

Compressive Strength on Partial Replacement of Cement with Fly Ash in Concrete

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Abstract - Fly ash are currently used as clinker replacement to reduce costs and environmental pollution associated with the production of cement. The objective of study was to understand the effect of physical and chemical properties of fly ash on strength development and hydration of mortars and cement pastes. Cement in concrete in mix design is replaced by fly ash as 0% 5% 10% 20% and maximum strength in 20%. The results from experiments show that the early strength of mortar with fly ash is lower than cement mortar but most of the mortar recover strength by 28 days. Finer fly ash show higher or equal strength as compared to OPC after 28days

Key Words: M-25, Fly Ash Cement, water, compressive strength test.

INTRODUCTION

Coal is a major source of fuel for production of electricity in many countries in the world. In the process of electricity generation large quantity of gate produced and becomes available as a by-product coal-based power station. Fly ash is used as replacement for Portland cement in concrete increases its chemical resistance and durability. Fly ash can significantly improve the compressive strength of concrete.

Pulverized fuel ash extracted from flue gases by electrostatic precipitators or cyclone Separators of coal-fired thermal power plant is known as fly ash and the

coarse ash particles that are too heavy to fly with flue gases and settle in the boiler are knows as bottom ash. The energy consumption and CO₂ emission associated with the manufacturing of cement can be reduced when fly ash is used as a partial replacement of clinker. India standard allowing up to 35% replacement of cement by fly ash, the majority of fly ash available in India still goes to landfills. Fly ashes generally tend to retard hydration, fly ash content little effect on the modulus of elasticity of concrete. The properties of fly ash in order to improve the compressive strength of concrete.

Advantages of fly ash in cement concrete

- Reduction in heat of hydration and thus reduction of thermal cracks and improves soundness of concrete mass.
- Improved pumpability of concrete.
- Contributing additional strength to concrete mass.
- Reduced requirement of cement for same strength thus low cost of concrete.
- It gains the early strength of concrete in cold weather concrete.
- Fly ash is easily available material at near the site at any place.

METHODOLOGY

- Study the physical properties of raw material and physical/chemical properties of blast furnace.
- Mix design

- Casting of conventional concrete
- Test in laboratory for finding compressive strength.
- Partial replacement of cement with fly ash in concrete are as follows.
- Partial replacement of cement by 5%.
- Partial replacement of cement by 10%.
- Partial replacement of cement by 20%.

- Minimum cement content: 300 Kg/cum.
- Water cement ratio : 0.45
- Workability : 50 mm (slump)
- Exposure condition : moderate
- Type of aggregate : crushed angular aggregate
- River sand
- **Target strength for mix proportion**

$$F_{ck} = f_{ck} + 1.65S$$

Where,

F_{ck} – target average compressive strength at 28 days.

f_{ck} – characteristic compressive strength at 28 days.

S – Standard deviation

Therefore, target strength = $25 + 1.65 \times 4 = 31.6$ N/mm.

PROPERTIES OF FLY ASH



COMPRESSIVE STRENGTH



ELEMENT	FLY ASH %
Silicon dioxide	49.95%
Aluminium oxide	25.32%
Ferric oxide	5.31%
Calcium oxide	5.90%
Magnesium oxide	1.51%
Sulphur trioxide	0.62%
Sodium oxide	0.83%
Potassium oxide	0.89%

Standard metallic cube moulds 15 cm³ casted for compressive strength. A table vibrator was used for compaction of the hand fill concrete cubes. The mould were demoulded after 24 hours and immersed in water for curing. After 7 days, 14 days, 21 days and 28 days cubes were tested for finding the average compressive strength. Test was performed on compressive testing machine having capacity 1000 KN.

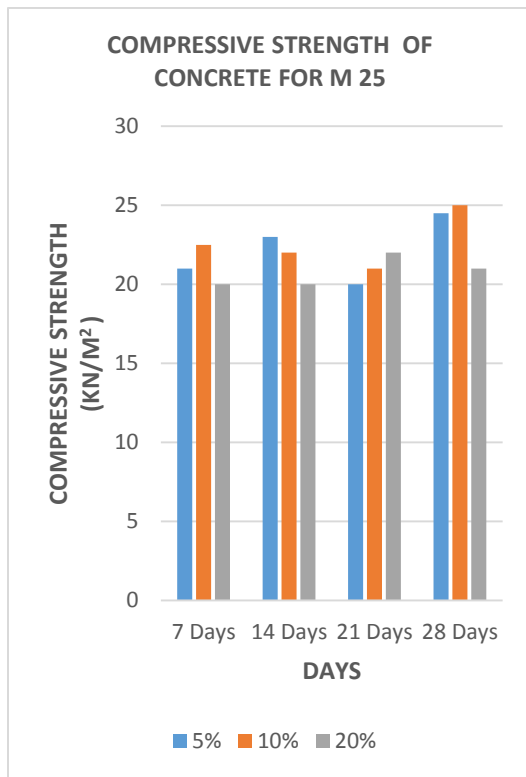
MIX DESIGN

Calculation for trial mix **M - 25**.

Stipulation for proportioning

- Grade designation : M-25
- Type of cement : OPC 53 grade
- Maximum nominal size of aggregate : 20 MM

RESULTS



SR.NO	FLY ASH %	COMPRESSIVE STRENGTH
1	0	25
2	5	23.5
3	10	24.5
4	20	22

Above table shows the 28 days compressive strength. At 5 % shown the satisfied result of concrete cubes but after 28 days strength get decreases also the 7 days results indicate the strength developed by the concrete cube was more.

CONCLUSIONS

- Fly ash can increase the rate of hydration during the acceleration period.
- Fly ash reduces the cost of cement.
- Fly ash developed the equal strength as compare with plain cement concrete.
- Workability of concrete is shear slump.
- It reduces the disposal cost of fly ash in thermal industries etc.
- Compressive strength of concrete get reduced while more replacement more than 20%.

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