Recron Fibre Reinforced Concrete Pavements

[1]B Venkat Narsimha Rao, [2] M Mahesh, [3]Ch Satya Sri
[1] Assistant Professor, [2] Assistant Professor, [3] Assistant Professor
Department of Civil Engineering
Princeton College of engineering & Technology, JNTUH, TS, India.

***Abstract* - Road transportation is undoubtedly the lifeline of the nation and its development is a crucial concern. The traditional bituminous pavements and their needs for continuous maintenance and rehabilitation operations points towards the scope for cement concrete pavements. There are several advantages of cement concrete pavements over bituminous pavements. 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. The design procedure and paving operations of FRC are also discussed in detail. A detailed case study of Polyester fiber waste as fiber reinforcement is included and the results of the study are interpreted. The paper also includes a brief comparison of FRC pavements with conventional concrete pavement. The merits and demerits of FRC pavements are also discussed. The applications of RFRC in the various construction projects in Kerala are also discussed in brief.**

***Index Terms* – Epoxy resin, Silica fume, Polymer mortar, Polymer concrete**.

I INTRODUCTION:

1.1. GENERAL INTRODUCTION:

Concrete is one of the most important materials among the building materials in all types of civil engineering works. Since the adaptation of concrete as a building material, lot of researches and studies has been made to improve the quality, strength and durability of it. By the same time efforts are also being made to economize concrete construction compared to other materials.

Plain concrete is good in compression but weak in tensile strength with very limited ductility and little resistance to cracking. Internal micro cracks are inherently present in concrete and its poor tensile strength is due to propagation of such micro cracks, eventually leading to brittle fracture of concrete. Generally in case of rigid pavements cracks are formed due to the variation in temperature, shrinkage and heavy moving loads.

Attempts have been made to reduce the cracks and impart improvements in tensile property of concrete members using conventionally reinforced steel bars and also by applying restraining techniques. Although both these methods provide tensile strength to concrete members, they however do not increase the tensile strength of concrete itself. In plain concrete and similar brittle materials, structural micro cracks develop even before loading due to drying and shrinkage or other causes of volume changes. When loaded these micro cracks propagate and open up owing to effect of stress concentration.

It has been recognized that the addition of small closely spaced and uniformly dispersed fibers to concrete would act as crack resistance and substantially improve its static and dynamic properties. This type of concrete is known as FIBER REINFORCED CONCRETE. In these dissertations an attempt will be made to view the behavior of concrete mixed with RECRON 3s FIBRE in comparison with plain concrete.

1.2. STATEMENT OF THE PROBLEM:

Since the concrete is weak in tension, heavy reinforcements have to be made the concrete to increase its tensile and flexural strength. This increases the cost of the structure to a larger extent. Also the corrosion of the reinforcements is a major problem. Further concrete is brittle so its impact strength is also quiet low.

1.3. OBJECTIVE OF THE STUDY:

The following are the main objective of study:

- Compare the crushing strength of plain cement concrete with fiber reinforced concrete.
- To evaluate flexural strength of plain cement concrete and fiber reinforced concrete.
- Evaluate split tensile strength of plain cement concrete with fiber reinforced concrete.

1.4. SCOPE OF THE WORK:

The properties of Recron fiber reinforced concrete mixes and various factors 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.

1.5. EXPERIMENTAL METHODOLOGY:

1. Properties of all ingredient materials cement, sand, aggregate, water, Recron fiber required for RFRC are studied experimentally.
2. The design of required concrete mix is prepared.
3. For different doses of fibers, the concrete parameters such as compressive strength, flexural and split tensile strength is determined.

4. Based on the experimental results the compressive strength, flexural strength and split tensile strength for various dosages are compared with conventional concrete.

II LITERATURE REVIEW:

3.1 SREETAM KANUNGO'S TRAINING AT RSP, ROURKELA

Normal reinforcing steel is designed to take account of all tensile and bending stresses as well as temperature related stresses in concrete structures. The design parameters are well established in the Indian Standard Code I.S. 456 and are minimum structural requirement for design and construction. These required steel are termed for this paper as primary steel. Use of secondary reinforcements does not alter the requirements of "Primary Steel".

But structural reinforcement does not provide its benefits until concrete hardens. Hence secondary reinforcement in form of fiber reinforcement should be added to concrete is still in plastic stage. They enhance some of the properties of hardened concrete also. Hence it is proved that by addition of small quantities of evenly distributed secondary fiber reinforcement improves the static and dynamic properties of concrete.

Fiber reinforcement concrete provides the three dimensional random reinforcement in the entire mass of the concrete. The properties which fibers induce is totally intrinsic to the type and number of fibers being administered with concrete i.e. each type of fiber will induce different kinds of characteristics into the concrete mass. As a whole fiber reinforced concrete has greater resistance to Drying Shrinkage Cracking, Compressive strength, Tensile & Flexural strength, Abrasion and impact resistance and water permeability/penetration.

Recron 3s FRC has been approved by various governments, semi-government, private and industrial projects. It has been approved by

1. Airport Authority of India
2. Military Engineer Services
3. State PWD schedule of rates (Maharashtra, Gujarat, Rajasthan, J&K, Tamilnadu, and Karnataka &Assam)

It has been also used in major industrial and private project referred by structural consultants. The approval has been awarded after extensive field trials by all these authorities.

It has been supported by in depth details testing of the Recron 3s on all parameters at many institutes including IIT Chennai & Guahati, CRRI Delhi, REC sutra, GERI Ahmadabad, National Test House Kolkata, Airport Authority Delhi, REC Coimbatore, AI Futtain Bodycote Dubai etc.

3.2 Victor Y. Garas and C.
Vipulanandan Center for Innovative Grouting Materials and Technology (CIGMAT)
Department of Civil and Environmental Engineering

ABSTRACT

Polymer Concrete (PC) composites posses a unique combination of properties that depend upon the formulation. This study reviewed the variations in polyester polymer concrete mixture components that affected the properties. The effect of resin content, aggregates, fibers and coupling agents were critically reviewed. It was found that the
optimum polymer content varied from 12% to 14% (w/w). Using fibers and coupling agents showed further enhancement of the mechanical properties of PC. Also, a new database was designed to document different properties of PC.

1. Introduction

Polymer concrete (PC) is a composite material formed by combining mineral aggregates such as sand or gravel with a monomer. Due to its rapid setting, high strength properties and ability to withstand a corrosive environment, PC is increasingly being used as an alternate to cement concrete in many applications, construction and repair of structures, highway pavements, bridge decks, waste water pipes and even structural and decorative construction panels. These widely divergent uses clearly indicate that no commercially available product could be compounded to perform all these tasks well; therefore, the term PC should never suggest only one product, but rather a family of products. Advances in coupling agents and material science in general further optimize the PC mixtures. Information collected will be used in developing a database for polymer concrete and their corresponding properties and applications.

III OBJECTIVE OF THE PROJECT

1. FIBRE REINFORCED CONCRETE

1.1. GENERAL:

The use of fiber reinforced concrete can be tracted in history to the construction of the Roman Coliseum; still, it took several years of strong testimonials for the wide spread use to become main stream, the use of fibers in concrete has gained enormous popularity in the last decade.

In today's concrete industry, fibers can be broadly grouped into two categories:

1. Steel and
2. Synthetic.

Steel fibers are used in very specific applications are not typically used in common concrete slabs, pavements, or flatwork. Steel fibers are added to concrete where a high impact resistance is essential. Concrete floors subjected to a punishing, industrial environment (such as an automotive assembly plant) is where the use of steel fibers can easily be justified. Steel fibers will help to

reduce shrinkage, cracking, as well as synthetic fiber, however, it is not often one uses steel fibers for protection against shrinkage cracking alone. Steel fibers are found in a Varity of sizes and shapes. The most common being the 1.5” to 2” variety with a serrated shape and a diameter approximately 2mm. the dosage rates per cubic yard vary from 50 to 200 pounds.
Synthetic fibers are made from polypropylene, Recron, nylon or glass fibers.

Recron fibers are light weight and tend to be fairly buoyant meaning they can collect more at the surface of the slab. Nylon fibers are also light weight but heavier than Recron and May sometimes be consider more user friendly to the finisher. With the use of nylon and Recron fibers becoming more wide spread, fiber glass products have taken the back seat and its use diminished.

Freshly mixed concrete undergoes a variety of chemical; events. During the transformation from a fluid (plastic) material to a hardened material the chemical transformation occurring within the concrete creates heat. Though this heat is essential for early strength gained, it can also act as an enemy to the concrete in that is causes expansion. As the concrete continues to harden, a peak temperature is reached. From the point of peak temperature, the concrete begins to cool slowly and thus contact or shrink. This volume change can create stresses in the concrete, which may lead to what is referred to ads thermal cracking. Fibers help to bridge across the stressed areas and provide an interlocking matrix of connectivity.

Plastic shrinkage cracking is different than thermal cracking in that it is more related to moisture than internal heat. Before the initial hardened state is reached, weather conditions may dry out the surface of the concrete. Though the interior of the concrete maintains plasticity, the surface may completely dehydrate. Excessive moisture loss at the surface causes a premature stiffening and shrinkage. The similarity between thermal cracking and plastic shrinkage cracking is that both are caused by a volume change of the concrete mass. The differences are in the cause of the volume of the change.

1.2. HOW FIBRES WORK IN CONCRETE?

The problem: before we can learn to control a problem we must attempt to understand the cause of the problem, the tendency for concrete to crack has for years been accepted as natural to its use. There is only one reason that cracks occur in concrete at a specific time. There are two types of stress, which occur, on concrete, external and intrinsic. Providing higher structural strengths to concrete structures, pavements and slabs can offset stress from external forces. However, the intrinsic stress caused by shrinkage within the concrete itself have historical been a problem to control because of their unpredictable variety and occurrence due to climatic changes.

The most common type of intrinsic cracking occurs in the plastic state and is caused by plastic drying shrinkage. These cracks are formed within the first 24 hours after the concrete has been placed. Settlement and shrinkage cracks may not be observed until some latter date. They are often surface sealed by finishing operation or are simply not wide enough to be seen until the concrete shrinks further or a load causes these weak planes to escalate into visible cracks.

1.3. BENEFITS OF FIBRES IN CONCRETE:

FIBRES VERSUS WELDED WIRE FABRICS: both synthetic fibers and wire mesh used as secondary reinforcement can help control cracking. The primary differences are when and how well they work. Fibers are most beneficial soon after concrete placement by controlling the formation. Instead, the mesh merely holds the cracks together after they have formed, provided the wire is properly placed in concrete. From an economic standpoint, fibers are much more cost effective then wire (typically about half the cost of wire in a 4” slab) and unlike wire, fiber will not rust and cannot be misplaced in the concrete.

OTHER BENEFITS:

The effects of fibers on the behavior of plastic and hardened concrete vary depending on the concrete materials, mix proportions, fibers type, length and additional rate. Research from various sources generally agrees that synthetic fibers to concrete can improve the following properties (depending on additional rates).

i. Increased impact and shatter resistance.
ii. Increased abrasion resistance.
iii. Lower permeability.
iv. Provides toughness & post crack integrity.

1.4. FACTORS AFFECTING PROPERTIES OF FRC:

Fiber reinforced concrete is the composite material containing fibers in the cement matrix in the orderly manner or randomly distributed manner. Its properties would obviously depend upon the efficient transfer of stress between matrix and the fibers, and distribution of the fibers, mixing and compaction technique of concrete, and size and shape of the aggregate. These factors are briefly discussed below:

Relative fiber matrix stiffness:

The modulus of elasticity of matrix be much lower than that of fiber efficient stress transfer. Low modulus of fibers such as nylons and polypropylene are therefore unlikely to give strength improvement, but they help in the absorption of large energy and therefore, impact greater degree of toughness and resistance to impact. High modulus fibers such as steel, glass and carbon impact strength and stiffness.

Interfacial bond between the matrix and the fiber also determine the effectiveness of stress transfer from the matrix to the fiber. A good bond is essential for improving tensile strength of the composite. The interfacial bond is could be improved by larger area of contact, improving the frictional properties and degree of griping and by treating the steel fiber with sodium hydroxide or acetone.

Orientation of fiber:

One of the differences between conventional reinforcement and fiber reinforcement is that in conventional reinforcement, bars are oriented in the direction desired while fibers are randomly oriented. To see the effect of random, mortar specimens reinforced with 0.5% volume of fibers were tested. In one set specimens, fibers were allied in the direction of the load, in another in the direction perpendicular, to that of the load and in the third randomly distributed.

It was observed that fibers aligned parallel to the applied load offered more tensile strength and toughness than randomly distributed are perpendicular fibers.

Workability and compaction of concrete:

Incorporation of steel fiber decreases workability considerably, the situation adversely affects the consolidation of fresh mix. Even prolonged external vibration face to compact the concrete, the fiber volume at which this situation is depends on the length and diameter of the fiber.

Another consequence of poor workability is non uniform distribution of the fiber. Generally, the workability and compactions standard of the mix is improved through increased water/cement ratio or by the use of some kind of water reducing admixtures.

Several investigations recommended that the maximum size of coarse aggregate should be restricted to 10mm, to avoid appreciable reduction in strength of the composite. Fibers are also act as aggregate. Although they have a simple geometry, their influence on properties of fresh concrete is complex. The inter particle friction between fibers and aggregates controls the orientation and distribution of the fibers and consequently the properties of the composite. Friction reducing admixtures and admixtures that improve the cohesiveness of the mix can significantly improve the mix.

1.5. TYPES OF FIBERS:

Although every type of fiber has been tried out in cement and concrete, not all of them can effectively and economically used. Each type of fiber has its characteristics properties and limitations. Some of the fibers that could be used are Recron, polypropylene, steel, nylon, asbestos, coir, glass and carbon fibers.

Fiber is a small piece of reinforcing material possessing certain characteristics properties. They can be circular or flat. The fiber is often described by a convenient parameter called “aspect ratio”.

The aspect ratio of the fiber is the ratio of its length to its diameter typical aspect ratio from 30 to 150.

i. polypropylene fiber:

Polypropylene is an economical material that offers a combination of outstanding physical, mechanical, thermal and electrical properties not found in any other synthetic fibers. There are two general types of fibers currently available in the market. These are referred to as fibrillated and monofilament.

ii. Recron fiber:

Reliance industry limited (RIL) has launched Recron 3s fibers with the objective of improving the quality of plaster and concrete. The general properties and applications of RECRON 3s fiber reinforced concrete used in construction. The thinner and stronger elements spread across entire section, when used in low dosage arrests cracking.

1.6. DETAILS OF RECRON 3s FIBER:

Reliance industry limited (RIL) has launched Recron 3s fibers with the objective of improving the quality of plaster and concrete.

Recron 3s is a triangular polyester fiber in cross section with cut length of 6mm & 12mm which is being widely used in the Indian construction industry market. It is much cheaper than any other imported construction fibers. At the specified dosage of 0.25% by wt of cement there are millions of fibers which form a mesh in the concrete. The spacing is approx less than 1mm between any two fiber filaments in any coordinate of the matrix.

This describes the general properties and application of RECRON 3s fiber reinforced concrete used in construction. The thinner and stronger elements spread across entire section, when used in low dosage arrests cracking.

Fabrication:

Before mixing the concrete, the fiber length, amount and design mix variables are adjusted to prevent the fibers from balling. Fiber – reinforce cement boards contain no coarse aggregate. These products are usually made, by spraying mortar and fine cut fiber simultaneously. Mortar with a high water: cement ratio is used to facilitate spraying.

Other application methods include simple casting, which is less versatile than spraying, and press moulding which results in a lower effective water: cement ratio, thus producing a stronger product. Super plasticizer, when added to fiber – reinforced concrete, can lower water: cement ratios, and improve the strength, volumetric stability and handling characteristics of the wet mix.

Aspect Ratio:

Ti is defined as the ratio of fiber length to equivalent fiber diameter. The diameter of Recron 3s fiber is 33-35 micron. So we neglect aspect ratio of Recron fiber.

1.7. SPECIFICATIONS	
diameter	33-35 micron
cut length	6mm, 12mm, 24mm
tensile strength	6000kg/cm^2
Melting point	>250^{0}C
Dispersion	Excellent
Acid Resistance	Excellent
Alkaline resistance	Good
Elongation	45-55%
Moisture	<1%

PICTURES OF RECRON FIBRES

1.9. PROPERTIES OF RFRC:

SHRINKAGE CRACKS:

Concrete will crack. The use of RFRC prevents the formation of micro cracks and further propagation of micro cracks into macro cracks at higher alternate stress cycles. The huge number of uniformly dispersed fibers controls the bleeding/segregation and improved homogeneity.

These fibers with high tensile strength bridge the cracks even after opening up by being present through the crack plane. Cracking leads to interstices and fissures through which water permeates or seep and cause distress to the reinforcement by oxidation in the form of rust and spelling thereafter. Since the use of FRC reduces water penetration and permeability by more than 50% w.r.t control according to IS 2645 stipulations it can also be used as waterproofing admixture. However the basic attributes of RFRC are reduction in shrinkage cracks and improvement in elastic properties of concrete.

FLEXURAL STRENGTH:

Addition of fibers produce non linear curve after first crack and reaches its peak at the ultimate strength of maximum sustainable static load. Factors affecting flexural strength are fiber type and fiber volume. Polymeric fibers having relatively low module of elasticity slightly reduce the initial stiffness and ultimate strength but their better extensibility results in a appreciable post-peak performance and toughness and are more effective in limiting the size of the cracks and arresting the micro cracks.

DETERIORATION RESISTANCE:

The effect of addition of Recron fiber to concrete mix and adequate concrete curing in enhancing the deterioration resistance of concrete surface skin subject to cyclic wet/dry sea water exposure were evaluated. The result indicate that the addition of Recron fiber effectively retards the deterioration process of the surface skin of the concrete specimens cured in hot weather environment. Tests were carried out on 30 concrete slab specimens of dimensions 75*375*750mm , made with and without Recron fibers some specimens were cured under

laboratory-controlled conditions and were subjected to the wet/ dry cycles for 85 weeks, while others were cured under field conditions and were subjected to the same cycles for 50 weeks.

ABRASION/ IMPACT RESISTANCE APPROVALS:

Recron 3s FRC has been approved by various government, semi government, private and Industrial Projects. It has been approved by

1. Airport Authority of India
2. Military Engineer Services
3. State PWD Schedule of Rates (Maharashtra, Gujarat, Rajasthan, J&K, Punjab)

1.10 ROLE OF RECRON 3S FIBRE

1. Controls cracking:

Recron 3s prevents the shrinkage cracks developed during curing making the structure/plaster/component inherently stronger. Further when the loads imposed on concrete approach that for failure, cracks will propagate, sometimes rapidly. Addition of Recron 3s in concrete and plaster prevents/arrests cracking caused by volume change (expansion and contraction).

2. Reduces water permeability:

A cement structure free from such micro cracks prevents water or moisture from entering and migrating throughout the concrete. This is turn helps prevent the corrosion of steel used for primary reinforcement in the structure. This is turn improves longevity of the structure

3. Reduces rebound in concrete-brings direct saving and gain:

Recron 3s fibers reduce rebound "splattering" of concrete and shotcrete. The raw material wastage reduces and results in direct saving in terms of raw material. More importantly it saves a great deal of labour employed for the job, which could be completed earlier.

4. Increases flexibility:

The modulus of elasticity of Recron 3s is high with respect to the modulus of elasticity of the concrete or mortar binder. The Recron 3s fiber help increases flexural strength. The post cracking behavior has shown its ability to continue to absorb energy as fibers pull out.

5. Safe and easy to use:

Recron 3s fiber are environmental friendly and non hazardous. They easily disperse and separate in the mix.

Economical:

Only 0.2-0.4% by cement Recron 3s is sufficient for getting above advantages. Thus it not only pays for itself, but results in net gain with reduced labour cost and improved properties. It leads to faster completion of the job work.

Direction of use:

Sprinkle the fiber in site mixer with little water. Keep rotating and add chips, sand, cement and balance water. Mix it for a few minutes. In case of manual mixing, for best results mix half the fiber in a bucket of water, stir well and mix in mortar. Likewise add balance fiber.

Recron 3s is meant for improving the quality of construction, savings on wastage and for speeding up the work pace. Recron 3s is meant for secondary reinforcement only.

Dosage rate Recron fiber:

Standard dosage 125-200gm per 50kg bag of cement. Its optimized as per application.

Field results show that with a dosage of only 125gms per bag of cement weighing 50kgs (0.25%) there is improvement in

1. Compressive strength increase by 15% with 0.5% fiber.
2. Thermal cracks are significant reduction.
3. In mortar cubes without fibers break on their own with fibers no cracks.
4. Thermal crack resistance is excellent with fibers.
5. Rebound loss reduced by 50% resulting in saving labour, raw material and faster pase of work.

1.11. ADVANTAGES OF RFRC:

1. Increases tensile strength.
2. Greater impact resistance of fiber reinforced concrete.
3. Reduces permeability.
4. Arrest drying shrinkage.
5. Easy to use and mix.
6. Controls cracking.
7. Reduces rebound loss-Brings direct savings and gains.
8. Increases flexibility and abrasion resistance.

1.13 DISADVANTAGES OF RFRC:

1. The fibres form very small lumps while mixing.
2. The fibres appearing on the surface of the concrete and are not recommended from the aesthetic views.

1.14 APPLICATIONS OF RFRC:

1. Plain concrete and wall plastering.
2. Used in footings, foundations and tanks.
3. Pipes, burial vaults, pre-stressed beams etc.
4. Roads and pavements.
5. Bridges and dams.

2. EXPERIMENTAL METHODOLOGY

MATERIAL USED AND THEIR PROPERTIES

The materials used in the experimental work are

1. Cement .
2. Water.
3. Coarse aggregate.
4. Fine aggregate.
5. Recron 3s fiber.

SL.NO	TEST CONDUCTED	RESULTS OBTAINED	REQUIRE AS IS 8112-1989
1	Specific gravity	3.15	Shall not be < 2.50
2	Normal consistency	33%	Shall not be > 40%
3	Initial setting time	75 Min	Shall not be < 30 min
4	Final setting time	540Min	Shall not be > 600 min
5	Finess	5%	Shall not be > 5 %

CEMENT:

In the present investigation ordinary Portland cement of grade 43 Ultra Tech cement is used. Tests are conducted in accordance with the Bureau of Indian Standards (BIS) confining to IS-12269: 19870. The physical characteristics of the tested cement have been shown in table Physical characteristics of cement.

WATER:

COARSE AGGREGATE:

The coarse aggregate in concrete are in greater volume, which contributes stability and durability of the concrete. From bulk of the concrete it should be of proper shape hard strong and well graded.

Coarse aggregate are those which are retained on IS sieve no. 4.75 for structural concrete. The common coarse aggregate are used in our project was crushed stone.

Sieve analysis of coarse aggregate.

Sl .No	Is sieve destination	% of passing	Standard requirement
1	20MM	95.00	95-100
2	10MM	29.00	25-55
3	4.75MM	2.00	0-10

Results:

- Conforms to IS 383-1970 grading aggregates of normal size 20mm.
- Specific gravity of coarse aggregate = 2.83
- Water absorption for coarse aggregate = 0.8%

FINE AGGREGATE:

Locally available natural river sand was used as the fine aggregate in the mortar mix. The test on fine aggregate was conducted in accordance with IS: 650-1966 7 IS: 2386-1968 to determine specific gravity and fineness modulus. the sand is confirming to zone-ii as per Indian standards. the results are presented in table.

SL NO	IS sieve Destination	% of passing	Standard requirement
1	4.75mm	99	90-100
2	2.36mm	97	75-100
3	1.18mm	88	55-100
4	600 micron	66	35-59
5	300 micron	53	8-30
6	pan	NIL	0.00

Physical Chrematistic of fine Aggregate:

SL NO	Particular of test	Results
1	Fineness modulus	2.68
2	Specific gravity	2.83
3	Zone	III
4	Water absorption	1.0%

2. CONCRETE MIX DESIGN

A freshly mixed concrete for a period of two hours, from the time addition of water to the dry ingredients is called the concrete mix. The problem of designing a mix for a given purpose means obtaining a concrete of required strength, and workability at lowest cost, by as suitable choice of materials and the proportions.

- ✓ Concrete designation : M25
- ✓ Characteristic compressive strength = f_{ck} = 25N/mm^2

STIPULATIONS FOR PROPORTIONING

Grade of cement	:	M25
Type of cement	:	OPC 43Grade
Trade name of the cement	:	UltraTech
Max size of coarse Agg	:	20mm Downsize
Min cement content	:	300Kg/m^3 as per IS456-2000 As per Table5
Workability of concrete	:	100MM Slump
Exposure condition	:	Severe
Method of concrete placing	:	manual
Degree of supervision	:	Good
Type of Aggregate	:	Crushed
Max cement content	:	450Kg/cm3
Chemical admixture	:	Super plasticizer

CONCRETE INGRADIENT TEST DATA'S

Cement used	:	OPC 43Grade
Specific gravity of cement	:	3.15
Specific gravity of fly ash	:	2.20
Specific gravity of Fine Aggregate	:	2.56
Specific gravity of coarse Aggregate	:	2.83
Water absorption of fine Aggregate	:	1%
Water absorption of coarse Aggregate	:	0.8%

TARGET STRENGTH FOR MIX PROPORTION

$f^{l}_{ck}= f_{ck}$ +ts

= 25+ (1.65×4)
= **31.6 N/mm²**

Where;

f'ck : target avg compressive strength @ 28 days
fck : characteristic strength of concrete @ 28 days
s : standard deviation from table 1(IS10262-2009)

SELECTION OF W/C RATIO

From IS 456-2000 table – 5;
Maximum W/C Ratio: 0.5 (from table no 5 adopting)
W/C Ratio: 0.46 < 0.5 , Hence satisfactory.

SELECTION OF WATER CONTENT

Maximum water content for 20mm Aggregate = 186 Its
Estimated water content for 100 mm slump range = 186+ (6/100) ×186 = 197 liters
As super plasticizer is used, the water content can be reduced up to 30%
Based on trials with super plasticizer water content reduction of 29% has been achieved. Hence,
The arrived water content = 197 ×0.71 therefore,
the water content = **140 liters**.

CALCULATION OF CEMENT CONTENT

WKT; W/C Ratio = **0.46**
Cement content = (water content) / W/C Ratio = 140 / 0.46
Hence; cement content = **305kg/m³ >300kg/m³**

VOLUME OF COARSE AND FINE AGGREGATE

From table-3, IS 10262-2009
For zone –III gradation, 0.5 = 0.64
Hence, for pumpable concrete, coarse Aggregate; (0.648 × 0.9) = 0.5832
Therefore; fine Aggregate = (1-0.5832) = 0.4168

MIX CALCULATIONS

Volume of concrete = 1M³
Volume of cement = (305/3.15) × (1/1000) = 0.0968M³
Volume of water = (140) × (1/1000) = 0.140 M³
Volume of polypropylene fibers = (6.1/0.91) × (1/1000) = 0.0067M³
Volume of all aggregate = ((1-(0.0968+0.14+0.0067)) = 0.7565M³
Mass of coarse aggregate = (0.7565 × 2.83 × 0.5832 × 1000) = 1248.570 kg
Mass of fine aggregate = (0.7565 × 2.56 × 0.4168 × 1000) = 807.19 kg

Therefore, the mix proportion ie;

	CEMENT	SAND	Aggregate
FOR W/C RATIO 0.46	305	807.19	1248.570
	1	2.645	4.10

IV.CONCLUSION

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. Its high time that we overcome the resistance and reach for the peaks.

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