iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 5 Issue: VI Month of publication: June 2017

DOI:

Volume 5 Issue VI, June 2017
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Experimental Study of Self Compaction Concrete by Using Flyash and GGBS

M. Vimalanathan[1]
[1]Civil and Structural Engineering, SCSVMV University

Abstract: ***Self compacting concrete (SSC) is a following concrete mixture that is able to consolidate under its own weight. The highly fluid nature of SSC makes its suitable for placing in difficult conditions and in section with congested reinforcement. Use of SSC can also help in minimize hearing related damage on the work site that is induced by vibration of concrete. In this paper experimental studies are carried out to understand the fresh and hardened properties of SSC in which cement is replaced by GGBS and fly ash in various properties for M40 grade concrete. The properties in which cement replaced are 10%, 20% of GGBS and fly ash and add 10%constantly. The strength behaviour, flexural behaviour and split tensile strength behaviour of SSC are studied. The parameters are tested at different ages in accordance with BIS for the various properties in which cement is replaced and also the obtained parameters are compared with normal SSC(100% cement). Super plasticizer GLENIUM B233 a product from BASF is used to maintain workability with constant water-binder ratio.***
Keywords*:* ***Waste product, Aggregate, Compressive Strength, GGBS, Flyash***

I. INTRODUCTION

The development of Self-Compacting Concrete (SCC) has recently been one of the most important developments in the building industry. The purpose of this concrete concept is to decrease the risk due to the human factor, to enable the economic efficiency, more freedom to designers and constructors and more human work. It is a kind of concrete that can flow through and fill gaps of reinforcement and corners of moulds without any need for vibrations and compacting during the pouring process. Because of that, SCC must have sufficient paste volume and proper paste geology. Paste volumes are usually higher than for conventionally placed concrete and typically consist of high powder contents and water-powder ratios.

The main advantage of using SCC is that it offers high homogeneity, fluidity and less segregation, minimal concrete voids and uniform concrete strength. Since low cement ratio is adopted it is possible to achieve early strength, quicker remoulding and faster use of elements and structures. The impact due to the use of vibrators is eliminated by the use of SCC in construction. Compaction of SCC is carried out in all parts of the formwork, including the hardly accessible parts, without any additional external force and no gravitational force that is as a result of self weight of concrete.

The filling ability and stability of SCC in the fresh state can be defined by four key characteristics: passing ability, flow ability, segregation resistance and viscosity. Such properties are achieved by addition of chemical additives to the concrete. The growing use of concrete in special architectural configurations and closely spaced reinforcing bars have made it very important to produce concrete that ensures proper filling ability, good structural performance and adequate durability.

II. GENERAL

A. Self Compacting Concrete

Self-compacting concrete (SCC) is a relatively new product that sees the addition of super plasticiser and a stabiliser to the concrete mix to significantly increase the ease and rate of flow. By its very nature, SCC does not require vibration. It achieves compaction into every part of the mould or formwork simply by means of its own weight without any segregation of the coarse aggregate. Apart from health and safety benefits, it offers faster construction times, increased workability and ease of flow around heavy reinforcement. Having no need for vibrating equipment spares workers from exposure to vibration. The fluidity of SCC ensures a high level of workability and durability whilst the rapid rate of placement provides an enhanced surface finish. SCC's overnight strengths typically reaches and two-day strengths can break the barrier which enable easier and more reliable demoulding.SCC is basically a concrete which is capable of flowing in to the form work, without segregation, to fill uniformly and completely every corner of it by its own weight without any application of vibration or other energy during placing. There is no standard SCC. Therefore each SCC has to be designed for the particular structure to be constructed. To establish an appropriate mixture proportion for a SCC the performance requirement must be defined taking into account the structural conditions such as plastic viscosity, deformability, flow ability and resistance to segregation, SCC may be proportioned for almost any type of concrete structures.SCC is certainly the way forward for both insitu and precast concrete construction. The health and safety benefits and the improved construction and performance results make it a very attractive solution.

B. Need For Scc

To make durable concrete structures, sufficient compaction is required. Compaction of conventional concrete is done by vibrating. Over vibration can easily cause segregation. In conventional concrete it is very difficult to ensure uniform material quality and good density in heavily reinforced locations. The SCC concept can be stated as the concrete that meets the special performance and uniformity requirements that cannot always be obtained by using conventional ingredients normal mixing procedure and curing practices. The SCC is an engineered material consisting of cement, aggregate, water and chemical admixtures to take care of specific requirements such as high flow ability, compressive strength, high workability, enhanced resistances to chemical or mechanical stresses, lower permeability, durability, resistance against segregation and possibility under dense reinforcement conditions.

C. Advantages Of Self Compacting Concrete

1) Improved quality of concrete and reduction of onsite repairs.
2) Faster construction times.
3) Lowers the overall costs.
4) Facilitation of introduction of automation into concrete construction.
5) Improvement of health and safety is also achieved through elimination of handling of vibrators.
6) Reduction of environmental noise loading on and around a site.
7) Possibilities for utilization of “dusts”, which are currently waste products and which are costly to dispose of.
8) Better surface finishes.
9) Easier placing.
10) Thinner concrete sections.
11) Greater Freedom in Design.
12) Improved durability, and reliability of concrete structures.
13) SCC makes the level of durability and reliability of the structure independent from the existing on – site conditions relate to the quality of labour, casting and compacting systems available.
14) The high resistance to external segregation and the mixture self – compacting ability allow the elimination of macro – defects, air bubbles, and honey combs responsible for penalizing mechanical performance and structure durability.

D. properties of scc

The three main properties of SCC in plastic state as

1) Filling ability (excellent deformability)
2) Passing ability
3) High resistance to segregation

E. Materials Used

All materials used in this study are commonly available.
Cement – OPC of 53 grade
Sand – 4.75 mm maximum size
Coarse aggregate – 12.5 mm size
Cement partial replace with GGBS
Add 10% with flyash

F. Ggbs

Use of GGBS replacement with Portland cement intended because of to have sulphate& chloride resistance, durable concrete with commercially economical. Also there are green environmental benefits by using waste recycled material as GGBS with replacement for OPC cement.

Volume 5 Issue VI, June 2017
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Fig 1 GGBS

Volume 5 Issue VI, June 2017
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

III.LITERATURE REVIEW

K. Ganesh Babu and V. Sree Rama Kumar (2008), has shown an effort to quantify the 28-day cementitious efficiency of ground granulated blast furnace slag (GGBS) in concrete at the various replacement levels. The replacement levels in the concrete studied varied from 10% to 80% and the strength efficiencies at the 28 days were calculated. Overall, the prediction of the strength of concretes varying from 20 to 100 MPa with GGBS levels varying from 10% to 80% by this method was found to result in a regression coefficient of 0.94, which was also the same for normal concretes. Finally, it was observed that for obtaining equal strength in concretes at 28 days, by adopting the efficiencies evaluated in the present investigation, it will be required to have an additional 8.5% and 19.5% increase in the total cementitious materials at 50% and 65% cement replacement levels, agreeing well with the values 10% and 20% additional material reported earlier.

Dubey (2012), studied the effect of blast furnace slag on concrete by replacing cement from 5% to 30%; from the experimental studies it was observed that the optimum replacement of ground granulated blast furnace slag was 15 % without much reduction in the compressive strength. Only a reduction of 5 % in strength was observed .Concrete cubes were cast of size 150 × 150 × 150 mm and cured for 7, 14 and 28 days. It was concluded that increasing the percentage of blast furnace slag resulted in decrease in compressive strength.

Tamilarasan & Perumal (2012), conducted an experimental study for the effects of replacing cement with ground granulated blast furnace slag on the compressive, split tensile and flexural strengths of concrete. In this study GGBS was used to replace cement from 0 to 100% in 5% increments, for this study M20 and M25 grades of concrete were used and it was concluded that tensile, compressive and flexure strength increased in all levels of replacements adopted. Compression tests were carried out at 3, 7 and 28 days curing, split tensile and flexure were carried out at the end of 28 days. The results obtained for M20 grade concrete were all above 20 MPa.

The compressive strength increased up to 30% (optimum mixes) thereafter there was a decrement observed till 60% replacement level. Tensile and flexural strength increased with an in replacement of GGBS up-to 60% level.

Deepa (2012),conducted a comparative study on mechanical properties of different ternary blended concrete by incorporating ground granulated blast furnace slag, silica fume and fly ash.

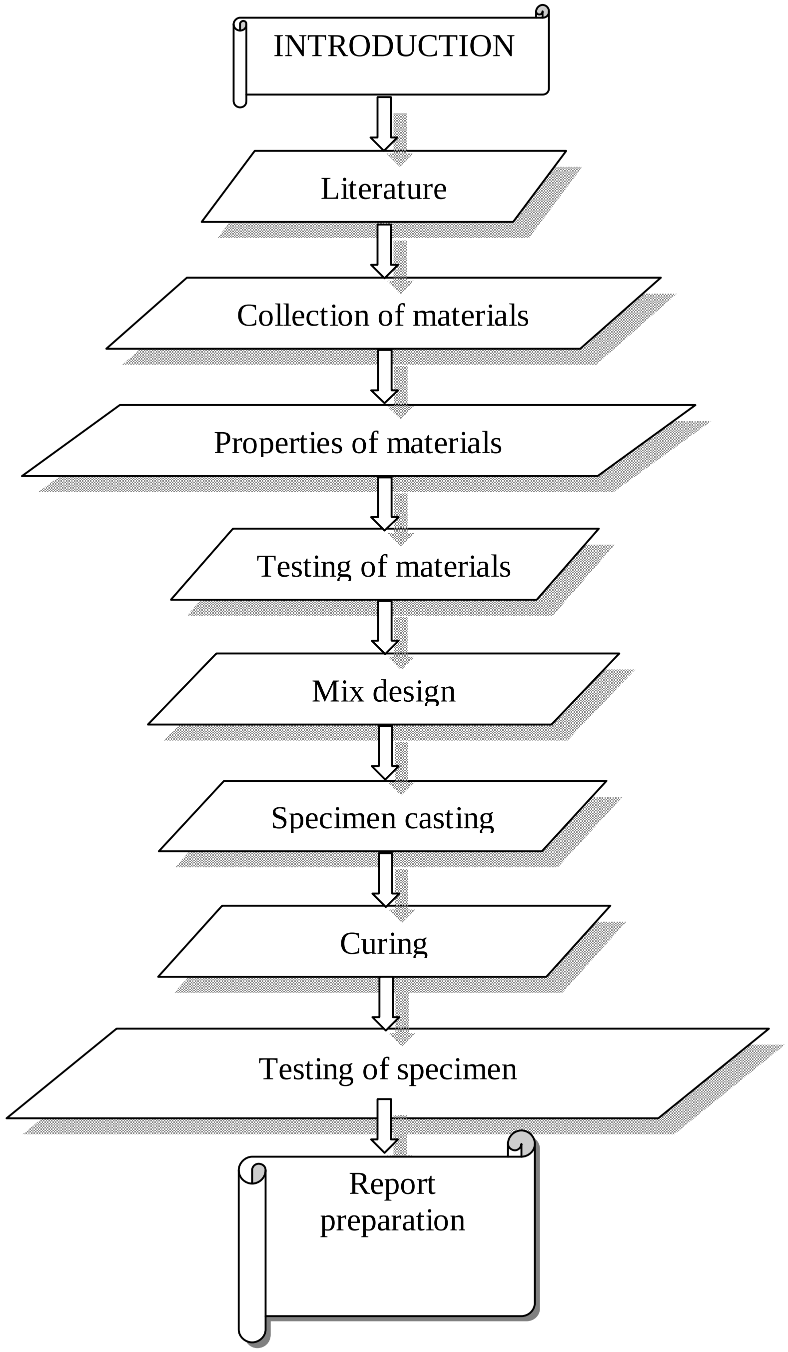
The properties investigated included workability, compressive strength and flexural strength. Mix design for M30 grade concrete was carried out, the dosage of super plasticizer used was 0.78% of cement weight. The specimens were prepared by using both hand compaction and using vibrating table; curing of the specimens was done for 28 days and 90 days. The ternary blends replacements were done from 0 to 30% in 5% increments. Silica fume replacement gave the highest strength in flexure after 28 and 90 days. Silica fume also gave the highest compressive strength after 90 days. The author also concluded that by using industrial waste materials environment can be made more sustainable.

Maiti & Raj (2010), did an experimental study on concrete mix design on Portland cement replacements by GGBS from 50 to 65% for M20 grade concrete. Tests were conducted to determine the compressive strength of concrete after moist curing of 28 and 90 days. The test results led to the conclusion that with the increase of percentage of GGBS in concrete, the chloride ion permeability decreases. It was recommended to increase more than 50% GGBS in concrete to reduce harmful alkali-silica reaction. The heat of hydration of concrete using flyash and GGBS was less than that of concrete with only ordinary Portland cement. Ground granulated blast furnace slag is the safest option to mitigate alkali – silica reaction in concrete.

Mohamed (2012), conducted an investigation on the locally available ground granulated blast furnace slag to protect the environment against waste dumping and to promote local products. The slag content such (20, 30, 40, 50, 60 and 80%) was used. Blast furnace slag had shown a positive effect on both the flexural and compressive strength of concrete after 28 days. The real gain in strength was noticed after the 28 day mark especially when 120 grade GGBFS was used. The long term strength of slag cement depended on many factors such as the amount of slag and Portland cement, and water to cement ratio. Clinkers have well reacted with slag, but a slight difference in the resulting resistance was observed mainly at medium and long term. The best resistance at 28 days was obtained with higher C_3S and the C_3A content.

It was also noted that the minor elements played an important role in the slag reaction. The results of the long-term mechanical tests have shown that regardless the type of clink used, the performance in compressive strength was very significant. An average of 30% increase in resistance with regards to the findings recorded at 28 days was also noted. The major reasons of such increase were higher C_3S content and its quick reaction with water which provided an important degree of resistance.

IV. METHODOLGY



V. RESULT AND DISCUSSION

A. General

In this chapter the experimental results of the control specimen and specimen replaced by 10%, 20% of GGBS and adding constant proportion of fly ash 10% are being compared. Their behaviour throughout the test is described using mechanically obtained the load carrying capacity. All the specimen is tested for their ultimate strengths find out.

Volume 5 Issue VI, June 2017
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

B. Result Comparison

Table 1 Compressive Strength for Cube (7 Days)

% OF GGBS REPLACED WITH FLY ASH (10%)	LOAD (KN)			COMPRESSIVE STRENGTH (N/mm^2)			
	Trial 1	Trial 2	Trial 3	Trial 1	Trial 2	Trial 3	MEAN
0	450	473	495	20	21	22	21
10	652.5	675	697.5	29	30	31	30
20	742.5	765	787.5	33	34	35	34

Table 2 Compressive Strength for Cube (7 Days)

% OF GGBS REPLACED WITH FLY ASH (10%)	LOAD(KN)			COMPRESSIVE STRENGTH(N/mm^2)			
	Trial 1	Trial 2	Trial 3	Trial 1	Trial 2	Trial 3	MEAN
0	472.5	652.5	562.5	21	29	25	25
10	697.5	742.5	787.5	31	33	35	33
20	855	900	922.5	38	40	41	39.6

% OF GGBS REPLACED WITH FLY ASH (10%)	LOAD(KN)			COMPRESSIVE STRENGTH (N/mm^2)			
	Trial 1	Trial 2	Trial 3	Trial 1	Trial 2	Trial 3	MEAN
0	641.25	663.75	618.75	28.5	29.5	27.5	28.55
10	787.5	765	810	35	34	36	35
20	945	990	967.5	42	44	43	43.50
% OF GGBS REPLACED WITH FLY ASH (10%)	LOAD(KN)			COMPRESSIVE STRENGTH (N/mm^2)			
	Trial 1	Trial 2	Trial 3	Trial 1	Trial 2	Trial 3	MEAN
0	641.25	663.75	618.75	28.5	29.5	27.5	28.55
10	787.5	765	810	35	34	36	35
20	945	990	967.5	42	44	43	43.50

Table 3 Compressive Strength for Cube (28 Days)

Volume 5 Issue VI, June 2017
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

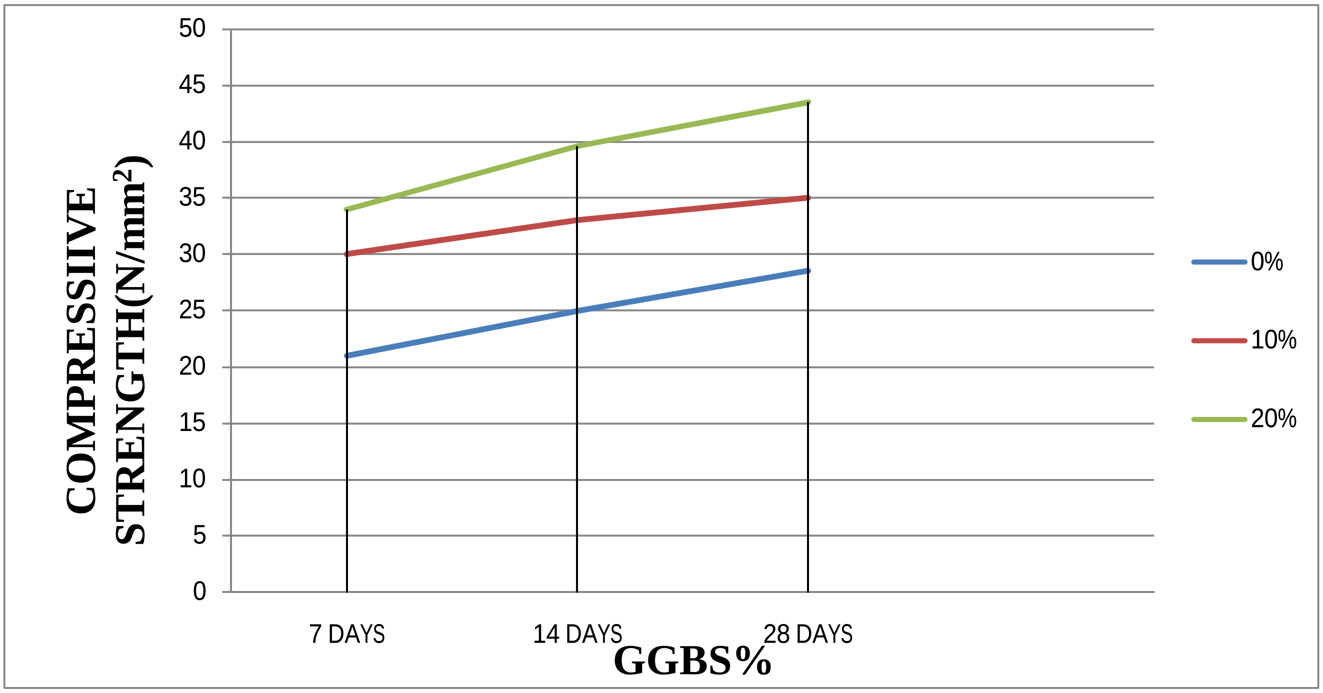


Fig 2 Chart Comparison

Compressive Strength It may be noted from above Table and compressive strength for GGBS based SCC of M40 grade is 43.50 MPa(28 days), which is about more than the design strength of the normal cube.
Strength will increase gradually to the both 10%, 20% mix.

VI. SUMMARY AND CONCLUSION

A. General

In this project the study on compressive strength of SCC with GGBS and FLY ASH.
Cubes are casted with different curing period. The ultimate load to be find out and test result compare with nominal mix.

VII. CONCLUSION

Based on the experimental results from this project the following conclusions are made.
The study of properties of SCC gives favourable results with Flow ability and Passing ability of concrete for M40 grade mix proportion.

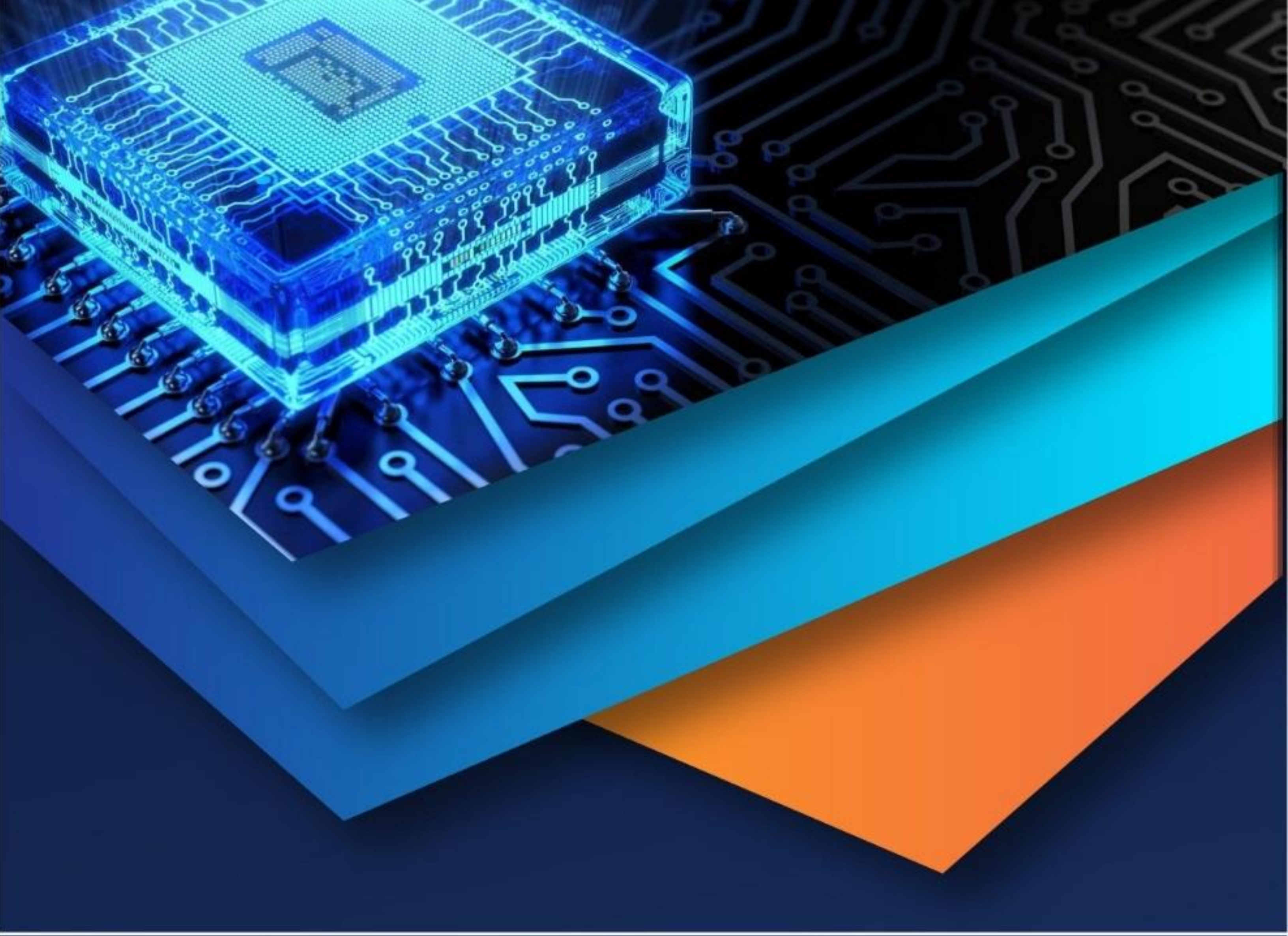
A. Compressive strength of cubes values gradually increase different replacement of ggbs and fly ash content
B. Various curing period 7, 14 and 28 days compressive strength increase high compare to normal cube.
C. All the cubes are tested for their ultimate strength to be find out.
D. Its cost effective method.
E. Waste material by product using effective manner.
F. Scc technology can save time, cost, durability.

REFERENCES

[1] Japan Society of Civil Engineers, ―Recommendation for Construction of Self Compacting Concrete, 157- 164 pp., 1998.
[2] Siddique, R., ―Properties of self-compacting concrete containing class F fly ash, Journal of Materials and Design, Vol. 32, 1501-1507 pp., 2011.
[3] IS: 12089 (Specification for Granulated Slag for Manufacture of Portland Slag Cement), Indian Standard Code of Practice, 1987.
[4] Nan Su., Kung-Chung Hsu., and His-Wan Chai., ―A simple mix design method for self-compacting concrete, Journal of Cement Concrete Research Vol. 31, No. 12, 1799-1807 pp., Dec. 2001.
[5] Dinakar, P., Kali, P.S., Umesh, C.S., ―Design of self-compacting concrete with ground granulated blast furnace slag, Journal of Material and Design, Vol. 43, 161–169 pp., Jan 2013.
[6] IS: 12269 (53 Grade Ordinary Portland cement Specifications), Indian Standard Code, 1987.

Volume 5 Issue VI, June 2017
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

[7] IS: 383 (Specification for coarse and fine aggregates from natural sources for concrete), Indian Standard Code of Practice, 1970.
[8] IS: 10262 (Concrete Mix Proportioning- Guidelines), Indian Standard Code, 2009.
[9] Khayat, K.H., Hu, C., Monty, H., ―Stability of SCC, advantages and Potential applications‖, In: Proceedings of RILEM international conference on self-compacting concrete, Rilem Publications SARL, 143-152 pp., 1999.
[10] Pai .B.H.V, Nandy M., K.H, Sarkar.P.K, Ganapathy.C.P, -Experimental study on self-compacting concrete containing industrial by-products, European Scientific Journal, vol12, ISSN 1875-7881, April, 2014.



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY