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Design of Rigid Pavement by Using Geosynthetic Materials (Polypropylene Fibre)

Payal Ishwar Umate¹, Pratiksha Vijay Kawade², Rupesh Manoj Kuchekar³, Pranoti Vinod

Sakhare⁴, Juhee Babarao Lokhande⁵, Prof. A.R. Palheriya⁶

B.E 8th Semester Student, Department of Civil Engineering, Guru Nanak Institute of Engineering and Technology,
Nagpur, Maharashtra, India¹²³⁴⁵

Assistant Professor, Department of Civil Engineering, Guru Nanak Institute of Engineering and Technology, Nagpur,
Maharashtra, India⁶

ABSTRACT: Geosynthetics have been used to reinforce the base layer of rigid pavement systems for the past thirty years. However, and in spite of the good field evidence that geosynthetic reinforcements can improve pavement performance, the specific conditions or mechanisms that enable and govern the reinforcement function are, at best, unclear as they have remained largely unmeasured. Overall, the selection of design parameters for geosynthetics has been complicated by the difficulty in associating their relevant properties to the improved pavement performance. Field evidences indicate that geosynthetic reinforcements can improve pavement performance. Yet, the specific conditions or mechanisms that enable and govern the reinforcement function are, at best, unclear as they have remained largely unmeasured.

Significant research has been recently conducted with the objectives of:

- Determining the governing mechanisms and relevant properties of geosynthetics that contribute to the enhanced performance of pavement systems,
- Developing appropriate analytical, laboratory and field methods capable of quantifying the above properties for geosynthetics, and
- Enabling the prediction of pavement performance depending on the various types of geosynthetics used.

In this paper Polypropylene Fiber (.50%,1%,2%,6%,8%12%) adding with concrete for experimental study. For polypropylene - The capability of durable structure to resist weathering action, chemical attack, abrasion and other degradation processes during its service life with the minimal maintenance is equally important as the capacity of a structure to resist the loads applied on it. Although concrete offers many advantages regarding mechanical characteristics and economic aspects of the construction, the brittle behavior of the material remains a larger handicap for the seismic and other applications where flexible behavior is essentially required.

KEYWORDS- Geosynthetic Materials, Rigid Pavement, Polypropylene Fiber

I. INTRODUCTION

Geosynthetics have been widely used to serve a variety of roles that greatly lead to roadways performing well. These provide isolation, filtration, stabilization, stiffing, drainage, barrier, and safety functions. Any or more of these different features is used in at least six major roadway applications. The applications include migration of reflective cracking in asphalt overlays, isolation, road base stabilization, ground soft subgrade stabilization, and lateral drainage. The American Society for Testing and Materials (ASTM) Committee D35 on geosynthetics has described geosynthetics as planar products made from polymeric materials used with materials related to soil, rock, earth, or other geotechnical engineering as an integral part of a man-made project, structure, or system. Geosynthetics is the term used to describe a variety of polymeric materials used in construction of civil engineering works. The concept is commonly considered to cover eight major categories of goods. These include geotextiles, geogrids, geonets, geomembrane, liners of geosynthetic mud, geofoam, geocells, and geocomposite. The geotextiles and geomembrane are the most common geosynthetics employed. The ASTM (1994) describes geotextiles as permeable textile materials used as an integral part of a civil engineering project, structure, or device in contact with soil, rock, earth, or any other geotechnical substance. Geomembrane is an inherently impermeable membrane, in the shape of a sheet that is commonly used as cut-offs and

liners. These are also used to landfill lineups. Geotextiles, as permeable textile materials, are used as an integral part of a civil engineering project, structure or system in contact with soil, rock, earth or any other associated geotechnical material.

Geosynthetic Advantages:

Geosynthetics, including geotextiles, geomembranes, geonets, geogrids, geocomposites and geosynthetic clay liners, often used in combination with conventional materials, offer the following advantages over traditional materials:

- Space Savings - Sheet-like, geosynthetics take up much less space in a landfill than do comparable soil and aggregate layers.
- Material Quality Control - Soil and aggregate are generally heterogeneous materials that may vary significantly across a site or borrow area. Geosynthetics on the other hand are relatively homogeneous because they are manufactured under tightly controlled conditions in a factory. They undergo rigorous quality control to minimize material variation.
- Construction Quality Control - Geosynthetics are manufactured and often factory “prefabricated” into large sheets. This minimizes the required number of field connections, or seams. Both factory and field seams are made and tested by trained technicians. Conversely, soil and aggregate layers are constructed in place and are subject to variations caused by weather, handling and placement.
- Cost Savings - Geosynthetic materials are generally less costly to purchase, transport and install than soils and aggregates.
- Technical Superiority - Geosynthetics have been engineered for optimal performance in the desired application.
- Construction Timing - Geosynthetics can be installed quickly, providing the flexibility to construct during short construction seasons, breaks in inclement weather, or without the need to demobilize and remobilize the earthwork contractor.
- Material Deployment - Layers of geosynthetics are deployed sequentially, but with a minimum of stagger between layers, allowing a single crew to efficiently deploy multiple geosynthetic layers.
- Material Availability - Numerous suppliers of most geosynthetics and ease of shipping insure competitive pricing and ready availability of materials.
- Environmental Sensitivity – Geosynthetic systems reduce the use of natural resources and the environmental damage associated quarrying, trucking, and other material handling activities.

Plain concrete possess a very low tensile strength, limited ductility, and little resistance to cracking. Internal micro cracks are inherently present in the concrete and its poor tensile strength is due to the propagation of such micro cracks, eventually leading to brittle failure of the concrete. The most widely accepted remedy to this flexural weakness of concrete is the conventional reinforcement with high strength steel. Restraining techniques are also used to. Although these methods provide tensile strength to members, they however do not increase the inherent tensile strength of concrete itself. Also the reinforcement placing and efficient compaction of RCC is very difficult if the concrete is of low workable especially in the case of heavy concrete.

In plain concrete and similar brittle materials, structural cracks (micro-cracks) develop even before loading, particularly due to drying shrinkage or other causes of volume change. The width of these cracks seldom exceeds a few microns, but their two dimensions may be of higher magnitude. When loaded, the micro cracks propagate and open up, and owing to the effects of stress concentration, additional cracks form in places of minor defects. The development of such micro crack is the main cause of inelastic deformation in concrete. It has been recognized that the addition of small, closely spaced and uniformly dispersed geo-fibres to concrete would act as crack arrester and would substantially improve its and dynamic properties. This type of concrete is known as fibre reinforced concrete. Polypropylene fiber's do the same effect and perform better than any other fiber's.

Polypropylene Reinforced Concrete can be define as a composite material consisting of mixtures of cement, mortar or concrete and discontinuous, discrete, uniformly dispersed geo-fibres. Fiber reinforced concrete is concrete containing fibrous material which increases its structural integrity. It contains short discrete fibers that are uniformly distributed and randomly oriented. Fibres include steel fibres, glass fibres, synthetic fibres and natural fibres. Within these different fibres that character of fibre reinforced concrete changes with varying concretes fiber materials, geometries, distribution, orientation and densities. It is true that plain cement concrete possess a very low tensile strength.

II. LITERATURE REVIEW

2.1 POLYMER CONCRETES: A DESCRIPTION AND METHODS FOR MODIFICATION AND IMPROVEMENT

G. Martínez Barrera, Vigueras-Santiago, Gencel and H.E. Hagg Lobland (2011)

Portland cement concrete (PCC) has been successful in many applications. However, since the 1960s technological investigations concerning modifications of concrete by polymeric materials have been conducted. Attention has been focused on concretes in which the continuous phase is some kind of polymeric resin and the discrete phase is some type of mineral aggregate. Such composite materials are known as Polymer concrete (PCt) and boast several advantages such as higher strength and a shorter curing process. In spite of these advantages, there are deficiencies that could be addressed by fiber incorporation into PCts, however this kind of approach is not typical. Here we acquaint readers with the nature of polymer concretes as these materials have not yet gained wide recognition. We describe recent developments regarding the influence of fiber reinforcements on PCts. The curing process is a critical concern in dealing with polymer concretes as it is with Portland cement concrete. Studies on the effects of gamma ionizing radiation on the curing process and on final properties of PCts are ongoing. Developments in this area are also described here. In particular, the effects of gamma irradiation on the mechanical properties are discussed. Notably, improvements of the Young's modulus E described here have wider implications and may be indicative of improvements or modifications to other properties not directly tested. Specifically, the modifications to the Young's modulus can be a defining measure of whether one will obtain a ductile or more brittle concrete.

Conclusion:

The objective of this report has been to describe the special characteristics of polymer concretes (PCt) as well as the role of how additives and processing can enhance PCt properties. In that regard we have discussed fiber reinforcement of PCts, and especially the effects of gamma irradiation on the curing process. It has been shown that combining fiber reinforcements and the matrix curing effects of irradiation can provide significant improvements to the properties of PCt. It is hoped that further studies into developments of PCt properties and applications may find this overview a useful resource.

2.2 PERFORMANCE OF GLASS FIBER REINFORCED CONCRETE

Yogesh Iyer Murthy, Apoorv Sharda, Gourav Jain (2012)

In the present investigation, the compressive strength, flexural strength and workability of concrete containing varying proportions of glass fiber as replacement of fine aggregate is studied. The result of these parameters is compared to those of standard M30 grade concrete. The increase in compressive strength is nominal while the flexural strength increased significantly as expected with the increase in percentage of glass fiber. Also, significant reduction in the slump value of the glass fiber reinforced concrete was observed with increase in glass fiber content. The preliminary investigations reveal that the use of this industrial waste is not only improving the properties of concrete but also provides a safe and efficient means of disposal of such non-biodegradable wastes.

Conclusion:

The present research work deals with the use of glass fiber in concrete which is obtained from the glass industry as a waste product. The work is in nascent stage but is promising, as the preliminary results satisfy the basic needs which the alternate material should fulfill in concrete. Though, as expected, the compressive strength of concrete did not increase much, the flexural strength showed almost 30% increase in strength compared to the beam with 0% fibers. The slump value decreased with increase in fiber content. The reasons for these behaviours are discussed. Thus, it can be concluded that the use of fiber glass in concrete, not only improves the properties of concrete and can do a small cost cutting, but also provides an easy outlet of the efficient disposal of this environmental hazard.



2.3 MECHANICAL PROPERTIES OF POLYPROPYLENE FIBRE REINFORCED CONCRETE FOR M 25 & M 30 MIXES: A COMPARATIVE STUDY

Saman Khan, Roohul Abad Khan, Amadur Rahman Khan, Misbahul Islam Saman Nayal (2015)

This paper represents comparative experimental study on mechanical performance of polypropylene fibre reinforced concrete (PFRC) under compression and split tensile loading. The cube compressive strength and cylinder split tensile strength of conventional concrete and polypropylene fibre reinforced concrete were determined in the laboratory. The M25 and M30 grades of concrete mixes and polypropylene mono-filament macro-fibres of length 35 mm at volume fractions of 0.0%, 0.5%, 1.0%, 1.5%, 2.0%, 2.5% and 3.0% were used in the research. All specimens were tested at curing age of 28 days. In this paper the relationship between cube compressive strength and cylinder split tensile strength for conventional and polypropylene fibre reinforced concrete were established and compared with standards. The study suggested the significant improvement in compressive and tensile strength for concrete mixes reinforced with polypropylene fibres. The samples with added polypropylene fibres of 1% and 1.5% showed better results in comparison with the others.

Conclusion:

Inter comparison of compressive strength and tensile strength with fibre the maximum strength is achieved in M20 mix.

- So on an average to gain maximum compressive and tensile strength with mono-filament macro fibre the optimum dosage be limited 1% to 1.5%, after further increase these strength properties decreases.
- The comparison of compressive strength concludes that with increase in cement content the strength gain due to percentage of fibre decreases.
- The increase in cement content with increased percentage of fibre caused loss of strength even greater.
- So we can say that the increased compressive strength due to fibre percentage is due to fibre and aggregate bonding and not due to cement paste bonding. The fibres are acting as anchors between the cement paste and the fine and coarse aggregates which results in increased durability of concrete before failure.

2.4 A REVIEW ON EFFECT OF FIBER REINFORCED CONCRETE ON RIGID PAVEMENT

Ms. Amreen N. Ali, Mr. Milind. V. Mohod (2015)

Road transportation is undoubtedly the lifeline of the nation and its development is a crucial concern. In recent years, cement concrete pavements are being adopted in many new road projects in India in view of their longer service lives, lesser maintenance requirements and smoother riding surface. This paper presents a comprehensive review on work done on fiber reinforced concrete pavement using polypropylene, steel, hybrid and glass fibers. Polymer fiber reinforced concrete pavement is a recent advancement in the field of reinforced concrete pavement design. Polymer fiber reinforced concrete pavements are more efficient than ordinary cement concrete pavements. Various issues and behavior of fiber reinforced concrete in pavement are also discussed.

Conclusion:

- 1} Steel fiber reinforced concrete with 2% steel fibres yields slightly more stress as compared to 1% & 3% steel fibre reinforced concrete for both Positive curling temperature gradient & negative curling temperature gradient.
- 2} The increment in stresses for SFRC lies in the range of 20-41% when compared with those of conventional concrete.
- 3} Frictional stresses in steel fibre reinforced concrete pavements are almost similar to the stresses obtained for conventional concrete pavements.
- 4} The increased diameter and reduced stiffness of the GFRP dowels results in lower bearing stresses between the concrete and dowel, which are major causes of dowel looseness and slab faulting.
- 5} Hybrid fibers improve the compressive strength marginally as compared to mono fibers. Hybridization also improves split tensile strength and flexural noticeably.
- 6} Fibrillated fibre is more effective in reducing the settlement of concrete than multifilament fiber. However, it has lesser effect on slump reduction than multifilament fiber at the same fiber content.
- 7} Polypropylene fibers reduce the water permeability, plastic, shrinkage and settlement and carbonation depth.



2.5 DIAGNOSING PERFORMANCE OF POLYPROPYLENE FIBRE IN CONCRETE MIX DESIGN FOR RIGID PAVEMENT

Gopi J. Sutaria, Prof.C.B.Mishra, Prof.N.F.Umrigar (2015)

India has a road system of more than 4.87 kilometers according to MoRTH, Techsci Research July 2015 and the second biggest road system on the planet. Development of Road and Highways are the foundation of infrastructure improvement upgrading the vital main thrust to accomplish quick and supported economic growth in the changing technological innovation. It is undoubtedly the lifeline of the nation which is a never ending process activity in India. Because of rising oil costs and a more tightly monetary environment, cement is turning into a more alluring choice for base venture comprehensively contrasted with conventional bituminous asphalts. The Ministry of Road Transport and Highways in India noticed that advanced society can't work adequately without concrete roads. Cement has a few deficiencies as low tensile strength, limited fatigue life and is characterized by brittle failure resulting in nearly complete loss of loading capacity, once failure is initiated. This paper manages exploratory examination on mechanical properties of M35 grade concrete by adding polypropylene fibers in the blend at measurements of 0.6 %, 0.8% and 1.0% by weight of cement added to the mix. A comparative analysis has been carried out for conventional concrete to that of the fiber reinforced in relation to compressive and flexural strength.

Conclusion:

PFRC can be used advantageously over normal concrete pavement. Polymeric fibers such as polypropylene are being utilized because of their This study has been made to focus the impact of polypropylene fibers in suitable measurements on strength of concrete. The research facility examinations gave the accompanying conclusions:

Up to 0.6% including of concrete with polypropylene fiber 12 mm length there is ideal rate to increment in the improved compressive strength and flexural strength which will allow lessening of slab thickness in wearing surface of cement concrete pavements and because of higher flexural strength prompts less material use. This will further prompt reserve funds in material and work cost by taking out traditional support. A consequence of 0.8% and 1.0% demonstrates that compressive and flexural strength declines.

III. PROPOSED METHODOLOGY

3.1 MATERIALS USED

3.1.1 POLYPROPYLENE FIBRE

Polypropylene fibre was first used to reinforce concrete in the 1960s. Polypropylene is a synthetic hydrocarbon polymer, the fibre which is made using extrusion processes by hot-drawing the material through a die. Polypropylene fibres are produced as continuous mono- filaments, with circular cross section that can be chopped to required lengths, or fibrillated films tapes of rectangular cross section. Polypropylene fibres are hydrophobic and therefore have the disadvantages of poor bond characteristics with cement matrix, a low melting point, high combustibility and a relatively low modulus of elasticity. Long polypropylene fibres can prove difficult to mix due to their flexibility and tendency to wrap around the leading edges of mixer blades.

Polypropylene fibres are tough but have low tensile strength and modulus of elasticity; they have a plastic stress-strain characteristic. Monofilament polypropylene fibres have inherent weak bond with the cement matrix because of their relatively small specific area. Fibrillated polypropylene fibres are slit and expanded into an open network thus offering a larger specific surface area with improved bond characteristics. Polypropylene fibre contents up to 12% by volume are claimed to have been used successfully with hand-packing fabrication techniques, but volumes of 0.1% of 50 mm fibre in concrete have been reported to have caused a slump loss of 75 mm. Polypropylene fibres have been reported to reduce unrestrained plastic and drying shrinkage of concrete at fibre contents of 0.1 to 0.3% by volume. Polypropylene Micro Fibre was procured from Bajaj Reinforcement Nagpur and was used in the present study. Specifically engineered and manufactured ISO 9001-2000 certified facility for use as concrete reinforcement at the recommended dosage rate of 1 kg per cubic meter for effective performance.



(Fig.3.1: Polypropylene Micro Fibre)

**Table 3.1 : Chemical and Physical Properties of Polypropylene Micro Fibre
(Bajaj Reinforcement Nagpur)**

Characteristic	Material Properties	Characteristic	Material Properties
Fibre Length	20 mm	Type/Shape	Monofilament Fibre
Absorption	Nil	Diameter	30 micron
Specific Gravity	0.90	Thermal Conductivity	Low
Tensile strength	4.5 kgf	Melt Point	162 ° C (324 ° F)
Acid and Salt Resistance	High	Electrical Conductivity	Low

3.2 PREPARATION OF MOULDS

3.2.1 MIX CALCULATIONS

Examples of concrete mix proportioning

For M20 Grade concrete

A-1 Design stipulations for proportioning

- | | |
|---------------------------------------|-------------------------|
| a) Grade designation | : M20 (1:1.5:3) |
| b) Type of cement | : PPC (J K Laxmi) |
| c) Maximum nominal size of aggregates | : 20 mm |
| d) Minimum cement content | : 300 kg/m ³ |
| e) Maximum water cement ratio | : 0.4 |

f) Workability	: 100 mm (slump)
g) Exposure condition	: Severe (for reinforced concrete)
h) Degree of supervision	: Good
i) Type of aggregate	: Crushed angular aggregate
j) Maximum cement content	: 450 kg/m ³

3.2.2 TEST DATA FOR MATERIALS

a) Cement used	: PPC (J K Laxmi)
b) Specific gravity of cement	: 3.15
d) Specific gravity of Coarse aggregate	: 2.74
Fine aggregate	: 2.74
e) Water absorption Coarse aggregate	: 0.5 percent
Fine aggregate	: 1.0 percent
f) Free (surface) moisture Coarse aggregate	: Nil (absorbed moisture also nil)
Fine aggregate	: Nil
g) Sieve analysis Coarse aggregate	: Conforming to Table 2 of IS: 383
Fine aggregate	: Conforming to Zone I of IS: 383

Calculation for M20 (1:1.5:3)

- Volume of Mould = $150 \times 150 \times 150 \text{ mm}$
 $= 3375000 \text{ mm}^3$
 $= 0.003375 \text{ m}^3$
 - Volume of Cement = $300 \text{ kg/m}^3 \times 0.003375 \text{ m}^3$
 $= 1.0125 \text{ kg}$
 - Volume of sand = $450 \text{ kg/m}^3 \times 0.003375 \text{ m}^3$
 $= 1.519 \text{ kg}$
 - Volume of Aggregate = $900 \text{ kg/m}^3 \times 0.003375 \text{ m}^3$
 $= 3.0375 \text{ kg}$
- Volume of water = $120 \text{ kg/m}^3 \times 0.003375 \text{ m}^3 = 0.405 \text{ kg}$

Calculation for 3 moulds

- Volume of Cement = $3 \times 1.0125 \text{ kg}$
 $= 3.0375 \text{ kg}$
- Volume of sand = $3 \times 1.519 \text{ kg}$
 $= 4.557 \text{ kg}$
- Volume of Aggregate = $3 \times 3.0375 \text{ kg} = 9.112 \text{ kg}$
- Volume of water = $3 \times 0.405 \text{ kg}$
 $= 1.215 \text{ kg}$

3.2.3 PROCEDURE OF CASTING CUBES

We tried to check the **Compression test** by preparing test cubes from the freshly prepared concrete of partially replacement of cement with marble powder. We carried out different tests using different percentage of polypropylene fibre they are as follows 0.5%, 1%, 2%, 6%, 8%, 12%.

The method of compression strength of concrete cubes:

- The cube moulds are made for specimen size 15 x 15 x 15 cm.
- The metal moulds can be assembled and taken apart by bolting or unbolting.
- The concrete is hand compacted and then machine compacted.

- The specimens are covered with wet gunny bags for 24 hours and then immersed in curing tank containing fresh, clean water.
- These are kept in water for 7, 14 and 28 days and then taken out and tested under compression testing machine.
- The failure load divided by cross sectional area, i.e. 225 cm^2 gives the ultimate compression strength of the cubes.
- Two cubes each of 7, 14 and 28 days curing are tested and can give a good idea about the rate of increase of strength.
- Pozzolana Portland cement concrete shows about 70% strength gain in the first 7 days and remaining gain in the days thereafter.
- Thus from the 7, 14 and 28 days tests the pattern of strength acquiring can be studied and we modified that if needed.
- The co-relation of test result is done by testing on 3 specimens at each curing period.
- We compute the durability, impermeability and other characteristics from the test results.

3.3 COMPRESSIVE STRENGTH TEST ON MOULDS

3.3.1 COMPRESSIVE STRENGTH

Concrete is a construction material which has always been meant to resist compressive stresses most efficiently. Hence unless or otherwise mentioned, the strength of concrete means Compressive strength.

The tensile strength of concrete is the very less and this drawback is over by combining steel rod with concrete.

The compressive strength depends upon a number of factors, in addition to the main factor which is water- cement ratio, these are:

1. Type of cement and its quality.
 2. Texture of aggregates.
 3. Curing.
 4. Temperature at which the concrete is hardened.
 5. Time of hardening.
- The compressive stress is tested by casting cubes of concrete of 15 cm side, in standard cube moulds.
 - Strength at 3 days, 7 days, 14 days and 28 days are tested.
 - The 28 days strength gives the compressive strength of the concrete. 3 days, 7 days & 14 days strength indicate the rate of hardening or gaining strength and can be useful in deciding the removal of formwork.

The method of compression strength test of concrete cubes:

- This test is carried out by preparing test cubes from the freshly prepared concrete.
- The cube moulds are made for specimen size $150 \times 150 \times 150 \text{ mm}$.
- The metal moulds can be assembled and taken apart by bolting or unbolting.
- The concrete is hand compacted and then vibration machine compacted.
- The specimens are covered with wet gunny bags for 24 hours and then immersed in curing tank containing fresh, clean water.
- These are kept in water for 3, 7, 14 and 28 days and then taken out and tested under compression testing machine. i.e. Compression Testing Machine or Universal Testing Machine.
- The failure load divided by cross sectional area, i.e. 225 cm^2 gives the ultimate compression strength of the cubes.
- Two cubes each of 3, 7, 14 and 28 days curing are tested and can give a good idea about the rate of increase of strength.
- Portland cement concrete shows about 70% strength gain in the first 7 days and remaining gain in the days thereafter.

- Thus from the 3, 7, 14 and 28 days tests the pattern of strength acquiring can be studied and we modified that if needed.
- The co-relation of test result is done by testing on 3 specimens at each curing period. We compute the durability, impermeability and other characteristics from the test results.

3.4 Testing of Concrete Cube

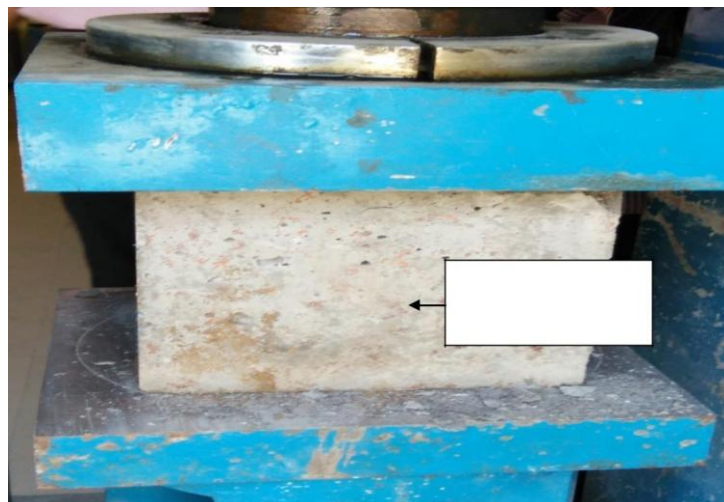
The following figures show the experimental setup and failure pattern of the concrete cubes. The figure shows the failure patterns of cube after 28 days, as the maximum strength of concrete is developed at 28 days as per IS 456:2000.

Specimen (Cube)



(Fig.3.2: Experimental Setup of the Conventional Concrete Cube)

Cracks Pattern



(Fig.3.3: Conventional Concrete Cube with cracks during testing)

Fig. shows the conventional concrete at the age of 28 Days curing. The cracks developed by applying the load of 600 KN. Cracks developed in inclined pattern but near to the centre of the cube because the cracks appear in the centre due to the zero percent of fibre used, the crack patterns shown in figure.



(Fig.3.4: Experimental Setup of concrete Cube M20 (1% Polypropylene in Concrete))

Fig shows the M20 concrete at the age of 28 days curing. The cracks developed by applying the load of 600 KN. The failure pattern of concrete after applying the load is seen at outer face of the cube because Polypropylene Micro fibre is not completely homogeneous mix with concrete it is separate while mixing due to this it create cracks on corner of the cube the cracks pattern are as shown in figures.



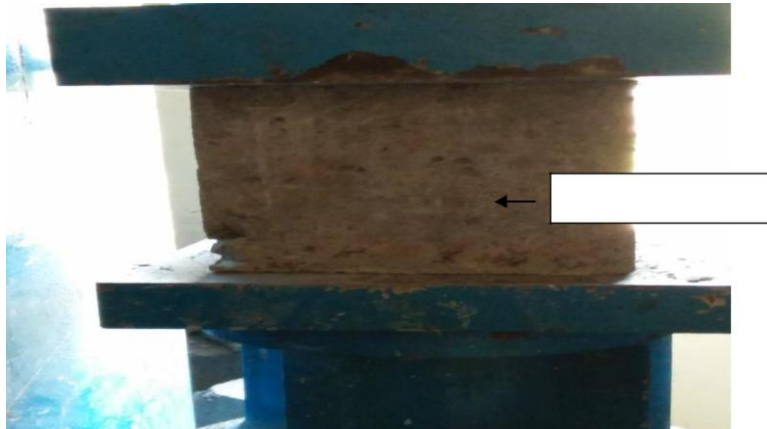
(Fig.3.5: Experimental Setup of concrete Cube M20 (1% of Fibre))

Figure shows the M20 concrete at the age of 28 days curing. The cracks developed by applying the load of 660 KN. The failure pattern of concrete after applying the load is seen at outer face of the cube because polypropylene macro fibre not completely homogeneous mix with concrete it separate while mixing due to balling of fibre and its low density, so it create cracks on outer face of the cube the cracks pattern are shown in figure.



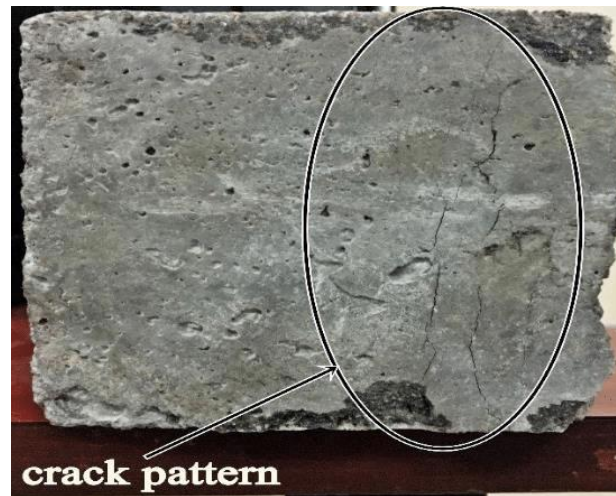
(Fig.3.6 : Experimental Setup of concrete Cube M20 (0.5% Polypropylene Micro Fibre))

Cracks Pattern



(Fig.3.7: concrete Cube with cracks after testing)

Figure shows the M20 concrete at the age of 28 days curing. The cracks developed by applying the load of 660 KN. The failure pattern after applying the load is seen at outer face of the cube in inclined line and very fine crack because Polypropylene Micro Fibre mix completely and make homogeneous mix with concrete it do not separate while mixing due to use of 0.5% Polypropylene Micro Fibre and 0.5% of Polypropylene Micro fibre due to availability of both fibre the bonding of fibre with concrete is very good. The cracks patterns are shown in figure.



(Fig.3.8 : M20 Concrete Cube with cracks after testing)

Figure shows the M20 concrete at the age of 28 days curing. The cracks developed by applying the load of upto 660KN. The failure pattern after applying the load is seen at outer face of the cube because polypropylene micro fibre not completely homogeneous mixes with concrete. The cracks pattern appears on the face of the cube the macro cracks are seen and micro cracks are very much reduce due use of 0.5% polypropylene micro fibre the cracks pattern are as shown in figure.

IV. RESULTS AND DISCUSSION

4.1 General

In this chapter the experimental results of all the cubes, with conventional concrete compared with Hybrid Fibre Reinforced Concrete (HFRC) are interpreted. Their behaviour throughout the test is described using recorded data on test, compressive test. Cubes, were tested for 7 days of curing and cubes, were tested for 28 days curing. The cubes cured in water tank for the period of 7 days and 28 days, the results compared between conventional concrete, individual fibre concrete and HFRC.

4.2 Concrete Strength

Here the strength of cubes, at different fibres were analysed. Compressive strength, Tensile Strength of each cube are compared with conventional concrete and Individual Fibre and Different Fibre mix proportion. For calculation of compressive strength of concrete the compressive testing machine was use.

4.3 Compressive Strength of Concrete

Compressive strength of concrete, out of many test applied to the concrete, this is theutmost important which gives an idea about all the characteristics of concrete. By this single test one judge that whether concreting done properly or not. For testing of concrete cubical moulds of size 150 mm x 150 mm x 150 mm are commonly used. Results of all specimens which are tested for Compressive strength are presented in the table.

Table 4.1: COMPRESSIVE TEST

Crushing strength in 28 days	0.5%	1%	2%	6%	8%	12%	Plain M20
7 days	445KN	481KN	505KN	515KN	410KN	200KN	280KN
14 days	590KN	560KN	590KN	265KN	400KN	200KN	290KN
28 days	660KN	600KN	610KN	240KN	410KN	260KN	480KN

V. CONCLUSION

From the experimental study it is observed that 0.5% and 1% of polypropylene fibre used with replacement of cement gives better result than Normal Plain Cement concrete. But as the ratio increased to 6% to 12% and above the result decreases and it is found to be very low range as compared to Normal Plain Cement Concrete, 0.5% and 1%. So it is concluded that polypropylene fibre can be used as a partial replacement with Cement only up to 2%.

So alternatively we may propose to replace some percentage of cement with polypropylene fibre. So that we may reduce the usage of cement and at the same time we may utilize the waste material for the building industry itself, by utilizing this waste materials we are also reducing environmental pollution to some extent. The further investigations regarding the practical point of view will be continued in future on this project.

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