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Study of Feasibility of Partial Replacement of Pozzolanic Materials for Cement In Recycled Aggregate Concrete

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ABSTRACT

In developing country like India infrastructures play an important role in achieving rapid and continuous growth of country. Concrete is major material required for construction of infrastructure. The main gradient of concrete is aggregates and cement. Aggregate used in concrete are obtained by crushing or breaking a large rock in required size. But natural aggregates are becoming increasingly scarce and its shipment is becoming more difficult. The cement is manufactured through a closely controlled chemical combination of calcium, silicon, aluminium, iron clay and other ingredients. Hence to reduce use of natural rock, recycled aggregates and pozzolanic materials are currently used in concrete surface applications, but there is need for some additional work to determine the feasibility of utilizing this industrial by-product more wisely as a replacement for cement in a conventional concrete mixture. The primary aim of this project is to evaluate the strength of concrete made with recycled aggregates and pozzolanic materials. This study present result of experimental investigations carried out to evaluate effect of partially replacement of cement by pozzolanic materials on various concrete properties. In the present study M40 grade of concrete having three cubes for each mix tested for their 7 days and 28 days compressive strength were determined adopting conventional testing procedure. Ingredients used in this project for making concrete cubes are cement, sand, recycled, aggregates and pozzolanic materials as partial replacement of cement and water is used for making mixture of this ingredients. All tests are taken which is necessary before they are used for making concrete. Keyword: Pozzolanic, Compressive strength, concrete.

Keywords : Recycled Aggregate, Concrete, Pozzolanic Material, Compressive Strength, Workability

I. INTRODUCTION

Large quantities of natural materials are traditionally used in construction of infrastructure. Uncontrolled depletion of natural, non-renewable resources leads to environmental destruction and distortion of natural balance. Global warming and environmental destruction have become the major issue in recent years. Use of more and more environmental-friendly materials in any industry in general and construction industry in particular is of paramount importance. Preventing the depletion of natural resources and enhancing the usage of waste materials has become a challenge to the scientist and engineers. A number of studies have been conducted concerning the protection of natural resources, prevention of environmental pollution and contribution to the economy by using this waste material.

Pozzolanic materials are the main ingredients of project research. Pozzolanic material such as Fly ash is waste product of sugar industry which is produced during its process. With increasing capacities, disposal of large quantities of pozzolanic materials becomes a

big environmental concern and a critical issue for sugar or other industries.

Due to modernization, demolished materials are dumped on land & not used for any purpose. Such situations affect the fertility of land. As per report of Hindu online of March 2007, India generates 23.75 million tons demolition waste annually. As per report of Central Pollution Control Board (CPCB) Delhi, in India, 48million tons solid waste is produced out of which 14.5 million ton waste is produced from the construction waste sector, out of which only 3% waste is used for embankment.

Out of the total construction demolition waste, 40% is of concrete 30% ceramics, 5% plastics, 10% wood, 5%metal, & 10% other mixtures. As reported by global insight, growth in global construction sector predicts an increase in construction spending of 4800 bilion US dollars in 2013. These figures indicate a tremendous growth in the construction sector, almost 1.5 times in 5 Years.

II. PROBLEM STATEMENT

Strength of recycled aggregate is less as compared to natural aggregate, to enhance strength without affecting other parameters, pozzolanic materials can be blended with cement to achieve good bonding and reduce void ratio i.e. to increase the compressive strength of recycled aggregate concrete. Optimization of different pozzolanic material can be studied for cost effectiveness with desired compressive strength.

Objectives

- To study effect of variation of Fly ash as partial replacement to cement in recycled aggregate concrete on compressive strength of concrete.
- To study effect of variation of GGBFS (Ground Granulated Blast Furnace Slag) as partial replacement to cement in recycled aggregate concrete on compressive strength of concrete.
- To study effect of combination of Fly ash and GGBFS (Ground Granulated Blast Furnace Slag) as partial replacement to cement in recycled aggregate concrete on compressive strength of concrete.
- To study and compare cost analysis for optimized percentage for Fly ash and GGBFS (Ground Granulated Blast Furnace Slag) as partial replacement to cement.

III. SCOPE OF PROJECT WORK

This study can show an alternative use of Pozzolanic materials by incorporating them into recycled aggregate concrete construction as partial replacement to cement.

The aim of this study is to introduce an environmental friendly technology, which can benefit the society and the nation. This project can reduces the wastage of pozzolanic materials, it is recycled very smoothly and reduces the depletion of natural resources.

IV. RESULTS AND DISCUSSION

5.1 Experimental Analysis

The experimental work is carried out to evaluate the effect of percentage variation of study of feasibility of partial replacement of pozzolanic materials for cement in recycled aggregate concrete on compressive strength of concrete. The percentage of Fly ash and GGBFS is varied from 10% to 30% with increment of 10% and the percentage. Various tables presented in this chapter shows the results obtained from the tests on hardened concrete.

5.2 Density of Concrete

The density of concrete is a measure of solidity and microstructure of concrete. The density is obtained by measuring the mass and volume of cube respectively. The details of densities of concrete cube with varying

percentage of pozzolanic materials are as shown in table no.5.1

Sr. No.	Pozzolanic materials	Specimen No.	Variation (%)	Compressive Strength(f_c) N/mm^2 [7 days]	Average of Compressive Strength N/mm^2	% Variation in Compressive Strength
1	Nil	1	00%	25.33	24.56	00
		2		24.35		
		3		24		
2	Fly ash	1	10%	34.35	30.68	24.91
		2		30.93		
		3		26.75		
3	Fly ash	1	20%	30.4	29.21	18.93
		2		27.33		
		3		29.91		
4	Fly ash	1	30%	21.51	22.16	-9.77
		2		21.42		
		3		23.55		
5	GGBFS	1	10%	19.28	17.28	-29.64
		2		16.44		
		3		16.13		
6	GGBFS	1	20%	26.88	25.19	2.56
		2		26.93		
		3		24.17		
7	GGBFS	1	30%	20	18.78	-23.53
		2		17.46		
		3		18.88		
8	GGBFS + Fly ash	1	10+20%	10.71	10.85	-55.82
		2		11.33		
		3		10.53		
9	GGBFS + Fly ash	1	20+10%	13.51	14.39	-41.40
		2		14.84		
		3		14.84		

The compressive strength of recycled aggregate concrete increases as the percentage of fly ash decreases. The increase in compressive strength is observed after 10% replacement of fly ash over cement. And the compressive strength of recycled aggregate concrete increases as the percentage of GGBFS increases. The increase in compressive strength is observed after 20% replacement of GGBFS over cement.

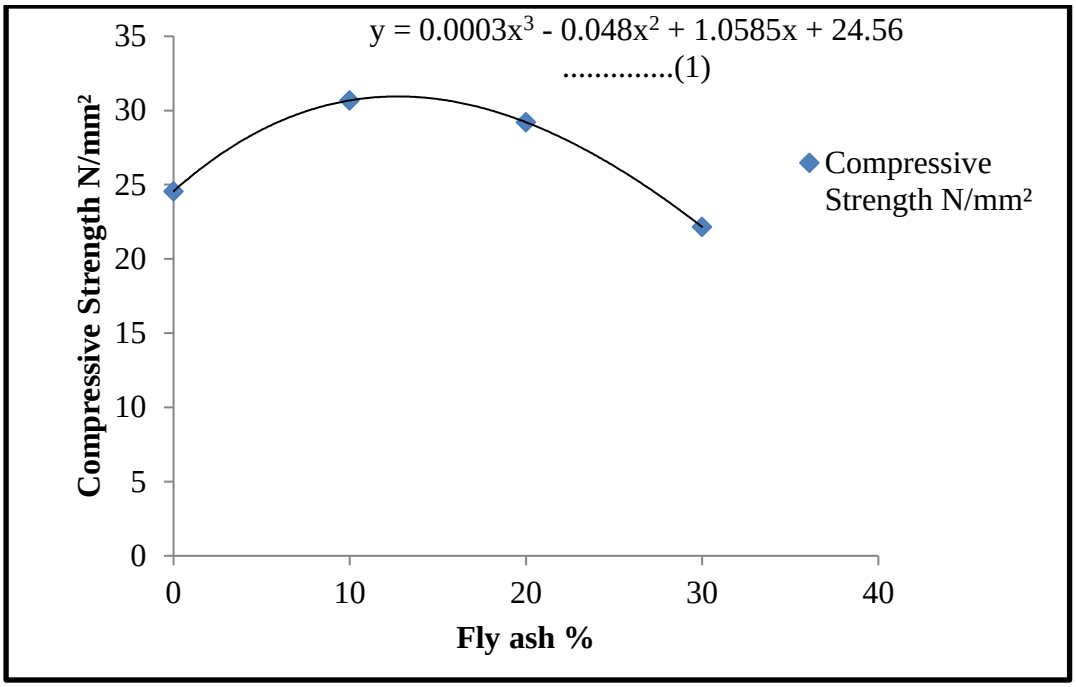

Figure 5.1. Variation of compressive strength with respect to percentage of Fly Ash after 7 days

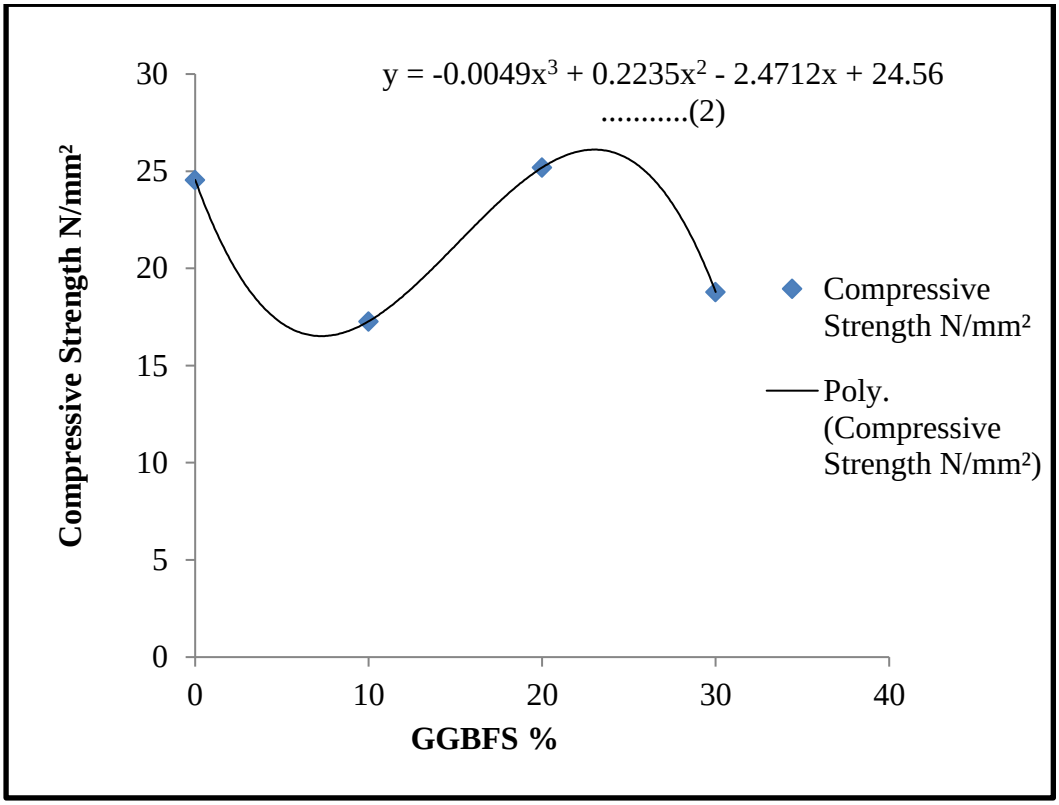

Figure 5.2.Variation of compressive strength with respect to percentage of GGBFS after 7 day Table No. 5. 2 Compressive Strength of recycled aggregate concrete with varying percentage of Pozzolanic materi

Sr. No.	Pozzolanic materials	Specimen No.	Variation (%)	Compressive Strength(f_c) N/mm^2 [28 days]	Average of Compressive Strength N/mm^2	% Variation in Compressive Strength
1	Nil	1	00%	40.93	40.61	00
		2		38.97		
		3		41.95		
2	Fly ash	1	10%	45.11	45.92	13.07
		2		46.17		
		3		46.48		
3	Fly ash	1	20%	49.86	46.89	15.46
		2		46.66		
		3		44.17		
4	Fly ash	1	30%	36.04	35.43	-12.75
		2		34.84		
		3		35.42		
5	GGBFS	1	10%	33.55	31.03	-23.59
		2		31.2		
		3		28.35		
6	GGBFS	1	20%	47.15	46.29	13.98
		2		44.88		
		3		46.84		
7	GGBFS	1	30%	28.62	31.89	-21.47
		2		33.91		
		3		33.15		
8	GGBFS + Fly ash	1	10+20%	21.86	22.39	-44.86
		2		23.02		
		3		22.31		
9	GGBFS + Fly ash	1	20+10%	32	32.67	-19.55
		2		33.15		
		3		32.88		

V. CONCLUSION

From the present experimental study, we conclude that The recycled aggregate may be suitable for architectural application, concrete kerb and gutter mix, embankment fill material, typical paving blocks, backfill materials, building blocks etc.

1. From the present experimental study, we can conclude that recycled aggregates are feasible solution for concrete production, economically and environmental.
2. This Study provides a solution for disposal of demolished aggregate which can be used as an aggregate up to 50% certain limit.
3. The compressive strength achieved by recycled aggregate concrete at 7 days and 28 days was 30.68 N/mm^2 and 46.89 N/mm^2 in case of

concrete containing 10% and 20% pozzolanic materials.

4. As the percentage of Pozzolanic materials increases the dry density of concrete decreases.

Due to use of recycled aggregate in concrete natural stone aggregate are saved to a certain quantity.

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