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A Study on Performance of Granite Powder in Concrete

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Abstract: Granite powder is a byproduct from the granite industry. Disposal of granite powder is a serious concern similar to Fly Ash disposal. In the present work the grade of concrete used is M30 and the fine aggregate is partially replaced with Granite powder in percentages of 10, 15, 20 and 25. In addition to this 20% of Fly Ash is also used to replace cement for all percentages of granite powder. For different percentages of replacement of Granite and Fly Ash in concrete the properties such as compressive strength, split tensile and deflection were determined. At 20% replacement of cement with fly ash and at 20% replacement of fine aggregate with granite powder the above properties of concrete were promising.

Keywords: Concrete, Fly ash, Granite powder, Compressive strength, Split tensile strength

I. INTRODUCTION

Fly ash is generally used as a replacement material for cement. In addition to this the fine aggregate is replaced with granite powder to reduce the use of fine aggregate in the concrete mixture. Granite powder is obtained during sawing blocks of granite. It is used as a fine aggregate replacement in the concrete. Disposing of granite waste is a cost effective process and affects the environmental condition of the surroundings.

Dr. Flexi Kala et al (2013) mentioned that Granite powder improves the mechanical properties such as workability, and chemical resistance of conventional concrete mixtures when it is partially replaced with fine aggregate. M. Vijaya Lakshmi et al (2013) mentioned that granite wastes are effective fillers and pozzolanic materials for concrete due to the ability to enhance the mechanical properties and corrosion resistance of concrete by improving compactness. The properties of powder produced by sawing granite stone is similar to the properties of the fine aggregate used in concrete. Ying Li et.al (2012) from the experimental studies it can be used as partial replacement for the fine aggregate in the concrete. The powder produced by granite industry will not affect the strength parameters if it is partially replaced with fine aggregate. It acts as a filler material in the concrete mixture. By using granite powder as partial replacement for fine aggregate its requirement can be reduced. The granite powder is produced in all stages beginning from extraction to polishing to the required texture.

II. LITERATURE REVIEW

Ying Li et.al (2012) carried out the studies by replacing fine aggregate with granite powder and fly ash magnesium oxy chloride cement instead of normal cement in the concrete compressive strength is carried out. XRD and SEM analysis is carried out for granite powder. The granite powder upto 30% replacement showed good result behind that compressive strength decreases.

Flexi Kala and Partheeban (2013) carried out studies by replacing fine aggregate with granite and cement is replaced by 7.5% silica fume, 10% fly ash, 10% slag and super plasticizer is added by 1% to the weight of the cement. At 25% of replacement of granite powder in fine aggregate the value of high performance concrete gave good strength when compared with conventional concrete.

Vijaya Lakshmi, Sekar, Ganesh Prabhu (2013) conducted experiments by replacing fine aggregate with granite waste in concrete. The split tensile and flexural strength of the concrete mixtures at 5%, 10%, 15% replacement showed almost equal to the control mixture and there is loss of strength if fine aggregate is replaced with granite powder more than 15%.

III. MATERIAL PROPERTIES

A. Chemical Properties

Chemical compound	Chemical content in granite
Al ₂ O ₃	15.8
MgO	1.2
CaO	0.9
K ₂ O	4.9
Silica(SiO ₂)	72.25
Na ₂ O	3.69
Fe ₂ O ₃	1.26

Table 2 Chemical Composition of Granite

Chemical compound	Chemical content in Class f fly ash
Al ₂ O ₃	25.8
MgO	1.8
CaO	8.7
Na ₂ O & K ₂ O	0.6
SiO ₂	54.9
SO ₃	0.6
Fe ₂ O ₃	6.9

Table 3 Chemical Composition of Fly Ash

B. Physical Properties

Granite powder Physical Properties

S.No	Physical Property	Test Result
1	Specific Gravity	2.7
2	Fineness Modulus	2.4
3	Water Absorption (%)	1.2

Specific Gravity of materials

Materials	Specific Gravity
Cement	3.12
Fly Ash	2.5
Fine Aggregate	2.8
Coarse Aggregate	2.8

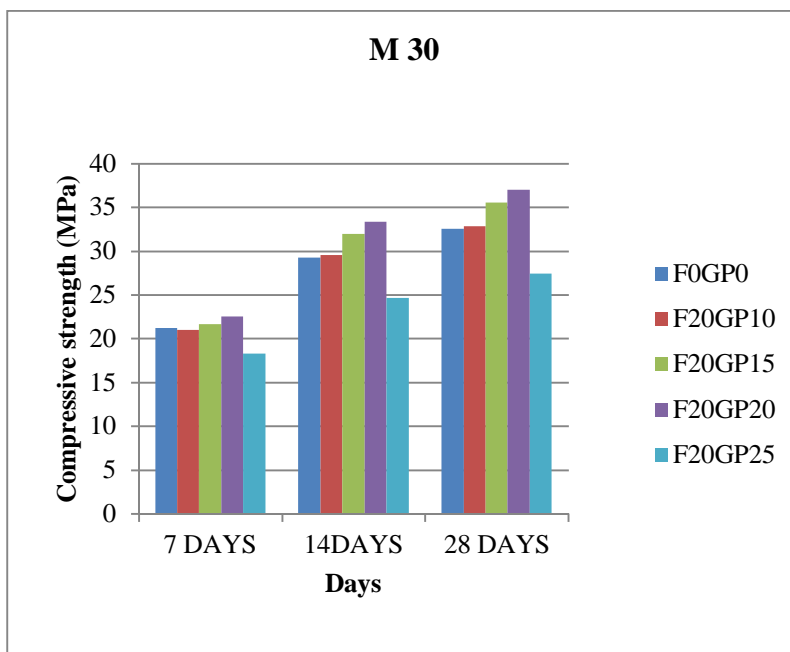
IV. METHODOLOGY

The fine aggregate was replaced with granite powder for M30 grade concrete at different percentages and the 15 cm cubes were cast for M30 grade concrete. The cement is replaced with fly ash and fine aggregate is replaced with granite powder for different percentages cubes, cylinders were cast for M30 grade concrete. For optimum value prism of 700mm X 150 mm X 150 mm were cast for M30 grade concrete. To increase the strength by using a chemical admixture (super plasticizer) and thereby adopting low w/c ratio. The super plasticizer of 0.5% to the weight of the cement is added. Water absorption test is carried out to find the percentage of water absorbed by the cubes. The cubes were cast to determine compressive strength, cylinders for split tensile strength and reinforced concrete beam for flexural strength were carried out. The compressive strength and split tensile strength were carried for 7 days, 14 days and 28 days. Reinforced concrete beams were tested for 28 days.

V. RESULTS

Compressive Strengths of M30 grades Concrete at Different Percentages

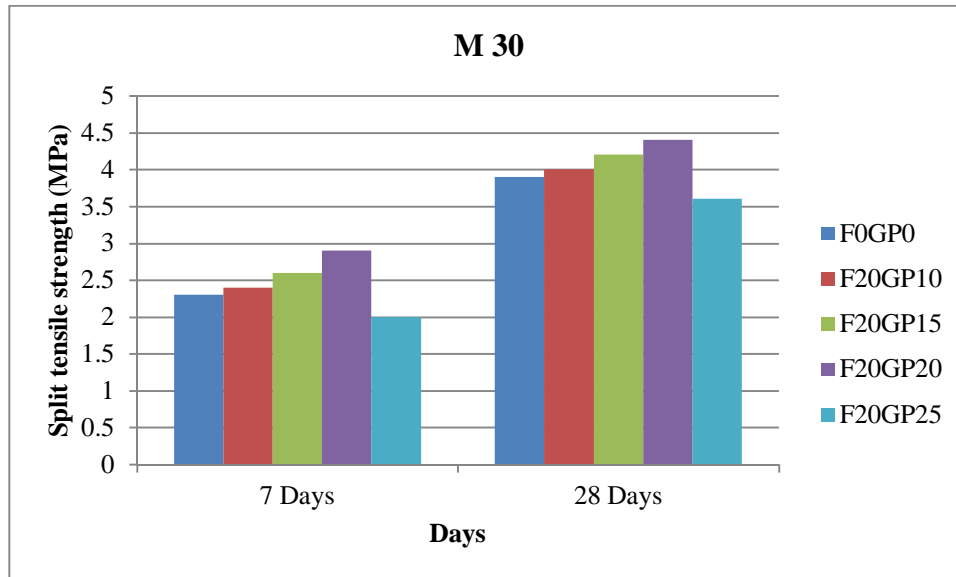
DESIGNATION	7 DAYS MPa	14DAYS MPa	28 DAYS MPa
F0GP0	21.2	29.2	32.5
F20GP10	21	29.5	32.8
F20GP15	21.6	31.3	35.5
F20GP20	22.5	31.5	37
F20GP25	18.3	24.6	27.4



The graph represents the compressive strength of the M 30 grade concrete when cement is replaced with fly ash at 20% and fine aggregate with granite powder at 10%, 15%, 20% and 25% for 7 days, 14 days and 28 days. There is an increase in compressive strength when fly ash is replaced at 20 % in cement and granite powder with varying percentage there is 8 % to 10% increase in compressive strength when compared to nominal mix for 14 and 28 days. There is increase in compressive strength when fly ash is replaced at 20 % in cement and granite powder with varying percentage there is 5 % to 8% increase in compressive strength when compared to nominal mix for 7 days. Behind that percentage it shows decrease in compressive strength when the percentage of granite powder is increased.

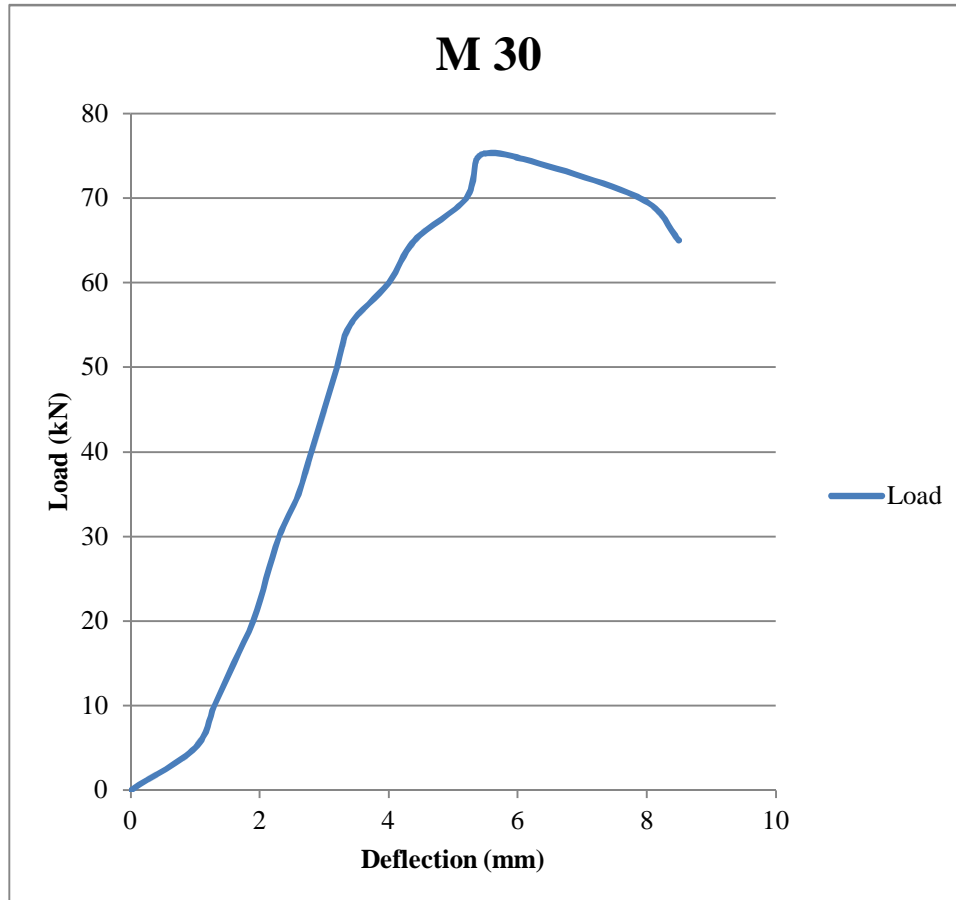
VI. SPLIT TENSILE STRENGTH OF M30GRADES CONCRETE AT DIFFERENT PERCENTAGES

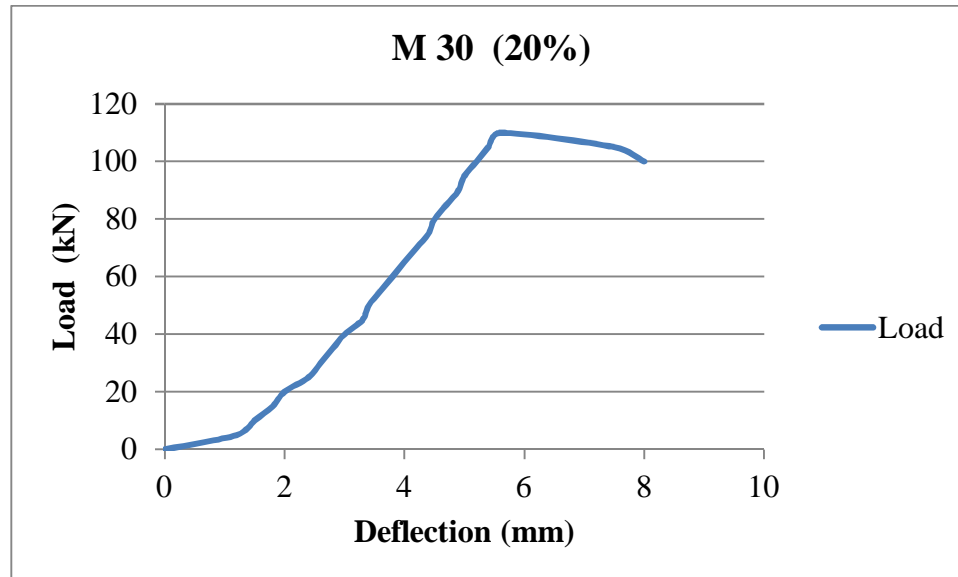
Designation	7 Days MPa	28 Days MPa
F0GP0	2.3	3.9
F20GP10	2.4	4
F20GP15	2.6	4.2
F20GP20	2.9	4.4
F20GP25	2	3.6



The graph represents the split tensile strength of the M 30 grade concrete when cement is replaced with fly ash at 20% and fine aggregate with granite powder at 10%, 15%, 20% and 25% for 7 days, 14 days and 28 days. When cement is replaced with fly ash upto 20 % and fine aggregate is replaced with granite at 10%, 15% and 20% in the M50 grade concrete there is increase in spit tensile strength value upto 2% to 12% when compared to nominal mix. Beyond that percentage there is a decrease of 7% when compared to nominal mix of the concrete.

A. Load Vs Deflection Curve of Concrete





VII. CONCLUSIONS

- A. From the experimental data it can be concluded that the fine aggregate can be replaced upto 15 % with granite powder in M30 grade of concrete, there is an increase of 8% to 20% in strength of the concrete. When the replacement of granite powder in fine aggregate above 15% then there is decrease of 10% to 12% in the strength when compared to normal mix of the concrete.
- B. The cement is replaced with fly ash upto 20% and fine aggregate is replaced with granite powder upto 20 % in M30 grade of concrete then there is increase of 15% to 20% compressive strength for 28 days when compared to normal mix of the concrete
- C. Also there is increase of 4% to 9% split tensile strength for 28 days when compared to nominal mix of the concrete for in M30 grade of concrete.
- D. The load vs. Deflection curve of the reinforced concrete for M 30 grade is plotted for normal concrete and replaced concrete. There is no change in the pattern of the curve.
- E. The granite powder when used as a partial replacement for fine aggregate in concrete upto 20% when cement is replaced with fly ash upto 20% can be used.

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