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Enhancing the Strength of Pervious Concrete using Polypropylene Fiber

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ABSTRACT: The technology of polypropylene fiber is used to increase the strength of the pervious concrete It is used in construction of pavements to serve as drainage. Many types of fibers have been used to increase the strength related properties of concrete. But the polypropylene fiber is the most economical fire. In this project only the strength aspect of pervious concrete using polypropylene fibers has been studied.

In this project, test specimen has been casted and then investigation has been carried out on concrete by adding different percentage of polypropylene fibers. The test specimen left for curing for twenty eight days and after that tests such as compression test and permeability test has been carried out after the slump cone test. On the basis of test results, comparison has been carried out between plain pervious concrete and polypropylene fibers mixed pervious concrete and necessary results have been concluded.

I. INTRODUCTION

Pervious concrete is a composite material consisting of coarse aggregate, Portland cement, and water. It is different from conventional concrete in that it contains no fine sin the initial mixture, recognizing however, that fines are introduced during the compaction process. The aggregate usually consists of a single size and is bonded together at its points of contact by a paste formed by the cement and water. The result is a concrete with a high percentage of interconnected voids that, when functioning correctly, allow the rapid percolation of water through the concrete. Pervious concrete is a special type of concrete with high porosity. It can be used for concrete flatwork applications that allow water from precipitation and other sources to pass directly through thereby reducing the runoff from a site and allowing ground water recharge. The concrete paste then coats the aggregates and allows water to pass through the concrete slab. Pervious concrete is traditionally used in parking areas, areas with light traffic, residential streets, pedestrian walkways, and greenhouses. It is an important application for sustainable construction and is one of many low Impact development techniques used by builders to protect water quality.

The pervious concrete system and its corresponding strength are as important as its permeability characteristics. The strength of the system not only relies on the compressive strength of the pervious concrete but also on the strength of the soil beneath it for support.

Pervious concrete consists of cement, coarse aggregate and water with little to no fine aggregates. Water to cement ratio of 0.28 to 0.40 with a void content of 15 to 25%. The correct quantity of water in the concrete is critical. A low water to cement ratio will increase the strength of the concrete, but too little water may cause surface failure. As this concrete is sensitive to water content, the mixture should be field checked. Entrained air may be measured by a Rapid Air system, where the concrete is stained black and sections are analyzed under a microscope.

A perceptible concrete mixture contains little or no sand (fines), creating a substantial void content. Using sufficient paste to coat and bind the aggregate particles together creates a system of highly permeable, interconnected voids that drains quickly. Typically, between 15% and 25% voids are achieved in the hardened concrete, and flow rates for water through

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 5.928

| Volume 4, Issue 6, June 2021 |

pervious concrete are typically around 480 in./hr (0.34 cm / s, which is 5 gal / ft. / min or 200 L / m / min), although they can be much higher

II. LITERATURE REVIEW

Kanalli (2014) [4] conducted a preliminary study on **compressive strength, tensile strength and flexuralusing polypropylene fiber** in varying ratio of fiber dosage of 0.25% by volume of M20 grade. Experimental studies show that maximum values of compressive, split, tensile and flexural strength of concrete pavement are obtained at 0.75% fiber dosage

G. Navya et al. (2010) (5) determined the **compressive strength, water absorption and flexural strength** of paver blocks by adding coconut fibers in the top 20 mm thickness. Coconut fibers were added in proportions of 0.1% 0.2%, 0.3%, 0.4% and 0.5% in volume of concrete. The compressive strength, flexural strength and water absorption were determined at the end of 7 and 28 days. Test results indicate that addition of coconut fiber by 0.3% paver block attains maximum compressive strength. Test results indicate that addition of coconut fiber gradually increases flexural strength and water absorption at 7 and 28 days

Fernando et al. (2012) [6] added **synthetic fibers such as polypropylene, glass, nylon and PET fibers** in concrete cracking control. The polyethylene terephthalate (PET) fibers diameter is 25 30 micron length - 15 mm. The fiber added at the three different volumes of fractions about 0%, 0.05% 0.10%, w / c - 0.6. After 40 days, as the PET fiber ratio Increased, cracking length and number of crack decreased, 0.10% of the added PET fiber gives good results. The experimental results have showed that the addition of short polypropylene fibers to the mortar mixture was more at restraining considerably crack formation due to plastic shrinkage

Yeole et al. (2014) [7] carried out the experimental study for producing paving blocks using waste steel aggregates (the form of rounded bearings of size 6.35 mm). Waste steel bearings are added in concrete of paver blocks in various percentages Rubber pads are also used below the paver blocks. Impact strength of paver blocks with various percentages of waste steel aggregates and using rubber pads are Investigated. Test results show 50% more Impact strength than ordinary paver blocks.

Dipanpatel (2013) [8] studied the **use of steel fiber in rigid** pavement M20 Concrete mix was prepared with crimped end steel fibers with 25 mm length and 0.5 mm diameter. Cube specimens were casted and tested for 0.4 and 0.5% of volume of concrete. The results showed that the compressive strength of steel fiber concrete increased when compared to plain cement concrete. Addition of steel fiber in concrete, the pavement thickness is decreased by 23% and which is economical when compared to plain cement concrete slab

Rakeshkumar (2014) (19) Investigated suitability of concrete reinforced with synthetic fiber for the construction of pavements. The effects of addition of polypropylene discrete and fibrillated fiber on the properties of a paving grade concrete mix of about compressive strength 48 MPa at 28 days are discussed. Six concrete mixes were casted with fiber dosages of 0.05%, 0.10%, and 0.15%. The properties such as settlement, compressive strength, drying shrinkage and abrasion resistance of the concrete were evaluated.

Sutaria (2015) [10] diagnosed the performance of polypropylene fiber in concrete mix design for rigid pavement carried out 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 The weight of cement added to the mix Conventional concrete was compared with the fiber reinforced concrete in relation to compressive and flexural strength. The study revealed that up to 0.6% polypropylene fiber 12 mm length in concrete shows an ideal rate to increase in the compressive strength and flexural strength.

Panda and Ray (2014) (2014) established an experiment on design procedure and operations of polymer fiber reinforced concrete pavements. They explained a brief comparison of Polymer Fiber Reinforced Concrete (PFRC) pavement with conventional concrete pavement. Polymeric fibers are gaining popularity because of its properties like zero risk of corrosion and cost effectiveness. They analysed various forms of recycled fibers like plastic wastes, disposed tires, carpet wastes and wastes from textile industry can also use as fiber reinforcement. Concrete pavements may be weak in tension and against impact loads, but PFRC is a suitable material which may be used for cement concrete pavement and it consists of the extra strength in flexural fatigue and impact etc. There are two components of PFRC pavement one is the concrete mix and the other is polymer fibers. The polymer fibers increases the compressive strength 12% to 16%

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 5.928

| Volume 4, Issue 6, June 2021 |

III. METHODOLOGY

Batching

Batching is the process of measuring and combining the ingredients of concrete. Careful procedure was adopted in the batching, mixing and casting operations

For compressive strength with water cement ratio 0.36% and different percentage of admixtures by volume of concrete.

Dosage of fibers and their calculations:

1.Calculation for volume of cube

Volume of one cube = (0.15x0.15 0.15) m3=0.003375 m3

Weight of one cube - 0.003375x2362= 7972 kg

2. Calculation of volume of concrete for M20 grade

a. Volume of cement for one meter cube - 1 / (1 + 4) =0.2 m3

Weight of cement per meter cube 0.2 x 1200 =240 kg

b. Volume of aggregate for one meter cube 02 x 4 =0.8 m3

Weight of aggregate per meter cube -0.8 x 1450 = 1160 kg

c. Water cement ratio =0.36

Weight of water = 258.16 x (1 / 0.36) =717.11 kg

d. Density of concrete = (weight of (cement sand + aggregate water)) per meter cube =(240 + 1160 + 717.11) = 2117.11 kg / m3

e. Weight of concrete for one cube = 2117.11×0.003375 =7.145 kg

3. Weight of polypropylene fibre

a. 0.1% of Polypropylene fiber = 7.145× 0.001= 0.07145 gm

b. 0.15% of Polypropylene fiber =7.145 × 0.0015= 0.01071 gm

c. 0.2% of Polypropylene fiber = 7.145 × 0.002 – 0.0143 gm

d 0.25% of Polypropylene fiber = 7.145× 0.0025 =0.01786 gm

e. 0.3 of Polypropylene fiber = 7.145 -0.003= 0.0214 gm

Curing

The specimens were allowed to remain on moldfoxt 24 hours under ambient condition. After that, these were remolded with care so that no odes were broken and were placed in curing tank at the ambient temperature for curing The ambient temperature for curing was 27.2.C.

IV. TEST & OBSERVATION

Compressive Test (Cubes) Of M20

The best carried out 7 days, 14 days and 28 days, the comparison is made between the plain Pervious concrete and polypropylene fiber mixed Pervious concrete.

a. compressive strength of polypropylene fiber mixed Pervious concrete is increased compare to the plain Pervious concrete.

b. When we used the polypropylene fiber in Pervious concrete in various proportion 0.1%, 0.15%, 0.2%, 0.25%, and 0.3% of volume of concrete result obtained by the compressive strength of polypropylene free to 0.35 of used result get increased

Permeability test of M20

Plain Pervious Concrete

1000 ml water which is passed through the voids of the polypropylene fibre mixed Pervious concrete and the water is retained to another pen that stored water measures is 860 ml.

Polypropylene Fiber Mixed Pervious Concrete

1000 ml water which is passed through the voids of the polypropylene fiber mined pervious concrete cube and the water is retained to another pan that stored water measures it is 970 ml.

a. The permeability of polypropylene fiber mixed pervious concrete is increased as comparison to the plain pervious concrete

b. The 0.25% and 0.3% polypropylene fiber mixed pervious concrete is compressive strength is less but the permeability is more than 0.2% polypropylene fiber mixed pervious concrete

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 5.928

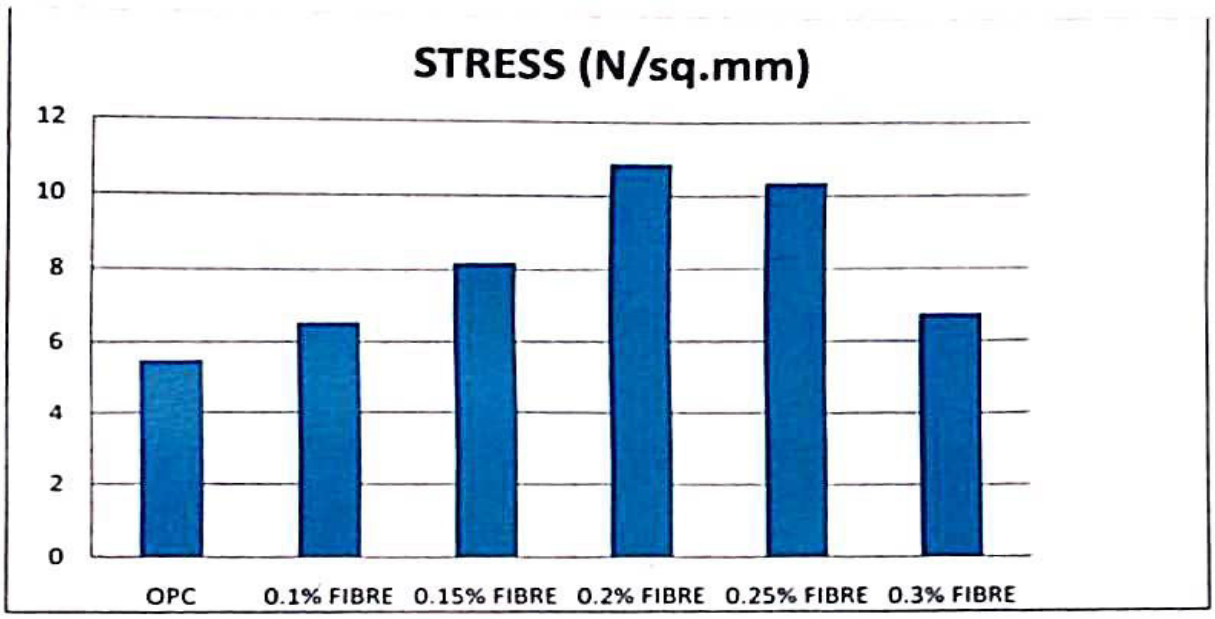
| Volume 4, Issue 6, June 2021 |

c. The strength of pervious concrete is increased when fiber used in 0.2% more than of its used the strength decreased. So we conclude that the ratio of fiber used as less than 0.2%

Bar Chart

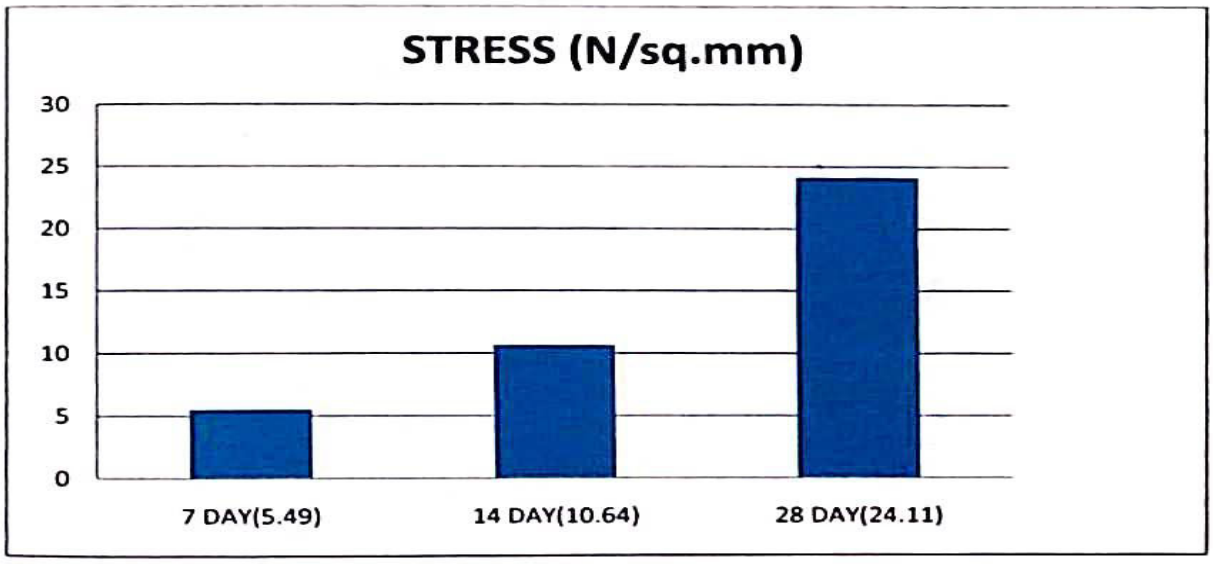
Bar Chart Increase in Stress with increase in Percentage of Polypropylene Fibre (M20)

Graph No. 4



Bar Chart for M20 Plain Cement PerviousConcrete

Graph No. 5

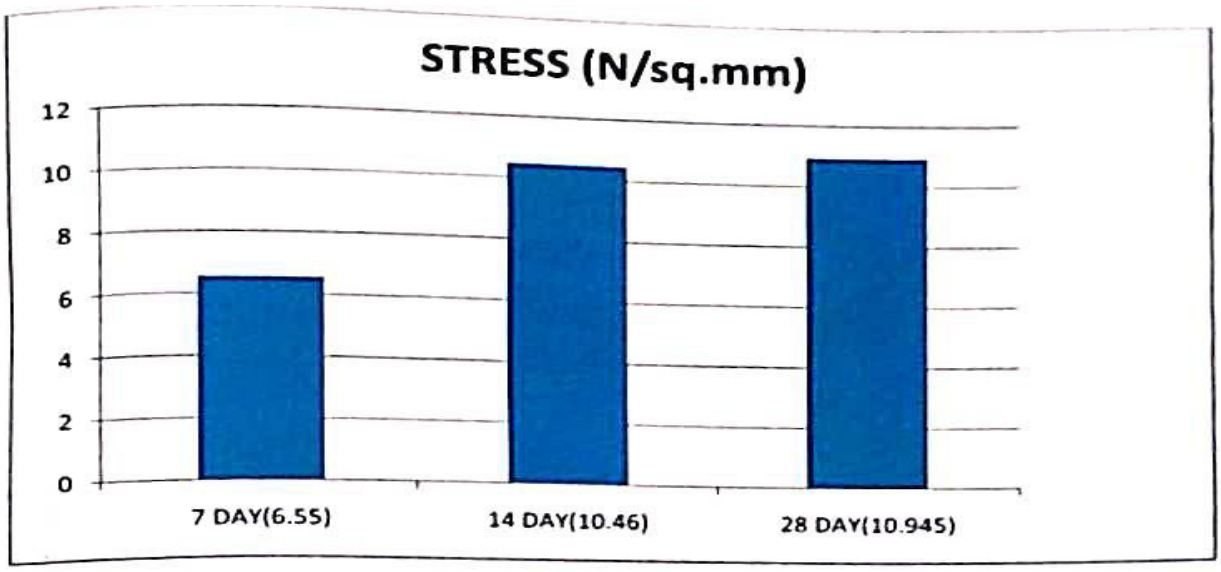


Bar Chart for M20 Plain cementPervious concrete with 0.1% of Polypropylene Fibre

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 5.928

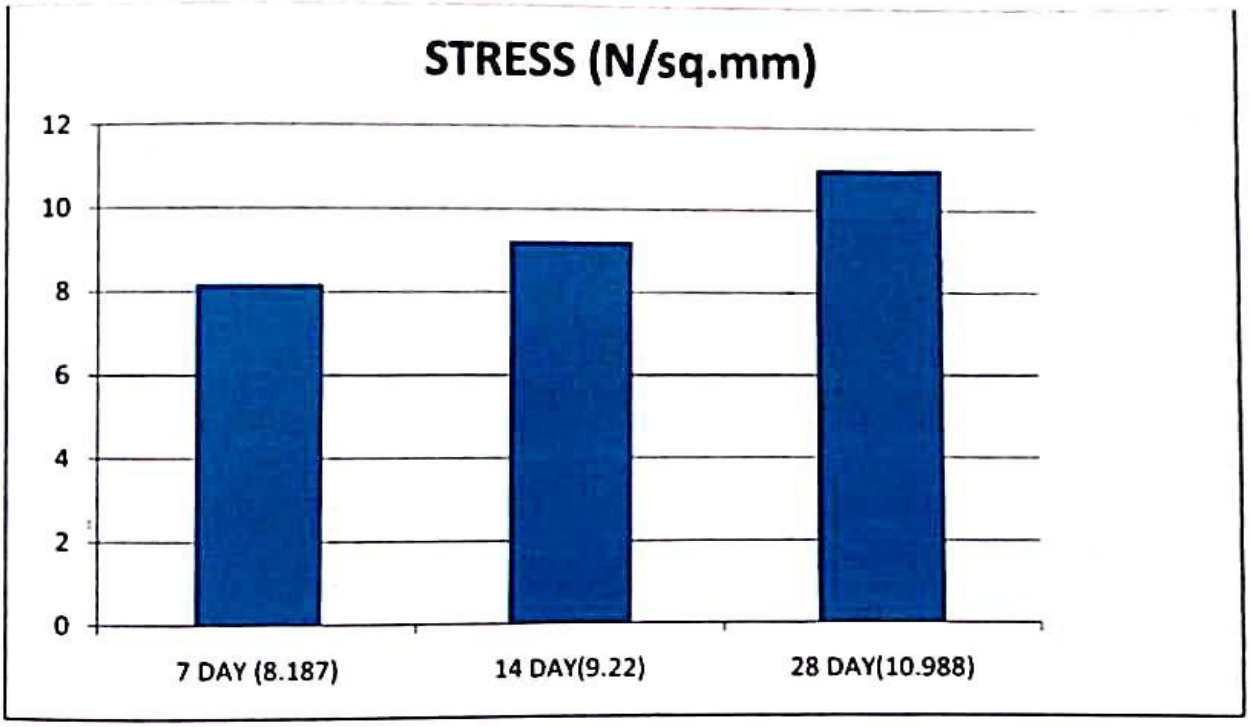
| Volume 4, Issue 6, June 2021 |

Graph No.6



Bar Chart for M20 Plain Cement Pervious Concrete with 0.15% of Polypropylene Fiber

Graph No. 7

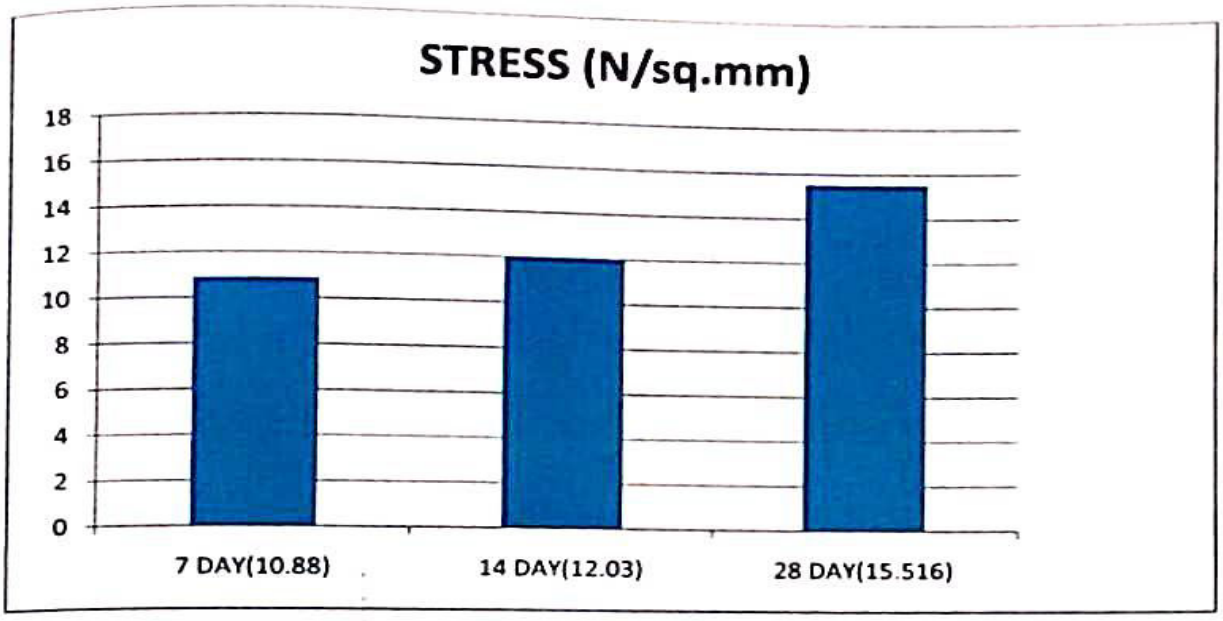


Bar Chart for MIZO Plain Cement Pervious Concrete with 0.2% of Polypropylene Fiber

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 5.928

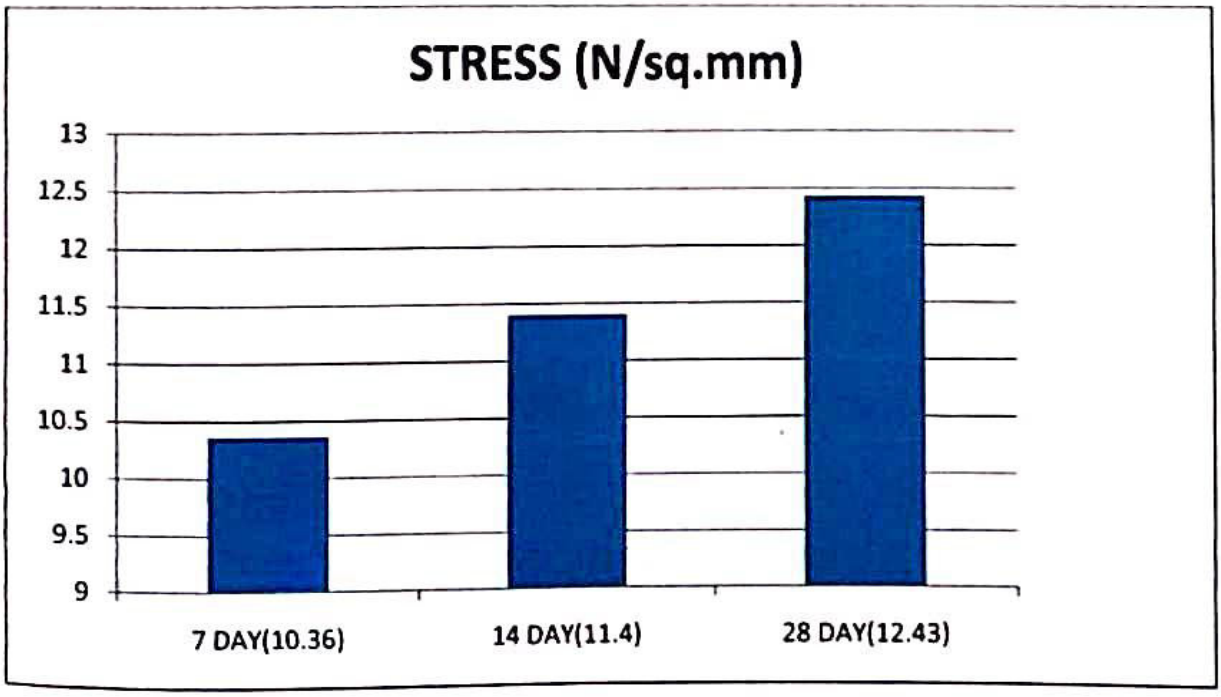
| Volume 4, Issue 6, June 2021 |

Graph No.8



Bar Chart for M20 Plain Cement Pervious Concrete with 0.25% of Polypropylene Fiber

Graph No. 9

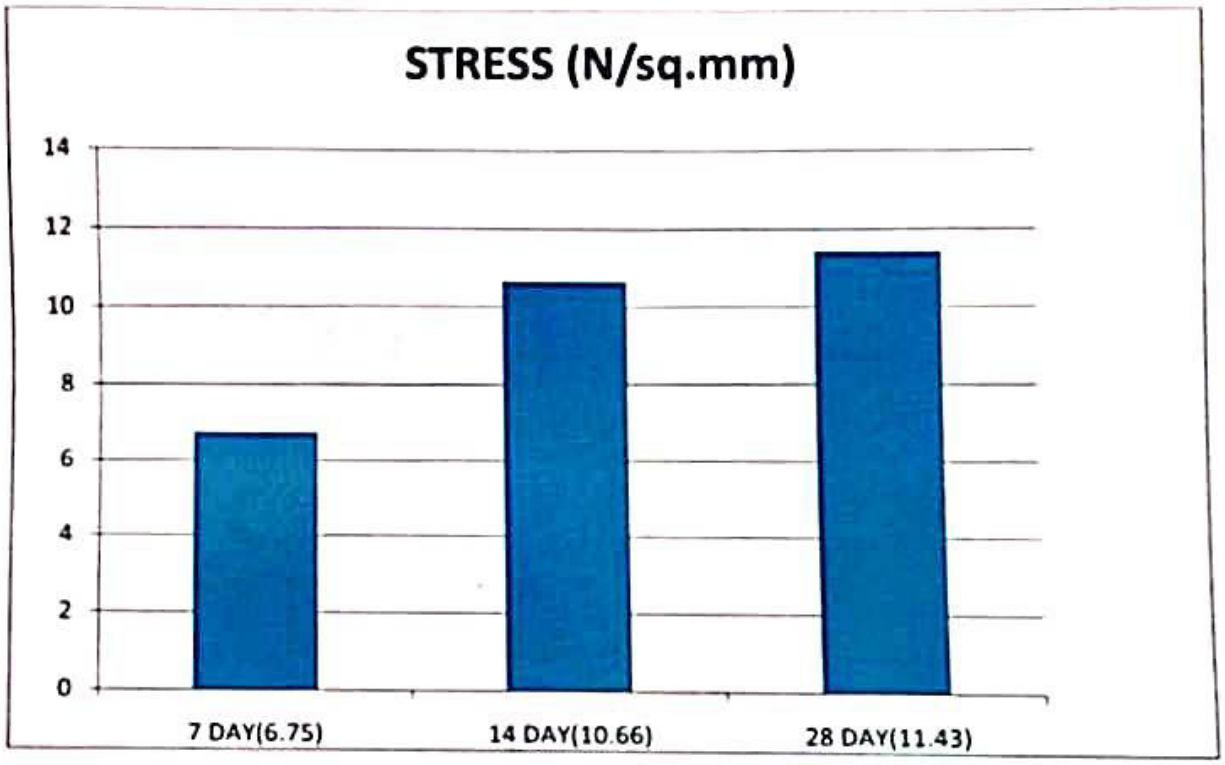


Bar Chart for M20 Plain Cement Pervious Concrete with 0.3% of Polypropylene Fiber

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 5.928

| Volume 4, Issue 6, June 2021 |

Graph No. 10



V. FUTURE WORK

1. The effect of gradation of aggregate on different properties of Pervious concrete should be investigated
2. The effect of fibers on pervious concrete should be investigated
3. Investigate the effects of core pregate on the comparable durability compressive strength.
4. Investigation the effect of coarse aggregate on the permeability.
5. Other than compressive and permeability text, toughness test, flexure test can also be performed

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