Mechanical Properties of Concrete with Mineral Admixtures - an Experimental Programme

N. Sanjeev, T.Sairam

Abstract: ***Concrete is a general composite material used in construction industry over many decades. Due to rapid Growth of infrastructure, the demand of concrete is raising day by day. This composite material mainly made up of cementitious material such as cement and natural sand. This cement production results in release of large amount of CO_2 which directly effects environment pollution and Global warming and also, the usage of natural sand leads to environmental degradation. So, better way to reduction in CO_2 emission by minimizing cement content with some other puzolonic materials such as Metaakolin,Fly ash, Ground granulated blast furnace slag(GGBS) and This present Experiment is for to observe the cube and cylinder specimens strength of M40 grade of concrete at 7 days and 28 days with partial replacement of cement with ground granulated blast furnace slag ,Metakaolin and flyash @ 15%,30%,45% of binding material and natural sand with manufactured sand (M-sand).***

Keywords: Concrete, Fly Ash, GGBS, Metakaolin, M-Sand, Compressive Strength, split tensile strength

I. INTRODUCTION

Concrete is a utmost adopted material in worldwide for construction works because of its main properties such as workability, compressive strength and durability etc. Concrete is a heterogeneous mixture made up of Cement, coarse Aggregate, fine aggregate and Water. The main ingredient being Cement, whose production involves emission of green house gases which causes the Environmental pollution and Global warming. Better way to reduce green house emissions by replacing cement with some materials known as puzolonas, like Ground granulated blast furnace slag(GGBS) ,flyash and Metakaolin. Flyash and GGBS are by-products of thermal, power and steel manufacturing industries respectively, whose usage in concrete reduces cement's utilization and eliminates disposal problems of mineral admixtures - Fly Ash and GGBS. During the past few decades, usage of natural sand in large amounts for manufacturing of Concrete degrades the environment as the depletion of natural resource, sand. To minimize the extraction of sand from river beds, manufactured sand (M-sand) is intended to use which is obtained by crushing the Granite and other stones. Th The aim of this research program is to observe the strengths of M40 grade of concrete with cubes and cylindrical specimens made in the laboratory with partial replacement of cement with Ground granulated Blast furnace slag,flyash and Metakaolin and also use M-sand in place of natural sand as fine aggregate .

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II. MATERIALS USED

The properties for various materials used in the present experiment are explained below:

A. Cement : OPC of 53 grade confirming to IS 12269:1987. compressive strength - 3, 7, 28 days are 25.3MPa, 36.8MPa, 53MPa respectively, initial and final setting time are 60 mins and 300mins respectively.

B. Fine Aggregate: M sand was used as fine aggregate confirming to Zone-II as specifications of IS:383-1970.

C. Coarse Aggregate: Crushed granite aggregates of size 20mm with angular shape were used confirming to IS 383:1970.specific gravity-2.80,water absorption -Nil.

D. Water: potable water suitable for concrete mixing and for curing .

E. Fly Ash*:* Type -Class F, color– Dark grey, Bulk density - 1041kg/m^3, fineness 336 m^2/kg, sp. gravity - 2.2.

F. GGBS: color-off white, Bulk density-1280 kg/m^3, sp. gravity -2.81, fineness-342m^2/kg,sp.gravity-2.8

G. Metakaolin: color-off white, Bulk density-790 kg/m^3,sp.gravity-2.6

III. EXPERIMENTAL PROGRAM

The research work is carried out on M40 grade concrete to observe the strength appraisals of cubes 15cm*15cm*15cm and cylinders 15cm dia*30cm height casted in laboratory with partial replacement i.e. 15%,30% and 45% of cement with Fly ash, ggbs and Metakaolin. For this work, the samples (one set of sample means 3 specimens) casted and tested for 7 days and 28 days respectively.

The following tests are performed on specimens as:

A. Compressive strength test

The compression test is carried out on3 specimens of cubes size 15cm*15cm*15cm at 7 &28 days curing age as per specifications of IS 516-1969.

B. Split tensile test

The split tensile strength test is carried out on 3 cylindrical specimens of size 15cm dia*30cm height at 7 &28 days curing age and are tested in accordance with IS:5816-1970

C. Mix Design

The mix design adopted for M40 concrete is as Per IS :10262:2009 and obtained proportion is cement:M sand:Coarse aggregate is 1:1.98:2.79 and water - cement ratio kept as 0.46 with Super Plasticizer(Master rheobuild920SH-naptha formaldehyde) dose is 1.2% weight of binder.

D. Concrete Mixes

The different type of concrete mixes with proportion are tabulated below:

Mix	Proportion
C1(conventional mix)	100%opc+M sand+coarse aggregate
M1	85%opc+15%admixtures(5%Each)+M-sand+coarse aggregate
M2	70%opc+30%admixtures(5%Each)+M-sand+coarse aggregate
M3	55%opc+45%admixtures(5%Each)+M-sand+coarse aggregate

IV. TEST RESULTS

Table-I : Cube and cylindrical strength values of various mixes

Mix	Cube strength(MPa)		cylinder strength(MPa)	
	7 days	28 days	7 days	28 days
C1	36.04	50.73	2.32	3.29
M1	37.92	51.42	2.74	3.61
M2	38.91	53.45	3.04	3.74
M3	39.31	56.41	3.29	4.06

A. Compressive Strength

The compressive strength of cubical specimens of four mixes at 7 days and 28days age are shown graphically in Fig.1

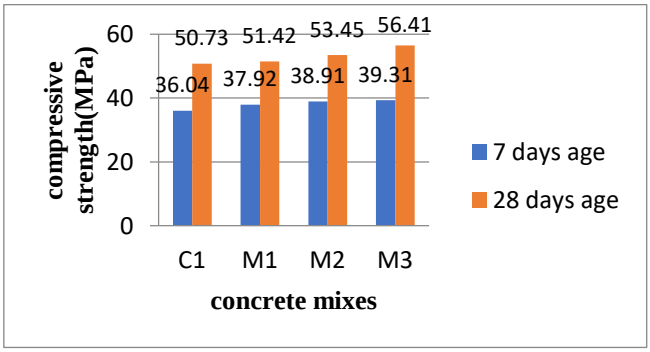

Fig.1

B. split tensile strength:

The split tensile strength of cylindrical specimens of four mixes at 7 days and 28 days are shown graphically in Fig 2.

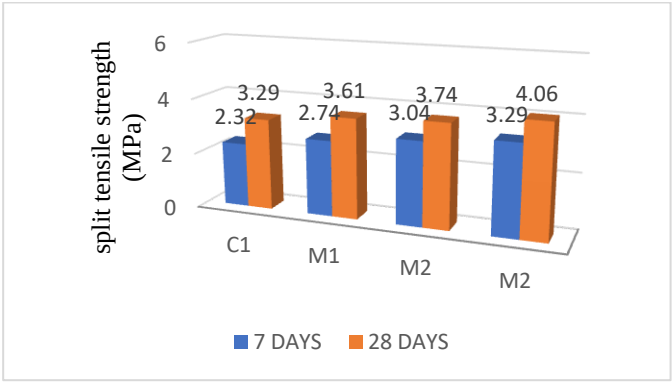

Fig.2

V. DISCUSSIONS

A. As compare the Conventional concrete mix(C1),with raise in Fly ash, GGBS and Metakaolin content in the mixes(M1,M2,M3) compressive Strength is increases by 5.21%,7.96% and 9.07 %for 7 days respectively.

B. As Compare the Conventional concrete mix(C1),with raise in Fly ash, GGBS and Metakaolin content in the mixes(M1,M2,M3) compressive Strength is increases by 1.36%,5.36% and 11.19% for 28 days respectively.

C. As Compare the Conventional concrete mix(C1),with raise in Fly ash, GGBS and Metakaolin content in the mixes(M1,M2,M3)split tensile Strength is increases by 18.10%,31.03%, 41.81% for7 days respectively.

D. As Compare the Conventional concrete mix(C1),with raise in Fly ash, GGBS and Metakaolin content in the mixes(M1,M2,M3)split tensile strength is increases by 9.72%,13.67% ,23.40% for 28 days respectively.

VI. CONCLUSION

A. workability of concrete decreases with addition of M-sand but it can be achieved by addition of super plasticizers.

B. From the past researches and with observed test results in this study ,the cube and cylinder strength values are increased with M-sand and with increase in content of mineral admixtures when compared with river sand and mineral admixtures.

C. Use of M-sand ,Flyash, GGBS and Metakaolin in concrete reduces usage of Cement ,solve the industrial waste disposal problems and prevent environmental problems.

D. Procuring M40 grade of concrete with M-sand and mineral admixtures is lesser when compared with concrete made up of river sand and mineral admixtures.

REFERENCES

1. M Nagarjuna and M Praveen kumar(2017),'' A study on workability and split tensile strength of multi blended of M20 concrete",International Research Journal of Engineering and Technology,Vol 04, Issue 12
2. M.Jagadeesh Naik and S.M. Naik (2016),"Experimental Investigation on the properties of Concrete Replacing Cement and Natural sand With Metakaolin and Robo sand",Journal of civil Engineering and Environmental Technology,Vol 3,Issue 6
3. B K Varun, Harish B A (2018),"Effect of Addition of Flyash and GGBS on Cement Concrete in Fresh And Hardend State",International Journal of Advance Engineering and Research Development,Vol 5,Issue 2

AUTHOR'S PROFILE

Dr.N.Sanjeev[1] He is a master of structural Engineering program and obtained his masters degree in management(M.B.A) in 1996 and Doctorial degree in 2003 from Andhra University,vishakapatnam.He has started his career with central warehouse corporation as a sub divisional engineer in 1983.Later he joined military engineering services as an Indian defence service of engineers in 1996 and continued up to 2005.Later he has served engineering colleges for 10yrs in the capacity of professor and Indian private construction industry for 6yrs.His research areas include geopolymer concrete, Basalt fibre reinforced high volume flyash and pavements.

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