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Experimental Investigation on Reinforced Concrete with Plastic Fiber

Mr. K C. Denesh[1], M. Arunkumar[2]
[1]*Assistant Professor, Department of Civil Engineering, Nandha Engineering College Erode*
[2]*PG Student Department of Civil Engineering, Nandha Engineering College Erode*

Abstract: ***Most of the buildings in the whole world is made of concrete which makes it one of the most extensively used construction material in the world. These materials are often used in residential buildings, commercial buildings, building foundations, roads etc. Solid waste management, especially solid waste plastic is one of the major environmental concerns in the world today. The plastic waste which we have used in our experiment is collected from local plastic waste management center, the purpose of this study was to enable the practical use of this material as an alternative to the existing building material. Recyclable Plastics are used as a replacement to the fine aggregates. The Recyclable Plastics were partially replaced in place of fine aggregates by 0, 30%, 35%, 40% and 45%. M25 grade of concrete was designed and tested. The mix design for different types of mixes were prepared by replacing the fine aggregates at different percentages of Recyclable Plastics. Experimental investigations like workability, Compressive strength test, split tensile strength test, Flexural strength test for different concrete mixes with different percentages of waste crushed after 7, 14 and 28-days curing period has done. It has been observed that the workability increases with increase in the percentage of replacement of Recyclable Plastics increases. The strength of concrete also increases with the Recyclable Plastics up to 35% percentage.***

Keywords: Plastic, Recycled Plastics, Compressive tensile strength, Flexural strength, Impact strength.

I. INTRODUCTION

The swift urbanization and industrialization all over the world has resulted in large deposition of different type of plastic wastes material. In 1950, the world produced only 2 million tonnes of plastic annually. Since then, annual production has increased from that to 381 million tonnes in 2015. This is roughly equivalent to the mass of two-thirds of the world population. In last 70 years, 8.3 billion tonnes of plastic have been produced globally. In India, 25,940 tonnes of plastic wastes is being produced every day. Plastic waste materials consist of extra, out-dated, damaged, old plastic furniture, different household plastic materials, tools, anti-static packaging materials and devices made of plastic. These plastic wastes are almost non-degradable in the natural environment even after a long period of exposure. “A plastic bottle takes between 450-1000 years to decompose” – Harsh Vardhan, environmental minister, India. Addition of plastic waste in concrete can be a proper utilization of this valuable property. Thus, utilization of plastic waste material in making concrete/mortar can be good solution to this environmental hazard. It is been estimated by Ministry of Petroleum and Natural gas that the annual per capita consumption in India would be 20 kg by 2022. Only 60% of total plastic produced in India is being recycled. The Central Pollution Control Board (CPCB) has estimated that 80.28% of total plastic waste produced is collected by respective authorities of different cities in India, out of which only 28.4% was treated. Other remaining quantities were disposed in landfills, open dumps or in ocean. Dumping the plastic waste in ocean has greatly affected the oceanic life, dumping it on the land pollutes the land minerals and air quality too.

Plastics currently play a massive role in our daily lives. Plastics are utilized in virtually all areas of manufacturing. Tons and tons of plastic products are molded on a daily basis, even as the waste continues to build up. Due to the fact that most plastics are not biodegradable, an enormous sum of plastic waste continues to build up worldwide, with industrialized nations contributing the largest amount of plastic waste. More specifically, the majority of plastic waste comes from packaging and containers. The amount of land required for landfills is of increasing concern everywhere in the world.

Following parameters influences behavior of the Recyclable Plastics concrete, so these parameters are kept constant for the experimental work.

Thus, the scope of the project can be summarized as:

1) To obtain Mix proportions of Control concrete by IS method.
2) To perform the specific gravity test, sieve analysis and slump test under Indian Standard methods.
3) To conduct compressive strength, split tensile test using with and without Recyclable Plastics as per Indian Standard methods.

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Vikas Srivastava , investigated the effects of silica fume on fresh and hardened concrete. Materials used were Ordinary Portland cement and Silica fume. Tests conducted were workability, Compressive Strength, Tensile Strength, Bond Strength and Modulus of Elasticity. Based on the results obtained it was concluded that (i) Workability reduced with the addition of silica fume. However, workability improved in some cases. (ii) Compressive strength of concrete was significantly increased (6-57%) with inclusion of silicafume. The increase depended upon the replacement level. (iii) Flexural and tensile strength of silica fume concrete was almost like the referral concrete. (iv) Bond strength was improved with the addition of silica fume (v) Modulus of elasticity of silica fume concrete was almost like the referral concrete.

M. Sudhakar et.al, carried out the experimental investigation to study the behaviour of ESFRC by varying the volume percentage content of steel fiber. Four rectangular reinforced concrete beams, with the steel fiber reinforced concrete in critical sections along with the stirrup confinement, have been tested. The findings of the investigation indicate that up to about 80 percent of ultimate strength, the behaviour of ESFRC beams was similar to that of beams with rectangular tie confinement. The effect of the steel fiber was felt prominently beyond the post ultimate stage. The ductility is increased due to increase in percentage of fiber content.

P. Rajalakshmi, Use of ceramic waste will ensure an effective measure in maintaining environment and improving properties of concrete. The replacement of aggregates in concrete by ceramic wastes will have major environmental benefits. In ceramic industry about 30% production goes as waste. The ceramic waste aggregate is hard and durable material than the conventional coarse aggregate. It has good thermal resistance. The durability properties of ceramic waste aggregate are also good. This research studied the fine aggregate replacement by ceramic tiles fine aggregate accordingly in the range of 10% and coarse aggregate accordingly in the range of 30%, 60%,100% by weight of M-30 grade concrete. This paper recommends that waste ceramic tiles can be used as an alternate construction material to coarse and fine aggregate in concrete irrespective of the conventional concrete, it has good strength properties i.e., 10% CFA and 60% CCA being the maximum strength.

Paul O. Awoyera, The usage of ceramic tiles in concrete was observed in this paper. In this, both the coarse and fine aggregates are replaced with ceramic fine and ceramic coarse aggregates obtained from construction sites of Ota, Lagos and Nigeria in various percentages. The ceramic fine and coarse aggregates are replaced in conventional concrete individually and the strength parameters are studied. Finally, it states that usage of ceramic waste in concrete gives considerable increase in strength compared to conventional concrete.

II. MATERIALS USED

A. Cement

Ordinary Portland cement 53 grade was used for the investigation. It was tested for its physical properties in accordance with Indian Standard specifications

B. Fine Aggregate

The sand used for experimental program was locally procured and conforming to zone III. The sand was first sieved through 4.75 mm sieve to remove any particles greater than 4.75 mm. It was tested as per Indian Standard Specification IS: 383-1970. The specific gravity Fine aggregate are 2.6.

C. Coarse Aggregate

Locally available coarse aggregates were used in this work. Aggregates passing through 20mm sieve and retained on 16mm sieve were sieved and tested as per Indian Standard Specifications IS: 383-1970. The specific gravity coarse aggregate are 2.7.

D. Recyclable Plastics Property

Recyclable Plastic are produced by cutting or chopping the thick & thin flat sheet. A number of Recyclable Plastic types Indented round, Crimped round, Machined round, Flat sheet and crimped flat are available as reinforcement to concrete conforming IS: 280-1976 with an aspect ratio 30-250. The relative density or specific gravity of Recyclable Plastics generally ranges between 1.9 and 2.8 and the color is generally grey.

E. Water

Potable water which is available in laboratory is used for casting of specimen and as well as curing of specimen as per IS 456-2000.

F. Percentage Variation of Recyclable Plastics in Mix

The proportions of Recyclable Plastics used in concrete mix. Table 1 shows the details of the tested specimen designation.

Table 1: Specimen Designation

Recyclable Plastics Content by Volume (%)
0%
30%
35%
40%
45%

G. Concrete Mix Design for M25 Concrete (IS 10262:2009)

Table 2: Stipulation for mix proportioning

S.No	Content	Mix Proportion
1	Grade destination	M25
2	Type of cement	OPC 53 Grade
3	Maximum nominal size of aggregate	20mm
4	Minimum cement content	300kg/m^3
5	Workability	75mm
6	Exposure condition	Severe
7	Method of concrete placing	Normal
8	Degree of supervision	Good
9	Type of aggregate	Crushed angular aggregate
10	Maximum cement content	450kg/m^3

III. METHODOLOGY

A preliminary study on compressive strength, tensile strength and flexural using different proportions of Recyclable Plastics resulted in a varying ratio of Recyclable Plastics of 0, 30,35 and 45 percent by volume of concrete. In the present study, experimental concrete cubes of size 150mm x 150mm, in thickness of 150mm and cylinder of diameter 150mm and height of 300mm, both with PCC (plain concrete) and Recyclable Plastics concrete with experimental Recyclable Plastics were cast and tested for compression, tensile for 7 ,14 and 28 days of curing. A concrete beam of size 150mm x 150mm x 500 mm were casted and tested for flexural strength after 7 ,14 and 28 days.

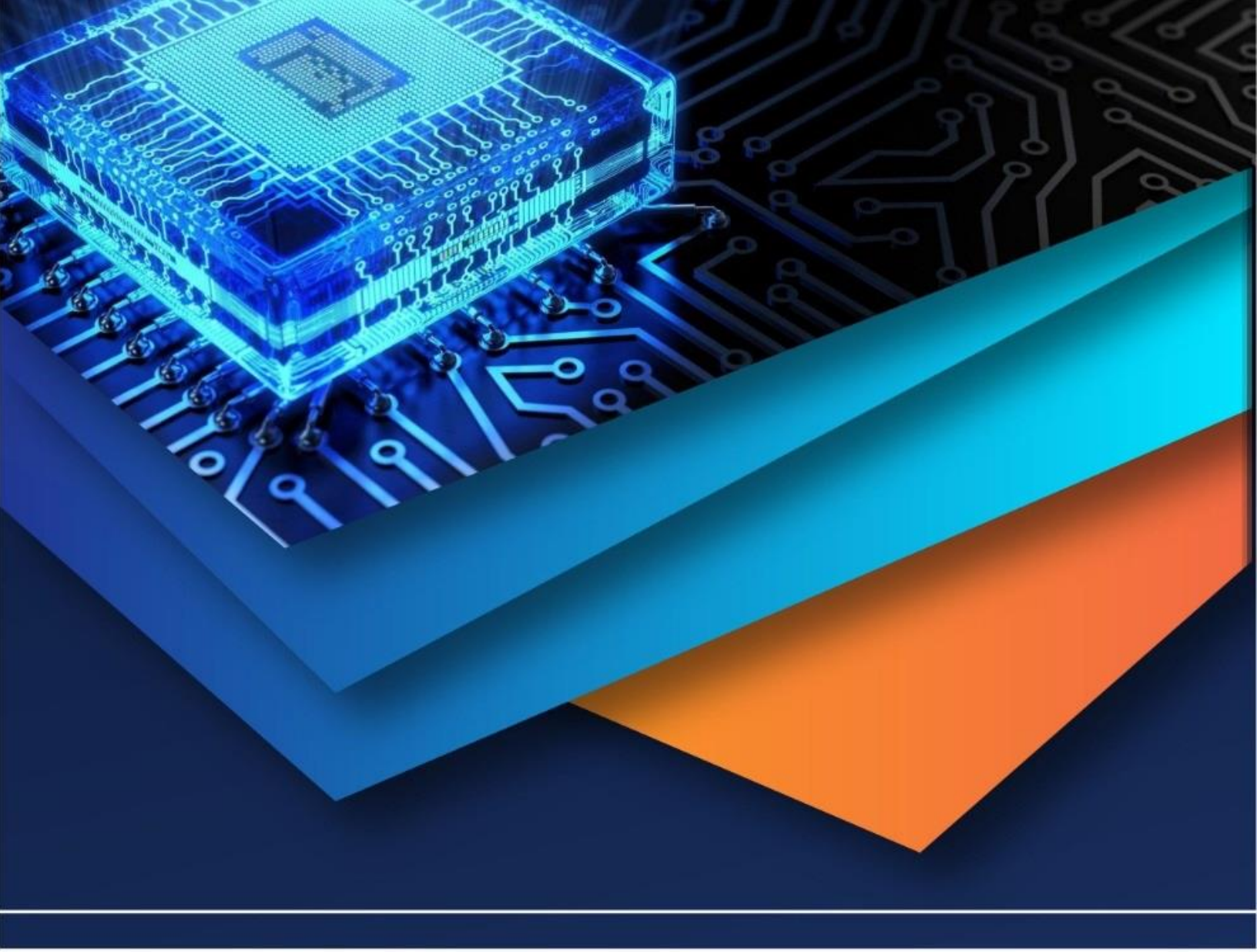
Partial replacement of fine aggregate with Recyclable Plastics concrete can, in general, be produced using conventional concrete practice, though there are obviously some important differences. The basic problem is to introduce a sufficient volume of uniformly dispersed to achieve the desired improvements in mechanical behavior, while retaining sufficient workability in the fresh mix to permit proper mixing, placing and finishing. The performance of the hardened concrete is enhanced more by Recyclable Plastics with a proper mix, since this improves the good matrix bond. In general, the problems of both workability and uniform distribution increase with increasing Recyclable Plastics mix. Partial replacement of fine aggregate with Recyclable Plastics concrete can be placed adequately using normal concrete equipment. It appears to be very stiff because the Recyclable Plastics tend to inhibit flow; however, when vibrated, the material will flow readily into the forms. It should be noted that water should be added to Recyclable Plastics concrete mixes to improve the workability only with great care, since above a w/c ratio of about 0.5, additional water may increase the slump of the Recyclable Plastics concrete without increasing its workability and place ability under vibration. The finishing operations with Recyclable Plastics concrete are essentially the same as for ordinary concrete, though perhaps more care must be taken regarding workmanship.

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