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EFFECT OF STYRENE BUTADIENE RUBBER LATEX ON REPAIRABLE PROPERTIES OF CEMENTIOUS MATERIALS

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Abstract - *In this project deals with an experimental investigation on effect of Polymer latex and fiber on mechanical properties of cementations materials Our project mainly deals with the effect on Bond strength of the polymer modified fiber reinforced concrete and Bonding of Old and New concrete by using the Styrene Butadiene Rubber co-polymer latex. The project main aim is to study the Bond strength of concrete by pullout test. For Pullout test, volume fraction of BOASEE fibres is kept as the constant of 0.3% by weight of the cement and Styrene Butadiene Rubber polymer latex are added in the ratio of 0%, 10%, 15% and 20% by weight of the cement were used. For this test, specimen of size 150mm×150mm×150mm with 16mm high yield deformed bar of length 650mm is placed at the centre of the cube and 150mm is embedded in the concrete. Pullout test on specimen were carried out on universal testing machine. For other test, the fiber volume fraction varies between 1% to 3% in the ratio 1% for mortar cube and 0.1% to 0.3% in the ratio of 0.1% for concrete by weight of the cement and the polymer volume fraction varies between 2% to 6% in the ratio of 2% for mortar cube and 2%, 5%, 10% for concrete. To assess the strength by bonding the old hardened and new fresh concrete by using the styrene butadiene rubber polymer latex bonding layer.*

Key Words: Pullout test, Bond strength, BOASEE fiber, Old hardened Concrete, New fresh concrete, Styrene Butadiene Rubber Co-polymer Latex.

1. INTRODUCTION

Fibers are usually used in concrete to control cracking due to plastic shrinkage and to drying shrinkage. They 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 the structural steel reinforcement. Indeed, some fibers actually reduce the strength of concrete. The amount of fibers added to a concrete mix is expressed as percentage of the total volume of the composite (concrete and fibers), termed as "volume fraction" (V_f). V_f typically ranges from 0.1 to 3%. The aspect ratio (l/d) is calculated by dividing fiber length (l) by its diameter (d). Fibers with non circular cross section use an equivalent diameter for the calculation of aspect ratio. If the fiber's modulus of elasticity is higher than the matrix (concrete or mortar binder), they help to carry the load by increasing the tensile strength of the material. Increasing the aspects ration of the fiber usually segments the flexural strength and toughness of the matrix. However, fibers that are too long tend to "ball" in the mix and create workability problems. 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 long fibers.

1.1. AIM & OBJECTIVE

The main aim of this research is to assess the strength, cracks and shrinkage by using the styrene butadiene rubber latex and fiber (Polypropylene) in concrete production. To assess the pullout strength of concrete by using the SBR polymer latex. Also to access the repairing of concrete like bonding the old hardened concrete to the new fresh concrete to attain the maximum strength by polymer latex than the bonding the hardened concrete to the fresh concrete without using the polymer layer for bonding.

The present work is aim to analyses and gives technical specifications on strength Characteristics and repairing work of concrete with and without fiber and polymer latex. The main objective of the experimental investigation is to assess the utility of Fiber in the production of structural concrete.

1.2 MATERIALS USED

The various materials used in the experimentation namely cement, fine aggregate and coarse aggregate have been tested in the laboratory. The specification and properties of these materials were presented in the subsequent sections. All the materials used in the study were tested in accordance to the Indian standards.

(i) BOASEE Fibre
(ii) SBR Latex

The Polypropylene fibers should not be used for structural reinforcement. These fibers should not be used to produce thinner sections and also to increase joint spacing than those suggested for unreinforced masonry. Polypropylene when

copolymerized with ethylene is generally tough and flexible, which allows polypropylene to be used as engineering plastics. Polypropylene is reasonably economical and when UN coloured appears translucent.

Advantages

- Reduces the cracks and water permeability into the concrete.
- Increases the tensile, flexural strength by 15 to 20% and compressive strength by 10-15%.
- Increases the shatter resistance and thaw resistance of the concrete.
- Increases the impact resistance by 100%.
- Increases fatigue resistance of the concrete.
- Reduces The Shear Cracks In The Beam Column Junction.

Applications

- Cement concrete roads and pavements, Airport runway canal linings.
- Guniting/ shotcreting, Tunnel Linings.
- Precast and Pre stressed concrete protects.
- RCC for Beams, columns, slabs and bridge structures.
- Water retaining structure viz. storage tanks waste water treatment tanks.
- External and Internal Plaster.

Butadiene is a byproduct of ethylene production and is a colorless gas with a faint odour of gasoline. Due to the Polymerization, typically in a ratio of around 25% styrene and 75% butadiene, produces styrene butadiene rubber (SBR), an elastomeric co-polymer widely used as an alternative to natural rubber. SBR is found in products as diverse as tires and carpet backing.SBR Latex is a carboxylate styrene butadiene rubber copolymer latex admixture that is designed as an integral adhesive for cement bond coats, mortars and concrete to improve bond strength and chemical resistance.

Advantages

- Improved flexural and tensile strengths.
- Better overall durability.
- Reduced shrinkage.
- Increased resistance to abrasion, chemical and frost.
- Improved workability for the same w/c.
- Suitable for potable water.
- Enhanced adhesion to smooth surfaces: dense concrete, steel etc.

Applications

- Amelioration of cementious waterproofing products and tile adhesives.
- Thin, water resisting screeds, toppings, renderings, mortars etc.
- Waterproof, bonding bridges for mortars and concrete (always mixed with fresh cement and always wet on wet). Mixing proportion: 1:1.8 latex/cement by volume.
- Anticorrosion protection for reinforcement in concrete repairs (1:1 with cement by volume).
- Polymer mortars for repairs of carbonated concrete. Preventive treatments against carbonisation.

2. MIX PROPORTION

Table -1: Mix Proportion

Water (L)	Cement (Kg)	Fine Aggregate(Kg)	Coarse Aggregate(Kg)
191.5	478.95	625.19	1099
0.4	1	1.31	2.29

Fig -1: Pullout Specimen & Bonding of Repaired Concrete Using Polymer

3. RESULT AND DISCUSSION

In the addition percentage of fiber and polymer latex of concrete for Results for cube, cylinder and prism are shown here.

Table -2 Compressive Strength of cement mortar with fiber & Polymer

S No	Fiber Volume Fraction	Compressive Strength of Mortar (N/mm²)	
		7 days	28 days
1	0	13	20
2	1	14.3	22
3	2	13	20
4	3	11.7	18

S No	Polymer %	Compressive Strength of Mortar (N/mm²)	
		7 days	28 days
1	0	19.5	30
2	2	20.8	32
3	4	14.3	22
4	6	7.8	12

Table-3 Compressive Strength of Concrete Cube with fiber & Polymer

S No	Composition of Concrete		Compressive Strength of Concrete (N/mm²)	
	Fiber	Polymer	7 days	28 days
1	0	0	15.6	24
2	1	2	18.2	28
3	2	4	19.5	30
4	3	6	13	20

S No	Fiber Content	Tensile Strength of Cylinder (N/mm²)	
		7 days	28 days
1	0	2.12	3.18
2	0.1	2.26	3.39
3	0.2	2.54	3.81
4	0.3	2.33	3.54

5.5 Pullout Test of the Concrete

- For pullout strength, the fiber content added in the concrete is kept as constant (0.3% by weight of the cement)
- The polymer latex content is added to the concrete are in the ratio of 0%, 10%, 15% and 20% by weight of the cement.

Table-4 Bond Strength of concrete by using Fiber & Polymer

S No	Concrete Composition		Pullout Force KN	Bond Strength N/mm²	Increase % Bond Strength
	Fiber	Polymer			
1	0	0	29.2	0.89	0
2	0.3	10	37.6	1.15	28.76
3	0.3	15	59.2	1.81	102.73
4	0.3	20	78.4	2.39	168.49

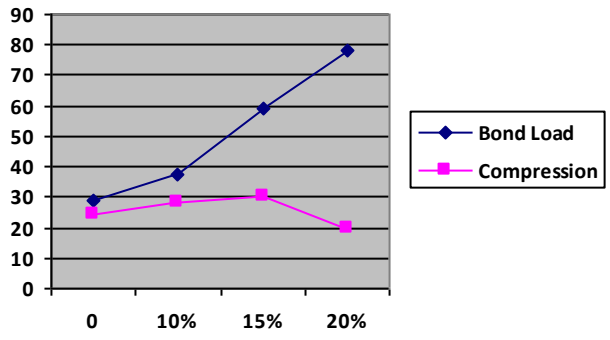

Chart -1: Bond & Compressive Strength of Concrete

Table-5 Recovery Strength of Polymer Slurry Repaired concrete

S No	Specimen	Conventional Concrete		Polymer Slurry Repaired Concrete		
		Load KN	Stress KN/mm²	Load KN	Stress KN/mm²	% recovery
1	Cube	800	35.55	570	25.33	71.25
2	Cylinder	225	3.18	190	2.68	84.27
3	Beam	16	3.31	10.2	2.11	63.74

5.6 Bonding between Old and New Concrete

- In this, the old hardened and new fresh concrete of same mix design are bonded using two methods.
- In first methods, the cement latex slurry in the ratio of 1:1:3 (SBR: Water: Cement) is used for bonding.
- In second methods, the polymer alone is used for bonding the concrete.

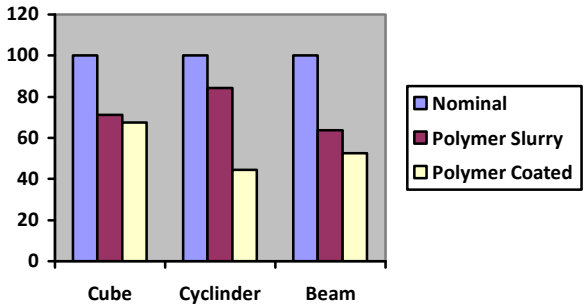

Chart -2: Recovery Strength of Repaired Concrete

Table-6 Recovery Strength of Polymer Coated Repaired concrete

S No	Specimen	Conventional Concrete		Polymer Coated Repaired Concrete		
		Load KN	Stress KN/mm²	Load KN	Stress KN /mm²	% recovery
1	Cube	800	35.55	540	24	67.51
2	Cylinder	225	3.18	100	1.41	44.34
3	Beam	16	3.31	8.4	1.74	52.56

4. CONCLUSIONS

An experimental study of effectiveness of styrene butadiene rubber Polymer latex and polypropylene fibers in concrete has been carried out in the laboratory. On the basis of the results obtained from experimental work, observation are made during casting and testing of specimens, and results of the behaviour of polymer modified fiber reinforced concrete and normal concrete, the following conclusion are drawn:

- By adding the fiber 1% to the cement mortar, the compressive strength increases by 10%.
- By adding the polymer 2% to the cement mortar, the compressive strength increase by 6.67%.
- By adding both fiber 2% and polymer4% to the cement mortar, the compressive strength increases by 25%.
- The split tensile strength of concrete increases by 20% by the addition of fiber 0.2% by weight of the cement.
- The split tensile strength of concrete increases by 15.5% for the addition of fiber 0.2% and polymer 5% by weight of the cement.
- By the addition of polymer and both fiber and polymer, there is no change in the compressive strength of concrete.
- Concrete made with fiber 0.3% and polymer 20%, the pullout strength of the concrete increases by 168.49% from the normal concrete.
- By adding the polymer latex to the concrete and cement mortar, the setting time is reduced.
- Using polymer slurry as the bonding layer gains more strength than the using polymer alone as the bonding layer between the old hardened concrete and new fresh concrete.

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