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Experimental Investigation on RO Waste Water in Concrete

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Abstract: As a sustainable approach this project is conducted to investigate the possibility of RO waste water in concrete, concrete is the most widely used construction material in the world. Production of Portland cement used in concrete produces 2.5 billion tonne's of carbon dioxide and other greenhouse gases worldwide. Furthermore, one of the sectors that uses the most water is the concrete industry. It is estimated that 150 litres of water are needed. for per cubic meter of concrete mix. Demand of fresh water by the construction sector is expected to increase due to high increase in the growth of construction activities in India. Without taking into account the additional uses of water in the concrete industry, water is a serious environmental problem, and water availability and quality are getting worse globally. The present study focusses on making concrete by including waste water from reverse osmosis into the mixing and curing process. Four mix amounts of different materials make up the experimental technique in water cement ratios. Fresh concrete is tested for workability. Cubes were casted and tested to find out compressive capacity of concrete. Test results of potable water concrete and RO waste water concrete will be compared.

Keywords: *RO Waste Water, Workability, Mechanical and Durability Characteristics of Concrete.*

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I. INTRODUCTION

In our present-day ground water scarcity is the major problem. Lot of money required and spent more investment on research for it. Agriculture, drinking, washing, transportation, chemical, heat, and fire exchange, recreation, industrial food processing, and medical applications are among the primary uses of water. Day by day clean and safe drinking availability become very less because due to the water scarcity issue So, the reuse of this waste water in the industrial activities like construction purpose and other many more industries. The nation's second-largest water-consuming industry is concrete.Demand of fresh water by the construction section sector are expected to overcome it approximately 150 litres required for per cubic meter of concrete mix in concrete water is required for both preparing and curing process. The efficient water is one of the most important requirements and the uses of this type of water used for the mixing did not affect the concrete slump and density. Because of scarcity of portable water, it is very important to use this waste water has been processed in concrete in our industry. To overcome this problem, we choose the sustainable approach side that means in this paper we used treated waste water in concrete instead using ordinary portable. using wastewater in the building industry without having an adverse effect on the environment. Water scarcity can be lessened by using this waste water in the construction phase. The water treatment plant (SPSR Nellore) is the source of the waste processed water. Once properly treated, this wastewater can be utilised for building. Waste water is also utilised for concrete, which is appropriate for concrete companies and yields the greatest results. The result also more or less equal when compared portable water. As the strength properties of RO waste water utilization is low to gain strength characteristics Fibers are added to concrete mix to get over this drawback. Although there are many various kinds of fibers, steel fibers are utilised in this case due to their high tensile strength, ductility, enhanced bond strength, and capacity to stop cracks from spreading.

II. LITERATURE REVIEW

Domestic sewage as mixing water in concrete" these authors review the characteristic of domestic sewage and used in this study as mixing water setting time, air content, specific gravity, and strength tests were performed on Untreated domestic sewage increases the

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initial setting time, entrains air, and decreases the strength of mortar and concrete, according to cement paste, mortar, and concrete specimens manufactured using

Concrete mixing and curing the impact of waste water on the characteristic strength of concrete. This study aimed to ascertain the impact of waste water on the compressive strength of concrete and investigate the feasibility of recycling waste water for concrete production and curing. samples of waste water from four distinct sources. After the cubes were crushed, the loads were calculated to determine their compressive strength, which indicates how close the cubes are to portable water. [2].

III. SCOPE & RESEARCH OBJECTIVES

- *Assess Feasibility* –
  Evaluate the suitability of Reverse Osmosis (RO) wastewater as a partial or complete replacement for adding water to concrete production.

- *Chemical Composition Analysis* –
  Study the physicochemical properties of RO wastewater to determine its influence on cement hydration, setting time, and durability.

- *Mechanical Performance* –
  Investigate the impact of RO wastewater on the strength, workability, and durability of concrete over short- and long-

distilled water. When used as mixing water, typical biologically treated household wastewater is identical to distilled water. [1].

These authors conducted research on the durability impact of concrete made with recycled waste water. They tested the basic properties of both treated and untreated tannery industry wastewater for use in construction, and they proceeded to test the mechanical properties of the concrete. They found some differences from specimens cast with potable water, so they used chemicals in the form of inhibitors to be satisfactory. [3]

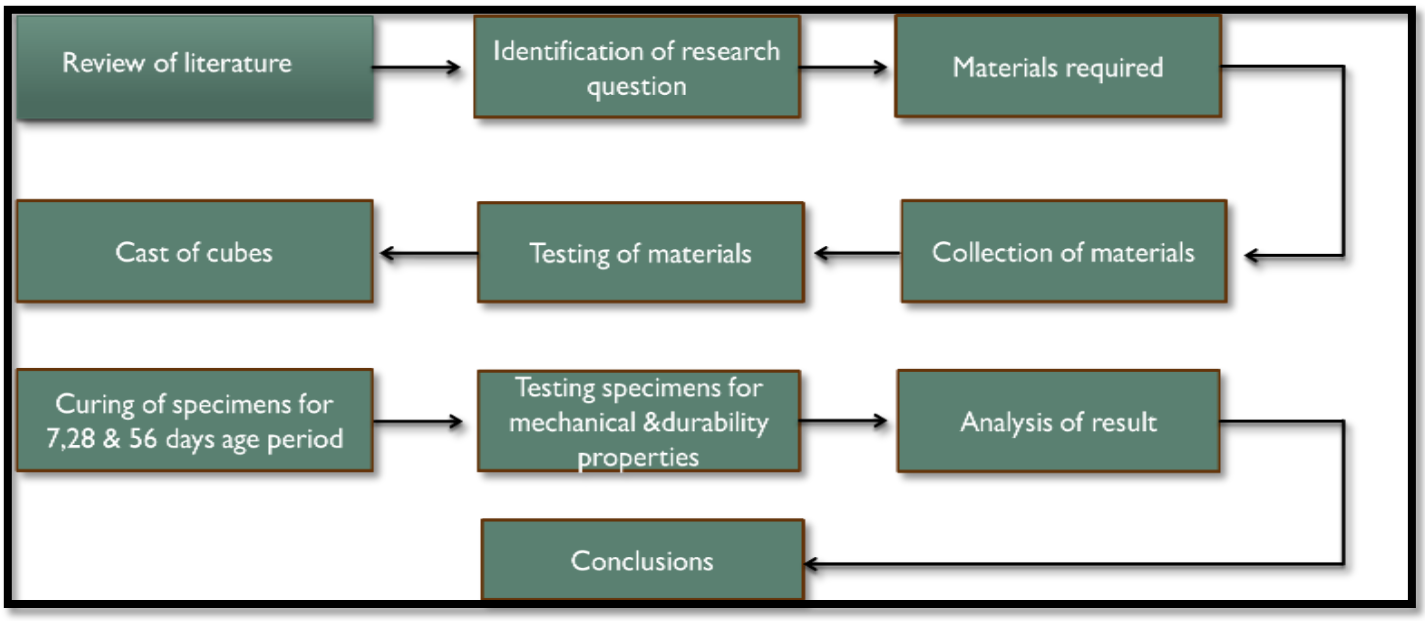
term periods.

- *Sample Collection & Testing* –
  Collect RO wastewater samples from different sources and analyze key parameters such as pH, total dissolved solids (TDS), chloride, and sulfate content.

- *Concrete Mix Design* –
  Prepare various concrete mixes with different proportions of RO wastewater and compare them with control mixes using potable water.

- *Laboratory Testing* –
  Conduct compressive strength, slump test, durability (sulfate/chloride resistance) to assess the effects of RO wastewater.

IV. METHODOLOGY



V. PRELIMINARY TESTS ON MATERIALS

- *Cement:*
  The cement that was utilized in this experimental investigation is Portland Pozzolanic Cement confirming to IS:12269: 1987. KCP PPC is used for the project. Figure 3 show case the chemical composition PPC and Table Show case physical characteristics of cement.

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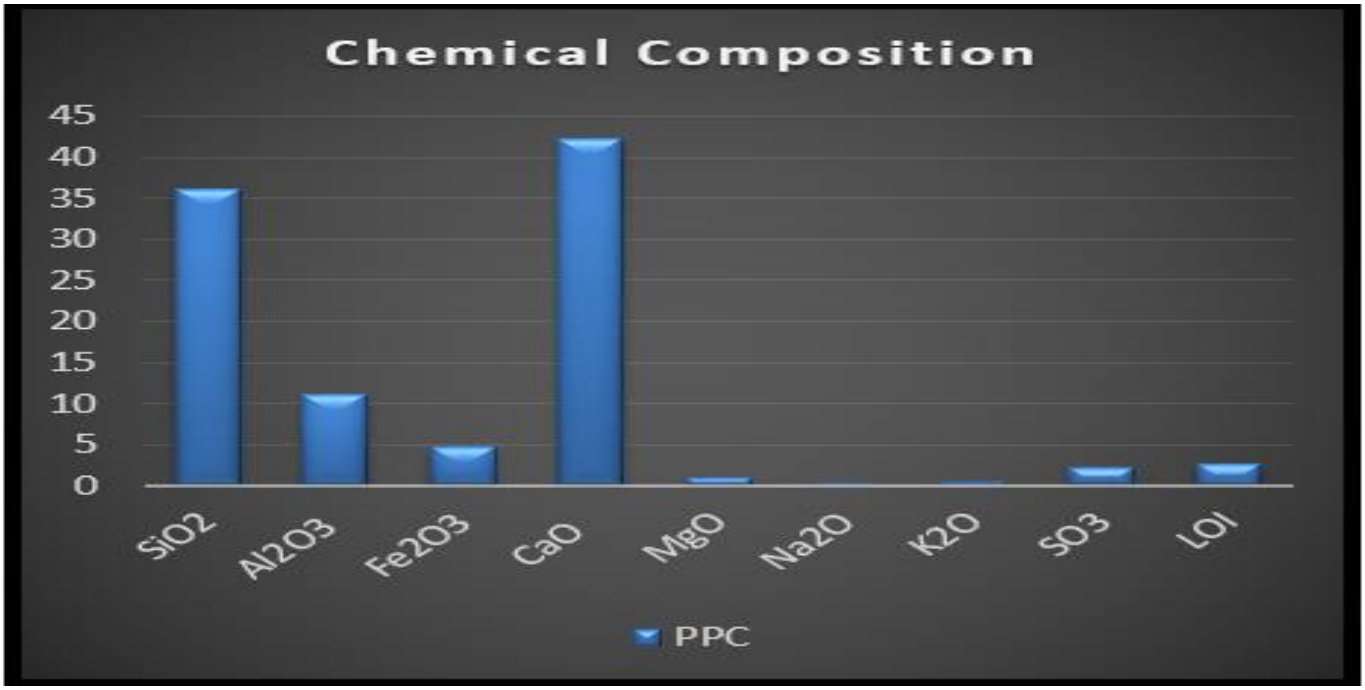

Figure 1 Chemical Composition of OPC, FA & RHA

Table 1 Physical Characteristics of PPC

S.No	Property	PPC
1	Specific Gravity	2.85
2	Fineness (%)	6
3	Consistency (%)	34
4	Initial Setting Time(min)	45
5	Final Setting Time(min)	248

➢ *Coarse Aggregate:*

Coarse aggregate is collected from Sri kalahasthi quarry Tirupathi District**.** Since aggregate makes up the majority of the concrete's volume, it is evident that it is a crucial component. They provide the concrete body, lessen shrinkage, and have an impact on the economy. In this study, aggregate of 20mm size was used. To achieve the necessary range, the coarse aggregate utilised in the study was sieved. Table 2 describes the aggregate's physical characteristics.

Table 2 Physical Characteristics of Coarse Aggregate

S.No	Property	Coarse aggregates
		20mm
1	Specific Gravity	2.75
2	Water Absorption (%)	1.1
3	Abrasion Value (%)	21.5
4	Impact Value (%)	16.5

➢ *Fine Aggregate:*

Fine Aggregate is collected from penna river SPSR Nellore district. Fine aggregate acts as a inert material occupies most of the volume of the concrete show they are the important constituents of concrete. They give body to the concrete, reduce shrinkage and effect economy. In this study, aggregate of 2.36mm size was used. To achieve the necessary range, the fine aggregate utilised in the study was sieved. Table 2 describes the aggregate's physical characteristics.

Table 3 Physical Characteristics of Fine Aggregate

S.No	Property	Fine aggregate
1	Specific Gravity	2.65
2	Fineness	2.7
3	Water Absorption (%)	1.23
4	Bulk Density (Kg/m^3)	1550

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➢ *Steel Fiber:*

Steel fiber's physicochemical parameters should be in compliance with IS14871:2000; its length should be between 20 and 60 mm, and its diameter, or equivalent diameter, should be between 0.3 and 1.2 mm. The ratio of length to diameter should be between 30 and 65

Table 4 Steel Fibers Properties

S.No	Property	Value
1	Diameter (d)	0.6 mm
2	Length of fiber (l)	50 mm
3	Aspect ratio of fiber (l/d)	83
4	Appearance and form	Bright, clear
5	Modulus of Elasticity	180 GPa
6	Tensile strength	998 MPa

➢ *Water:*

To mix concrete, RO waste water is used which have proper treatment process that tends to remove the all unwanted physical, chemical and biological microorganisms is called as RO waste water. RO waste water is collected from Geethanjali institute of science and technology, SPSR Nellore. Tap water is also used for comparison and treated as conventional that complied with IS: 456 - 2000 standards. RO waste water is utilized for curing purpose also. Table 5 showcases the water quality parameters of RO waste water and potable water.

Table 5 Quality Parameters

S.No	Property	Potable water (mg/l)	RO Waste water (mg/l)
1	P^H	6.5	7.5
2	Chloride content	260	60
3	Alkalinity	270	455
4	Sulphate content	210	72
5	Calcium content	190	1.70
6	Total Hardness	290	98

VI. DESIGN MIX OF PC

The mix proportion of RO waste water utilize concrete is given in Table3. For the design mix we had used M50 grade concrete. Steel fibers were also utilized for replacing aggregate content. Figure 3 showcase mix of RO waste water concreting process.

Table 3 Mix Proportion Of RO Waste Water Concrete

S.No	Mix	Cement Content (kg/m^3)	Fine Aggregate Content (kg/m^3)	Coarse aggregate content (kg/m^3)	W/C Ratio	Proportion of RO and SF
1	PWC	423	620	706	0.35	Conventional
2	ROWC					RO water
3	ROWSFC1			636		10% SF
4	ROWSFC2			600		15% SF
5	ROWSFC3			565		20% SF
M50 Grade ratio 1:1.48:3.05						

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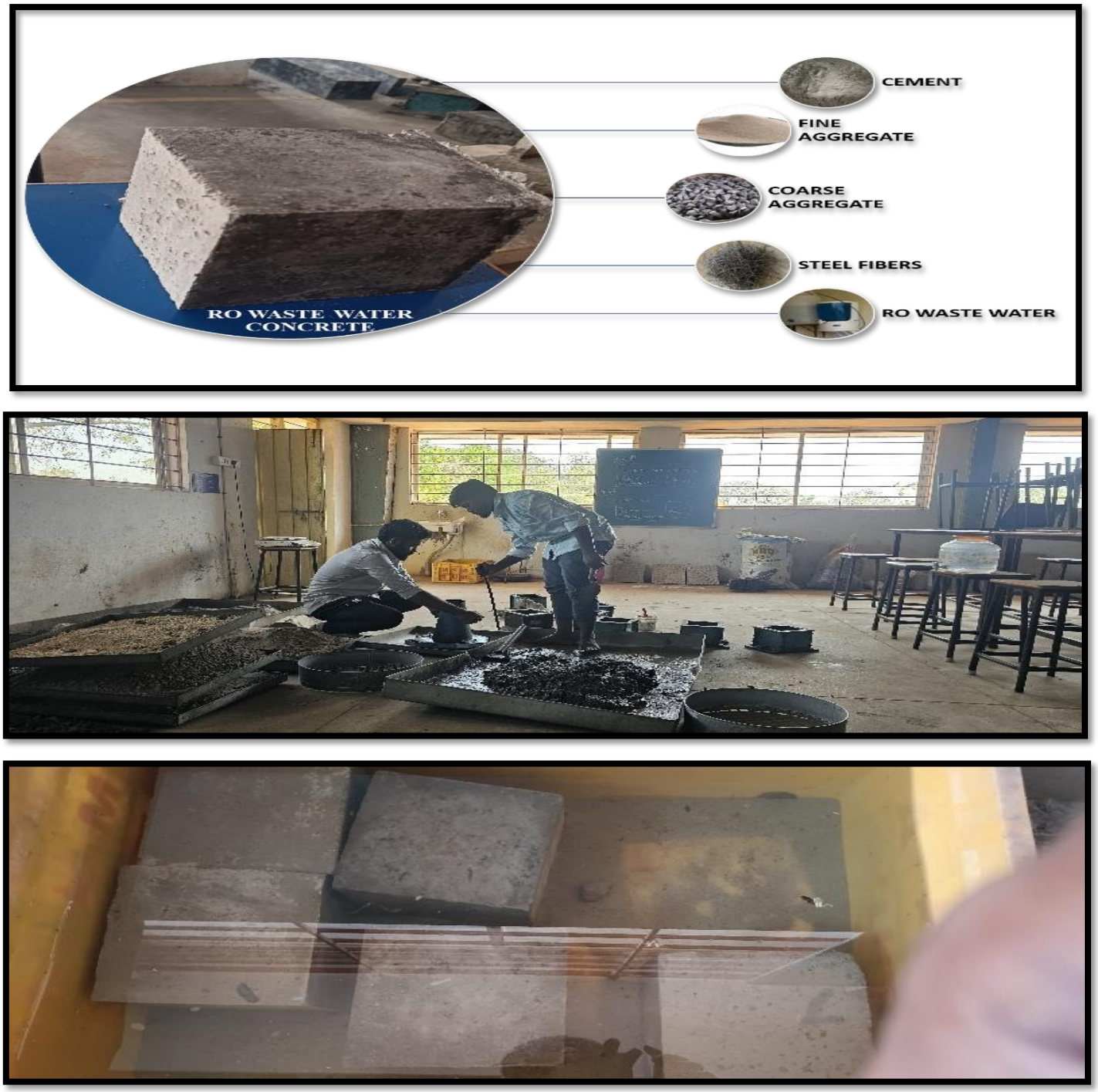

Figure 3 Mix of Ro Waste Water Concrete, Cast and Curing

VII. EXPERIMENTAL INVESTIGATION

The evaluation of RO waste water concrete for utilizes as a replacement of potable water begins with the concrete testing. RO waste water concrete contains cement, water, coarse aggregate steel fibers. In RO waste water concrete 10% 15% and 20% of the coarse aggregate is replaced with steel fibers. Three cube samples were cast on the mould of size 150*150*150 mm with RO waste water with a w/c ratio of 0.35 for each concrete mix. The specimens were demolded after around 24 hours, and the water curing process was carried out until the corresponding specimens were tested for compressive and tensile strength following days 7, 28, and 56.

- *RO Waste Water Concrete's Compressive Strength (IS:516-1959)*

Using cube samples, Tests of compressive strength were conducted on a compression testing equipment. The mean values of strength presented in this research were tested on 3 samples per mix. Comparative tests were conducted on every mix of concrete for RO waste water, steel fibers replacement with W/C ratio of 0.35. The compressive capacity of RO waste water is demonstrated in Figure 4. Figure 5 displays the outcomes of the experiment.

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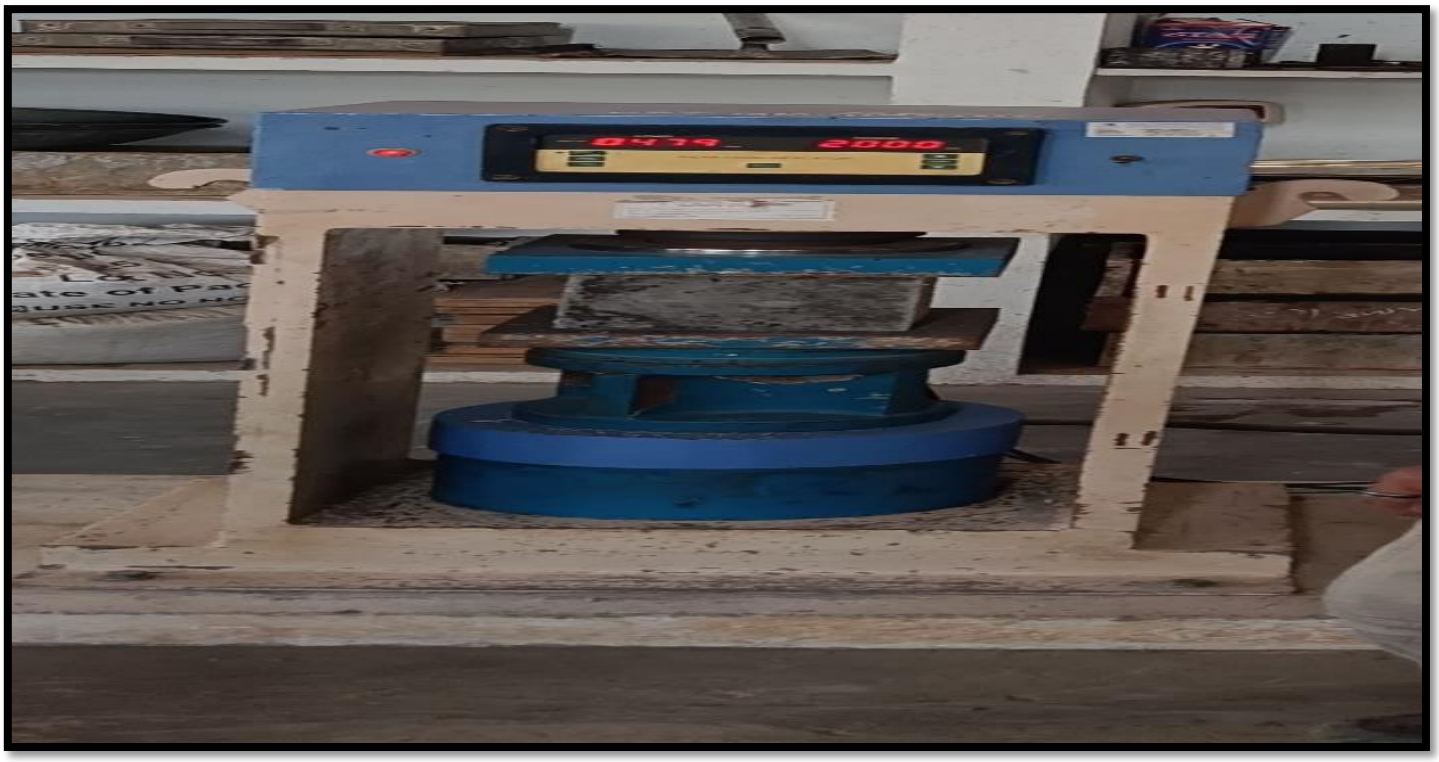

Figure 4 Compressive Strength Test of RO Waste Water Concrete

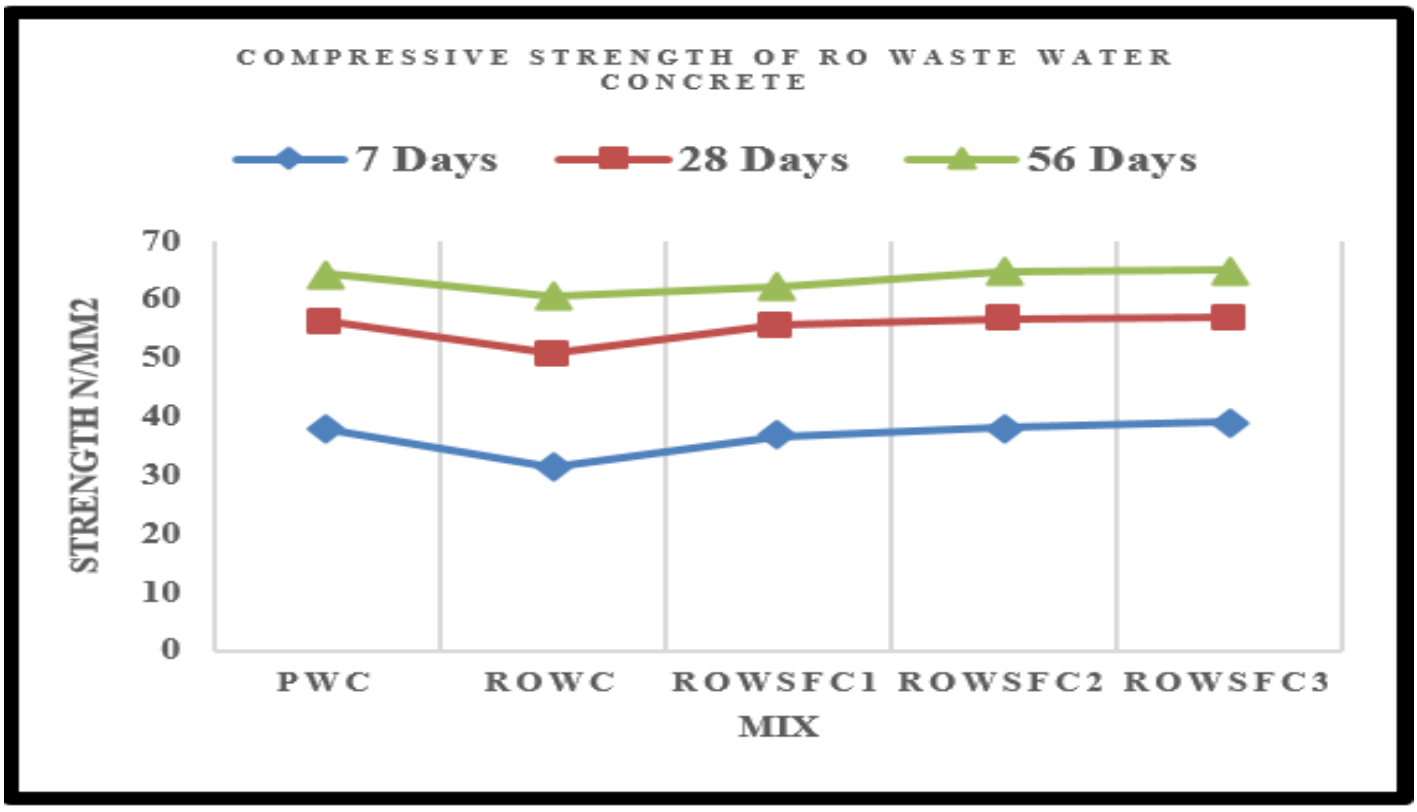

Figure 5 Graph Plot between Compressive Strength and RO Waste Water Concrete Mixes

➢ *RO Waste Water Concrete Acid Attack Durability Test (IS:516-1959)*

Cube samples were used in acid attack tests using H_2SO_4 (Sulphuric acid) of 5 % in water content of curing with RO waste water. Strength test carried out for 7,28, and 56 days of durability before acid attack the compressive strength noted with same mix another sample is tested for after acid attack strength test is carried out. The loss of weight is also taken due acid penetrates into concrete sample which detoriates the cement paste. RO waste water concrete acid attack test is seen in Figure 6. Figure 7,8 and 9 displays the outcomes of the experiment.

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Figure 6 Acid Attack Test of RO Waste Water Concrete

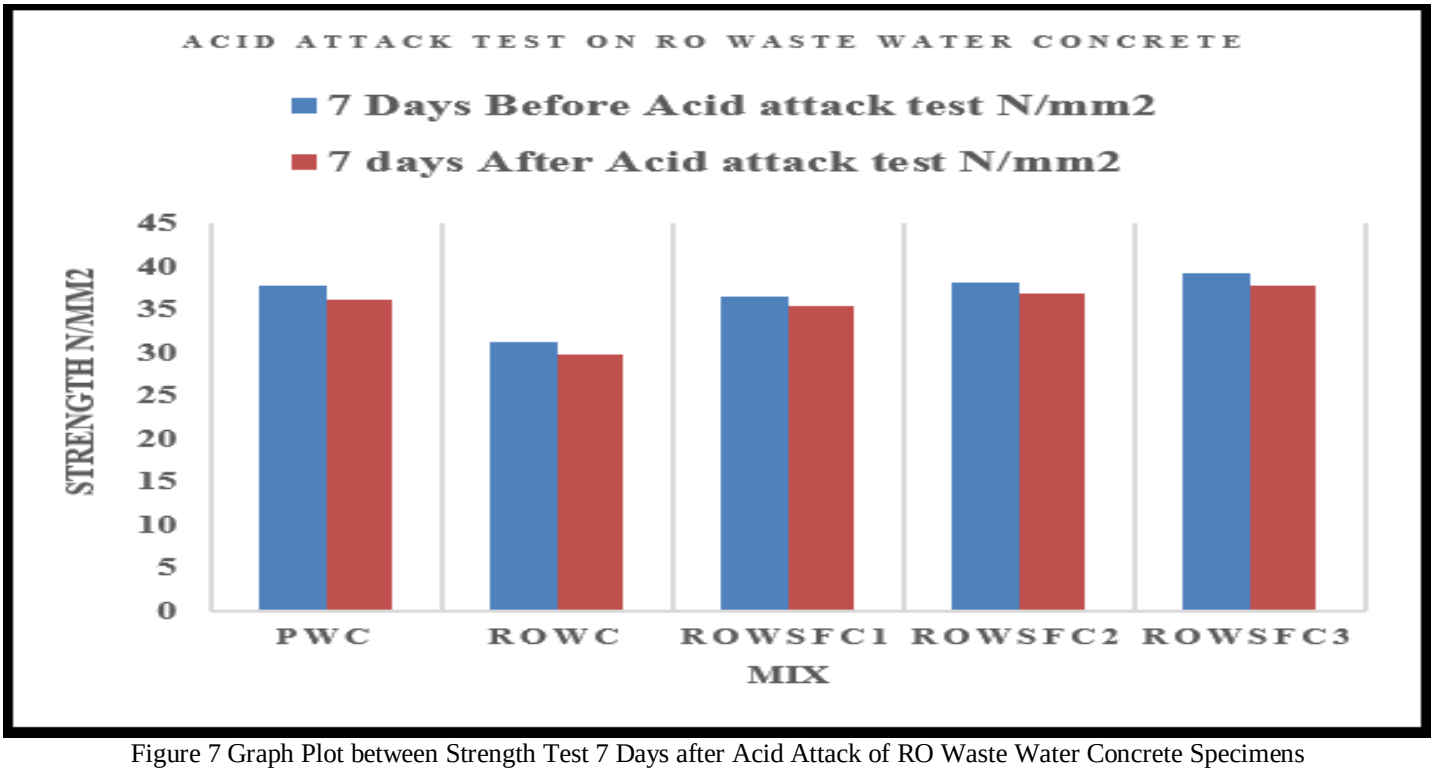

Figure 7 Graph Plot between Strength Test 7 Days after Acid Attack of RO Waste Water Concrete Specimens

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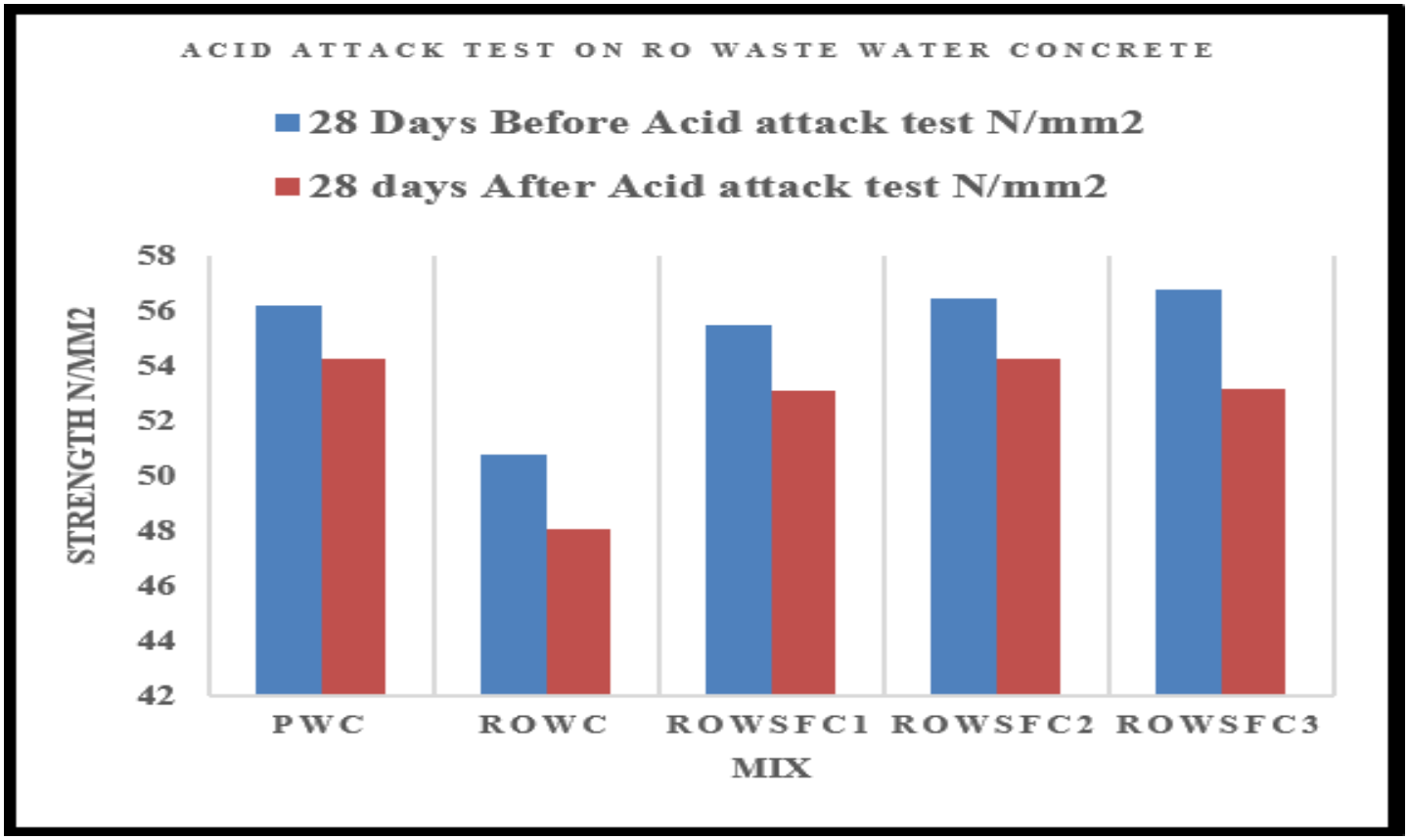

Figure 8 Graph Plot between Strength Test 28 Days after Acid Attack of RO Waste Water Concrete Specimens

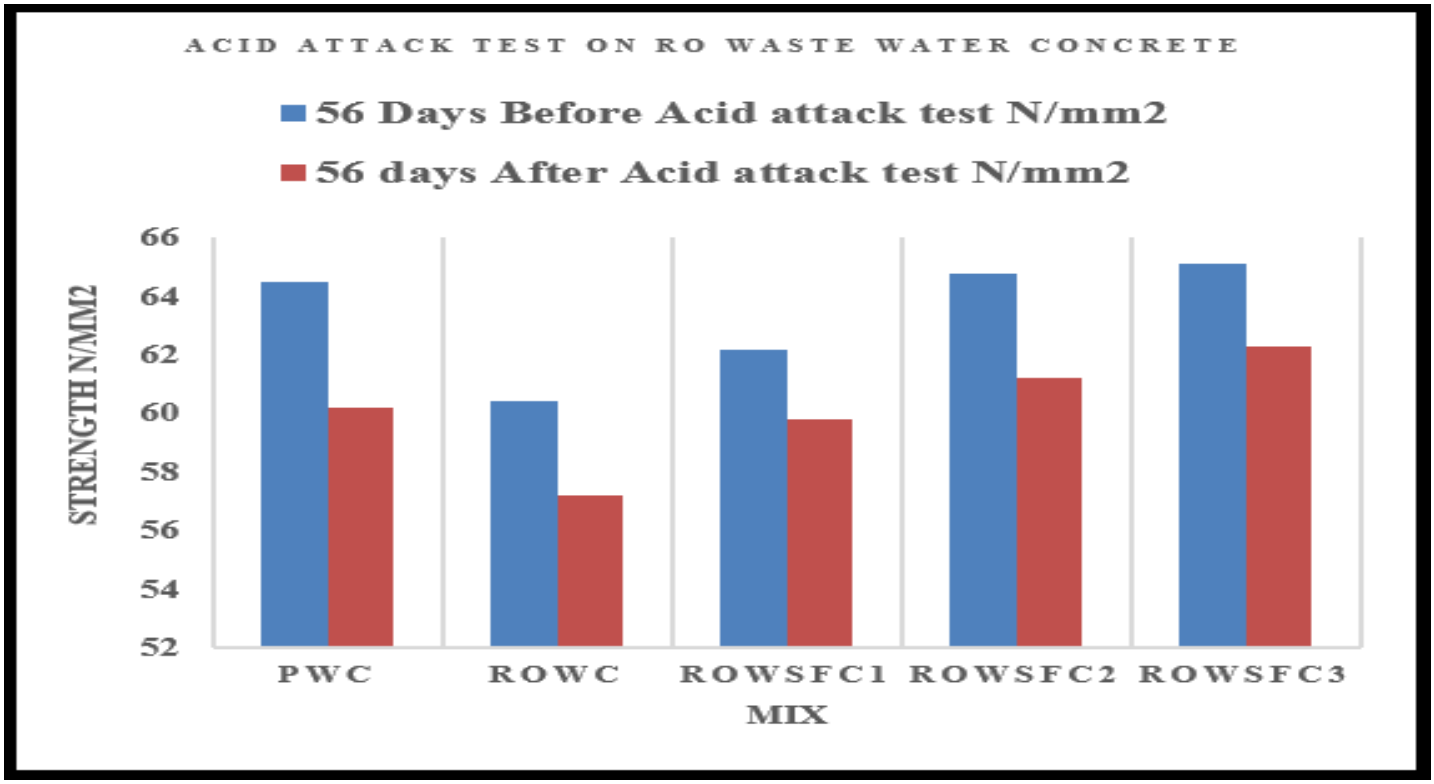

Figure 9 Graph Plot between Strength Test 56 Days after Acid Attack of RO Waste Water Concrete Specimens

VIII. CONCLUSIONS

The impacts of RO Waste water and steel fibers on the mechanical and durability characteristics of RO waste water concrete have been examined in this experimental investigation. The following findings can be made in light of the thorough analysis of the research investigation.

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- The inclusion of RO waste water reduced workability condition than potable water concrete mix workability.
- Since the conventional M50 grade concrete with RO waste water curing edifice normal strength less than potable water concrete mix. There is slight reduction in strength parameter of Ro waste water concrete.
- It was determined that adding 10–20% of steel fibers in coarse aggregate substitution there was increase in strength parameter due to PPC is used there is strength gain for long period. 56 days achieve more strength for all mixes corresponding to their strength.
- Acid attack tests conflict the age durability condition of concrete specimens. By adding H_2SO_4 of 5 % in water content there is slight reduction in compressive strength respective of their ages submerged in acid solution of 7,28 and 56 days.

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