Modification of Mechanical Properties of Concrete Using Glass Fiber And Fly Ash

Rajan Panchal[1], Dr. Hetal Pandya[2]
[1]Dept of Civil Engineering
[2]Professor, Dept of Civil Engineering
[1, 2] LDRP Institute of Technology and Research, Gandhinagar, Gujarat-382015.

Abstract- *Fly ash is a residual material of energy production using coal, which has been found to have numerous advantages for use in the concrete industry. When M30 Grade of concrete mix with different proportion of fly ash and glass fibre we can achieve higher compressive and flexure strength. Polyethylene glass fibre with 0.076 % volume has been added in M30 grade of concrete along with Fly ash in the range of 10 to 30 % with replacement of cement which reduce overall cost of concrete. Testing of workability, compressive strength and flexure strength has been carried out."*

Keywords- Fly ash, M30 Grade of Concrete, Glass fibre, Compressive strength, flexure strength, workability.

I. INTRODUCTION

Plain cement concrete has relatively high compressive strength but possess a very low tensile strength, limited ductility, and little resistance to cracking. It has been recognize that the addition of small closely spaced and uniformly dispersed fibers to concrete would act as a crack arrester and would substantially improve its mechanical properties. Fly ash is a pozzolanic material, Addition of fly ash will improve workability, reduce"permeability and reduce heat of hydration. The fineness and lime content properties of fly ash has concern with air content and water demand of the concrete.

OBJECTIVES OF THE STUDY

"To compare the properties of concrete with 0.076 % polyethylene glass fiber and fly ash in the range of 10 to 30%. To check whether the glass fiber and fly ash can increase the different properties of the concrete. To understand the effect of glass fiber and fly ash on the compressive strength and flexure strength of the concrete."

II. LITERATURE REVIEW

"Tapeshwarkalra,etal. Presented " A Review on fly ash concrete" in April 2015. In this paper author has discussed the use of fly ash concrete in construction as a solution to address two environmental problems–disposal of huge amount of fly ash by production of thermal power plants causing environmental degradation through large areas of land fills and second is high percentage of carbon dioxide emissions in atmosphere from cement" "industry. It shows slower strength gain at early ages as major problem in making fly ash concrete. It requires higher days of curing."

"B.K.Narendra Presented "Compressive strength development of fly ash concrete for different cement replacement levels." May 2013.They studied CompressivestrengthtestonM30,M40,and M50 grade concrete with cement replacement of 20%, 35% and 50% measure compressive strength on time period interval of 3 day, 7 day, 28 day, 56 day and 91 days. Three different W/C ratio are considered for the study, optimum W/C ratio is choose which gives a compressive strength equal to that of normal concrete for curing period of 28 days Comparative Study of compressive strength is discussed in this paper."

"M.N.Balakrishna, etal. Presented "Proportioning of fly ash concrete mixes a comprehensive approach" in June 2013. In this paper the influencing factor of flyash and cement to arrive at appropriate combination to satisfy the requirement of placement and development of strength with age has been studied. To determine the various properties of concrete variation of fly ash is in the range of 10 to 40%. Compressive strength is measured at 7 day, 14 day 28 day, 56 day and 90 day. Grade of strength, W/C ratio of concrete and fineness and carbon content of fly ash is important to develop strength with age."

"Drspatil, etal. Presented "Fly ash concrete: A technical analysis for Compressive strength." December 2012. Author has studied the utilization of fly ash in cement concrete as a partial replacement of cement as well as an additive so as to provide an environmentally consistent way of its disposal and reuse. This paper present a case study of deep nagger thermal power plant at bambhori, jalga on. The cement in concrete mix is replaced by 5% to 25% by increment" "of 5%. They have observed that any percentage of replacement of cement result in to reduce the compressive strength of

concrete also it delay hardening time of concrete. By considering the in tangible cost of disposal problem of fly ash and hidden cost of environmental protection this methodology appear to be indeed successful."

"J.ALAM,etal. Presented "fly ash utilization in different sectors in Indian scenario." In august 2011. In this paper author has briefly present different ways of using fly ash in various sectors of civil engineering construction industry in India.

They have studied implementation of fly ash in cellular light weight concrete block, development of fly ash based polymer composites as wood substitute, Portland pozzolana cement, Ready mixed fly ash concrete, Fly ash sand lime bricks/block Fly ash in road construction, Roller Compacted concrete, Asphalt Concrete. The waste is applicable as raw material in many civil engineering industries."

METHODOLOGY

I) Workability:

"Work ability is the ease with which concrete mix flows to the concrete corner of the formwork. In more scientific terms, it is the property of concrete which determines the amount of useful internal work necessary to produce full compaction. Slump test gives a measure of work ability of the mix in terms of slump observe after the subsidence of a concrete mix. We can get fairly good idea of cohesiveness by gently tapping the platform on which the cone stands."

II) Compressive Strength of Concrete:

"Concrete is primarily strong in compression and in""actual construction, the concrete is used in compression. Concrete which is strong in compression, is also good in other quality. Higher the compression strength better is the durability. Bond strength is importance in R.C.C. compressive strength also indicated extent of control exercised during construction. Resistance to abrasion and volume stability improves with the compressive strength. Test for compressive strength in there for vary important in quality control of concrete. Cube used is 150 mm width and 150 mm height. Wherever cube are used for compressive strength results the cube strength can be used to calculate with the following formula, Minimum cube strength required = 0.8 compressive strength specified for 150 mm cube."

III) Flexure Strength of Concrete:

"Flexure strength is one measure of the tensile strength of concrete. It is a measure of unreinforced concrete beam or slab to resist failure in bending. It is measured by loading 150mm X 150mm X 750mm beam with a span length of at least three times the depth. The flexure strength is expressed as modulus of rupture in MPA and is determined by standard test methods ASTM C 78 and ASTM C 293.Flexure MR is about 10 to 20 percent of compressive strength depending on the type, size and Volume of coarse aggregate used."

Figure: 1 M30 Grade concrete cube

Figure: 2 M30 Grade concrete beam

Figure: 3 Testing of M30 grade of concrete

III. RESULTS AND DISCUSSION

"Workability observed during concreting is as shown in below table. It shows that workability decreases as we reduce the water-cement ratio.

Theworkabilityofconcretedependsonmanyfactorslike watercementratio,method of compaction, method of placement, method of mixing concrete and environmental Condition. So, Workability observed during concreting is as shown in below table. It shows that"

"Workability decrease as we reduce the W/C ratio. The workability of concrete can be enhanced by use of rounded aggregates. Thus, the strength of concrete inversely proportional to the workability of concrete. Because of the length characteristic of fly ash the workability is seen to be more than concrete without fly ash. Particle size of fly ash is finer, so it impart some properties like air entraining, reduce water demand, it lead to give good workable concrete."

Table-1 Workability for different water-cement ratio of fly ash based concrete

Type of fibre	Fly Ash Volume by %	Workability		
		0.5	0.45	0.4
E – GLASS (0.076%)	10	70	65	50
	20	85	70	45
	30	90	80	60

"The below table shows compressive strength when 0.076% of E – Glass fiber is added in concrete along with fly ash In the range of 10 % to 30 %. Good results have been achieved for almost every addition of glass fiber, except increase in addition of fly ash. Increase in percentage of fly ash result in less compressive strength at 7 days, 28days and 56 days. The below table shows that strength increases have been seen in Compressive strength when 0.076% of E – Glass fiber is added along with 10% of fly ash in concrete."

Table-2 compressive Strengths of E - glass fiber and at w/c = 0.4 with fly ash for 7 days, 28 daysand 56 days

TYPE OF FIBER	FLY ASH VOLUME BY %	COMPRESSIVE STRENGTH (N/MM2)		
		7 DAYS	28 DAYS	56 DAYS
E– GLASS (0.076%)	10	25.3	47.6	54.8
	20	24.7	46.2	53.1
	30	24.1	45.3	51.4

"The below table shows flexure strength when 0.076% of E – Glass fiber is added in concrete along with fly ash In the range of 10 % to 30 %. Good results have been achieved for almost every addition of glass fiber, except increase in addition of fly ash. Increase in percentage of fly ash result in less flexure strength at 7 days, 28days and 56 days. The below table shows that strength increases have been seen in Flexure strength when 0.076% of E – Glass fiber is added along with 10% of fly ash in concrete."

Table-3flexure Strengths of E - glass fiber and at w/c = 0.4 with fly ash for 7 days, 28 days and 56

TYPE OF FIBER	FLY ASH VOLUME BY %	FLEXURE STRENGTH (N/MM2)		
		7 DAYS	28 DAYS	56 DAYS
E– GLASS (0.076%)	10	3.9	4.7	5.9
	20	3.8	4.4	5.6
	30	3.4	4.2	4.9

IV. CONCLUSION

"It conclude that as we increase the content of fly ash compressive and flexure strength will decrease. From the experimental study of M30 grade concrete with 0.076% E-Glass fiber and 10% of fly ash, we conclude that at w/c= 0.40, 58% of increase in compressive strength and 64% of flexure strength can be achieved."

V. ACKNOWLEDGEMENT

"I would like to extend my heartiest thanks with a deep sense of gratitude and respect to all those who provide me immense help and guidance during the research. I would like to thank you my dissertation guide Dr.hetal pandya for providing a vision about the dissertation. I would also like to thank my professor for their coordination and sparing their valuable time to assist me in my work. I have not developed not only technical skills but also learned all those qualities required to become a good professional engineer. I extend my words of thanks to friends and colleagues who always have helped and motivated me through my study. Last but not Least I would like to mention here that I am greatly indebted to each and everybody who has been associated with this research at any stage but whose name does not find a place in this acknowledgement."

REFERENCES

[1] "Gururaj T, et al. presented "A study on the effect of inclusion of fly ash as partial replacement of cement and granulated blast furnace slag as partial replacement of sand in concrete. In May 2015.
[2] Rakeshkumar, et al. A review on partial replacement of cement by fly ash in concrete. In April 2016.
[3] Saiyedsaifali, et al. Construction of building using fly ash concrete. In April 2017.
[4] A Kranthiswarup, comparative study on mechanical and durability properties of concrete using fly ash and cow dung ash. In July 2017.
[5] Ra. B. Deepa, An experimental study on fly ash as self - healing material. In 2018."