STUDY ON PERVIOUS CONCRETE BY USING COST EFFECTIVE MATERIALS

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Abstract - *The past decade of the construction world has shown vast interest in pervious concrete. The study focus is on the strength comparison eco-friendly pervious concrete by replacement of cost effective materials in pervious concrete. The effective utilization of waste recycles materials like fly ash, steel slag, rubber chips and silica fume will indirectly reduce environment pollution. The replacement for cement was done by 8% to 25% of fly ash and silica fume and for coarse aggregate by 2% to 30% of steel slag and rubber chips. Using the selected aggregates the strength of pervious concrete is improved economically. In the past few days flyash generation is more and it is used to increase the strength of the concrete world.*

Key words: Pervious concrete, No fines, strength, porosity, Replacement.

1. INTRODUCTION

Pervious concrete is a special type of concrete made using coarse aggregates with little or no fine aggregate with carefully controlled amount of water and cementitious materials hence it called as 'no-fines concrete'. Pervious concrete is a zero-slump concrete having void content of about 15% to 25% and a have flow rate of 0.34 cm/second. Pervious concrete has a large open pore structure hence it has less heat storage and faster in flow characteristics. The paste coats and binds the aggregate particles together to create a system of highly permeable, interconnected voids that promote the rapid drainage of water. Pervious concrete is traditionally used in parking areas, areas with light traffic, residential streets, pedestrian walkways, and green houses. It is an important application for sustainable construction. Pervious concrete have high porosity used for concrete flat applications allows water from precipitation and other sources to pass directly through, thereby reducing the runoff from a site and allowing groundwater recharge. In India electricity demand has tremendously increased due to industrialization and rapid economic growth. Coal plays a major role in production of flyash and this will increase in future. India ranks fourth in production of coal ash in world level. In the year 2014, 777.1 Million tonnes of flyash was produced at world level in that 415.5 Million tonnes of flyash was utilized, rate of utilization is 53.5% (Sirajuddin Ahmed et al). In the same year India's contribution in production of flyash is 184.14 Million tonees and utized is 102.54 Million tonnes and the utilization rate is 55.69%. In India the production rate is the generation rate is decreased in the year 2015-16 to 176.74 Million tonnes and the utilization rate is increased to 107.77 Million tonnes, the utilization rate is 60.79%. In the first half of 2016-17 the generation is 85.48 Million tonnes and utilized is 49.52 Million tonnes and the utilization rate is 57.93% (ENVIS Centre on Flyash). In current scenario the production steel slag is 12 Million tonnes in India (Indian mineral year book May 2016). Steel slag is used as recycled raw materials as road aggregate, cement and concrete admixture, soil stabilizer and construction materials etc, by its physical and chemical properties. The main objective of the project is to utilize the by-products from the production of steel and thermal power stations which are considered as waste residues as a replacement material in concrete thus to enable recycle process. The optimum percentage replacement of supplementary materials and industrial by-products helps in reduction of overall construction cost and also to play a major role in improvement of social and environmental standards in an eco-friendly manner.

2. MATERILAS AND THEIR PROPERTIES

53 grade OPC ensures better concrete properties and withstand other natural causes of Concrete deteriorations such as Sulphate and Alkali attacks as per IS:12269-1987 is selected. Coarse aggregate having maximum size of 20mm are used for the work. As per IS:2386-1963 ,Coarse aggregate is chosen. Fly ash can be used in Portland cement concrete to enhance the performance of the concrete. Fly ash has high pozzolans. Fly ah is selected as per ACI:318-08. The fly ash selected Class C. Silica fume is a by-product of production of silicon and ferrosilicon alloys. Silica fume is added to Portland cement concrete to improve its properties, compressive strength, bond strength and abrasion resistance. The quality of silica fume is specified by ASTM C 1240 and AASHTO M 307. The non-degradable nature of rubber and consequent disposal problem has led to a serious environmental issue in the recent decades. Using this waste materials in concrete can solve these problem. Tires are from MRF brand are chosen. Replacement of Steel Slag is done for both coarse

aggregates as well as fine aggregate. Steel slag aggregates are highly angular in shape and have rough surface texture. They have high bulk specific and moderate water absorption. All the materials we utilized have good mechanical strength.

3. MECHANICAL PROPERTIES OF PERVIOUS CONCRETE

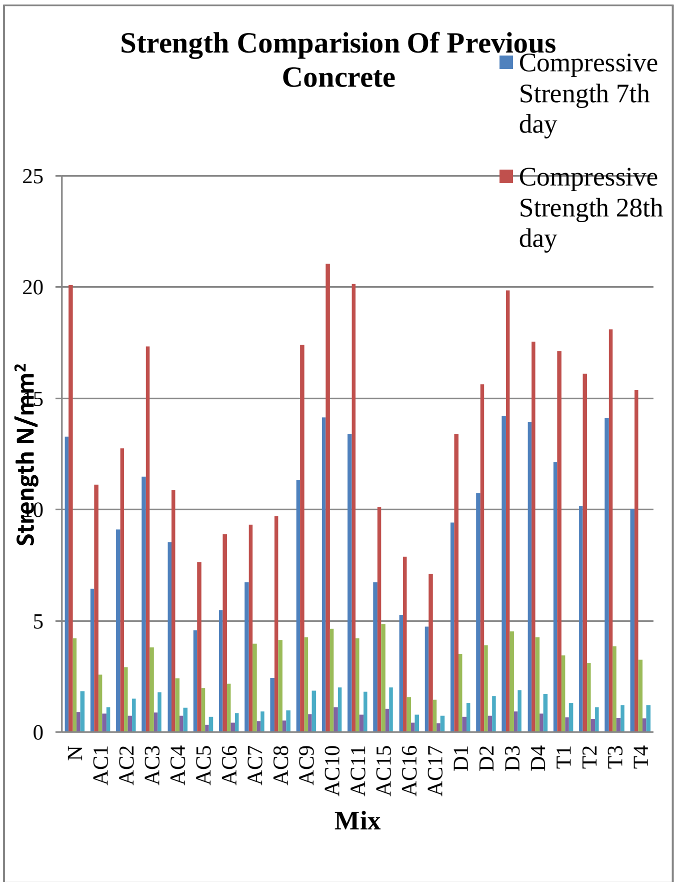

Chart-1: Comparison of strength of pervious concrete

For the single blended mixes replacement of steel slag by 6% gives maximum compressive strength of 21.04N/mm² (M.Sowmiya et al) and maximum split tensile strength of 2.01N/mm² and flexural strength of 4.64N/mm² but the maximum flexural strength is 4.85N//mm² at replacement of rubber by 2%. In binary blended mixes the result is we have high split tensile strength of 1.89N/mm² and flexural strength of 4.53N/mm² and compressive strength of 19.85N/mm² at replacement of fly ash at 15% and steel slag at 4% but high compressive strength of 20.09N/mm² at nominal mix. In ternary blended mixes we have high compressive strength of 21.09N/mm² split tensile strength of 1.84N/mm² and flexural strength of4.21N/mm² at nominal mixes.

4. SOFTWARE ANALYSIS

4.1. Regression analysis

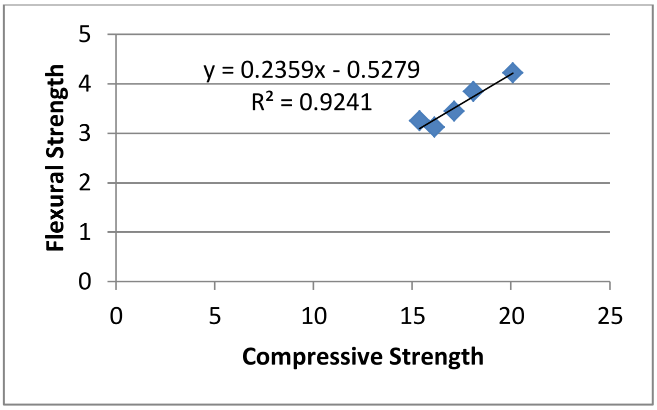

Chart-2: Regression of flexural strength and compressive strength

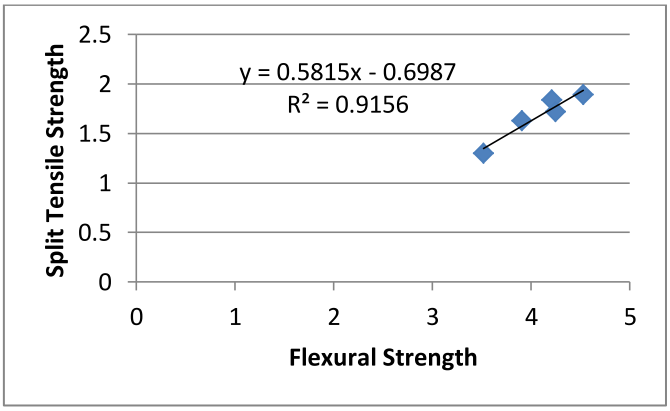

Chart-3: Regression of split tensile strength and flexural strength

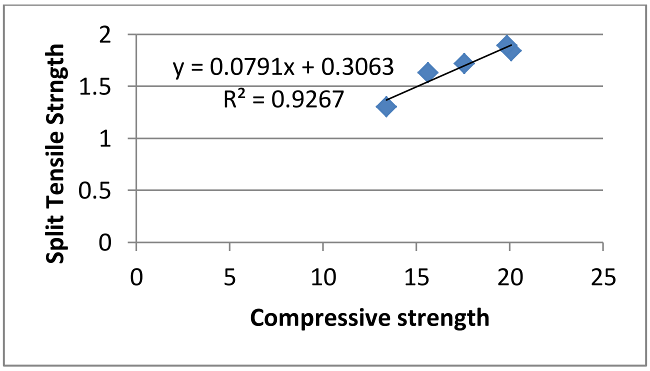

Chart-4: Regression of split tensile strength and compressive strength

The above three figures is compared with regression software. With the comparison of the strength of the mixes it has been seen that the linear equation is obtained. So it can be said that the strength activity is obtained. It is said that the linear equation is obtained.

4.2. Anova analysis

Anova: Single Factor

SUMMARY

Groups	Count	Sum	Mean	Variance	Standard Deviation	Low	High
COMPRESSIVE STRENGTH	23	324.59	14.11261	20.7239929	4.552361243	9.56024745	18.66497
FLEXURAL STRENGTH	23	78.97	3.433478	0.99336008	0.99667451	2.43680375	4.4301528
SPLIT TENSILE STRENGTH	23	31.3	1.36087	0.19281739	0.439109771	0.92175979	1.7999793

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	2153.922	2	1076.961	147.460443	4.47047E-25	3.13591793
Within Groups	482.0237	66	7.30339			
Total	2635.946	68				

Fig-1: Anova analysis of strength of concrete

Where,

SS- Sum of square

df- Degree of freedom

MS- Mean square

F- Critical value

MS=Mean square between group/mean square within the group

df=K-1 (between groups)

df=K(n-1) (within group)

n= Total column value

5. CONCLUSION

The summary of the conclusion is based on experimental and analytical study on conventional rigid concrete and pervious rigid concrete.

1. With the replacement of flyash for a portion of cement increases the compressive strength to some extend and it will decrease with the increase in flyash.
2. The silica fume plays act as good reactive pozzolan, as per our result silica fume increases the mechanical properties of pervious concrete.
3. With the increase in steel slag at 6% increases the compressive strength. Usage of steel slag instead of natural aggregates avoids the environmental footprint of quarrying, and also prevents deforestation.
4. T3 mix with replacements by 10% silica fume and 4% steel slag gives the highest flexural strength.
5. Addition of rubber waste increases the split tensile strength. Increase in rubber percentage increases the split tensile strength to some extend. The rubber of 2% replacement gave the highest split tensile strength.
6. Thus as per our study flyash is widely used as concrete material. The mechanical strength of pervious concrete is increased by replacements of waste materials for cement and coarse aggregate
7. The carbon footprints has drastically decreased by replacements for cement.
8. It is observed that the cost of construction of our pervious concrete mix is decreased by 27% as compared when super plastizers are used.

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