iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 6 **Issue:** V **Month of publication:** May 2018

DOI: http://doi.org/10.22214/ijraset.2018.5302

Importance of Admixtures for Manufacturing of Concrete for Road Pavement

Akash W. Firke[1], Prof. Swapnil R. Satone[2], Er. Rishikesh Khope[3], Prof. Dr. Valsson Varghese[4]
[1]*MTech (Structure) Student – Civil Engg. Dept, KDKCE, Nagpur*
[2]*Asst. Professor – Civil Engg. Dept, KDKCE, Nagpur*
[3]*QC Engineer, Unity Infraprojects Ltd.,*
[4]*Professor – Civil Engg. Dept, KDKCE, Nagpur*

Abstract: The liberties taken on the durability of concrete and concrete structures are on a southward journey. Production of cement involves emission of large amount of carbon-dioxide into the atmosphere. It is one of the major contributors leading to global warming. The content of cement can be effectively reduced with the addition of fly ash. Fly ash is an industrial by-product obtained from thermal power plants. This paper discusses the mix designs and results of concrete with conventional and different proportions of fly ash i.e. (20%, 30% and 40%). To control the crack formation in concrete, use of polypropylene fibre is added to the mix in the proportions of 0.25% as directed by the standard manufacturers.
Keywords: Concrete, Admixture, Fly ash, Polypropylene fibre, compressive strength ,flexural strength, impact test by drop ball method.

I. INTRODUCTION

Concrete made with new innovative ideas, modern techniques and scientific study helps concrete industry to improve concrete properties such as workability ,durability, strength of Portland cement concrete by adding some industrial by products such admixtures. More than 11.4 billion tons of concrete is consumed annually worldwide. The production of concrete has reached a value of more than one ton concrete per capita globally. The durability of structures from the last fifty years with Ordinary Portland Cement(OPC) and mild steel bars, the constituent materials concrete preparation and the method of combination of the constituents of concrete leads to mass of concrete having bred contempt. Mineral and chemical admixture in concrete are used for some specific work and each are independent of each others. Admixture is an essential component in modern concrete mix which plays a important role in development of concrete technologies .Using plasticizers in concrete has various challenges and technical requirement for high performance concrete technology for construction.

II. ADMIXTURES

The term admixture is defined as the material other than cement ,sand and aggregate used as a ingredients to modify the freshly mixed or hardened properties of concrete. Generally chemical admixtures such as Super plasticizer and mineral admixtures such as fly ash, silica fume, rice husk ,corrosion inhibitors, colors and fibers are used in concrete. Admixtures are used in concrete only when there is a need of improvement in properties of concrete and making it economically attainable by adjusting the basic mixture.

A. Function

1. Increases strength.
2. Improves impact resistance.
3. Increases workability
4. Increases durability
5. Improves early age strength.
6. Reduces slump rate and segregation.

III.MATERIAL AND ITS PROPERTIES

A. Cement

Cement is a powdery substance made by calcining lime and clay ,mixed with water to form mortar or mixed with sand, gravel, and water to make concrete. It contains calcium silicate and calcium compound which are having hydraulic properties. Portland cement

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue V, May 2018- Available at www.ijraset.com

is the basic ingredient of concrete. Concrete is formed when Portland cement creates a paste with water that binds with sand and rock together as the concrete hardens. Cement is manufactured through a chemical composition of various minerals such as calcium ,silicon, aluminum, iron and other ingredients .Ordinary Portland cement (43 Grade) is used Cement is a fine, grey powder. The ordinary Portland cement contains two basic ingredients namely argillaceous and calcareous. In argillaceous material clay predominates and in calcareous materials calcium carbonate predominates. The basic composition of cement as shown in below table:-

TABLE I COMPOSITION LIMIT OF ORDINARY PORTLAND CEMENT

COMPOUND	FORMULA	SHORTHAND FORM
Calcium oxide (lime)	CaO	C
Silicon dioxide (silica)	SiO_2	S
Aluminium oxide (alumina)	Al_2O_3	A
Iron oxide	Fe_2O_3	F
Water	H_2O	H
Sulphate	SO_3	S

Chemical composition of cement

The cement clinkers formed has the following typical composition

TABLE II CHEMICAL COMPOSITION OF CMENT

COMPOUNDS	FORMULA	SHORTHAND FORM	% BY WEIGHT
Tricalcium aluminate	$Ca_3AL_2O_6$	C_3A	10
Tetracalcium alumina ferrite	$Ca_4Al_2Fe_2O_{10}$	C_4AF	8
Belite or dicalcium silicat	Ca_2SiO_3	C_2S	20
Alite or tricalcium silicate	Ca_3SiO_4	C_3S	55
Sodium oxide	Na_2O	N	Up to 2
Potassium oxide	K_2O	K	
Gypsum	$CaSO_42H_2O$	CSH_2	5

Physical properties of cement

The physical properties of cement according to IS 10262-2009 are given in table

TABLE IIII PHYSICAL PROPERTIES OF CEMENT

SR. NO.	PROPERTIES	RESULT OBTAINED	STANDARD VALUE
1.	Consistency	27.0%	--
2.	Specific gravity	3.023	--
3.	Initial setting time	190 min	Not less than 30min
4.	Final setting time	260min	Not be greater than 600 min
5.	Soundness by le chatelier's expansion	0.50 mm	<10
6.	Fineness by blains air permeability	$323.0m^{2}/kg$	-
7.	3 days compressive strength	32 mpa	-
8.	7 days compressive strength	39 mpa	-
9.	28 days compressive strength	47 mpa	-

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue V, May 2018- Available at www.ijraset.com

B. Fine Aggregate

The sand used for the experimental program of sieve analysis. The sand was first sieved through 4.75mm to remove any particles greater than 4.75 mm and then was washed to remove the dust. The sand confirming to zone I as per IS 383:1970 was used for making references concrete. sand was sieve analyzed and test were carried out

Fig.1 Fine Aggregate

Properties used in the experimental work are tabulated in table.

TABLE IIIV PHYSICAL PROPERTIES OF FINE AGGREGATE

SR. NO.	PROPERTIES	RESULT OBTAINED
1	Type	Natural
2	Specific Gravity	2.62
3	Water Absorption	1.3%
4	Surface Moisture	Nil
6	Bulkage	6%
7	Dry Loose Bulk Density	1560 kg/m^3
8	Fineness Modulus	2.48
9	Silt Content	1.6%
10.	Surface Texture	Smooth
11.	Particle Shape	Rounded
12.	Grading Zone (Based on percentage passing 0.60 mm)	Zone-I

C. Coarse Aggregate

All types of aggregate are suitable. The normal maximum size is generally 10-20mm. consistency of grading of vital importance. Coarse aggregate confirming to IS 383:1970.Regarding the characteristics of different types of aggregates, crushed aggregates tend to improve the strength because of the interlocking of the angular particles, whilst rounded aggregates improve the flow because of lower internal friction.

Fig.2 Coarse Aggregate 20mm & 10 mm

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue V, May 2018- Available at www.ijraset.com

TABLE V PHYSICAL PROPERTIES OF COARSE AGGREGATE(20MM &10MM)

SR NO	PROPERTIES	10mm	20 mm
1.	Type	Natural	Natural
2.	Specific Gravity	2.93	2.93
3.	Dry Loose Bulk Density	1830kg/m^3	1830 kg/m^3
4.	Water Absorption	1.0%	1.0%
5.	Flakiness Index	9.8%	15.4%
6.	Elongation Index	15.6%	26.0%
7.	Impact Value	13.2%	12.7%
8.	Crushing Value	15.9%	16.9%
9.	LA Abrasion Value	--	13.5%
10.	Fineness Modulus	7.246	7.246
11.	Surface Texture	Rough	Rough
12.	Particle Shape	Angular	Angular
13.	Surface Moisture	Nil	Nil

D. Water

Generally, water that is suitable for drinking is satisfactory for use in concrete. Water from lakes and streams that contain marine life also usually is suitable. When water is obtained from sources mentioned above no sampling is necessary. When it is suspected that water may contain sewage, mine water or waste from industrial plants or canneries, it should be avoided since the quality of water could change due to low water by intermittent tap water is used for casting.

polypropelene fiber (fibermesh 150 e3) multidimensional graded multifilament 100% virgin

Fig. 3 polypropylene fiber

TABLE VIV PROPERTIES OF POLYPROPYLENE FIBER

SR.	PROPERTIES	RESULT
A.	Aspect ratio	1600-1800
B.	Tenacity	3.5-8.0 gm/den
C.	Density	0.91gm/cc
D.	Elongation at break	10-45%
E.	Elasticity	Very good
F.	Moisture regain (%)	0%
G.	Resiliency	Good
H.	Melting point	170 □c
I.	Ability to protest friction	Excellent
J.	Colour	White
K.	Ability to protest heat	Moderate
L.	Lustre	Bright to light

E. Flyash

Fly ash is a by-product of coal burning power plants which possess good pozzolanic properties and is usually considered a waste material. These are generally finer than cement and spherical in shape. It is cost effective. More than 1000 million tons of fly ash is

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue V, May 2018- Available at www.ijraset.com

generated each year worldwide out of which 80% is disposed of in landfills and it is likely to exceed 2000 million tons in 21st century. With pozzolanic and cementitious properties, it has been used as a substitute for cement in concrete.

F. Chemical reaction

CEMENT + WATER ⟶ C-S-H gel + $Ca(OH)_2$

$Ca(OH)_2$ + S (FLY ASH) ⟶ C-S-H gel

The use of fly ash in concrete as a construction material has following technical advantages such as

1) Reduced bleeding and segregation
2) Improved finished ability and flow properties
3) Reduced heat oh hydration
4) Increase cracking resistant
5) Increase durability

Fig .4 Fly Ash

TABLEVI V PHYSICAL PROPERTIES OF FLY ASH

Sr.	Properties	Result
A.	Specific gravity	2.173
B.	Fineness by blains air permeability	384 m^2/kg
C.	Consistency (%)	27.5
D.	Soundness by autoclave method (%)	0.031
E.	Initial setting time(in minutes)	170
F.	Final setting time (in minutes)	240

G. Chemical property of Fly Ash

TABLE VIII CHEMICAL PROPERTIES OF FLY ASH

Sr. no.	Properties	Test results	Requirement as per 3812(part-1)-2013
1.	Loss of Ignition-%	0.14	5.0 mac
2.	Silicon dioxide (SiO_2) in percent by mass	61.15	35 min
3.	Calcium oxide (CaO) Content-%	1.73	--
4.	Magnesium Oxide (MgO) Content-%	0.26	5.0 max
5.	Total Sulphur as Sulphur trioxide (SO_3) in percent by mass	Below 0.1	3.0 max
6.	Silicon dioxide (SiO_2)+aluminium oxide (Al_2O_3)+iron oxide(Fe_2O_3)in percent by mass	93.42	SiO_2 +Fe_2O_3+ Al_2O_3 Min 70%

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue V, May 2018- Available at www.ijraset.com

IV. TEST RESULTS

A. Compressive strength

1) *Compressive Testing Machine:* Compressive strength of concrete is defined as the load which causes failure of the specimen divided by the area of the cross section in compression under a given load .Tests shall be made at recognized ages of the test specimens, the most usual begins 7, 14,28 &56 days. The ages shall be calculated from the time of addition of water of the dry ingredient. At least three specimen preferably from different batches shall be made for testing at each selected ages of 7, 14, 28&56 days. Compressive strength of concrete is determined as per IS 516:1959(Clause 5.)

Fig. 5 Compressive strength testing machine.

TABLE VIx COMPRESSIVE STRENGTH

Calculation: The measured compressive strength of the specimen shall be calculated by dividing the maximum load applied to the

MATERIAL MIX	CASTING DATE	COMPRESSIVE STRENGTH (N/mm2) SAMPLE SIZE 150mm*150mm*150mm			
		7 DAYS 23/2/18	14 DAYS 02/03/18	28 DAYS 16/3/18	56 DAYS 13/4/18
0% FA +0.25% FIBER	19/02/18	29.4	35.8	43.2	48.9
		31.8	40.6	47.6	50.2
		30.9	32.8	42.6	49.5
20 %FA +0.25% FIBER	16/02/18	34.3	42.8	53.15	55.4
		36.1	44.05	56.3	58.1
		35.4	44.8	49.8	51.2
30% FA +0.25% FIBER	17/02/18	37.2	51.2	52.7	57.4
		35.7	48.5	50.6	52.7
		38.8	47.3	49.5	50.6
40% FA +0.25% FIBER	18/02/18	33.4	49.81	51.2	53.5
		30.9	48.6	50.5	52.0
		29.5	45.2	52	54.4

specimen during the test by the cross sectional area, calculated from the mean dimension of the section and shall be expressed to the nearest MPa. Average of three shall be taken for calculation

2) *Flexural Strength*

a) *Universal testing machine:* The flexural strength of the specimen shall be expressed as the modulus of rupture *f*b, which, if '*a*' equals the distance between the line of fracture and the nearer support, measured on the centre line of the tensile side of the specimen, in cm, shall be calculated to the nearest 0.5 kg/sq cm as follows:

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue V, May 2018- Available at www.ijraset.com

$f_b = \frac{P \times l}{b \times d^2}$

Tests shall be made at recognized ages of the test specimen, the most usual being 7, 14, 28& 56 days. The ages shall be calculated from the time of the addition of water of the dry ingredients

At least three specimen, preferably from different batches, shall be made for testing at each selected age of 7,14,28,56 days.

Fig .6 Flexural strength test on beam

TABLE X FLEXURAL STRENGTH

MATERIAL MIX	CASTING DATE	FLEXTURAL STRENGTH (N/mm^2) SAMPLE SIZE 150mm*150mm*700mm			
		7 DAYS 23/2/18	14 DAYS 02/03/18	28 DAYS 16/03/18	56 DAYS 13/04/18
0% FA+0.25% FIBER	19/02/18	3.4	4.07	4.84	5.23
		2.9	3.7	4.14	4.75
		3.7	4.2	5.09	5.36
20 % FA +0.25% FIBER	16/02/18	4.44	5.10	5.89	6.4
		4.20	4.89	5.64	6.7
		4.69	4.6	5.80	6.2
30% FA +0.25% FIBER	17/02/18	4.2	4.58	5.19	5.8
		4.0	4.46	5.26	5.54
		4.3	4.49	4.90	5.1
40% FA +0.25% FIBER	18/02/18	3.6	4.1	4.90	5.3
		3.8	3.98	4.87	4.98
		4.1	4.17	4.70	5.23

b) Calculation: The measured flexural strength was computed using the expression, $f_b = \frac{pl}{bd2}$ where f_b is the flexural strength in MPa, p is the maximum load applied (N), L is the length (mm) that is the distance between the line of fracture and the nearest support measured from the centre line of the tensile side of specimen, b is the width of the specimen (mm), d is the depth of specimen (mm). The standard gives details of the testing ring and requires that the universal testing machine used to apply load. For centre- point loading the flexural strength is $3PL/2bd^2$ which has been found to give result 13% higher than two-point loading.

TABLE XVII AVERAGE STRENGTH

MATERIAL MIX	AVERAGE COMPRESSIVE STRENGTH (N/mm2) SAMPLE SIZE 150mm*150mm*150mm				AVERAGE FLEXURAL STRENGTH (N/mm2) SAMPLE SIZE 150mm*150mm*700mm			
	7 DAYS	14 DAYS	28 DAYS	56 DAYS	7 DAYS	14 DAYS	28 DAYS	56 DAYS
0% FA+0.25% FIBER	30.7	36.4	44.46	51.5	3.33	3.99	4.69	5.11
20 FA +0.25% FIBER	35.26	43.88	53.08	54.9	4.44	5.0	5.79	6.43
30 FA +0.25% FIBER	37.23	49.0	50.93	53.5	4.17	4.5	5.19	5.48
40 FA +0.25% FIBER	31.26	47.86	51.23	53.3	3.83	4.06	4.82	5.19

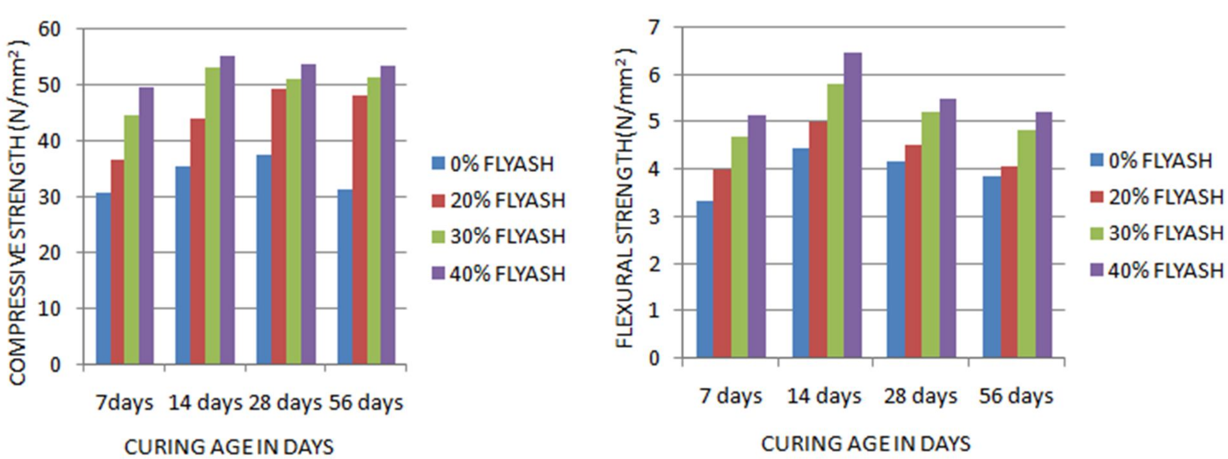
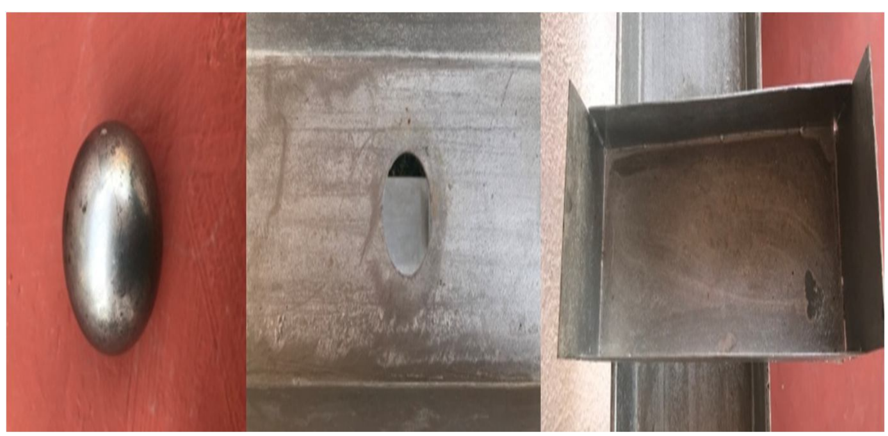


Fig .7 Comparision chart.

3) *Impact test by Drop ball test*



Impac Test Stand Steel Ball Hole Mould

DIMENSIONS OF TEST APPARATUS.

a) DAIMETER OF HOLE=6.5 cm
b) FALLING HEIGHT= 900mm
c) WEIGHT OF BALL=1 KG =9.81 N

TABLE XVIIII IMPACT ENERGY READING

SR NO	SPECIMEN IDENTIFICATION	FA VOLUME FRACTION %	IMPACT RESISTANCE (NO. OF BLOWS)		IMPACT ENERGY (N-m)
			FIRST CRACK	ULTIMATE CRACK	STATIC
1.	MIX C	CONVENTIONAL 0%	3	5	433.06
2.	MIX C		2	3	259.83
3.	MIX C		2	4	346.4
4.	M45	20%	6	9	779.5
5.	M45		4	6	519.6
6.	M45		6	10	866.1
7.	M45	30%	3	4	346.6
8.	M45		3	5	433.06
9.	M45		2	5	433.06
10.	M45	40%	2	3	259.83
11.	M45		4	5	433.06
12.	M45		3	5	433.06

TEST SAMPLE AT MAX IMPACT ENERGY M-45 GRADE

TABLE XIXII MAXIMUM IMPACT ENERGY

SR NO.	MIX NAME	FA VOLM FRACTION %	IMPACT REISTANCE (NO. OF BLOWS)		IMPACT ENERGY (N-m)
			FIRST CRACK	ULTIMATE CRACK	STATIC
1.	MIX C	0%	3	5	433.06
2.	M45	20%	6	10	866.1
3.	M45	30%	3	5	433.06
4.	M45	40%	4	5	433.06

IV. CONCLUSION

Manufacturing of cement emits huge amounts of carbon-dioxide. This emission leads to global warming. Thermal power plants also generated massive heat resulting in global warming. Fly ash is the by-product of these thermal plants and can be used as a replacement to cement in optimised proportions. Use of fly ash in the manufacturing of concrete is a perfect combination that blends in maintaining the environmental balance.

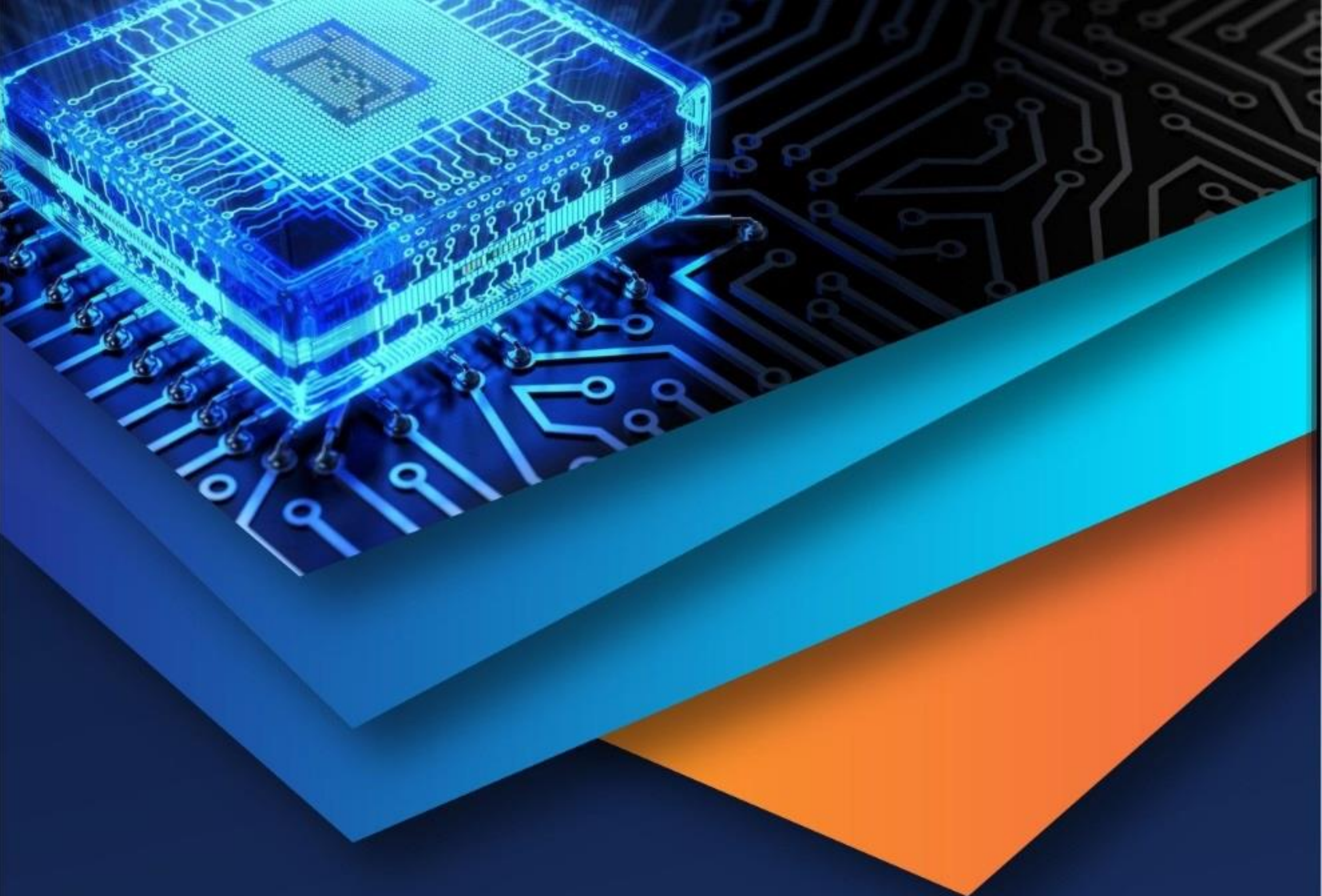
Experimental test results of 28 days curing of compressive test depict that for 20% of fly ash with fibre the strength of concrete is increased by 15% compared to conventional mix which satisfies the gain of strength criteria as per British Code Table 7.1 [MS Shetty – print].

Experimental test results of 28 days curing of flexural test depict that for 20% of fly ash with fibre the strength of concrete is increased by 11% compared to conventional mix which satisfies the gain of strength criteria as per British Code Table 7.1 [MS Shetty – print].

Thus it can be concluded that, 20% of fly ash is the optimum percentage that can be incorporated in the concrete mix design.

REFERENCES

[1] Tatyana Boikovaa, Dmitry Solovyova, Valentina Solovyovaa," Concrete for road pavements" Transportation Geotechnics and Genecology, TGG 2017, 17-19 May 2017, Saint Petersburg, Russia.
[2] Marcela Guirola," Strength and performance of fiber-reinforced concrete composite slabs "October 2001.
[3] Rahul Bansal, Varinder Singh and Ravikant Parekh, 'Effect on Compressive Strength with Partial Replacement of Fly ash' , International Journal on Emerging Technology, January 2015.
[4] Tomas U. Ganiron Jr," Analysis of fly ash cement concrete for road construction", "International Journal of Advanced Science and Technology Vol.60, (2013).
[5] Okan Karahan, Cengis Duran Atis. ' The durability Property of Polypropylene Fibre Reinforce Fly ash Concrete", Materials and Design. ELSEVIER, Volume 32, Issue 2, Feb 2011.
[6] Don L. Ivey, Teddy J. Hirsch," Effects of chemical admixtures in concrete and mortar", The Texas highway department, March 1967.
[7] C. Manthong, T.P. Agarwal," Effect of fly ash additives on concrete properties"International journal of engineering research and application's: 2248-9622, Vol 2, Issue 4 pp,2012.
[8] V.M.Sounthararajan,A.Jain,A.K.Singh,S.Thirumurugan and A.Sivakumar,"Evaluation of composite polypropylene fiber reinforced concrete", International journal of engineering and technology;ISSN:0975 -4024,Vol 5,Issue 2 pp,2010.
[9] M.S. SHETTY, "Concrete Technology Theory & Practice", Seventh Revised Edition 2013 Published by S. CHAND & Company, Ram Nagar, New Delhi.
[10] IS 10262:2009, "Guidelines for Concrete Design Proportioning", Bureau Of Indian Standards, New Delhi.
[11] IS 456:2000,"Plain and Reinforced Concrete Code for practise"



doi crossref
10.22214/IJRASET

INDEX COPERNICUS
45.98

ISRA JIF
IMPACT FACTOR:
7.129

SJIFactor
TOGETHER WE REACH THE GOAL
IMPACT FACTOR:
7.429

ISI

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY