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STRENGTH AND DURABILITY STUDIES OF RECRON 3S FIBER REINFORCED CONCRETE

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ABSTRACT:

The use of admixtures in concrete is becoming common in these days owning to the attempts made by the researches in the direction of utilization of materials, which are available in nature abundantly. The new additives RECRON 3S which is tried in recent times without any scientific study was found to be satisfactory. While there is much to be done in order to standardize the properties of the additives. An attempt is made in the present work to investigate of these additives on the compressive strength of cement concrete. The experimental study of this investigation consists of design of concrete mix of mix for characteristic mean strength. The mix was worked out giving certain proportions by keeping the obtained water-cement ratio constant this mix was obtained with water-cement ratio as 0.50. For the above mix, the additive (Recron-3S) is added with different percentages by volume of concrete. This paper describes the enhancement in the strength of the M30 grade concrete mix by the addition of recron 3S in the proportion of 0.0%, 0.1%, 0.2%, 0.3%, 0.4%, by volume of concrete were used in the. The tests were carried out to determine the mechanical properties of concrete upto 7, 14, 28, 56, 90 days for compressive strength, 28, 56, 90 days for split tensile strength and 28, 56, 90 days for flexural strength and durability. Slump test were carried on fresh concrete while compressive strength, split tensile strength and flexural strength were carried on hardened concrete. The slump test results conclude that the workability of the RECRON 3S fibre mixes goes on decreasing as the fibre content is increased in the concrete mix.

KEY WORDS: Recron- 3S, M30 Grade, Compressive Strength, Slump Test, Split Tensile Strength, Flexural Strength.

I. INTRODUCTION

Plain concrete possesses a very low tensile strength, limited ductility and little resistance to cracking. The presence of micro cracks at the mortar aggregate interface is responsible for the inherent weakness of plain concrete. Because of the poor tensile strength, cracks propagate with the application of load, leading to brittle fracture of concrete. Fibre in the cement based matrix acts as cracks arrester which restricts the growth of flows in the matrix, preventing these from enlarging under load, into cracks, which eventually cause failure. Also the supplementary cementitious

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material and additives such as ground granulated blast furnace slag (GGBS), pulverized fly ash, silica fume, Metakaolin, etc have been successfully used to enhance the properties of concrete. Production of cement results in a lot of environmental pollution as it involves the emission of COR 2R gas. Supplementary cementitious materials (SCM) are finely ground solid materials that are used to replace a portion of the cement in a concrete mixture. Various types of pozzolanic materials that improve cement properties have been used in cement industry for a long time. Recron-3s is a polypropylene monofilament, discrete, discontinuous short fibre that can be used in concrete to control and arrest cracks. Recron 3s fibre reduces rebound splattering of concrete and Shotcrete. This reduces wastage of mortar and speeds up the space of work. They reduce bleeding so solids in the concrete don't settle as much, and they increase the tensile strength. More importantly it saves a great deal of labour employed for the job. The gains are higher when plastering is in progress at higher floors, ceilings and outside surfaces of the buildings.

Fiber-reinforced concrete (FRC) is concrete containing fibrous material which increases its structural integrity. It contains short discrete fibers that are uniformly distributed and randomly oriented. Fibers include steel fibers, glass fibers, synthetic fibers and natural fibers – each of which lend varying properties to the concrete. In addition, the character of fiber-reinforced concrete changes with varying concretes, fiber materials, geometries, distribution, orientation, and densities. Fibers are usually used in concrete to control cracking due to plastic shrinkage and to drying shrinkage. They also reduce the permeability of concrete and thus reduce bleeding of water. Some types of fibers produce greater impact, abrasion, and shatter resistance in concrete. Generally fibers do not increase the flexural strength of concrete, and so cannot replace moment–resisting or structural steel reinforcement. Indeed, some fibers actually reduce the strength of concrete. Some recent research indicated that using fibers in concrete has limited effect on the impact resistance of the materials. This finding is very important since traditionally, people think that ductility increases when concrete is reinforced with fibers. The results also indicated that the use of micro fibers offers better impact resistance to that of longer fibers. In the present study Recron 3s fiber reinforced concrete mixes and various such as w/c ratio, type of fiber, volume, aspect ratio and its effect on strength has now been well established and much research has been carried up to date. The improvement in strength of Recron reinforced concrete is accompanied by a relatively greater increase in flexural toughness & impact resistance, which are important factors. The structural behavior of Recron fiber reinforced concrete needs to be examined.

II. LITERATURE REVIEW

B Venkat Narsimha Rao, M Mahesh, Ch Satya Sri

This paper explains on RECRON FIBRE REINFORCED CONCRETE PAVEMENTS, which is a recent advancement in the field of reinforced concrete pavement design. FRC pavements prove to be more efficient than conventional RC pavements, in several aspects, which are explained in this paper. RFRC can be used advantageously over normal concrete pavement. Polymeric fibers such as polyester or polypropylene (Recron fibers) are being used due to their cost effective as well as corrosion resistance. RFRC requires specific design considerations and construction procedures to obtain optimum performance. The higher initial cost by 15-20% is counterbalanced by the reduction in maintenance and rehabilitation operations, making RFRC cheaper than flexible pavement by 30-35%. In a fast developing and vast country like India, road networks ensure mobility of resources, communication and in turn contribute to growth and development.

Resistance to change though however small disturbs our society; hence we are always reluctant to accept even the best. It's high time that we overcome the resistance and reach for the peaks.

Priya A. Bhosale, Urmila. R. Kawade

From last many decades, usage of concrete has increased on large scale all over the world. Concrete ingredients used are becoming more costly day by day and also demand for the same is increasing widely all over. These ingredients are also extinguishing with time and some of them are also polluting the surrounding environment on large scale. One of the main ingredients is cement, while production of cement CO2 is emitted out. Replacement of cement by a pozzalanic material named Ground Granulated Blast Furnace Slag, which is byproduct or waste product of steel manufacturing industries. Ground Granulated Blast Furnace Slag act as cost reducing ingredient and also increase many mechanical properties of concrete. Glass fiber of 12mm size were also added to increase both compressive and tensile strength of concrete. This concrete is more environments friendly and will give more life to concrete. To maintain workability for lower water/cement ratio and to maintain the effect of admixture added, Superplasticiser is added by trial and error method. Mechanical properties of pozzalanic concrete using GGBFS show that this concrete gives better compressive strength and increases durability of concrete. Glass fiber also increases mechanical properties like compressive strength, flexural strength and split tensile strength of concrete. This page revives all details of the material, test to be conducted on concrete using the supplementary admixture and literature showing the advantages of using GGBFS and Glass Fiber in concrete in different proportion.

A. M. Alhozaimy, P. Soroushian, F. Mirza

A comprehensive set of experimental data were generated regarding the effects of collated fibrillated polypropylene fibers at relatively low volume fractions (below 0.3%) on the compressive, flexural and impact properties of concrete materials with different binder compositions. Statistical analysis of results produced reliable conclusions on the mechanical properties of polypropylene fiber reinforced concrete, and also on the interaction of fibers and pozzolanic admixtures in deciding these properties. Polypropylene fibers were observed to have no statistically significant effects on compressive or flexural strength of concrete, while flexural toughness and impact resistance showed an increase in the presence of polypropylene fibers. Positive interactions were also detected between fibers and pozzolans.

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III. MATERIALS AND METHODOLOGY

Basically concrete is a versatile engineering material which can be mould in to wide verities of shapes when in wet condition. Concrete is a mixture of cement, fine aggregates, coarse aggregates, water, recron 3s and admixture (if any).

MATERIALS USED

A. CEMENT:

Cement is a binder, a substance used in construction that sets and hardens and can bind other materials together. The most important types of cement are used as a component in the production of mortar in masonry, and of concrete which is a combination of cement and an aggregate to form a strong building material. Ordinary Portland Cement (53 Grade) confirming to IS: 269-1976 was used throughout the investigation. Different tests were performed on the cement to ensure that it confirms to the requirements of the IS specifications.

B. FINE AGGREGATES:

It is the aggregate most of which passes 4.75 mm IS sieve and contains only so much coarser as is permitted by specification. According to source fine aggregate may be described as:

- Natural sand-it is the aggregate resulting from the natural disintegration of rock and which has been deposited by streams or glacial agencies.

- Crushed stone sand-it is the fine aggregate produced by crushing hard stone.

According to size the fine aggregate may be described as coarse sand, medium sand and fine sand. IS specifications classify the fine aggregate into four types according to its grading as fine aggregate of grading zone-1 to grading zone-4. The four grading zones become progressively finer from grading zone-1 to grading zone-4.90% to 100% of the fine aggregate passes 4.75mm IS sieve and 0 to 15% passes 150 micron IS sieve depending upon its grading zone.

C. COARSE AGGREGATES

It is the aggregate most of which is retained on 4.75 mm IS sieve and contains only so much finer material as is permitted by specification. According to source, coarse aggregate may be described as:

- Uncrushed Gravel or Stone– it results from natural disintegration of rock
- Crushed Gravel or Stone– it results from crushing of gravel or hard stone.
- Partially Crushed Gravel or Stone– it is a product of the blending of the above two aggregate..

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A coarse aggregate which has the sizes of particles mainly belonging to a single sieve size is known as single size aggregate. For example 20 mm single size aggregate mean an aggregate most of which passes 20 mm IS sieve and its major portion is retained on 10 mm IS sieve.

D. ROLE OF RECRON - 3S

Controls cracking Recron 3S prevents the micro shrinkage cracks developed during hydration, making the structure/plaster/component inherently stronger. Further, when the loads imposed on concrete approach that of failure, cracks will propagate, sometimes rapidly. Addition of Recron 3 s to concrete and plaster arrests cracking caused by volume change (expansion and contraction), simply because 1 kg of Recron 3s offers millions of fibres which support mortar/concrete in all directions like Reduction in Water Permeability, Reduction in Rebound Loss, Increase in Flexibility etc., .The modulus of elasticity of Recron 3s is high with respect to the modulus of elasticity of the concrete or mortar binder which helps in increasing flexural strength. The post cracking behaviour has shown its ability to continue to absorb energy as fibres pull out. Recron 3s is meant for improving the quality of construction, savings on wastage and for speeding up the work place. Recron 3s is meant for secondary reinforcement only. Christo Ananth et al.[7] analyzed microwave waveguides and components such as microwave T junctions , circulators, attenuators and Isolators.

D. WATER:

Fresh and clean water is used for casting and curing of specimen. The water is relatively free from organic matters, silt, oil, sugar, chloride and acidic material as per requirements of Indian standard. Combining water with a cementitious material forms a cement paste by the process of hydration.

Mix Design for M30 Grade Concrete:

Final Trial Mix for M30 Grade Concrete is 1:1.86:2.89 at w/c of 0.50

GRADES OF CONCRETE	CEMENT(OPC53) (kg/m3)	RECRON 3S FIBER	FINE AGGREGATES (kg/m3)	COARSE AGGREGATES (kg/m3)	WATER CONTENT (Liters/m)
M30	225	0.05KG	417.60	646	112.2555
Addition of extra 10%	245.7	0.055kg	459.36	710.6	123.48105

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IV. RESULTS AND ANALYSIS

I. MATERIAL PROPERTIES:

A. CEMENT:

Sl.no	Test	Results	IS code used	Acceptable limit
1	Specific gravity of cement	3.160	IS:2386:1963	3 to 3.2
2	Standard consistency of cement	6mm at 34% w/c	IS:4031:1996	w/c ratio 28%-35%
3	Initial and final setting time	45 mins and 10 hours	IS:4031:1988	Minimum 30mins and should not more than 10 hours
4	Fineness of cement	3.00%	IS:4031:1988	<10%

B. COARSE AGGREGATES

Sl.no	Test	Results	Is code used	Acceptable limit
1	Fineness modulus	6.5	IS:2386:1963	6.0 to 8.0mm
2	Specific gravity	2.90	IS:2386:1963	2 to 3.1mm
3	Porosity	46.83%	IS:2386:1963	Not greater than 100%
4	Voids ratio	0.8855	IS:2386:1963	Any value
5	Bulk density	1.50g/cc	IS:2386:1963	-
6	Aggregate impact value	37.5	IS:2386:1963	Less than 45%
7	Aggregate crushing value	26.6%	IS:2386:1963	Less than 45%

C. FINE AGGREGATES:

Sl.no	Test	Result	Is code used	Acceptable limits
1	Fineness modulus	4.305	IS:2386:1963	Not more than 3.2 mm
2	Specific gravity	2.43	IS:2386:1963	2.0 to 3.1
3	Porosity	36.6%	IS:2386:1963	Not greater than 100%
4	Voids ratio	0.577	IS:2386:1963	Any value
5	Bulk density	1.5424	IS:2386:1963	-
6	Bulking of sand	3.0%	IS:2386:1963	Less than 10%

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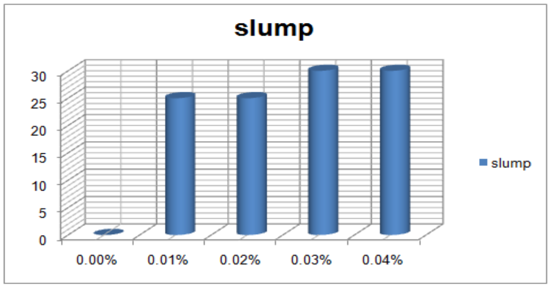
II. CONCRETE TESTS

A. TESTS ON FRESH CONCRETE:

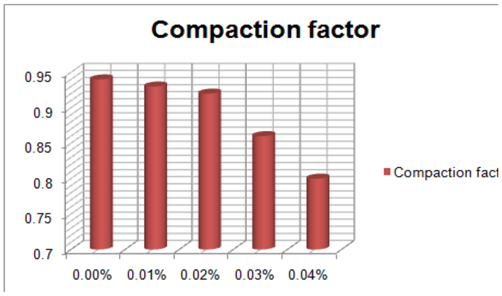
SLUMP CONE TEST:

S.no	% of Recron 3S fiber	Slump in mm
1	0.00%	0
2	0.01%	25
3	0.02%	25
4	0.03%	30
5	0.04%	30



COMPACTION FACTOR TEST

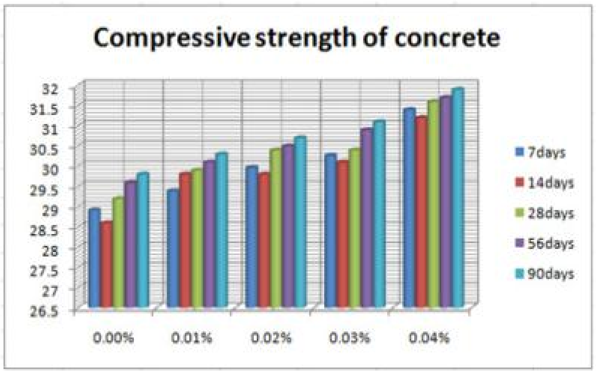
S.no	% of Recron 3S fiber	Compaction factor
1	0.00%	0.94
2	0.01%	0.93
3	0.02%	0.92
4	0.03%	0.86
5	0.04%	0.80



B. TESTS ON HARDENED CONCRETE

COMPRESSIVE STRENTH OF CONCRETE

S.no	% of Recron 3S fiber	Compressive strength of concrete				
		7days	14days	28days	56days	90days
1	0.00%	28.92	29.40	29.96	30.26	31.40
2	0.01%	28.60	29.80	29.80	30.10	31.20
3	0.02%	29.20	29.90	30.40	30.40	31.60
4	0.03%	29.60	30.10	30.50	30.90	31.70
5	0.04%	29.80	30.30	30.70	31.10	31.90



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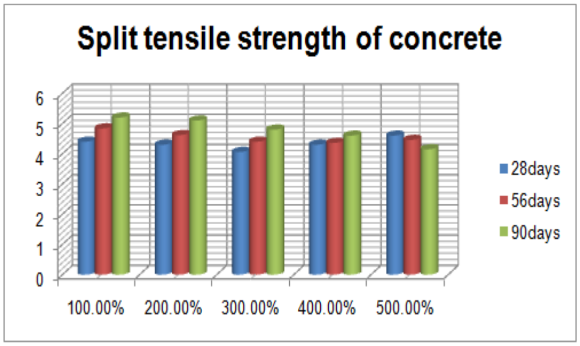
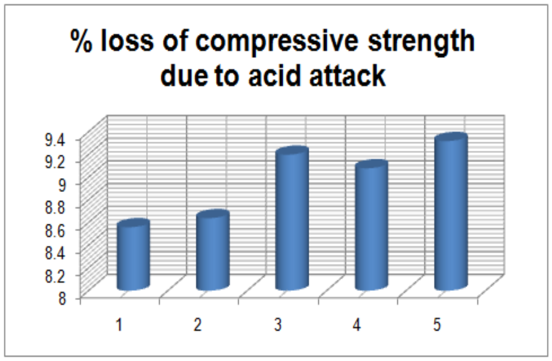
SPLIT TENSILE STRENGTH OF CONCRETE

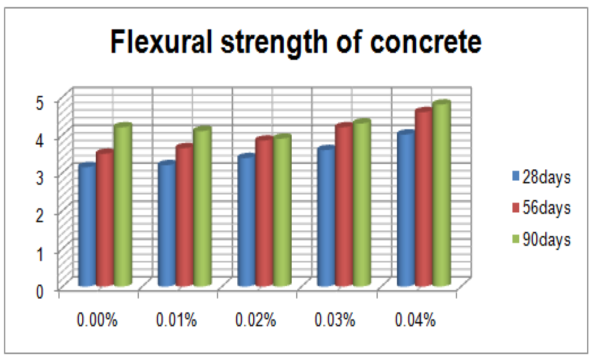




S.no	% of *Recron 3S fiber*	`Split Tensile Strength Of Concrete		
		28days	56days	90days
1	*0.00%*	4.40	4.84	5.20
2	*0.01%*	4.30	4.62	5.10
3	*0.02%*	4.06	4.40	4.80
4	*0.03%*	4.30	4.36	4.60
5	*0.04%*	4.60	4.46	4.15

FLEXURAL STRENGTH:

S.no	*% of Recron 3S fiber*	`Flexural Strength Of Concrete		
		28days	56days	90days
1	*0.00%*	3.15	3.50	4.20
2	*0.01%*	3.20	3.65	4.10
3	*0.02%*	3.39	3.85	3.90
4	*0.03%*	3.60	4.20	4.30
5	*0.04%*	4.01	4.60	4.80



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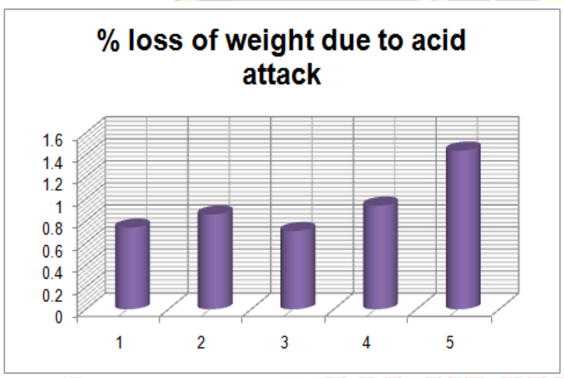
C. DURABILITY

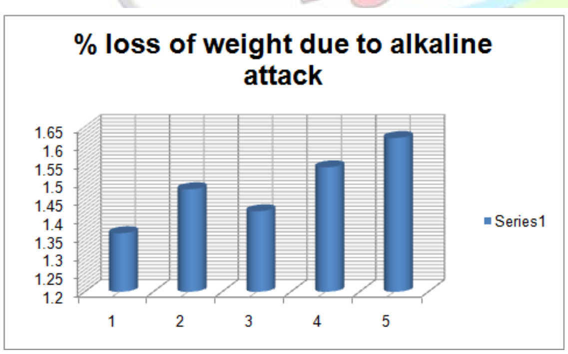
1. ACID ATTACK

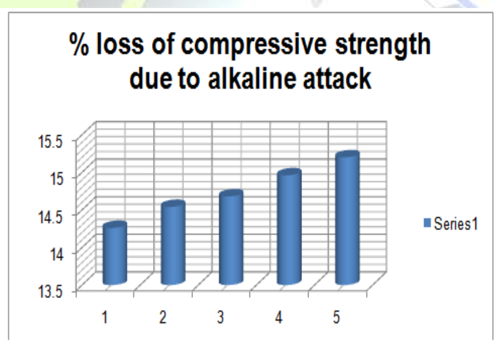
Sl.no	% of Recron 3S fiber	Initial weight of cube after 28days curing in grams	Final weight of cubes after 90days curing in grams	% loss of weight due to acid attack	Compressive strength of cube after 28days curing	Compressive strength of cubes after 90days curing	% loss of compressive strength due to acid attack
1	0.00%	2355	2337	0.74	29.96	27.40	8.56
2	0.01%	2335	2315	0.86	28.34	25.90	8.64
3	0.02%	2265	2249	0.71	27.60	25.06	9.20
4	0.03%	2230	2209	0.94	26.40	24.00	9.08
5	0.04%	2394	2360	1.44	26.90	24.40	9.32

1. ALKALINE ATTACK



Sl. No	% of Recron 3S fiber	Initial weight of cube after 28days curing in grams	Final weight of cubes after 90days curing in grams	% loss of weight due to alkaline attack	Compressive strength of cube after 28days curing	Compressive strength of cubes after 90days curing	% loss of compressive strength due to alkaline attack
1	0.00%	2286	2255	1.36	29.96	25.69	14.26
2	0.01%	2340	2305	1.48	28.34	24.22	14.54
3	0.02%	2280	2248	1.42	27.60	23.55	14.68
4	0.03%	2310	2275	1.54	26.40	22.45	14.96
5	0.04%	2296	2259	1.62	26.90	22.81	15.20





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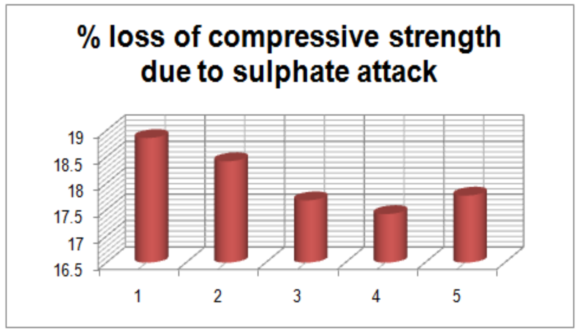
1. SULPHATE ATTACK TEST

Sl.no	% of Recron 3S fiber	Compressive strength of cube after 28days curing	Compressive strength of cubes after 90days curing	% loss of compressive strength due to sulphate attack
1	0.00%	29.96	24.31	18.86
2	0.01%	28.34	23.12	18.42
3	0.02%	27.60	22.72	17.68
4	0.03%	26.40	21.80	17.42
5	0.04%	26.90	22.12	17.77



V. CONCLUSIONS

1. The material properties of the cement, fine aggregates and coarse aggregates are within the acceptable limits as per IS code recommendations so we will use the materials for research.

2. Slump cone value for the RECRON 3S fiber reinforced concrete increases with increasing in the percentage of fibers so the concrete was not workable.

3. Compaction factor value of RECRON 3S fiber reinforced concrete decreases with increase in the percentage of fibers and the maximum values of compaction factor was observed at 0.01% of RECRON FIBER.

4. The compressive strength of concrete is maximum at 0.04% of 3S fiber reinforced concrete and is the optimum value for 7days curing, 28days curing, 56days curing, 90days curing.

5. Split tensile strength for the cylindrical specimens is maximum at 0.01% of RECRON 3S for 28days curing, 56days curing, 90days curing.

6. The flexural strength of RECRON 3S fiber maximum at 0.04% of RECRON fiber for 28days curing, 56days curing, 90days curing.

7. The percentage loss of weight and percentage loss of compressive strength is increases with in increasing the percentages in all cases in durability studies in RECRON 3S fiber reinforced concrete. So, the RECRON 3S fiber reinforced concrete is durable upto 0.04% replacement.

8. RFRC can be used advantageously over normal concrete pavement. Polymeric fibers such as polyester or polypropylene (Recron fibers) are being used due to their cost effective as well as corrosion resistance.

9. In a fast developing and vast country like India, road networks ensure mobility of resources, communication and in turn contribute to growth and development.

10. Resistance to change though however small disturbs our society; hence we are always reluctant to accept even the best. Its high time that we overcome the resistance and reach for the peaks.

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