# A STUDY ON HYBRID FIBRE REINFORCED FLYASH BASED CONCRETE

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***Abstract:*** **This study report deals with the reinforcing efficiency of hybrid fibres in the low volume fly ash concrete up to 30% replacement of cement. Micro mechanical action of hybrid fibres in fly ash based concrete will be improved with respect to different percentage of steel and polypropylene fibre addition. Hybrid fibres in concrete improves the matrix densification, refinement of microstructure, reduction of voids, minimize cracking due to stresses, and enhance the strength gain properties of reinforcement of corrosion resistance, alkali-silica expansion and sulphate attack. Henceforth, It is proposed to use M30 grade concrete with different percentages of fly ash such as 10%,20% & 30% by weight of binder content along with different percentages of Steel and polypropylene fibers for a volume fraction (VF) of 1%. The experimental test results will be found in mechanical properties of concrete such as compressive, split and flexural strength at different ages of curing of concrete compared with the conventional concrete.**

***Keywords:*** Fly ash, Polypropylene fibre, Steel fibre, strength gain properties.

## INTRODUCTION

The construction field provides innumerable contribution to this modern world by many of its latest techniques. Many types of buildings with different technologies are being built all over the world, but construction using the concrete always occupies the top place. In all these constructions, usage of cement is unavoidable as it is the soul of the concrete. But we all know that the cement production has to be reduced due to the emission of carbon dioxide during its manufacture. Hence fly ash can be partially replaced with the cement and can be effectively used for the construction. Fly ash is a finely divided residue resulting from the combustion of ground or powdered coal. It is a by-product of coal fired in electronic generating plants. Two class of fly ash are produced namely Class C and Class F, according to the type of coal used for ignition. But disposal of fly ash is a serious environmental hazard. Fly ash can be used with cement in construction of concrete. Fly ash offers both environmental advantages and also improves the performance and quality of concrete


**Snapshot for cement and fly ash**

. It affects the plastic properties of concrete by improving workability, reducing water demand, segregation and bleeding and lowers heat of hydration increases the strength, reduces permeability, reduces the corrosion of steel, increases sulphate resistance, and reduces alkali aggregate reaction. It reaches its maximum strength more slowly than concrete made with the port land cement. Also, Concrete is a relatively brittle material, when subjected to normal stresses and impact loads. The tensile strength of concrete is less due to widening of micro-cracks existing in concrete subjected to tensile stress. Due to presence of fiber, the micro-cracks are arrested. The introduction of fibers is generally taken as a solution to develop concrete in view of enhancing its flexural and tensile strength. Fiber reinforced concrete is a short discrete, uniformly dispersed and randomly oriented suitable fibrous material used to increase structural integrity. The amount of fibers added to concrete mix is measured as percentage of the total volume of composites. Aspect ratio (l/d) is calculated by dividing fiber length (l) by its diameter (d).

Usage of steel & polypropylene fiber takes care of increase in tensile strength & compression strength respectively

## REVIEW OF LITERATURE WORKS

**The following suggestions can be drawn from the various consolidated literature review:**

Khadake S.N. and Konapure C.G (2013) investigated the fly ash concrete with steel fibers of aspect ratio (l/d) 71 which varies from 0 to 1.5% of the total volume of concrete with fly ash 10% & 20%, showed higher flexural strength and also marginal strength gain in compressive strength for 1.0 and 1.5% steel fiber.

V.M. Sounthararajan and A. Sivakumar (2013) concluded that an experimental study on fly ash concrete with steel fibers at a constant volume fraction of 1.5% with utilization of fly ash up to 50% was replaced with cement which showed good composite performance. It was also observed increase trend in flexural strength results for 1.5% steel fiber. Modulus of elasticity of concrete showed maximum strength increases by 35%, when compared to conventional concrete.

Banthia and pigeon (2002) showed that the conductivities of hybrid fiber systems are far better than their equivalent mono fiber systems. They also showed that if hybrid fibers are incorporated in a cement matrix, presence of one fiber enables the utilization of the potential properties of the other fiber

Saravana Raja Mohan and Parthiban (2011) IJCSE used different proportions of class C fly ash such as 10, 15, 20, 25&30% with steel fibers of 0, 0.15, 0.3, 0.45 & 0.6% and found that the choice of 15% fly ash with 0.15% fiber content gives an overall strength increase of 12% at 7 days to 55% at the end of 28 days. Composite fibre shows a better performance up to 20% fly ash and 0.3% steel fiber.

Saiyad Waquar Husain(2015)GMS did an experiment with different steel fiber content such as 0.5,1.0,1.5% by weight and fly ash contents 0 to 15% by weight. Maximum compressive strength was attained for 10% fly ash and fiber content of 1.0% giving an increase of 21.49%.

Okan karahan, Cengiz Duran Atis(2010)MDS used different proportions of fly ash such as 0%,15%&30% with polypropylene fiber of volume fraction 0,0.05.0.1,0.2% and found the several concrete properties. Addition of fiber &fly ash reduces the unit weight, increases water absorption, lowers drying shrinkage. Fly ash increases the workability of concrete whereas polypropylene decreases the workability.

J. Blunt, G.Jen, C.P Ostertag (2015) used steel fibers and polyvinyl alcohol fibers to control micro cracks. Two steel fibers with different aspect ratios were used to control macro cracks. They found that hybrid fiber reinforced composites are effective in delaying corrosion initiation and reducing the corrosion rate due to their high propensity for crack resistance.

Xiao-Yong Wang (2015) evaluated compressive strength development of concrete containing high volume fly ash. It states that compressive stress of fly ash blended concrete at early stages is less than that of control concrete, but at later ages, if the volume of fly ash is 15% to 25% in concrete, compressive strength of fly ash concrete surpasses the control concrete and if the w/c ratio is lower, even 45% to 55% of fly ash in concrete also surpasses the control concrete.

Topcu and canbaz (2007) made a study on fibers and showed that addition of fibers with fly ash provides better performance of concrete since fly ash adjusts workability, strength loss caused by fibers and improves strength gain.

Cengiz Duran Atis, Okan Karahan (2007) CBS used different proportions of fly ash such as 0, 15&30% and volume fraction of fiber steel used was 0, 0.25, 0.5, 1, 1.5% in volume basis of aspect ratio varying from 50 to 70.he found that addition of steel fiber of 1% with 0 to 15% of fly ash gave an increase of 30% tensile strength and usage of 1.5% fiber gave an 66% increase in tensile strength.

Aan Jatale, et.al (2013) partially replaced cement with 20%, 40% and 60% of fly ash. The results showed that using fly ash improves workability of concrete. Compression strength reduced with increase in fly ash content. The strength reduced up to 50% when 60% of fly ash was replaced with cement.

C.X.Qian and P.Stroeven (2000) showed that usage of fly ash is necessary for evenly dispersing the hybrid fibers which includes ultra fine polypropylene fibers at an optimum dosage of 0.15% with steel fibers and also proved that cracks due to shrinkage, differential settlements could be effectively inhibited by PP and steel fibers by showing an improved potential against crack control

Jayeshkumar Pitroda, et.al (2012) produced a concrete of grade M25 and M40 by replacing cement up to 10%, 20%, 30% and 40% by fly ash. The results of compression strength showed the reduction in strength of concrete with increase in fly ash concrete.

Lohani T.k, et.al (2012) studied workability and strength of geopolymer concrete when partially replaced with fly ash. The results showed that the slump value increased with increase in percentage of fly ash based geopolymer for the replacement of cement with the same w/c ratio. The strength of fly ash geopolymer concrete increased compared to geopolymer concrete.

C. Marthong, et.al (2012) used 33, 43 and 53 grades of OPC and replaced it with fly ash by 10%, 20%, 30% and 40%. The results showed that the strength of concrete reduced as the fly ash contents increases in OPC. Fly ash concrete was more durable as compared to OPC concrete.

Dhillon, et.al (2014) carried out a study to see the effect of the fly ash content with steel and polypropylene fibers of 0.5 & 1.0% by volume. Cement had been replaced with 15, 20 and 25 per cent fly ash by mass. The results showed that with increase in percentage of fly ash replacement there was decrease in compressive, flexural and split tensile strength.

Moinul Islam, et.al (2010) studied the effects of fly ash on strength development of mortar and the optimum use of fly ash in mortar. Cement was partially replaced with six percentages (10%, 20%, 30%, 40%, 50% and 60%) of class F fly ash by weight. The result showed that strength increases with the increase of fly ash up to an optimum value, beyond which, strength values start decreasing with further addition of fly ash. the optimum amount of cement replacement in mortar was about 40%, which provided 14% higher compressive strength and 8% higher tensile strength as compared to OPC mortar.

Zongcai and Jianhui (2006) reported that flexural toughness of concrete combined with hybrid fibers was better than that of the concrete with single type of fibers.

Jo Jacob Raju, Jino John (2014) used fly ash concrete with polypropylene fiber at 0.1%, 0.2% & 0.3% to examine its strength. 60% of fly ash has been replaced. They showed that strength gain at 90 days is higher for fiber added fly ash based concrete than OPC concrete. Fiber addition of 0.1% has the maximum compressive and tensile strength compared to other ratios. Addition of higher amount of fly ash results in strength gain only after 90 days.

Darsh Belani, et.al (2013) used Fly Ash in construction of rigid pavement to provide a low cost pavement. The fly ash was replaced within the range of 10-40% by weight of cement. Compression and flexural strength were measured. The result showed that for CBR value of 2% and cost of rigid pavement decreased, when the wheel load applied up to 30 kN.

Malhotra & Mehta, (2002) reported that depending upon the quality of fly ash and up to 20% of its replacement, reduction in water requirement is possible. Heterogeneities in the microstructure of the hydrated Portland cement paste, especially the existence of large pores and large crystalline products in transition zone, were greatly reduced by introduction of fine particles of fly ash.

## CONCLUSIONS FROM THE REVIEW

- The optimum level of fly ash replacement should be between 10 to 30% in order to obtain maximum strength of the concrete. If fly ash replacement level up to 60%, concrete gains its strength only after 90 days of curing
- The increase in percentage of steel fiber results only in increase of tensile strength. The nominal percentage of steel fiber should not exceed 1% of the volume of concrete
- Polypropylene fiber gives a considerable strength increase in compression and since it reduces workability it must be added in lesser amount compared to steel fiber
- When both steel and polypropylene fibers (PP) are added in the fly ash (FA) concrete, the best proportion is found to be 0.75% and 0.25% respectively
- From the study of various literature review, the identified gap will be converted into the objective of this research by following the different proportions given below
- PROPORTION 1:
  Steel: 0.6% } + 10%, 20%&30% of FA
  PP: 0.4% } by weight of binder
- PROPORTION 2:
  Steel: 0.75% } + 10%, 20% & 30% of FA by
  PP: 0.25% } by weight of binder
- PROPORTION 3:
  Steel: 0.9% } + 10%, 20%&30% of FA
  PP: 0.1% } by weight of binder
- The best proportion of the above will be found which accounts for the maximum strength of the concrete.

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