International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 17
July 2018

Use of Waste Fibre as Complement Incorporate In Concrete

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Abstract

A Fiber Reinforced Concrete (FRC) is a composite material comprising of bond based grid with an arranged or arbitrary circulation of fiber which can be steel, nylon, polythene and so on. Advancement in innovation improves human solaces as well as obliterate the eco-framework. Fiber Reinforced Concrete is for the most part made with high bond content and low water content. Plain concrete flops all of a sudden once the redirection comparing to extreme flexural strength is surpassed, then again, fiber fortified solid keep on sustaining significant loads ever at avoidance extensively in overabundance of the crack diversion of plain concrete. Utilization of metals as holders has turned out to be prevalent and safe presently, particularly to convey the fluids, regardless of the inborn focal points and inconveniences existent in its disposal. Today the development business need discovering practical materials for expanding the strength of solid structures. Subsequently an endeavor has been made in the present examinations to consider the impact of expansion of waste materials like waste steel powder and soda pop jug tops, void waste tin from the workshop at a measurements of 1% of the aggregate weight of concrete as fibers. The present paper audits the writing identified with the usage of waste material and its different impacts on compressive strength, split tensile strength, flexural strength and workability of cement. The steel powder, void tins, soda bottle tops were distorted into the rectangular pieces of 3mm width and 10mm length.

Keywords:- *Fiber, fiber reinforcement, metal wastes, waste disposal, workability, compressive strength, flexural strength, split tensile strength .*

Introduction

The advancement and research of materials and techniques in structural building is to discover result in which three most critical angle are viewed as; accessibility, ecological similarity/safeguarding and money related limitations. Accordingly the determination of development material should just be made after a total survey of its long haul execution, toughness in the structure, and ecological similarity/conservation. The use of common fibers in development material has occurred since time immemorial, for instance, the utilization of straw in sun-dried mud blocks or the strengthening of mortar with horse-hair. In correspondence to that, numerous investigations on regular fibers has occurred for in excess of twenty years.The advantage from utilizing naturalfibers can decrease building cost and furthermore help to safeguard the earth by improving the utilization of plant and agrarian waste. Soroushian et al. (1992, 1995) proposed the utilization of magazine wastepaper as strengthening fibers in thin-sheet concrete items. The reused fibers utilized were gotten from reusing of wastepaper (magazine) by dry mechanical preparing. They found that ideal composites can be gotten utilizing 8% add up to fiber mass division, half substitution level of virgin with reused fibers, and refinement (beating) of fibers. Aziz et al. (1984) announced that coconut coir, sisal, sugarcane bagasse, bamboo, jute and wood bond composites had just been researched in excess of 40 nations all around the world as supplement in concrete. Among the diverse fibers utilized for controlling plastic shrinkage splitting, the most encouraging are manufactured fibers, for example, polypropylene fibers. Wang et al. (2001), Najm and Balaguru (2002), Banthia et al. (1996), Ma et al. (2005), Banthia and Yan 2000) contemplated distinctive kinds of fibers (PVA, steel, fibrillated polypropylene, polypropylene microfibre, and cellulose, polymeric fibers and Polyolefin fibers. They found that, the aggregate plastic shrinkage split territory was decreased.

Fiber Reinforced Concrete

Fiber fortified cement is a solid blend that contains short discrete fibers that are consistently dispersed and haphazardly arranged. Fiber material can be steel, cellulose, carbon, polypropylene, glass, nylon, and polyester. The measure of fibers added to a solid blend is estimated as a level of the aggregate volume of the composite (cement and fibers) named Vf. Vf normally runs from 0.1 to 3%. Perspective proportion (l/d) is ascertained by separating fiber length (l) by its width (d). Fibers with a non-roundabout cross area utilize an identical measurement for the estimation of angle proportion.

Types of Fibers in Concrete

The idea of utilizing fibers in fragile material to enhance protection from breaking and fracture is old and instinctive. For instance, straws were utilized to fortify sun supported blocks; horse hair was utilized to strengthen mortar and all the more as of late. At the point when Portland bond concrete began advancing as a building material, endeavors were made to add fibers to enhance its conduct and to beat the issue of intrinsically fragile sort of disappointment that happens in concrete under tensile pressure frameworks and effect stacking. Two periods appear to portray the advancement of fiber reinforcement in concrete. The main time frame, before the 1970s, compares to a moderate advancement, with no applications. While the second time frame, since the mid 1970, relates to a period of more quick imaginative advancements with expanding applications.

Amid this fast improvement distinctive sorts of fibers and fiber materials are presented and are in effect constantly acquainted with the market for new applications. These fibers can be made of metals, regular, glass or natural materials. Fiber strengthened cement is concrete made of water powered bonds containing fine total, or fine and coarse total and intermittent discrete fibers. These fibers are in different shapes and sizes. An advantageous numerical parameter portraying a fiber is its perspective proportion characterized as the fiber length isolated by an equal fiber distance across. Common angle proportions go from around 30 to 150 for length measurements of 6.4 mm to 76 mm (0.25 in. to 3.0 in.). Each kind of fiber has its own physical properties. Run of the mill scopes of a portion of the physical properties of the fibers are appeared in Table .

As a dependable guideline, little fibers have a tendency to be utilized where control of split spread is the most critical outline thought. High fiber tally (number of fibers per kg) licenses better appropriation of steel fiber reinforcement all through the network – and subsequently, more prominent break control amid drying process. Then again, in light of the fact that they display better network dock at high misshapenings and huge break widths, longer, vigorously disfigured fibers bear the cost of better post-split "strength". Be that as it may, not at all like shorter fibers, the significantly decreased fiber check of longer item yields

International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 17
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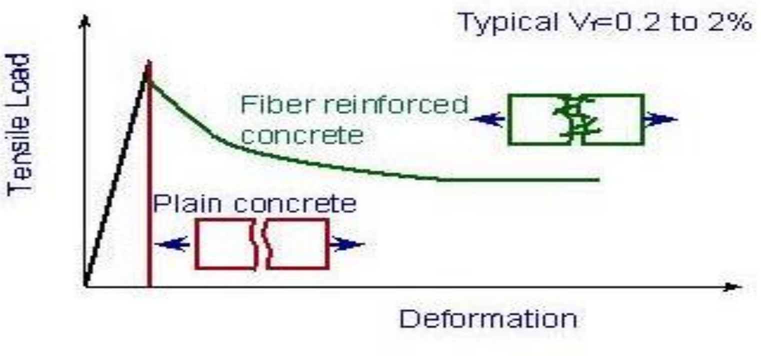
correspondingly less control of introductory break engendering.



Tensile Loads versus Deformation for Plain and Fiber Reinforced Concrete.

Selected Fiber Types and Properties

Fiber type	Diameter 0.001 in.	Specific Gravity	Young's modulus, ksi	Tensile strength, ksi	Strain at failure, %
Steel					
High tensile	4.0-40.0	7.80	29,000	50-250	3.5
Stainless	0.4-13.0	7.80	23,200	300	3.0
Glass					
E-glass	0.4	2.50	10,440	500	4.8
Alkali resistant	0.5	2.70	11,600	360	3.6
Polymeric					
Polypropylene					
Monofilament	4.0-8.0	0.90	725	65	18
Fibrillated	20.0-160.0	0.90	500	80-110	8
Polyethylene	1.0-40.0	0.96	725-25,000	29-435	3-80
Polyester	0.4-3.0	1.38	1450-2500	80-170	10-50
Acrylic	0.2-0.7	1.18	2,600	30-145	28-50
Aramid					
Kevlar 29	0.47	1.44	9,000	525	3.6
Kevlar 49	0.40	1.44	17,000	525	2.5
Asbestos					
Crocidolite	0.004-0.8	3.40	28,400	29-260	2-3
Chrysotile	0.0008-1.2	2.60	23,800	500	2-3
Carbon					
I (high modulus)	0.30	1.90	55,100	260	0.5-0.7
II (high strength)	0.35	1.90	33,400	380	1.0-1.5
Natural					
Wood	0.8-4.7	1.50	1450-5800	44-131	-
cellulose	<8.0	-	1890-3770	41-82	3-5
Sisal	4.0-16.0	1.12-1.15	2760-3770	17-29	10-25
Coir(coconut)	2.0-16.0	1.50	4790-5800	51-73	-
Bamboo	4.0-8.0	1.02-1.04	3770-4640	36-51	1.5-1.9

Jute **Akwara** **Elephant grass**	40.0-160.0 17.0	0.96 -	76-464 716	- 26	- 3.6

Fiber Enhancement of Slabs on Grade

Both steel fibers and engineered fibers can be utilized to enhance certain attributes of pieces on review. Blended into the solid, they offer the benefit of disseminated component inside the solid, the dominating impact being the control of plastic shrinkage breaking. They can likewise give modern floors added protection from affect, weakness, warm stun, and scraped area. Steel fibers are blended into the solid at rates extending from 30 pounds to 200 pounds or more for every cubic yard. Estimations of 30 pounds to 60 pounds for each cubic yard are generally normal. Steel fiber blends may demonstrate an expansion in modulus It is ideal, be that as it may, to decide the increment by shaft tests utilizing ASTM C 1018. Manufactured fibers, for example, polypropylene, nylon, and glass, are successful in opposing the arrangement of early-age plastic shrinkage breaking. Droop must be precisely controlled to allow legitimate situation and surface completing of the solid. Manufactured (polymeric) fibers blended are for the most part into the solid at rates going from 1 pound to 3 pounds for every cubic yard, contingent upon the kind of engineered and the coveted impact. Table 2.2 gives rules to fiber composes and doses to anchor enhanced1oor chunk properties

.Loading Condition or Enhancement Desired	Steel fibers	Polymeric (synthetic) Fibers
Shrinkage control Light dynamic loading Medium dynamic loading Severe dynamic loading High impacts	15-33 lbs./yd3 30-50 lbs./yd3 40-65 lbs./yd3 65-125 lbs./yd3 85-250 lbs.Iyd3	1.5 lbs./yd3 1.5 lbs./yd3 3-4.8 lbs./yd3 4.8-6 lbs./yd3 9.6-12 lbs./yd3

Fiber concentration guidelines.

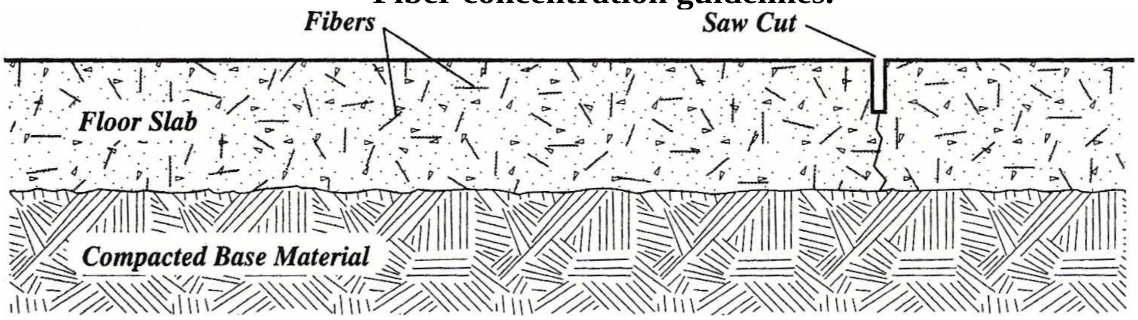


Fig.2.11.slab enhanced with fibers, either synthetic or steel

Fiber Reinforced Concrete Floor Slabs Benefits

- Significantly reduced risk of cracking.
- Reduced spalling joint edges.
- Stronger joints.
- High impact resistance.
- Greater fatigue endurance.
- Reduced maintenance costs.
- Longer useful working life

The literature shows that the general benefits of using fiber reinforced concrete include:

- Controlled Plastic Shrinkage.
- Minimized Crack Growth.
- Reduced Permeability.
- Improved Surface Durability.
- Uniform Reinforcement In All Directions.
- Higher fatigue resistance.
- The superior method and cost effective alternate to welded wire fabric for secondary reinforcement.
- Support and cohesiveness (homogeneous) in the concrete on steep inclines.
- Greater impact, abrasion and shatter resistance in concrete.
- Decreasing the thickness of slabs on grade.

The benefits of using steel fibers in beam-column joints include:

- Ductility and toughness.
- Damage tolerance against multiple load cycles.
- Shear resistance.

Field Performance of Fiber Reinforced Concrete
Residential

Fibremesh were utilized as auxiliary reinforcement in all the solid sections for this upscale loft complex situated in Destin, Florida. Engineered Industries Concrete Company (2000) completed the development of this condo. Fibremesh were utilized at an expansion rate of 0.9kg/m3 into the solid. The solid was put in serious summer conditions and the fiber strengthened cement was utilized to help with controlling the drying and shrinkage splitting.

Shotcrete

An ongoing venture done by Synthetic Industries Concrete Company (2000) in Sydney, Australia, the wilderness boating course was built for the Year 2000 Olympic recreations, utilized Fibremesh for shotcrete reinforcement. The interior dividers must withstand to turbulent water and continued battering from kayaks. This structure, which is nonstop, is equipped for creating water-stream rates up to four meters for every second along the 300-lineal meter course. Short Fibers included into the solid blend offering an elective framework to the time and work of setting customary steel reinforcement.

Transportation

This driving venture expressed by Novocon (2000), situated in Springfield, assachusetts, and is one of ten over the state developed to think about the utilization and advantages of Portland bond to bituminous cement. This solid street is 100mm thick comprise with 1.8kg/m3 of Fibremesh. This 100mm layer of cement is relied upon to last around 40 years, while normal bituminous solid endures 15 to 20 years.

MATERIALS AND MIXDESIGN

MATERIALS

This paper manages the materials that are utilized as a part of the present examination. Here we examined about the properties of the materials that are utilized as a part of the tasks and furthermore their passable limits that are specified by the agency of Indian models. Underneath materials are utilized as a part of the present examination.

1. Cement
2. Coarse aggregate
3. Fine aggregate
4. Water
5. Steel fibers
6. Polypropylene fibers

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 17
July 2018

Percentage variation of fibers in mix:

The proportions of fibers used in concrete mix are at percentage of 0.5%, 1%, 1.5% and for each proportion equal quantity (50% of each) of fibers are added in the mix. Hybridization of fibers are tabulated in below table 4.2.

Hybridization of fibers in concrete mix

10. Maximum cement substance :450 kg/m^3

Test data for materials

1. Cement used : grade OPC 53
2. Cement specific gravity : 3.15
3. Specific gravity of
- Fine aggregate : 2.46
- Coarse aggregate : 2.62
4. Water absorption
    - Fine aggregate: 1%
    - Coarse aggregate : 1.5 %
5. Surface moisture :
    - Fine aggregate : nil
    - Coarse aggregate : nil

Percentage of fiber added in overall concrete mix (%)	**Steel Fibers by Volume of Concrete (%)**	**Polypropylene Fibers by Weight of Cement (%)**
0	0	0
0.5	0.25	0.25
1	0.50	0.50
1.5	0.75	0.75

Concrete mix design for M25 concrete (IS-10262:2009)

Stipulation for mix proportioning

1. Grade designation : M25
2. Cement type : OPC 53 grade
3. Maximum supposed size of aggregate : 20m
4. Minimum cement content :320 kg/m^3
5. Workability :75mm
6. Exposure condition : severe
7. Manner of concrete placing : normal
8. scale of supervision : good
9. Aggregate type : crushed angular aggregate

TARGET STRENGTH FOR MIX PROPORTIONING

$f^1ck = fck + 1.65s$

Where

f^1ck =target average compressive strength at 28 days.

fck = compressive strength at 28 days, and

S= Standard deviation.

As of IS 10262: 2009, table 1, standard deviation s=4

Therefore, target strength (f^1ck) =25+1.65×4 = 31.6 N/mm^2

SELECTION OF WATER –CEMENT RATIO

From IS 456-2000, table 5, maximum water cement ratio=0.50

SELECTION OF WATER CONTENT

From IS 10262:2009, table 2, maximum water content for 20mm aggregate=186 liter Estimated water content for 75mm slump=186+ (3/100)×186=191.5lit.

CEMENT CONTENT CALCULATION

Water cement ratio=0.45

Cement content =191.5/0.50=383 kg/m3 < 450 kg/m3

VOLUME OF COARSE AGGREGATE AND FINE AGGREGATE PROPORTION CONTENT

As of IS 10262:2009,table 3,volume of coarse aggregate corresponding to 20mm size aggregate and fine aggregate (zone 2) for water-cement ratio 0 .50

M25 grade concrete mix proportion

Cement	Fine coarse Aggregate	Coarse Aggregate	water content	water-cement Ratio
383 kg/m3	641.66 kg/m3	1105.83 kg/m3	191.5 liters	0.45
1	1.67	2.88	191.5 liters	0.45

ADDITION OF FIBERS:

ADDITION OF STEEL FIBERS

This paper manages the materials that are utilized as a part of the present examination. Here we talked about the properties of the materials that are utilized as a part of the tasks and furthermore their admissible limits that are said by the department of Indian models. Beneath materials are utilized as a part of the present examination.

Steel fibers addition by 0.25% of volume of concrete.

The mass of fibers required for 1 m^3 are calculated and showed below and Fibers mass can be calculated by following formula.

Mass of fibers =density of steel fibers × percentage of addition of fibers

=(7860×0.25/100)=19.65 kg/m^3

FOR ONE CUBE

For calculating the mass of fibers for one cube,

First volume of cube is calculated (150×150×150) mm3=3.375×10-3M3.

Mass of fibers needed for one cube =mass of fibers required for proportion × volume of cube

=1965×3.375×10^{-3}

=66.415grams.

FOR ONE CYLINDER

For calculating the mass of fibers,

Volume of one cylinder =πr2h

=π(0.15/2)2×0.30

=0.0053m^3

Mass of fibers needed for one cylinder =mass of fibers required for proportion ×volume of cylinder

=19650 × 0.0053

=104.145 grams.

FOR ONE PRISM

For calculating the mass of fibers for one prism at first volume of prism is calculated.

Volume of prism= (L×B×H) = (0.1×0.1×0.5) =0.005m3

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Mass of fibers needed for one prism =mass of fibers required for proportion × volume of prism

=19650×0.005
=98.25grams.

ADDITION OF POLYPROPYLENE FIBER

Polypropylene fibers:

Polypropylene fibers having a thickness 0.95 kg/cm3 were utilized for the present examination. The fibers having a cut length of 12mm.

Augmentations of polypropylene fiber are done in various extents, for example, 0.25%, 0.50%, and 0.75% by weight of bond.

0.25% of weight of cement

The mass of fibers required for 1 m^3 are calculated and showed below.

Mass of fibers =0.25/100=0.0025 Kg

FOR ONE CUBE

Calculation of fibers needed for one cube is calculated as below

Weight of cement required for one cube = volume of cube × cement content for 1 m3 = 0.00337×383

Mass of fibers = weight of cement required for one cube × percentage of addition of fibers =1.290×0.0025
=3.225×10-3kg

FOR ONE CYLINDER

Calculation of fibers needed for one cylinder is calculated as below

Weight of cement required for one cylinder =volume of cylinder ×cement content for 1 m3
=0.0053×383
=2.03kg

Mass of fibers =weight of cement required for one cylinder × percentage of addition of fibers

=2.03×0.0025

=5.07×10^{-3} Kg

FOR ONE PRISM

Calculation of fibers needed for one prism is calculated as below

Weight of cement required for one prism =volume of prism × cement content for 1 m3

0.005 ×383 =1.915 Kg

Mass of fibers =weight of cement required for one prism × percentage of addition of fibers
=1.915 × 0.0025
=4.7875 ×10-3 Kg

MIXING CASTING AND CURING

Blending of cement is finished by machine and hand. Every one of the fixings that are added to the solid is legitimately weighed and clustered by the blend extents. Blending of cement is done in like manner by setting fixings as needs be right off the bat fine total took after by concrete, coarse total, water, steel fibers and polypropylene fibers individually.

Subsequent to blending the solid is put for throwing of 3D shapes. For getting ready of solid shapes, the molds are utilized. These molds are cleaned and settled with jolts firmly without losing a lot of water. These molds are lubed at the internal surface for getting the solid shapes effortlessly. The solid is then poured in to the form by three layers. Each layer is to be altered by packing bar for 25 times for getting the solid smaller.

In the wake of throwing the shapes, they ought to be kept aside for 24 hours. Following 24 hours 3D squares are expelled from the molds and are kept for solid shapes promptly in a water tub.

TESTS ON CONCRETE

FRESH CONCRETE:

The test conduct for fresh concrete is

1. Slump cone test.
2. Compaction factor.

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e-ISSN: 2348-6848
p-ISSN: 2348-795X
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TESTS ON CONCRETE AFTER 28 DAYS

The test conduct for hardened concrete is

1. Compression test
2. Split tensile test
3. Flexural test

Investigation Results and Discussion

1. Effect of Polypropylene Fibers on the Properties of Fresh Concrete

The densities of the various mixes

W/C	Fiber Weight Fraction (%)	Unit weight* Kg/m^3	Slump (mm)
0.5	0.0	2350	120
	0.25	2300	105
	0.50	2290	90
	1	2225	80

* Test accordance to ASTM C642-06.

Effect of PF on the Properties of Fresh Concrete Reduced rate of dying Settlement

of the coarse total was slower Because Hold the solid combine.

A slower rate of draining means a slower rate of drying and along these lines less plastic shrinkage breaking .Effect of Polypropylene Fibers on the Strength of the Concrete

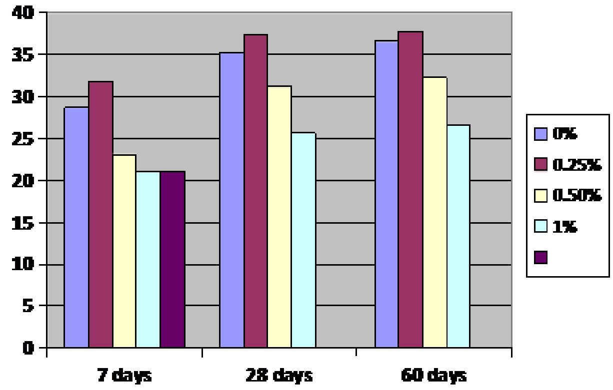
Compressive Strength at (7-day and 28-day) curing

Fiber Weight Fraction (%)	Compressive Strength 7-day (MPa)	Compressive Strength 28-day (MPa)	Compressive strength 60-day (Mpa)
0.0	28.7	35.25	36.56
0.25	31.8	37.35	37.9
0.50	23.08	31.20	32.25
1.0	21.1	25.68	26.63

* Average of 3 Specimens.

Note: Compressive Strength test according to ASTM C 39

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 05 Issue 17
July 2018



Compressive strengths of polypropylene fiber concrete

2. Compressive Strength Results Discussion

- The addition of polypropylene fibers effect on the compressive strength has increasing by 10% with (0.25%) of fiber than start decreases by with increase the fiber quantities.
- High quantities of fiber produced concrete with poor workability and

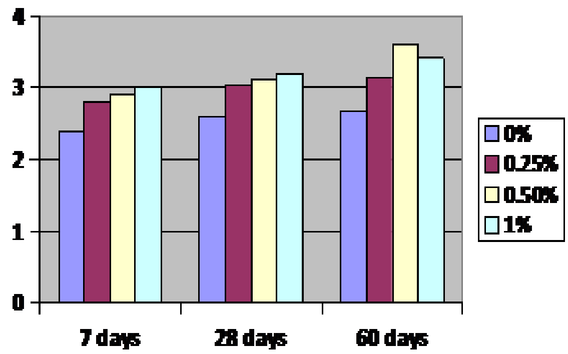
segregation, higher entrapped air and lower unit weight.

- A significant effect on the mode and mechanism of failure of concrete cylinders in a comp. testing with (FRC).The fiber concrete fails in a more ductile mode.
- The (PC) cylinders typically shatter due to an inability to absorb the energy by the test machine at failure.
- Fiber concrete cylinders continue to sustain load and large deformations without shattering into pieces.

Split Tensile Strength Results

Fiber Weight Fraction (%)	*Split Tensile Strength 7-day (MPa)	Split Tensile Strength 28-day (MPa)	Split Tensile strength 60-Day (Mpa)
0.0	2.40	2.6	2.67
0.25	2.80	3.04	3.15
0.50	2.91	3.10	3.6
1.0	3.01	3.20	3.41

*Average of 3 Specimens.
Note: Split Tensile Strength test according to ATM C 49S6



Tensile strengths of polypropylene fiber concrete

3. Split Tensile Strength Results Discussion

The expansion of polypropylene fibers impact on the split tensile strength has expanding by 17%, 18% and 20% with 0.25%, 0.5% and 1.0% of fiber separately.

•That enhance the tensile and attachment of cement.

•The fiber concrete bombs in more bendable mode inverse the plain solid that shattering into pieces.

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