THE COMPARISON OF COMPRESSIVE & FLEXURAL STRENGTH BETWEEN PLAIN CONCRETE AND THE CONCRETE WITH PARTIAL REPLACEMENT OF TYRE RUBBER, MARBLE FINES AND FLY ASH

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ABSTRACT

The aim of this project is to replace raw materials of concrete with waste from industries like Fly ash, Marble chunks and scrap tyre rubber. Around 163.56 million tones Fly ash, 7 million tones marble waste and 90,000 metric tones waste tyre generated every year in India. The degradation of this waste is very long process and hence project is helpful in reducing and recycling the waste. In this project we have partially replaced Fly ash with cement, Marble waste with sand and waste tyre rubber with coarse aggregate. With proper mix design cubes were casted and tested. It was determined that possibility of usage of these waste in the concrete as aggregate affected positively on the hardened properties of concrete. Green concrete is cost effective and environmentally friendly. River sand has been the most popular choice for the fine aggregate component of concrete in the past, but overuse of the material has led to environmental concerns, the depleting of securable river sand deposits and a concomitant price increase in the material. Therefore, it is desirable to obtain cheap, environmentally friendly substitutes for cement and river sand that are preferably by-products. Fly ash (pulverized fuel ash) is used extensively as a partial replacement of cement. However, though the inclusion of fly ash in concrete gives many benefits, such inclusion causes a significant reduction in early strength due to the relatively slow hydration of fly ash. Never the less, fly ash causes an increase in workability of concrete.

It has been a growing practice among the researchers to use the deformed shapes of rubber tyres while incorporating into the concrete mixture. The rubber tyres shows better performance in concrete when they are cut in the form of normally sized coarse aggregate to take the full advantage of the shape factor of the aggregate. Due to this fact, the compressive strength of the concrete can be made more or less stronger as compared to the aggregate sizes which are not in the proper shape to be incorporated in the concrete.

Keyword:- *Fly Ash, Marble chunks, Tyre Rubber, compressive strength, flexural strength*

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1. INTRODUCTION

The concrete is made with concrete wastes which are eco-friendly so called as Green concrete. The other name for green concrete is resource saving structures with reduced environmental impact for e.g. Energy saving, CO_2 emissions, waste water. Green concrete is a revolutionary topic in the history of concrete industry. This was first invented in Denmark in the year 1998 by Dr. WG.

Green concrete is a concept of using eco-friendly materials in concrete, to make the system more sustainable. Green concrete is very often and also cheap to produce, because for example, waste products are used as a partial substitute for cement, charges for the disposal of waste are avoided, energy consumption in production is lower, and durability is greater. This concrete should not be confused with its colour. Waste can be used to produce new products or can be used as admixtures so that natural resources are limited and used more efficiently and the environment is protected from waste deposits. Inorganic residual products like stone dust, crushed concrete, marble waste are used as green aggregates in concrete. Further, by replacing cement with fly ash, micro silica in larger amounts, to develop new green cements and binding materials, increases the use of alternative raw materials and alternative fuels by developing or improving cement with low energy consumption. Considerable research has been carried out on the use of various industrial by-products and micro-fillers in concrete. The main concern of using pozzolanic wastes was not only the cost effectiveness but also to improve the properties of concrete, especially durability.

Green concrete capable for sustainable development is characterized by application of industrial wastes to reduce consumption of natural resources and energy and pollution of the environment. River sand has been the most popular choice for the fine aggregate component of concrete in the past, but overuse of the material has led to environmental concerns, the depleting of securable river sand deposits and a concomitant price increase in the material. Therefore, it is desirable to obtain cheap, environmentally friendly substitutes for cement and river sand that are preferably by-products. Fly ash (pulverized fuel ash) is used extensively as a partial replacement of cement. However, though the inclusion of fly ash in concrete gives many benefits, such inclusion causes a significant reduction in early strength due to the relatively slow hydration of fly ash. Nevertheless, fly ash causes an increase in workability of concrete.

It has been a growing practice among the researchers to use the deformed shapes of rubber tyres while incorporating into the concrete mixture. The rubber tyres shows better performance in concrete when they are cut in the form of normally sized coarse aggregate to take the full advantage of the shape factor of the aggregate. Due to this fact, the compressive strength of the concrete can be made more or less stronger as compared to the aggregate sizes which are not in the proper shape to be incorporated in the concrete.

2. Methodology
I mix Design As per IS 10262:2009

M30 Concrete Mix Design

Mix Ratio = 1: 1.4: 2.7

Sr. No.	Items	For 1 m^3 concrete	Mix Ratio
1	Cement	394.92 Kg	1
2	Fine aggregate	563.35 Kg	1.4
3	Coarse aggregate	1078.8 Kg	2.7
4	Water	191.58 Liter	0.5

3. TESTS ON MATERIALS

a) Cement :

1. Standard consistency of cement

$$\text{Standard Consistency of Cement} = \frac{\text{Quantity of water for } 5-7 \text{ mm penetration from bottom of vicat mould}}{\text{Weight of cement sample}} \text{x}10 = \mathbf{34}\%$$

2. Time setting

1) Water required for normal consistency = 0.85 × water req. for standard consistency = 0.289
2) Initial setting time = ***118 minute***
3) Final setting time = ***342 minute***

3. Fineness Of Cement

1) Volume of cement = 100 gm
2) Time of sieving on 90µ IS sieve = 15 minute

Residue weight after 15 minute sieving

$$Fineness\ of\ Cement = \frac{Weigth\ of\ sample\ retained\ on\ 90\mu\ \text{Sieve}}{Total\ weight\ of\ sample} x100 = 3\%$$

4. Soundness Of Cement

1) The soundness of cement = 3mm ≤ 10mm.

b) Aggregate:

1) Coarse aggregate:

1. **Impact Value**

Aggregate impact Value $= \frac{31}{680}$x100 = 4.55 %

Impact value of aggregate is found to be **4.55 % ≤10 %,** hence aggregates are exceptionally strong.

2. Los-Angeles Abrasion Test

Aggregates abrasion value $= \frac{131}{5000}$x100 = 2.62

The aggregate abrasion value of given sample of aggregate is **2.62 % ≤ 16 %,** hence aggregate is good for making concrete.

3. Specific Gravity

$$\text{Specific Gravity} = \frac{W1}{W4 - (W2 - W3)}$$

The specific gravity of course aggregate is found to be **2.87.**

2) Fine aggregate:

1. Fineness Modulus

Fineness Modulus $= \frac{\text{(Total cumulative \% wt.retained)}}{100} = \frac{277.8}{100}$ = 2.778

2. **Specific Gravity**

Specific Gravity $= \frac{D}{A-(B-C)} = \frac{650}{663-(1811-1411)}$ = 2.

Test on fresh concrete

Slump cone test

Sr. No.	Mix Proportion	Slump in mm
1	Plain Concrete	100
2	05%	97
3	10%	94
4	15%	89

Tests on Harden Concrete

Strength parameter	Days	Plain concrete	05%	10%	15%	remarks
Compressive strength	**14**	**27.08**	**21.91**	**23.16**	**23.07**	
	28	**35.18**	**31.21**	**32.06**	**31.53**	
Flexural strength	**14**	**3.64**	**3.27**	**3.36**	**3.36**	
	28	**4.15**	**3.91**	**3.96**	**3.93**	

5. RESULTS

Table No: 5.5 Compressive strength of cubes

Sr. No.	Days	Avg. Compressive Strength of Concrete (N/mm^2)			
		Plain Concrete	05%	10%	15%
1	14	27.08	21.91	23.16	23.07
2	28	35.18	31.21	32.06	31.53

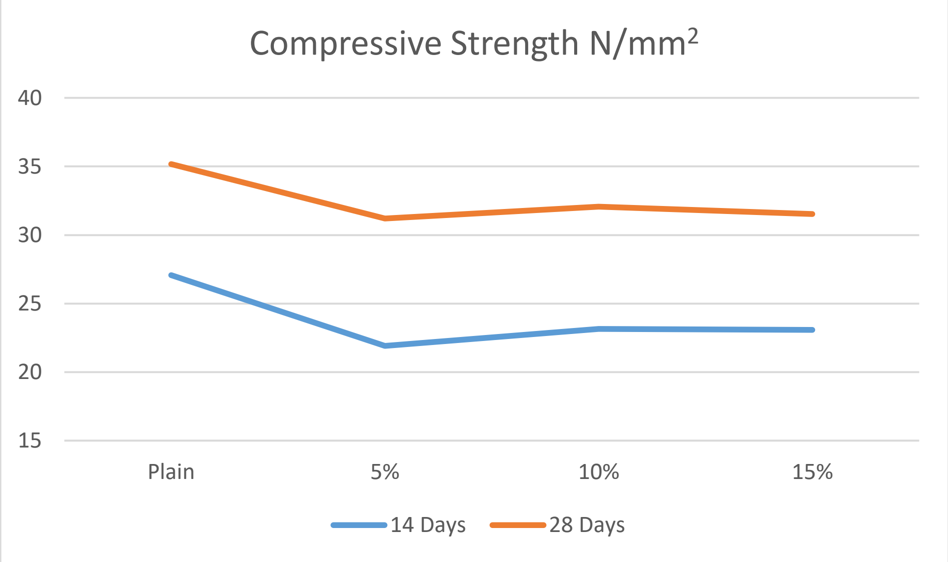
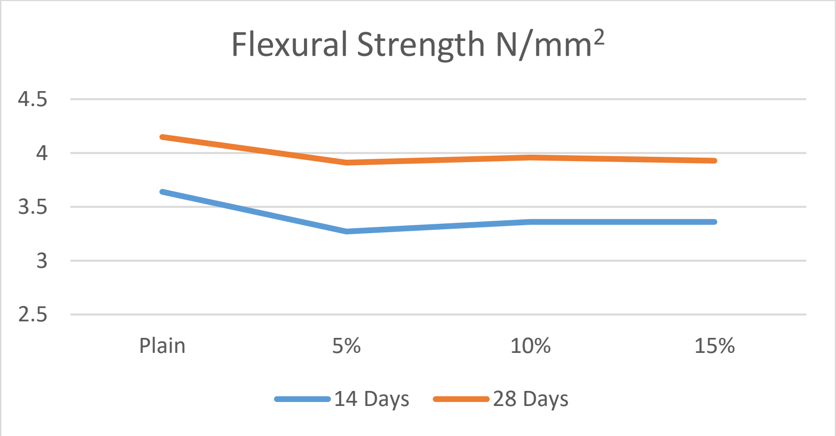


Table No: 5.6 Flexural strength of beam

Sr. No.	Days	Avg. flexural Strength of Concrete (N/mm^2)			
		Plain Concrete	05%	10%	15%
1	14	3.64	3.27	3.36	3.36
2	28	4.15	3.91	3.96	3.93



6. CONCLUSION

1. The compressive strength and flexural of concrete is approximately same for the mix proportion i.e. 5%, 10% and 15% with addition of waste 10% by weight in place of cement, sand and aggregates, further any addition of waste marble powder the compressive strength decreases.
2. It was determined that possibility of usage of the rubber tyre in the concrete as aggregate affected positively on the hardened properties of concrete.

3. The use of marble and fly ash in concrete will reduced the use of natural sources.
4. The use fly ash in the various projects will minimized the environmental issues
5. As the percentage of tyre increases strength will decrease.

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