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AN EXPERIMENTAL INVESTIGATION ON M30 GRADE CONCRETE BY REPLACING OF CEMENT WITH FLYASH AND ADDING POLYPROPYLENE FIBERS

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ABSTRACT

The development and use of mineral admixture for cement replacement is growing in construction industry mainly due to consideration of cost saving, energy saving, environmental production and conservation of resources.This experimental study was carried out to study of flexural behaviour of concrete grade of M30 by the replacement with fly ash and polypropylene fibre.The total production of fly ash is nearly as much as production of cement.In this investigation class fly ash in different proportions of 20%, 25% and 30% are used in the concrete along mix with polypropylene fiber of 1%, 1.5% and 2%. In this research, the concrete samples were made with water cement ratio of

0.4 by using of M30 grade of concrete. The cube specimens are taken of size 150 mm x 150 mm x 150 mm . Concrete cubes are kept moist for 7 days, 14 days and 28 days. The main purpose of this research study was to observe the compressive strength of concrete blended with various proportions of fly ash and polypropylene fibers.

KEY WORDS: Fly ash,Polypropylene fiber,Coarse aggregate,Fine aggregate,Cement,Compressive strength.

INTRODUCTION

Researchers and engineers are always looking for better ways to make construction more eco-friendly. One exciting approach is using fly ash and polypropylene fibers in concrete. Fly ash is a leftover from burning coal, and polypropylene fibers are synthetic materials known for making concrete stronger.

M30 grade concrete is widely used in construction for various structural elements, requiring a balance of strength, durability, and work ability. Cement is a key ingredient in concrete, but its production contributes significantly to carbon emissions. By replacing cement with fly ash, a byproduct of coal combustion, environmental impact can be reduced while potentially improving concrete properties. Additionally, the inclusion of polypropylene fibers aims to enhance the concrete's mechanical performance, such as reducing cracks and improving durability. This study seeks to evaluate the combined effects of fly ash replacement and polypropylene fiber addition on the properties of M30 grade concrete, contributing to sustainable construction practices and improved structural performance.

MATERIALS USED

A. Cement

Ordinary poartland cement 53 grade used. Specific gravity of cement was 3.14.

B. Fine Aggregate

Locally available river sand was used as fine aggregate. Specific gravity and fineness modules were found to be 2.54 and 2.77 respectively.

C. Coarse Aggregate

Locally available crushed 20mm coarse aggregate was used. A specific gravity and fineness module is 2.62 and 5.91 respectively.

D. Polypropylene fibers

- Synthetic fibers added to concrete to improve its durability, crack resistance.

- Length 12mm
- Diameter 40 microns

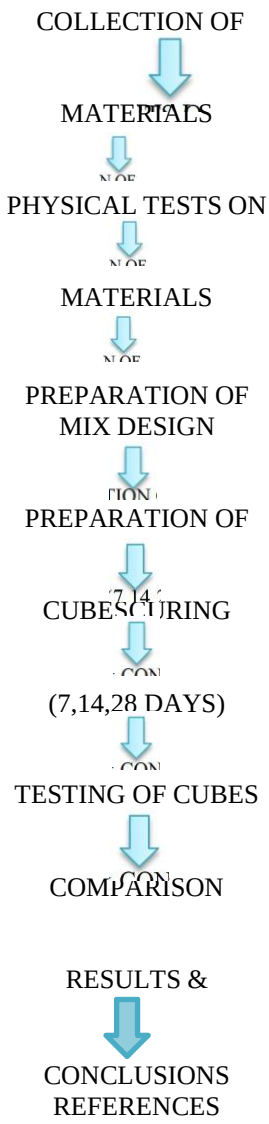
E. Fly Ash

Coal fly ash was used it was collected from cement bricks unit, the specific gravity and finesses modulus were found to be 4.76 and 32% respectively.

METHODOLOGY

The methodology employed in the experimental investigation on M30 grade concrete involving the replacement of cement with fly ash and the addition of polypropylene fibers followed a systematic approach. Firstly, the materials used, including cement, fly ash, aggregates, water, and polypropylene fibers, were carefully selected based on their properties and compatibility with the concrete mix. Mix designs were formulated to determine the optimal proportions of cement replacement with fly ash and the dosage of polypropylene fibers to be added. Various concrete specimens were then cast according to the designed mix proportions.

Flow chart of Methodology:



MIX DESIGN

Material Calculation:

M30 = 1:0.75:1.5

Cube size = 150x150x150 mm

Volume of cement per 1 cube = Density of cement x volume of cube

= 1440 * (0.15)3

= 4.86 kg

Volume of coarse aggregate per 1 cube = Density of coarse aggregate x volume of cube

= 1600 * (0.15)

= 5.4 kg

Volume of fine aggregate per 1 cube = Density of fine aggregate x volume of cement per cube

= 1900 * (0.15)3

= 6.41 kg

Water cement ratio = 0.45 x volume of cement

= 0.45 x 4.86

= 2.187 liters

- 20 % replacement of fly ash with cement and 1 % adding polypropylene fibers (for 3 cubes)Fly ash = 2.196 kg
  Cement = 11.664 kg
  Fine aggregate = 19.23 kg Coarse aggregate = 16.2 kg Water cement ratio = 5.24 liters
  Polypropylene fibre = 0.091 kg
- 25 % replacement of fly ash with cement and 1.5 % adding polypropylene fibers (for 3 cubes)
  Fly ash = 3.645 kg
  cement = 10.935 kg
  Fine aggregate = 19.23 kg Coarse aggregate = 16.2 kg Water cement ratio = 5.24 liters
  Polypropylene fibre = 0.1365 kg
- 30 % replacement of fly ash with cement and adding 2 % polypropylene fibres (for 3 cubes)
  Fly ash = 4.374 kg
  cement = 10.206 kg
  Fine aggregate = 19.23 kg Coarse aggregate = 16.2 kg Water cement ratio = 5.24 liters
  Polypropylene fibre = 0.1821 k

RESULTS AND DISCUSSION

Compressive strength test:

Compressive Strength = (Ultimate crushing load / area of loading) in N/ mm2

$CS = \frac{P}{A}$

Compressive strength test results are as given in the following tables for various percentage of ceramic tile and steel fiber reinforcement size of cubes: 150mm X 150mm x 150mm.

Compressive strength test : For 100% cement

SampleNo	Curing period(Days)	Weight of cube(kg)	Load(KN)	Compressive strength(N/mm^2)	Average compressive Strength(N/mm^2)
1	7	8.130	680	30.22	
2	7	8.010	700	31.11	**30.96**
3	7	7.930	710	31.55	
1	14	8.150	700	31.11	
2	14	8.230	720	32.00	**31.85**
3	14	7.970	730	32.44	
1	28	7.830	750	32.89	
2	28	8.130	730	32.44	**32.73**
3	28	8.160	740	32.88	

Compressive strength for 20% replacement of cement with fly ash and adding 1% polypropylene fibers

SampleNo	Curing period(Days)	Weight of cube(kg)	Load(KN)	Compressive strength(N/mm^2)	Average compressive Strength(N/mm^2)
1	7	7.430	690	30.55	
2	7	8.010	700	31.11	**31.07**
3	7	8.130	710	31.55	
1	14	7.970	700	31.11	
2	14	8.120	710	31.55	**31.70**
3	14	8.230	730	32.44	
1	28	8.010	740	32.88	
2	28	8.140	750	33.33	**33.47**
3	28	8.160	770	34.22	

Compressive strength for 25% replacement of cement with fly ash and adding 1.5% polypropylene fibers

SampleNo	Curing period(Days)	Weight of cube(kg)	Load(KN)	Compressive strength(N/mm^2)	Average compressive Strength(N/mm^2)
1	7	7.700	680	30.22	

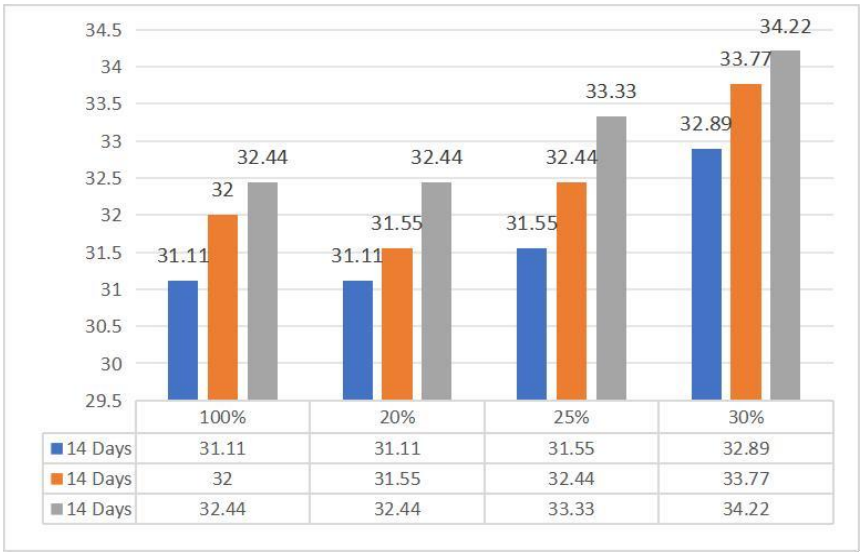
2	7	8.020	710	31.55	**31.25**
3	7	8.130	720	32.00	
1	14	8.340	710	31.55	
2	14	8.390	730	32.44	**32.29**
3	14	8.225	750	33.33	
1	28	7.930	740	32.89	
2	28	8.370	760	33.77	**33.77**
3	28	8.370	780	34.66	

Compressive strength for 30 % replacement of cement with fly ash and adding 2% polypropylene fibers

SampleNo	Curing period(Days)	Weight of cube(kg)	Load(KN)	Compressive strength(N/mm^2)	Average compressive Strength(N/mm^2)
1	7	7.830	700	31.11	
2	7	7.790	730	32.44	**32.29**
3	7	8.100	750	33.33	
1	14	7.870	740	32.89	
2	14	8.120	760	33.77	**33.62**
3	14	8.150	770	34.22	
1	28	8.010	760	33.77	
2	28	8.150	780	34.66	**34.51**
3	28	8.170	790	35.11	

COMPRESSIVE STRENGTH FOR 7 DAYS FOR 100 %,20%,25%,30%

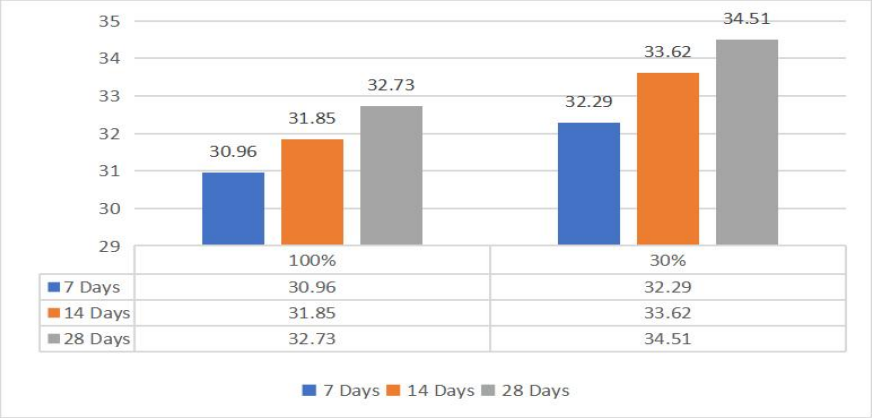
COMPRESSIVE STRENGTH FOR 14 DAYS FOR 100%,20%,25%,30%



COMPRESSIVE STRENGTH FOR 7,14,28 DAYS - 100%,20%

COMPRESSIVE STRENGTH FOR 7,14,28 DAYS - 100%,25%

COMPRESSIVE STRENGTH FOR 7,14,28 DAYS - 100%,30%



CONCLUSION

According to the tests performed, it is observed that there is remarkable increment in the properties of concrete on replacement of cement with Fly Ash and adding of polypropylene fibers.The experimental investigation on M30 grade concrete involving the replacement of 30% of cement with fly ash and the addition of 2% polypropylene fibers has yielded significant insights into the compressive strength of the concrete. The results indicate that this combination leads to a notable enhancement in compressive strength compared to conventional concrete.

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