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Comparative Investigation of Pervious Concrete Using Banana and Nylon Fibre

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Abstract- Pervious Concrete had its earliest beginnings in Europe. In the 19th century pervious concrete was utilized in the variety of applications such as load bearing walls, prefabricated panels and paving. Pervious concrete is a composite material consisting of coarse aggregate, Portland cement and water. Pervious concrete is a unique kind of concrete with high porosity that reduces the water runoff from particular site and promote to ground water recharge including banana and nylonfibers in the previous concrete matrix provides a number of benefits to the durability of the pavement. By using banana and nylon fiber and selecting appropriate configuration as well as the dosage level and length is critical to the successful use. The concrete with using banana and nylon fibres is the disruption of the void network within the cross section of the pavement. Thus it is critical to select the appropriate configuration, length and dosage level. Addition of banana and nylon fibreseffects on the properties of pervious concrete. This investigation shows comparison of effects of banana and nylonfibres on the properties of pervious concrete.

Index Terms-Banana fibres, Nylon Fibres, Pervious concrete, compressive strength, permeability.

1. INTRODUCTION

Increase in infrastructure development and resulting increase in urban storm water over the past few decades have led to increase in pollution and runoff problem. As more available land area in the major cities gets paved over, a maximum quantity of rainfall ends up falling on impermeable surfaces such as parking area, driveways, sidewalks, and highways rather than to pass into the ground. Pervious concrete is a porous concrete paving material with a high porosity which permits water to percolate through it, made by using large aggregates with little or no fine aggregates. Pervious concrete was first used in the 1800s in Europe as pavement surfacing and load bearing walls. It became popular again in the 1920s for two story homes in Scotland and England. It became increasingly viable in Europe after the Second World War due to the scarcity of cement. It did not become as popular in the US until the 1970s. In India it becomes popular in 2000. Pervious concrete is made by eliminating most or all fine aggregates from the concrete mix. Its internal interconnected void space allows storm water to percolate and thus to reduce the amount of run-off. The permeability or the saturated hydraulic conductivity of the pervious concrete signifies its capacity to drain the ponding water from the concrete surface. It quantifies the resistance of the medium to flow and depends only on the characteristics of the porous medium.It is an important application for sustainable construction and is one of many low impact development technique used by builder to protect water quality. It is usually a mixture of 4.75mm to 6mm average diameter aggregate, cement and water. Pervious concrete contains voids and these voids are held together by cement paste after the installation. The water cement ratio used in this study is 0.45. To reinforce pervious concrete with various proportionsof nylon fibers (i.e. 0.1%, 0.2%, 0.3% and 0.4% of weight of concrete).Fibre reinforced pervious concrete pavements are more efficient than ordinary cement concrete pavement. The fibres may be of steel, polymer or natural polymer. Banana and Nylon fibres are used in this study.

2. LITERATURE REVIEW

1. NaliniThakre, Hirendra Rajput, Jaya Saxena, Harish Mitangale (2014)presented a paper on "comparative studyon strength and permeability of pervious concrete by usingnylon and polypropylene fiber. The fibers are used invarious proportions i.e., 0.1%, 0.15%, 0.2% etc. of volumeof concrete. Also the paper says about types of fibres helpto increase the properties of pervious concrete. The fibresare glass fibers, natural fibers like flax, hemp, jute,banana and coir, synthetic fibers like nylon, polypropylene, carbon, polyester etc. Natural reinforcing materials can be obtained at low cost and low levels ofenergy using local manpower and technology. The test result also indicated that the compressed strength of nylon and polypropylene fiber up-to 0.2% of used result get increased. And the permeability of fiber mixed pervious concrete is increased as comparison to the plain pervious concrete.

2. Hussam A.A Rahman (2012)conducted a test on "some properties of fibre reinforced no fine concrete". The paper focuses on studying the mechanical characteristics of polypropylene and carbon fibre reinforced no fine aggregate concrete containing a different percentage offibre. Tests to determine

workability, density, compressive strength, split tensile strength and modulus of rupture were carried out. It was found that pervious concrete mixes with fibres have higher density than normal pervious concrete mixes containing polypropylene and carbon. The test results also indicated that the inclusion of fibre to the pervious concrete mixes increases compressive strength,split tensile strength and modulus of rupture.

3. Dhawal Desai (2010)studied the "effects of material properties on porosity of pervious concrete." This paper describes the effect of size of aggregates and proportion of cement, aggregate and water on porosity of pervious concrete. Different sample blocks were made in lab with variations in mixture to see the porosity for final conclusion. The samples in which aggregates above 20 mm were used were not porous from the base because of larger voids, the cement slurry settles down. Also in all those cubes in which compaction was done, the cement slurry settles down and thus made a flat bottom surface. So finally the conclusion was to use aggregate in the range of 9.5 mm - l9 mm and to reduce compaction while filling to yield the best results. Also the density of the concrete is less than the normal one because fine aggregates where not used. Its strength is lower than normal concrete

3. MATERIALS.

Materials used are as follows

- Cement- OPC, 53 grade confirming to IS: 269-1976.
- Coarse aggregate- Coarse aggregates of sizes ranging from 4.75mm-6mm were used confirming to IS: 383-1987.
- Banana fibre
- Nylon Fibre

4. METHODOLOGY

Mix proportioning- Cement to coarse aggregate ratio was adopted as 1:3 by weight. The w/c ratio used for the mix was 0.45.

2. Collection of raw materials-All the necessary materials for preparing thefibre reinforced pervious concrete such as cement, coarse aggregate, Banana fibre and Nylon fibre etc. was collected.

3. Preliminary tests on cement and aggregate- Various tests were performed on cement such as specific gravity, fineness, consistency, initial and final setting time. The physical properties of coarse aggregate such as flakiness index, elongation index were studied.

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

5.Casting- Cubes and cylinders of pervious concrete are casted for testing compressive strength. Cubes were casted and for determining the splitting tensile strength cylindrical specimens were prepared.

6. Curing- After casting the specimen were allowed to remain in iron mould for 24 hours. The specimens were allowed to remain in water for 28 days

5. RESULT AND DISCUSSION

We have casted cubes of 150×150x150mm and cylinders of length 300mm and having diameter 150mm size for testing the strength values. Also casted cylinders of size 200×200mm for testing permeability. The water cement ratio used is 0.45. The workability is determined by using slump test and compacting factor test. The given slump in all mix are true slump and the compacting factor value is within the range between 0.8 to 0.9. So the concrete are highly workable.

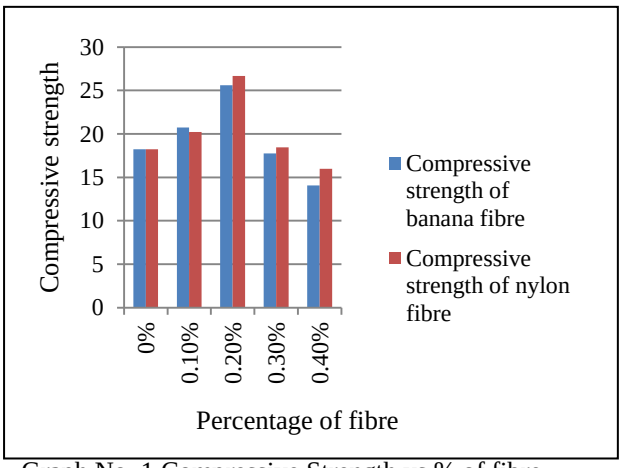
5.1 Compressive Strength

Table No.1 28 Day Compressive Strength by using Banana Fibre

% of Banana Fibre	Specimen1 (KN)	Specimen 2 (KN)	Specimen 3 (KN)	Average load (KN)	Strength (MPa)
0%	410	405	415	410	18.22
0.1%	470	460	480	466.66	20.74
0.2%	565	570	595	576.66	25.62
0.3%	390	400	410	400	17.77
0.4%	315	330	315	376.66	14.07

Table No. 228 Day Compressive Strength by using Nylon Fibre

% of Nylon Fibre	Specimen 1 (KN)	Specimen 2 (KN)	Specimen 3 (KN)	Average load (KN)	Strength (MPa)
0%	400	410	420	410	18.22
0.1%	455	445	465	455	20.22
0.2%	610	600	620	600	26.67
0.3%	405	425	425	415	18.44
0.4%	360	380	340	360	16



Graph No. 1 Compressive Strength vs % of fibre

From above graph optimum value will be at 0.2% of the fibre in pervious concrete. Further adding the % of fibre the compressive strength is goes on decreasing. The value

of compressive strength at the normal pervious concrete to 0.1% of fibre reinforced concrete is decreasing and from 0.1 to 0.2% it suddenly increases. The compressive strength obtained by adding nylon fibre is more than banana fibre.

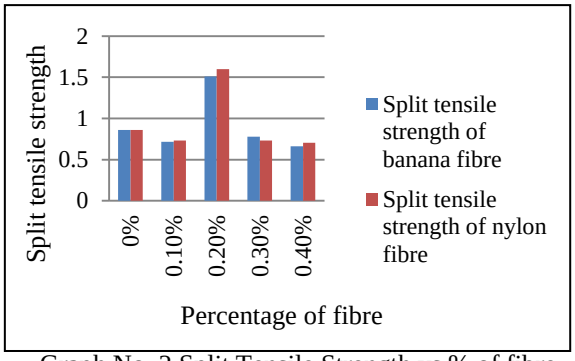
5.2 Split Tensile Strength

Table No. 3 Split Tensile Strength by using Banana Fibre

% of Fibre	Specimen 1 (KN)	Specimen 2 (KN)	Specimen 3 (KN)	Average load (KN)	Strength (MPa)
0%	56	65	62	61	0.862
0.1%	50	48	54	50.66	0.716
0.2%	90	110	120	106.6	1.508
0.3%	50	60	55	55	0.777
0.4%	55	40	45	46.67	0.66

Table No. 4 Split Tensile Strength by using Nylon Fibre

% of fibre	Specimen 1 (KN)	Specimen 2 (KN)	Specimen 3 (KN)	Average load (KN)	Strength (MPa)
0%	56	65	62	61	0.862
0.1 %	48	52	55	51.67	0.73
0.2 %	90	120	130	113.3	1.60
0.3 %	45	50	60	51.67	0.73
0.4 %	45	50	55	50	0.706



Graph No. 2 Split Tensile Strength vs % of fibre

From above graph, the optimum value will be at 0.2% of the fibre in pervious concrete. Further adding the % of fibre the split tensile strength is goes on decreasing. The value of split tensile strength at the normal pervious concrete to 0.1% of fibre reinforced concrete is decreasing and from 0.1 to 0.2% it suddenly increases. It is also observed that split tensile strength of pervious concrete using Nylon fibre is greater than Banana fibre.

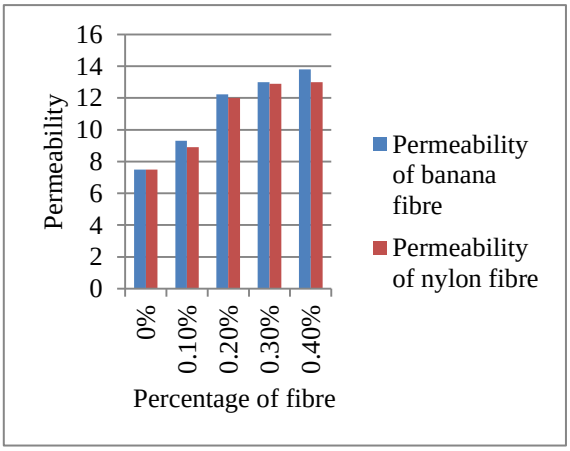
5.3 Permeability

Table No. 5 Permeability by using Banana Fibre

% of fibre	Specimen 1 (Litre)	Specimen 2 (Litre)	Specimen 3 (Litre)	Permeability (Litre)
0%	7.5	7.6	7.6	7.5
0.1%	9.4	9.3	9.5	9.3
0.2%	12.2	12	12.5	12.23
0.3%	13	12.8	13.2	13
0.4%	13.8	13.6	14	13.8

Table No. 6 Permeability by using Nylon Fibre

% of fibre	Specimen 1 (Litre)	Specimen 2 (Litre)	Specimen 3 (Litre)	Permeability (Litres)
0%	7.5	7.6	7.6	7.5
0.1%	8.8	9	8.9	8.9
0.2%	12	11.9	12.3	12
0.3%	12.9	12.7	13.1	12.90
0.4%	13	12.9	13.3	13



Graph No. 3 Permeability vs % of fibre

As the changes in the % of fibre content, the variation in the permeability values can be observed. As comparison to the nylon mixed pervious concrete the permeability of banana fibre mixed pervious concrete is increased. The increased permeability is caused due to increase in void ratio; water passing through concrete specimen is increase when the no of specimen is increase when the no of voids increases. From this graph it is clear that, the permeability will increases by increasing the fibre content. From the permeability characteristic, it is obtained that the permeability in $1m^2$area is nearly 248 liters. So banana fibre reinforced pervious concrete is effective than nylon fibre reinforced pervious concrete.

6. CONCLUSION

Evaluating the strength and permeability characteristic of pervious concrete and comparing the behavior of banana fibre reinforced pervious concrete with nylon fibre reinforced pervious concrete are the main objectives of this study. Various tests such as compressive strength

tests, split tensile strength tests, permeability tests were performed on concrete specimens. The following observations were made.

1. Compressive strength of banana fibre and nylon fibre mixed with pervious concrete is increased as comparison to the plain pervious concrete.
2. When we used the banana fibre and nylon fibre in pervious concrete in various proportion 0.1%, 0.2%, 0.3% and 0.4% of weight of concrete the result obtained by the compressive strength of banana fibre and nylon fibre up to 0.2% of used gets increased. Compressive strength of pervious concrete using nylon fibre is found to be greater than compressive strength of pervious concrete using banana fibre.
3. The permeability of banana fibre and nylon fibre mixed pervious concrete is increased as comparison to the plain pervious concrete. The permeability of banana fibre mixed pervious concrete is more than the permeability of nylon fibre mixed pervious concrete.
4. Split tensile strength of banana fibre and nylon fibre mixed with pervious concrete is increased as comparison to the plain pervious concrete.
5. When we used the banana fibre and nylon fibre in pervious concrete in various proportion 0.1%, 0.2%, 0.3% and 0.4% of weight of concrete the result obtained by the split tensile strength of banana fibre and nylon fibre up to 0.2% of used gets increased.
6. Split tensile strength of pervious concrete using nylon fibre is found to be greater than split tensile strength of pervious concrete using banana fibre.

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