometer(W1) kg	0.54	0.54	0.54
Weight of Pycnometer with aggregate(W2) kg	1.17	1.22	1.19
Weight of Pycnometer with fine Aggregate +Water (W3) kg	1.98	2.01	1.99
Weight of Pycnometer with water (W4) kg	1.58	1.58	1.58
Specific Gravity(G) = (W2-W1)/(W2-W1)-(W3-W4)	2.74	2.72	2.78
Average Specific Gravity	2.75		

Specific gravity of fine aggregate table

➢ **Specific gravity of coarse aggregate**:

Apparatus: Wire basket and spring balance.

Procedure:

1. Take minimum 2 kg of the aggregate sample is washed thoroughly to remove the fine, drained and then placed in the wire basket and immersed in distilled water data temperature between 230 and 320ºC and with a cover of at least 5 cm of water above the top of the basket.
2. Immediately after immersion the entrapped air is removed from the sample from lifting the basket containing 25 mm above the base of the tank and allowing it to drop 25 times at the rate of above one drop per sec. The basket and the aggregate should remain completely immersed in water for a period of 24±1/2 hr afterwards.
3. The basket and the sample are weighed while suspended in water at a temperature of 220 to 320ºC in case it is necessary to transfer the basket and the sample to a different tank for weighing, they should be jolted 25 times as described above

in the new tank to remove air before weighing. This weight is noted while suspended in water = w1 gm.

4. The basket and the aggregate are then removed from water and allowed to drain for a few minutes, after which the aggregates are transfer to one of the dry absorbent cloths.
5. The empty basket is then returned to the tank of water, jolted 25times and weighed in water = w2 gm.
6. The aggregates placed on the absorbent clothes are surface dried till these clothes could remove no further moisture. Then the aggregates are transferred to the second dry cloth spread in a single layer, covered and allowed to dry for at least 10 min until the aggregates are completely surface dry 10 to 60 minutes drying may be needed.
7. A gentle current of unheated air may be used during the first 10 min to accelerate the drying of aggregate surface. The surface dried aggregate is then weighed = w3 gm.

	Samples		
	1	2	3
Weight of Saturated Aggregate suspended inwater with the basket(W1) kg	2.7	2.7	2.7
Weight of basket Suspended in water(W2) kg	1.31	1.31	1.31
Weight of saturated Aggregate in Water (Ws) =W1-W2	1.39	1.39	1.39
Weight of Water equal to the volume of theaggregate (W3-Ws)	2.18	2.185	2.18
Specific Gravity(G) $\frac{W3}{W3 - WS}$	0.79	0.795	0.795
Average Specific Gravity(G)	2.75	2.74	2.75
Average Specific Gravity	2.63		

Specific gravity of coarse aggregate is 2.63

➢ **Mix Design**

Mix design can be defined as the process of selecting suitable concrete ingredients and determining their relative proportions in order to produce concrete with a certain minimum strength and durability in the most economical way possible. Concrete mix design requires a thorough understanding of the various properties of these components. Materials, these make the mixed design task more complex and difficult.

IV. MATERIALS USED

***Cement*:**

Cement is the important required material for the construction of concrete. Cement is a well-known construction material and has engaged a vital place in construction work. There is a change of cement obtainable in market and each type is used under convinced illness due to its singular properties such as color and arrangement of cement. Although cement creates only about ten percentage of the volume of the various concrete mix, it is the active portion of the compulsory medium and the only systematically controlled component of concrete.

***Fine aggregate*:**

Fine aggregate is the essential ingredient in concrete that consists of natural sand or crushed stone. The quality and fine aggregate density strongly influence the hardened properties of the concrete. The concrete or mortar mixture can be made more durable, stronger and cheaper if you made the selection of fine aggregate on basis of grading zone, particle shape and surface texture, abrasion and skid resistance and absorption and surface moisture.

A good concrete mix must include aggregates that are clean, hard, strong and free of absorbed chemicals or coatings of clay and other fine materials. Ignorance of these characteristics can cause the deterioration of concrete, thus regulatory authorities have decided grading zone of fine aggregate, where each zone defines the percentage of fine aggregate passed from the 600 microns sieve size:

1. Zone I: 15% to 34%
2. Zone II: 34% to 59%
3. Zone III: 60% to 79%
4. Zone IV: 80% to 100%

You can assess the quality of fine aggregate with help of the grading zones. However, for precise assessment, you can seek help from experts who are well versed in performing tests for bulk density, bulk age, and specific gravity to find the best in class material.

Coarse Aggregates:

Coarse aggregates are irregular broken stones or naturally occurring round gravels that are used to make concrete, coarse aggregates for structural concrete consist of broken stones of hard rock like granite and limestone (angular aggregates) or river gravels (round aggregates). Aggregates larger than 4.75 mm in size are termed as coarse aggregates. These aggregates are obtained from stone quarries and stone crushers, the size between 4.75 mm to 80 mm.

Coarse aggregate	Size
Fine gravel	4mm – 8mm
Medium gravel	8mm – 16mm
Coarse gravel	16mm – 64mm
Cobbles	64mm – 256mm

Sizes of Coarse aggregate table

Tin fiber (extracted from oil cans):

Generally fibers are used in the concrete mix to enhance the required property of the concrete. Fibers should be equally distributed in concrete during mixing. There are many types of fibers can be used such as steel, polypropylene, polyester etc. The guidelines for fiber reinforced concrete are given IRC SP: 46. Generally fibers are chosen depending upon the aspect ratio.

Figure tin fiber

Aspect ratio is defined as length to diameter of the fiber. Length, diameter, shape/type, can be used to specify fiber. Here, it is an attempt to use fibers from waste soft drink tins. Waste soft drink container made with aluminum metal is converted into fibers obtained by shear cutting method. The fiber dosages of 2% with different aspect ratio of fiber in concrete are studied. The aluminum tin fiber aspect ratio in this experiment is 50,100 and 150. The length of fiber of aspect ratio 50 is 10mm, the length of fiber of aspect ratio 100 is 20 mm and the length of fiber of aspect ratio 150 is 30mm. The various test specimens are casted for each aspect ratio and compared with strength of conventional concrete. The test on fresh concrete such as slump cone test to check the workability and test on harden concrete such as cube compressive strength test, beam flexural strength test and flexural fatigue test are performed.

V. CALCULATIONS

General stipulations for mix proportioning

1. Grade M30
2. Type of exposure- sever
3. Target slump- 100mm
4. Maximum size of coarse aggregate- 20mm
5. Fine aggregate- zone-2
6. Specific gravity of cement- 3.14
7. Specific gravity of water- 1
8. Specific gravity of coarse aggregate- 2.62
9. Specific gravity of fine aggregate- 2.75

Step 1.Target Strength:

F1ck = fck + 1.65(S)

S-standard deviation table-2 IS-10262

=30+1.65*5.0=38.5 N/mm2

F1ck = fck + x from table-1 IS-10262 =30+6.5=36.5 N/mm2

Which is ever high Target strength= 38.5N/mm2

Step 2. Selection of water cement ratio

From fig-1 IS-10262 for 43 grade cement the w/c ratio for f lck + 26.6 N/mm2 is 0.45 as per durability.

The maximum w/c ratio for sever exposure is condition is 0.45[As per IS 456- 2000] w/c ratio 0.5> 0.45

Step 3. Air Content

For 20mm aggregate percent of air cement- 1%

Hence ok

Step 4. Selection of Water Content

From table-4 IS 10262-2019 water content required for 1 cubic meter of concrete for 20 mm aggregate

For 50mm slump = 186kg

For 25mm slump = -3% =186-186*(3/100) =186 - 5.58 = 180.42kg

Step 5. Calculation of Cement Content

For W/C ratio = 0.45

Cement content = 181/0.45 = 402.22kg/m3 [Table-5 of IS-456-2019]

Minimum cement content for “sever” condition =320kg/m3 Hence ok.

Step 6. Proportion of volume of coarse aggregate & finer aggregate content

For W/C ratio = 0.5 Therefore, volume of coarse aggregate is required to increase to decrease the volume of fine aggregate content. As the water content ratio is lower than 0.05 the proportion of volume of coarse aggregate is increased by 0.01 at the rate of ±0.01 for every ±0.05 Therefore, proportion of volume of coarse aggregate for W/C ratio of 0.45= 0.63volume off in e aggregate = (1-0.63) =0.37

Step 7. Mix Calculations

The mix calculation per unit volume of concrete shall be as follows:

a = total volume of concrete = 1m3

b = volume of entrapped air in wet concrete = 0.01m3
c =volume of cement = (mass of cement/sp.gv of cement)*(1/1000) = (402.22/3.14) * (1/1000) =0.128 m3

d = volume of water = (mass of water/sp.gv of water)*(1/1000) = (181/1) * (1/1000) =0.181 m3

e = volume of all in aggregate = (1-(b+c+d)) = (1-(0.01+0.128+0.181)) = 0.681

Volume of coarse aggregate

= (0.681*1000*2.63*0.63) =1128.35 kg

Volume of fine aggregate = (0.681*1000*2.75*0.37) =692.91 kg

Mix proportion achieved

Cement = 403 kg

Fine aggregate = 692.9kg

Coarse aggregate = 1128.3kg

Water = 181 L

C: FA: CA: W/C 1: 1.71: 2.79: 0.45

Required quantity of tin fiber

0.50 % = 12.02 kg

1.00 % = 24.05 kg

1.50 % = 36.07 kg

2.00 % = 48.1 kg

2.50 % = 60.11

Volume of materials required for 3 cubes

Cement =403*1.2*3*0.15ˆ3 =5.82 kg

Water = 181*1.2*3*0.15^3 =2.19 L

Fine aggregate = 692.9*1.2*3*0.15^3 =8.41 kg

Coarse aggregate = 1128.3*1.2*3*0.15^3 =13.7 kg

- Addition of 0.5% tin fiber in concrete content= 30.6*(0.5/100) =0.15 kg
- Addition of 1.0% tin fiber in concrete content= 30.6*(1.0/100) =0.30 kg
- Addition of 1.5% tin fiber in concrete content= 30.6*(1.5/100) =0.45 kg
- Addition of 2.0% tin fiber in concrete content= 30.6*(2.0/100) =0.60 kg Addition of 2.5% tin fiber in concrete content= 30.6*(2.5/100) =0.75 kg

Volume of Materials Required For 3 Cylinders

Cement = 403*3*1.2*π*0.3*(0.15/2) ^2 = 7.69 kg

Water = 181*3*1.2*π*0.3*(0.15/2) ^2 = 3.45 L

Fine aggregate = 692.9*3*1.2*π*0.3*(0.15/2) ^2 = 13.22 kg

Coarse aggregate = 1128.3*3*1.2*π*0.3*(0.15/2) ^2 =21.52 kg

- Addition of 0.5% tin fiber in concrete content= 45.88 *(0.5/100) =0.23kg
- Addition of 1.0% tin fiber in concrete content=45.88 *(1.0/100) =0.46 kg
- Addition of 1.5% tin fiber in concrete content=45.88 *(1.5/100) =0.69 kg
- Addition of 2.0% tin fiber in concrete content=45.88 *(2.0/100) =0.92 kg
- Addition of 2.5% tin fiber in concrete content=45.88 *(2.5/100) =1.15kg

VI. EXPERIMENTAL INVESTIGATION OF CONCRETE

In this chapter, we are going to discuss about fresh properties (slump cone) & hardened properties (compressive, split tensile strength) of concrete with addition of tin fiber from 0% to 2.5% in concrete quantity with different sizes of tin fiber.

Casting of specimen, mixing and curing:

Figure casting of specimen

For cube test two types of specimens either cubes of 15cm X 15cm X 15cm or 10cm X 10cm x 10cm depending upon the size of aggregate are used. For most of the works cubical moulds of size 15cm x 15cm x 15cm are commonly used. This concrete is poured in the mould and appropriately tempered so as not to have any voids. After 24 hours, moulds are removed, and test specimens are put in water for curing. The top surface of this specimen should be made even and smooth. This is done by placing cement paste and spreading smoothly on the whole area of the specimen.

Curing Of Specimen:

The test specimens are stored in moist air for 24 hours and after this period the specimens are marked and removed from the moulds and kept submerged in clear freshwater until taken out prior to the test. The water for curing should be tested every 7 days and the temperature of the water must be at 27+-2oC.

Figure Curing Of Specimen

VII.TESTS ON CONCRETE

➢ **Slump cone test:**

Slump is the measure of workability of cement concrete. It gives the idea of water content needed for concrete to be used for different works. Slump is measured as subsidence of concrete.

Apparatus:

- Slump cone
- Tamping rod
- Steel rule
- Trowels

Procedure:

- The internal surface of the mould is thoroughly cleaned and applied with a light coat of oil.
- The mould is placed on a smooth, horizontal, right and non absorbent surface.
- The mould is then filled in four layers with freshly mixed concrete, each approximately to one –fourth of the height of the mould.
- Each layer is tamped 25 times by the rounded end of the tamping rod and strokes are distributed evenly over the cross –section.
- After the top layer is rodded, the concrete is struck off the level with a trowel.
- The mould is removed from the concrete immediately by raising it slowly in the vertical direction. vii. The difference in level between the height of the mould and that of the highest point of the subsided concrete is measured.
- This difference in height in mm is measured as slump of concrete.

➢ **Compressive strength of concrete:**

Compressive strength is the ability of material or structure to carry the loads on its surface without any crack or deflection. A material under compression tends to reduce the size, while in tension, size elongates. Compressive strength formula for any material is the load applied at the point of failure to the cross-section area of the face on which load was applied.

Compressive Strength = Load / Cross-sectional Area

Procedure:

1. Remove the specimen from the water after specified curing time and wipe out excess water from the surface.
2. Take the dimension of the specimen to the nearest 0.2m
3. Clean the bearing surface of the testing machine Place the specimen in the machine in such a manner that the load shall be applied to the opposite sides of the cube cast.
4. Align the specimen centrally on the base plate of the machine.
5. Rotate the movable portion gently by hand so that it touches the top surface of the specimen.
6. Apply the load gradually without shock and continuously at the rate of 140 kg/cm2/minute till the specimen fails 8.Record the maximum load and note any unusual features in the type of failure

Figure Compressive Strength

➢ **Split Tensile Strength of Concrete:**

Split tensile strength of concrete is done to determine the tensile strength of molded concrete. This is required to design any structure to bear the required amount of tensile force.

Apparatus Required

- Compression testing machine
- Standard cylindrical mould (150 mm diameter and 300 mm height)
- Tamping Rod (16 mm diameter and 600 mm length) •Jig
- Weighing machine

- Other accessories

Procedure:

- Before starting the test, take the specimen from the immersed water and wipe the water.
- Then note the dimension and weight of the specimen.
- Place plywood strip above and below the specimen.
- After that place the specimen on the testing machine
- Then gradually apply the load at a rate of 0.70 to 1.4 MPA/ min (1.2 to 2.4 MPA/ min based on IS 5816 1999)
- Record the load at which the specimen breaks

Figure Compression testing machine

Calculation:

Splitting tensile strength test splitting tensile strength of concrete,

$$T = 2P / \Pi LD$$

The unit of tensile strength is N/mm. The splitting test is easy to perform and we can get uniform results. It is a simple, reliable and convenient method to determine the strength of concrete.

VII. RESULTS AND DISCUSSIONS

➢ Slump cone test results

For normal mix the slump value is 32mm and workability of concrete is low.

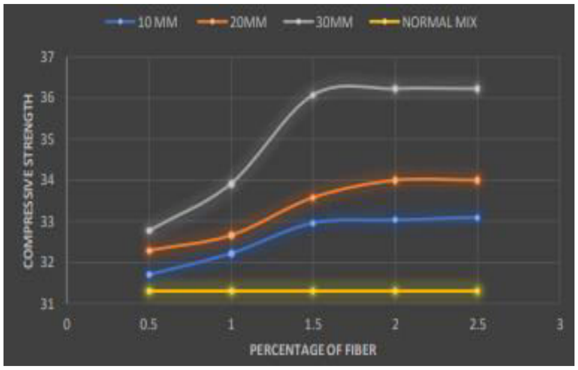
percentages	10 mm * 10 mm	workability	20mm* 10mm	workability	30mm*10 mm	workability
0.50	32	Low	32	low	29	low
1.00	30	Low	32	low	30	low
1.50	30	Low	29	low	25	Very low
2.00	30	Low	30	low	28	low

➢ Compressive strength results

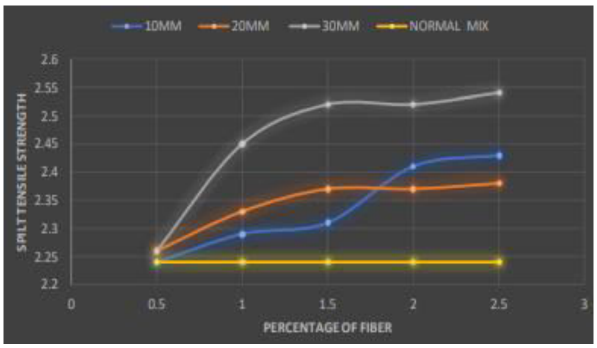
Percentage of fiber content	Specimen identification	load	area	Compressive strength	Avg. strength
0	A1	695	22500	30.8	31.3
	A2	700	22500	31.1	
	A3	720	22500	32	
0.50	B1	725	22500	32.89	32.77
	B2	740	22500	32.32	
	B3	745	22500	33.11	
1.00	C1	760	22500	33.78	33.92
	C2	785	22500	34.88	
	C3	770	22500	33.11	
1.50	D1	800	22500	35.56	36.08
	D2	825	22500	36.00	
	D3	810	22500	36.67	
2.00	E1	810	22500	36.67	36.23
	E2	810	22500	36.00	
	E3	825	22500	36.23	
2.50	F1	815	22500	36.23	36.23
	F2	815	22500	36.23	
	F3	815	22500	36.23	

➢ Spilt Tensile Strength Of Concrete:

Percentage Of Fiber Content	Specimen Identification	Length	Diameter	Load	Stress	Avg Stress
0	A1	300	150	160	2.26	2.24
	A2	300	150	160	2.26	
	A3	300	150	155	2.19	
0.50	B1	300	150	160	2.26	2.24
	B2	300	150	160	2.26	
	B3	300	150	155	2.19	
1.00	C1	300	150	165	2.33	2.29
	C2	300	150	160	2.26	
	C3	300	150	162	2.29	
1.50	D1	300	150	160	2.26	2.26
	D2	300	150	160	2.26	
	D3	300	150	160	2.26	
2.00	E1	300	150	165	2.48	2.41
	E2	300	150	175	2.33	
	E3	300	150	170	2.41	
2.50	F1	300	150	170	2.41	2.43
	F2	300	150	170	2.41	
	F3	300	150	175	2.45	



Graph Compressive Strength Test Results



Graph Spilt Tensile Test Results

VIII. CONCLUSION

- There is no much change in workability of concrete after the addition fibre also.
- The compressive strength of concrete is increased by 15 %(at a fibre content of around 2%)
- The spilt tensile strength of concrete is increased by 17 %(at a fibre content of around 2%)
- From the three aspect ratios (50,100 &150), we are getting higher values from the aspect ratio 150.
- In any aspect ratio the 1.5% addition of fibre gives higher values when compared to others.
- The 2.0% also gives higher values, but there is no much variation between the values of 1.5% and 2.0%.
- After 1.5% addition of fibre there will be no more variation in values by increasing the percentage of fibre.
- The compressive strength of concrete reaches its peak maximum at 1.5 to 2.5% of fibre by weight. Beyond 1.5%, variation is minimal.
- The compressive strength of concrete is increased by 15 %(at a fibre content of around 2%).
- 30mm x 10mm sized fibre is yielding more higher compressive strength compared to 10mm x 10mm and 20mm x 10mm

Finally what we determined from the results is 150 aspect ratio and 1.5% addition of fibre will give you higher values. Addition of 1.5% fibre is a better use case in terms of economy and efficiency.

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