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Experimental Study on Concrete by Using Polymer and Partial Repalcement of M.Sand

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Abstract: ***Polymer concrete (pc) is a composite material in which the binder consists entirely of a synthetic organic polymer. It is increasing popularity as a new construction material due to its high compressive, tensile and flexural strengths, short curing time and impact resistance. This paper explores a research study which has been initiated to improve fundamental understanding of this material and to provide the knowledge required for its broad utilization. Hence a comparison has made between the conventional concrete and polymer concrete along with Partial Repalcement of sand By M.Sand. The mix design of M25 grade concrete is done. In experimental methods such as compressive strength test and Flexural strength test is performed. Polymer resin concrete with resin percentage 0.1% to 0.3% and replacement of M.sand with 10% to 30% is performed and Compared the results with conventional concrete.***

Keywords: polymer concrete, compressive strength, flexural strength.

I. INTRODUCTION

Concrete is the widely used material on earth after water. Many aspects of our daily life directly on concrete. Concrete is prepare by mixing various constituents like cement, aggregates, water, etc., which are economically available. Concrete is unique among major construction materials because it is designed specifically for civil engineering projects. Now a days high strength concrete are used in industries. Concrete is a composite material composed of granular materials like coarse aggregates embedded in a matrix and bond together with cement or binder which fills the space between the particles and glues then together. Concrete place a critical role in the design and construction of the nation`s infrastructure . All along in india we have been using natural sand and gravel in concrete in manufacturing. Availability of natural aggregate is getting depleted and also becoming costly. Hence, there has to be an emphasis on the use of waste and by- products in all areas including construction industry. As 75% of concrete is composed of aggregate it is important that we look to maximize the use of waste as aggregate input in concrete making. Plain concrete possesses a very low flexural strength, limited ductility and little resistance to cracking. Internal micro cracks are inherently present in concrete and its poor flexural strength his due to propagation of such micro cracks, eventually leading to brittle fracture of concrete. In the past, attempts have been made to impart improvement in flexural properties of concrete members by way of using conventional reinforced steel bars and also by applying restraining techniques. Although both these methods provide flexural strength to the concrete members, they however, do not increses flexural strength of the concrete itself.In plain concrete and similar brittle materials structural cracks develops even before loading, particularly due to drying shrinkage or other causes of volume change. The width of these initial cracks seldom exceeds a few microns, but their other two dimensions may be of higher magnitude. When loaded, the micro cracks propagate and open up, owing to the effect of stress concentration, additional cracks form in places of minor defects. The structural cracks proceed slowly or by tiny jumps because they are retarded by various obstacles, changes of direction in by passing the more resistant grains in matrix. The development of such micro cracks is main cause of in elastic deformations in concrete. Finally, in this project to introduce the (pom) polymer as the new material into the concrete to improve the flexural strength.

II. LITERATURE REVIEW

Rebeiz (1996), the authors proposed an optimized mix based upon their study as that containing 10% resin, 45% pea gravel, 32% sand and 13% flyash.(ii) Polymer concrete achieves 80% of its strength after curing of one day, when compared to seven day curing period. Kim et al (1995) reported in his study an optimum mix was reported as having 50% pebble, 42.5% sand and 7.5% resin. Vipulanandan(1993) found that tine aggregates in combination with fly ash and river sand show synergism in strength behavior and resistance to water absorption up to the level of 75% by weight of fly ash .At the higher level of fly ash, properties decline as the mix becomes unworkable due to the fact that pure fly ash because of large surface area, does not mix with resin binder effectively. Orak,(2000) studies, Damping of polyester concrete is four to seven times higher than cast iron. Damping characteristics not much influenced by mix composition. Schulz, et al(1983) gives report on the polymer concrete bed had large damping factors over wide frequency range. Damping factors found experimentally were higher than those for steel structure and cast iron.

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III. ABOUT PoM-POLYMER

Pom polymer means polyacetal or polyoxymethylene is a high performance engineering polymer. Because of its high strength, modulus, and resistance to impact and fatigue, it is used as a weight saving metal replacement. Acetal is subjected to degradation in acid and base solutions and is not readily available in a flame – retardant grade. Acetal, first developed in the late 1950s, is available as a copolymer (such as ticona's celcon) The pom polymer has a higher crystallinity compared with the pom copolymer, on the other hand chemical resistance of the copolymer is higher. This results in a higher stiffness for the homopolymer and less thermal degradation of the pom copolymer during production and the field. The most common forming processes for polyacetal are injection moulding and extrusion but also blow moulding and rotational moulding are is possible. Pom is mainly used for technical parts where the mentioned mechanical properties are giving it an advantage over other plastics.pom polymer properties are high stiffness, low density, good resilience, low water absorption. Applications of (POM) polymer are un reinforced grades offer excceptionaly high mechanical strength and rigidity, toughness at low temperature (down to -40 degrees centigrade) ,high resistance to repeated impacts, it is a highly crystalline polymer that is known for its flexural strength, stiffness, hardness, and excellent chemical resistance.

IV. OBJECTIVE OF THE PROJECT

To study of the effect of using polymer concrete as a replacement of fine aggregate with M.Sand and its benefits. To find out the mix ratio by using polymer concrete to achieve the target mean strength as 32 N/mm^2.

A. Scope Of The Project

Introduction of sand and polymer concrete. sand as fine aggregate partially into the concrete in order to improve the compression strength and flexural strength To enhance the strength of conventional concrete by adding polymers in volumes of 0.10%, 0.20% & 0.30% to concrete. Replacement of M.sand as in the ratio of 10% to 30%. To solve the environmental problems and bring immense change in development of strength of Concrete

V. METHODOLOGY

A concrete mix of M25 grade was used in this experimental work. M.Sand of three different percentage such as 10% & 20% and 30% were replaced to fine aggregate. Polymer resin of varying percentage such as 0.10%, 0.20% & 0.30% added towards the total amount of concrete mix. Test on Compression and flexural strength of concrete for M25 grade concrete at 7 days and 28 days curing were conducted.

VI. RESULTS AND DISCUSSION

A. Compressive Strength Test

After curing the cubes for 7days and 28 days periods, they were uncovered in readiness for compression tests. The cubes were then placed with the cast faces in contact with the platens of the testing machine that is the position of the cube when testing should be at right angle to that of casting. The test load was then gradually applied on the specimens until failure happened. i.e the cube crashed.
Compressive Strength (N/mm^2) = Ultimate load in 'N' /Area of cross section in 'mm^2.
Compressive strength of the specimen is determined by using following formula
Compressive strength = load at failure/ area of specimen

Table1: Compressive Strength at 7 days strength of polymer concrete specimen

S.No	Mix ID	Compressive strength for 7 days specimen 1 (0.1%)	Compressive strength for 7 days specimen 2 (0.2%)	Compressive strength for 7 days specimen 3 (0.3%)
1.	0%	30	32	29
2.	10%	28	28	30
3.	20%	35	33	32
4.	30%	31	32	30

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Table 2: Compressive Strength at 28 days strength of polymer concrete specimen

S.No	mix id	Compressive strength for 28 days specimen 1 (0.1%)	Compressive strength for 28 days specimen 2 (0.2%)	Compressive strength for 28 days specimen 3 (0.3%)
1.	0%	42	43	40
2.	10%	37	38	39
3.	20%	40	39	38
4.	30%	42	43	41

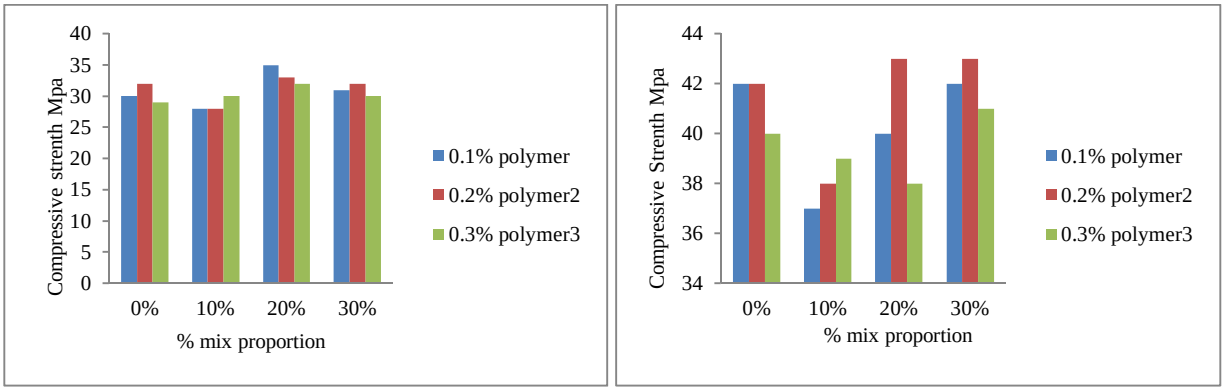

Figure 1 : Compressive Strength at 7 days and 28 days strength of polymer concrete specimen

B. Flexural Strength Test

The specimens were casted with concrete of characteristic strength 20 N/mm^2. The size of beam mould is 150mmx150mmx700mm and beam of 350mm in diameter and 70mm height. The mix design was computed according to the design specifications mentioned in IS10262-2009. Prepare the test specimen by filling the concrete into the mould in three layers of approximately equal thickness . tamp each layer 35 times using the tamping rod as specified above .

Table 3: Flexural Strength at 7 days strength of polymer concrete specimen

S.no	Mix ID	Flexural strength for 7 days Specimen 1 (0.1%)	Flexural strength for 7 days Specimen 2 (0.2%)	Flexural strength for 7 days Specimen 3 (0.3%)
1.	0%	2.5	2.7	2.6
2.	10%	2.60	2.8	2.75
3.	20%	2.66	2.78	2.69
4.	30%	2.70	2.8	2.79

Table 4: Flexural Strength at 28 days strength of polymer concrete specimen

S.no	Mix ID	Flexural strength for 28 days Specimen 1 (0.1%)	Flexural strength for 28 days Specimen 2 (0.2%)	Flexural strength for 28 days Specimen 3 (0.3%)
1.	0%	4.1	4.25	4.20
2.	10%	4.40	4.50	4.40
3.	20%	4.63	4.75	4.73
4.	30%	4.68	4.76	4.75

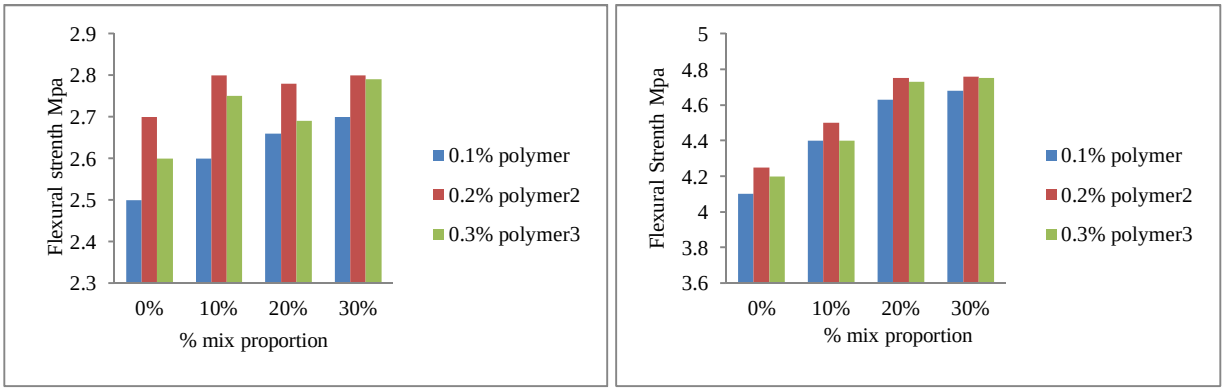

Figure 2: Flexural Strength at 7 days and 28 days strength of polymer concrete specimen

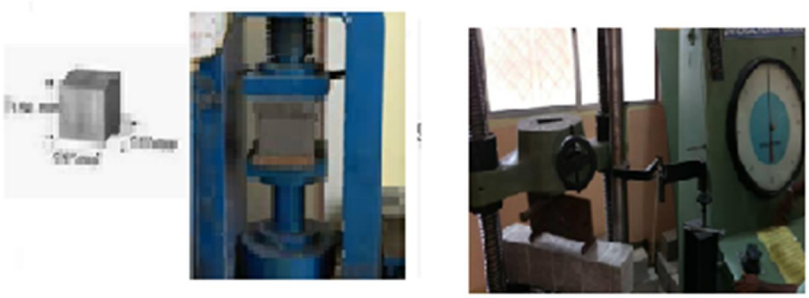

Figure 3:Compression and Flexural strength test

From the Figure 1 it is apparent that compressive strength 4% high than control mix concrete of 30% replacement of sand when added 0.3% of polymer. It is obvious that flexural strength increases with increase in 12% of-M.Sand upto 30% by weight of fine aggregate in mix. While adding polymer and replacement of fine aggregate with M.sand marginal increasing of strength was observed.

VII. CONCLUSION

Following conclusion obtained from this test

The compressive strength of polymer concrete is slightly increased when increasing percentage of polymer. It is obvious that flexural strength increases with increase in percentage of M.Sand upto 30% by weight of fine aggregate in mix.

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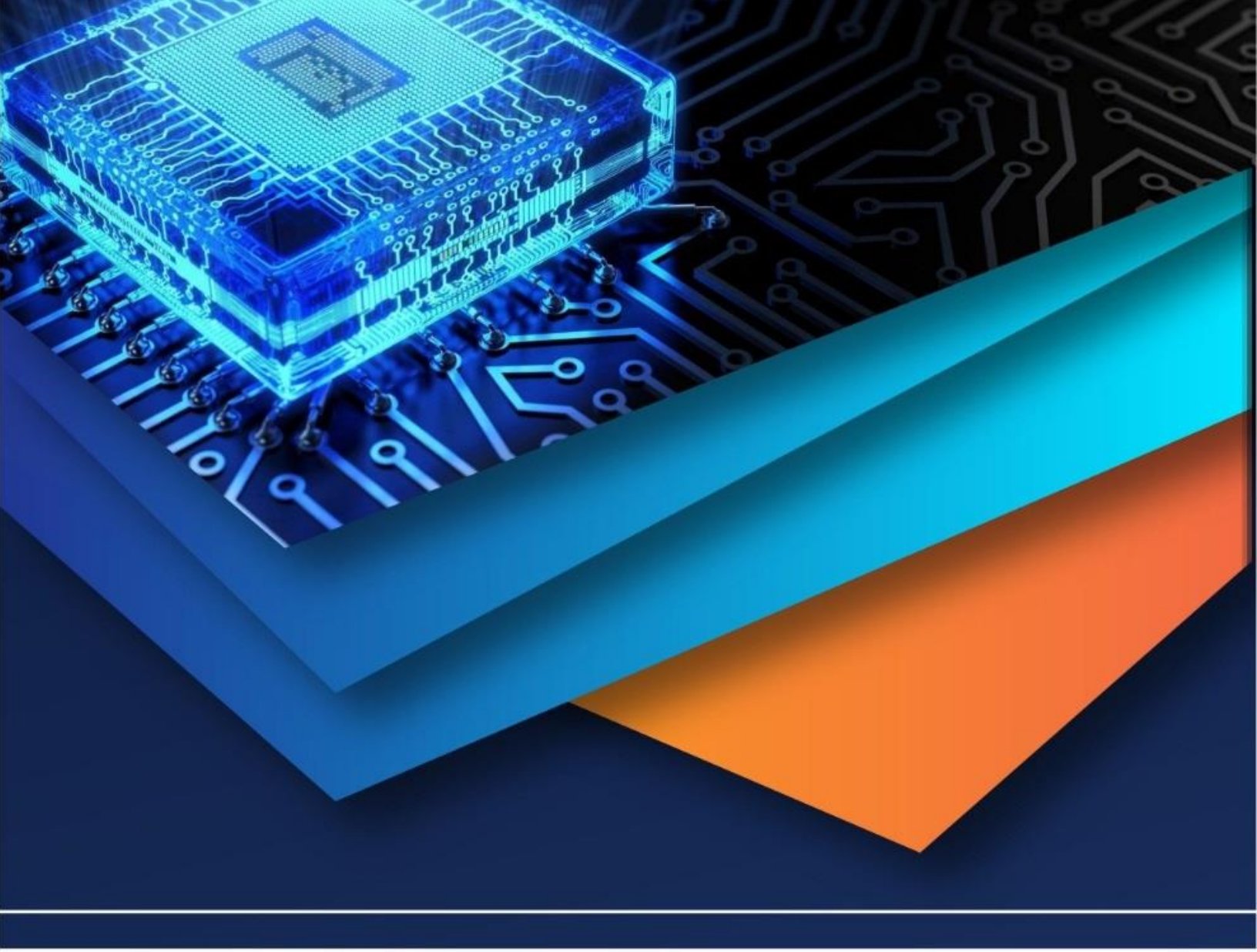

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