EXPERIMENTAL STUDIES ON CONCRETE USING BASALT FIBER AS ADDITIVE AND PARTIAL REPLACEMENT OF CEMENT WITH ALCCOFINE

Chetna Raina[1], Sourabh Lalotra[2]

[1]PG Scholar, Department of Civil Engineering, Sri Sai College of Engineering & Technology, India.
[2]Assistant Professor, Department of Civil Engineering, Sri Sai College of Engineering & Technology.

Abstract: The cost of constructing a building is increasing day by day as cost of building materials are increasing, the use of any alternative material that has tendency to partially replace the building material may reduce the cost of the construction to certain level. In this research we have selected two materials basalt fiber as additive and Alccofine for partially replacement with cement. Both the materials are easily available, renewable and also cheap. The grade of concrete on which the investigation will be performed will be M35 grade. The main aim of this research is to check if the two above materials can be used instead of cement up to certain percentage. In this project, the workability, compressive strength, split tensile strength and flexural strength of conventional concrete (CC), concrete made of adding 2% Basalt fiber and replacing cement with alccofine has been studied. The compressive and the flexural strength was calculated at 3 days, 7 days and 28 days of normal curing, while the split tensile test was calculated after 7 days and 28 days. The percentage replacement for the cement used is 0%, 5%, 10%, 15%, 20% and 25% by weight of cement with 2% of addition of basalt fiber. For calculating the compressive strength and Flexural Strength, cubes of size 150 x 150 x 150 mm and beams of size 500 x 100 x 100 mm were casted and were tested using Compression Testing Machine and Flexural Testing Machine. The split tensile strength was conducted on cylinder of size 300 x 500 mm. The test results indicate that the workability of concretegets increased up to a certain limit. The optimum strength is attained at 10% replacement of cement and 2% addition of basalt fiber and after this it gets decreasing.

Keywords: concrete, BF – Basalt Fiber, Alccofine, M35, workability, compressive strength, flexural strength, split tensile strength

1. INTRODUCTION

Concrete is a structure material made from blending coarse total, sand, concrete, and water. This blend can be filled any shape, size of form that on solidifying produces a strong stone like mass, the quality of solidified strong mass can be expanded by including admixtures. Admixtures are added into the solid to expand its solidarity somewhat. In like manner man language cement can be characterized as blend of glue and totals. In this exploration work we have included basalt fiber and hacked steel fiber in the solid. The exploration work has been completed on cement concrete of M-35 Grade. Concrete with high quality is such kind of solid which have high quality and high sturdiness when contrasted it and the ordinary customary cement. The development of high-quality cement is at some point bloated as a result of the way that the blend of the fixings is to be taken so that the ideal quality of strong mass is gotten subsequent to solidifying. The desire is to get high quality properties with low porousness. High quality cement isn't interesting kind of cement, the materials utilized in high quality cement is same as that utilized in customary cement.

A. Basalt Fiber

The basalt fiber that has been utilized in this exploration is appeared and was bought online from site www.indiamart.com. The most extreme size of basalt fiber utilized in this exploration is 10mm.The basalt fiber is an item that is extricated from the basalt rock, which is a characteristic stone found in the volcanic rocks which are additionally gotten from solidified magma. The volcanic rocks are difficult to the point that occasionally it has been utilized as a squashed stone in development stage. Since the stone is made from the solidified magma, it has best toughness, quality just as warm properties. To extricate this basalt filaments the volcanic rocks are dissolved at the temperature that differs somewhere in the range of 1500 and 1700 °C and constraining it through in platinum/rhodium pot bushings. The strands that are gotten through dissolving process are as cleaved and consistent filaments. It has additionally great protection from assault in seawater saline condition. Basalt fiber has one best favorable position that it very well may be utilized in low temperature of about - 200 °C up to high temperature of

about 580°C, because of this property basalt fiber are considered as a best prudent option in contrast to high temperature safe filaments

B. Alccofine

Alccofine is another age, miniaturized scale fine material of molecule size a lot better than other water driven materials like concrete, fly debris, silica and so on being produced in India. Alccofine has one-of-a-kind qualities to improve 'execution of cement' in new and solidified stages because of its upgraded molecule size appropriation. It tends to be utilized as down to earth substitute for Silica Fume as it has ideal molecule size appropriation not very coarse, not very better either per the outcomes acquired by Count Micro fine items Pvt. Ltd. (A joint endeavor with Ambuja concrete ltd and alcon engineers). It is fabricated in the controlled conditions with extraordinary types of gear to deliver streamlined molecule size conveyance which is its exceptional property

Table1: Conventional mix proportion.

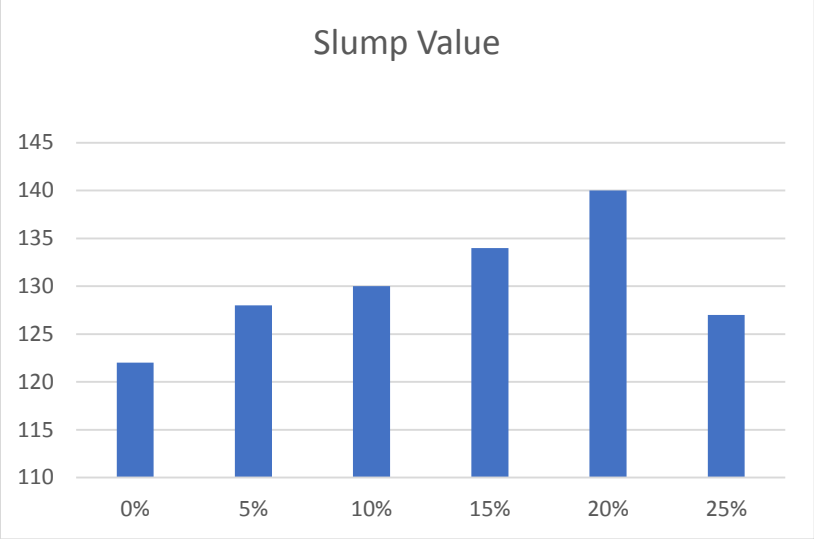
	Cement	Fine Aggregate	Coarse Aggregate	Water
Weight(kg/m^3)	463.5	616.2	1163.70	185.4L
Mix Ratio	1	1.32	2.51	0.40

II. RESULTS:

A. Slump Test.

Table2:Slump Values Obtained.

Replacement%	Slump Value with addition of BF (2%) & replacement with Alccofine
0	122
5	128
10	130
15	134
20	140
25	127



B. Compressive Strength Values

Table 3: Results for Compressive Strength Test Keeping Basalt Fiber constant at 2%

Replacement	3Days	7Days	28Days
0%	20.66	33.47	42.29
5%	20.95	34.81	50.14
10%	22.66	36.29	57.62
15%	22.14	35.62	49.03
20%	20.96	34.73	43.84
25%	19.03	29.10	37.99

C. Flexural Strength Values

Table 4: Results for Flexural Strength Test Keeping Basalt Fiber constant at 2%

Replacement	3Days	7Days	28Days
0%	4.06	5.14	6.07
5%	4.67	5.65	7.33
10%	5.30	6.35	8.53
15%	5.81	6.01	7.27
20%	5.23	5.24	6.41
25%	3.89	4.82	5.78

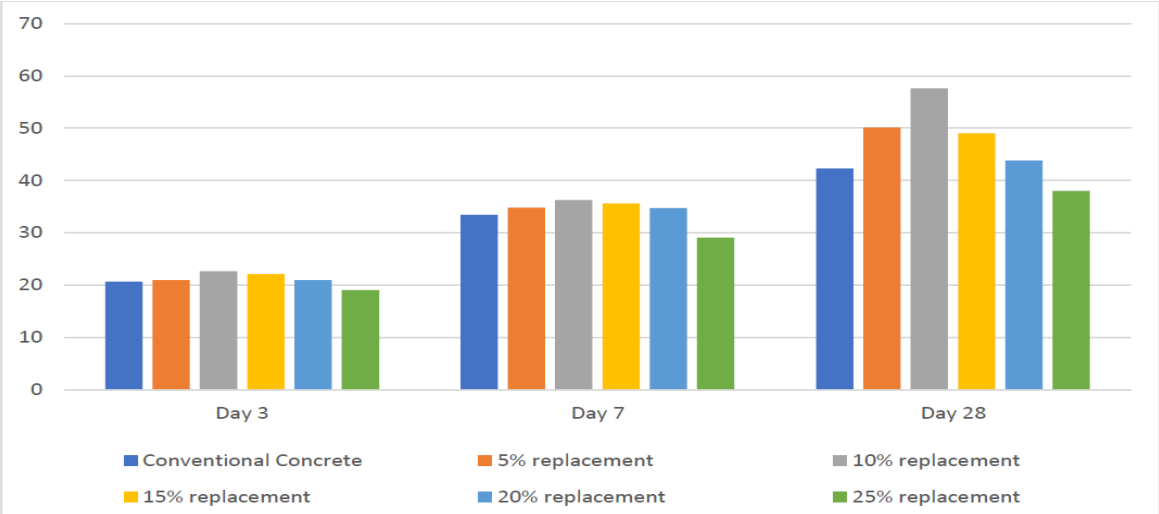
D. Split Tensile Strength Values

Table 5: Results for Split Tensile Strength Test Keeping Basalt Fiber constant at 2%

Replacement	7Days	28Days
0%	2.30	6.60
5%	2.73	7.78
10%	2.94	9.00
15%	2.85	7.87
20%	2.33	6.36
25%	2.12	5.13

III. DISCUSSION

A. Comparison of Compressive Strength of Conventional Concrete With Concrete Containing Replacements For Cement.

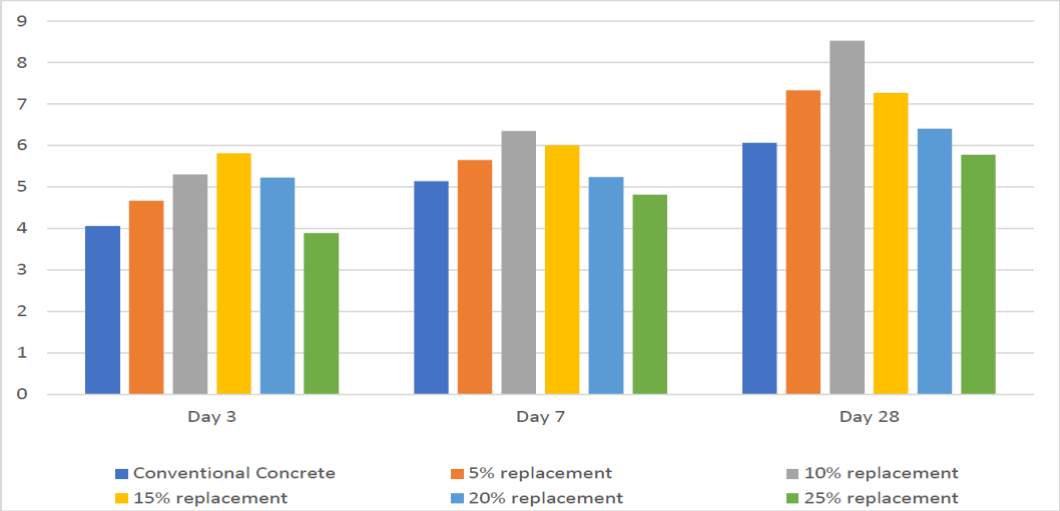


The graph represents compressive strength comparison of conventional concrete containing replacement for cement. The compressive strength of the conventional concrete after 3 days curing is 20.66 N/mm^2. If we compared it with concrete containing replacement for cement, we noticed that there is an increment of 1.40%, 9.68%, 7.16% and 1.45% for 5%, 10%, 15% and 20% replacement and the decrement of 7.88% for 25% when values compared with concrete containing fixed amount of basalt fiber.

After 7 days of curing the compressive strength for the conventional concrete is 33.47 N/mm^2. On comparing it with other replacement percentages we found that there is increment in the percentile of 4.00%, 8.42%, 7.16% and 3.76% for 5%, 10%, 15% and 20% replacement and the decrement of 13.05% for 25%.

For day 28, the conventional concrete compressive strength was found to be 42.29 N/mm^2. On replacing the cement, it was noticed that the strength increased about 18.56%, 36.24%, 15.93% and 3.66% for 5%, 10%, 15% and 20% replacement and the decrement of 10.16% for 25%.

B. Comparison of Flexural Strength of Conventional Concrete with concrete containing replacement for cement.

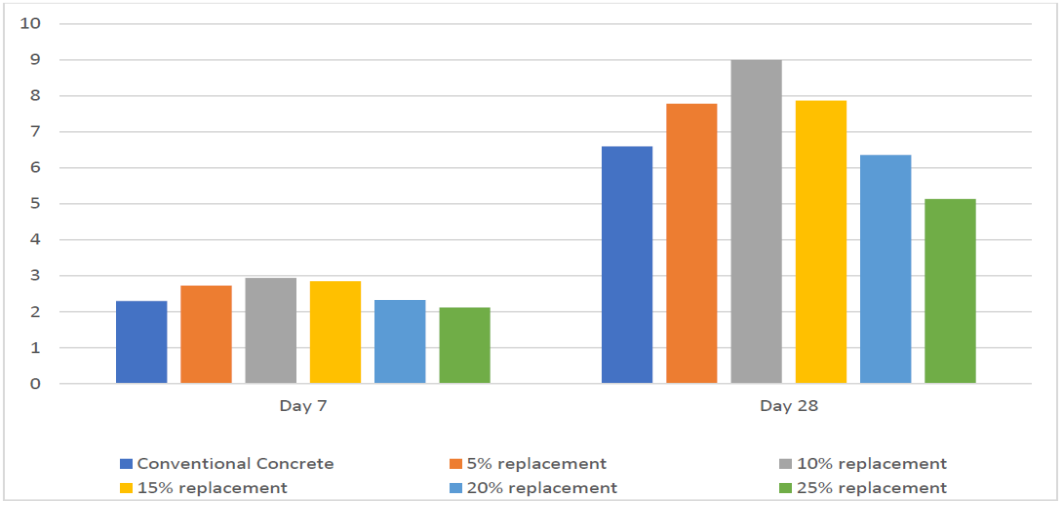


The graph represents flexural strength comparison of conventional concrete with replacement at different percentage. The flexural strength of the conventional concrete after 3 days curing is 4.06 N/mm^2. If we compared it with concrete containing 5%, 10%, 15% and 20% replacement we noticed that there is an increment of 15.02%, 30.54%, 43.10% and 28.81% respectively decrement of 4.18% for 25% replacement.

After 7 days of curing the flexural strength for the conventional concrete is 5.14 N/mm^2. On comparing it with other replacement percentages containing 5%, 10%, 15% and 20% replacement we noticed that there is an increment of 9.92%, 23.54%, 16.92% and 1.94% respectively decrement of 6.22% for 25% replacement.

For day 28, the conventional concrete flexural strength was found to be 6.07 N/mm^2. On replacing the cement with alccofine it was noticed that the strength enhanced about 20.75%, 40.52%, 19.27% and 5.60% for replacement of 5%, 10%, 15% and 20% respectively. For 25% of replacement the strength decreases by 4.77%.

C. Comparison of Split Tensile Strength of Conventional Concrete with concrete containing replacement for cement.



The graph represents split tensile strength comparison of conventional concrete with other replacement material at different percentage. The tensile strength of the conventional concrete after 7 days curing is 2.30 N/mm^2. If we compared it with concrete containing 5%, 10%, 15% and 20% replacement then the tensile strength improves by 18.69%, 27.82%, 23.91% and 1.30% respectively and for 25% replacement the same decrease by 7.82%.

After 28 days of curing the tensile strength for the conventional concrete is 6.60 N/mm^2. If we compared it with concrete containing 5%, 10% and 15% replacement then the tensile strength improves by 17.87%, 36.36% and 19.24. For 20% and 25% replacement the same decrease by 3.63% and 22.27% respectively.

IV. CONCLUSION:

Based on the experimental research that has been conducted following is the conclusion that could be drawn:

Addition of Basalt Fiber and Alccofine 1203 increases the workability of the concrete even at water cement ratio of 0.40. Alccofine 1203 is to be replaced by weight of cement in the concrete mixture. On filling up the moulds hand compaction should be opted, as to reduce the segregation of the ingredients in the concrete mould. In case of compressive strength test conducted on cubes of size 150 x 150 x 150 mm, the compressive strength increases with increase in the replacement percentage. The compressive strength of the concrete on comparing with conventional concrete gets increased in the percentage of 1.40%, 9.68%, 7.16% and 1.45% for 5%, 10%, 15% and 20% replacement and the decrement of 7.88% for 25% for day 3 of curing. After 7 days of curing, we found that there is increment in the percentile of 4.00%, 8.42%, 7.16% and 3.76% for 5%, 10%, 15% and 20% replacement and the decrement of 13.05% for 25%. After 28 days of curing, compressive strengths increased about 18.56%, 36.24%, 15.93% and 3.66% for 5%, 10%, 15% and 20% replacement and the decrement of 10.16% for 25%. In case of flexural strength conducted on beams of size 100 x 100 x 500 mm, the flexural strengths also increased with increase in the replacement percentage. The flexural strength of the concrete increases in the percentage of increment of 15.02%, 30.54, 43.10% and 28.81% respectively decrement of 4.18% for 25% replacement for day 3 of curing on comparing with the flexural strength of the conventional concrete. Day 7 flexural strength for replacement percentages containing 5%, 10%, 15% and 20% replacement we noticed that there is an increment of 9.92%, 23.54, 16.92% and 1.94% respectively decrement of 6.22% for 25% replacement. The 28 day flexural strength get 20.75%, 40.52%, 19.27% and 5.60% increased for replacement of 5%, 10%, 15% and 20% respectively. For 25% of replacement the strength decrease by 4.77%. The split tensile strength conducted on cylinder of size 300 x 500 mm also gets decreased with increasing the percentage of replacement. For day 7, the split tensile strength for 5%, 10%, 15% and 20% replacement we noticed that there is an increment of 9.92%, 23.54, 16.92% and 1.94% respectively decrement of 6.22% for 25% replacement. For day 28, the split tensile strength for 5%, 10% and 15% replacement then the tensile strength improve by 17.87%, 36.36% and 19.24. For 20% and 25% replacement the same decrease by 3.63% and 22.27% respectively.

V. REFERENCES

1. Concrete Structure, Properties and Materials, “The national academics of Science Engineering Medicine”.

2. Archanna Dongre, “Fiber Reinforced concrete: A case Study”- Conference paper.

3. https://www.slideshare.net/SUPREETHSuppi2/basalt-fiber-reinforced-concrete

4. Okamura and Ouchi, “Self-Compacting Concrete”, Journal for Advanced Concrete Technology, Vol. 1, April 2003.

5. Frances Yang, “Self - Consolidating Concrete”, Journal for Advanced Concrete Technology, Vol. 1, March 2004.

6. Mustafa Sahmaran, Alperen Yurtseven and I.Ozgur Yaman, “Workability of Hybrid Fiber Reinforced Self Compacting Concrete”, Building and Enviroment, Elsevier, Vol. 40, Issue 12, December 2005.

7. Giri Prasad. G, Seshagiri Rao. M.V and Rama Rao. G.V “Computation of Stress-Strain Behaviour of Self-Compacting Concrete in Higher Grade” International Journal of Scientific Computing, Vol.3, No.2 July-December 2009 pp193-197.

8. G.K.Geethanjali, Mohinder.R, Chandraraj.R, Venkateshwaran.M, Vijayaprabu.M, “Deformation characteristics of Basalt Reinforced concrete with Super Plasticizer”, IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE).

9. Mustapha Abdulhadi, "A comparative Study of Basalt and Polypropylene Fibers", International Journal of Engineering Trends and Technology (IJETT) – Vol. 9 Issue 6- March 2014.

10. Nayan Rathod, Mukund Gonbare, Mallikarjun Pujari, "Comparison study of Basalt Fiber and Steel Fiber as additives to concrete", IJSR Vol. 4, May 2013.

11. Anbas, Victor M.C.F. Cunha, "Relationship between fiber distribution and post cracking behavior in steel fiber reinforced self-compacting concrete panels", Cement and Concrete Research, Elsevier, Vol. 51, September 2013.

12. Iman Mehdipour, Nicolas Ali Libre, Mohammad Shekarchi and Maryan Khanjani, "Effect of Workability characteristics on hardened performance of FRSCCGF", Construction and Building Materials, Elsevier, Vol. 40, March 2013.

13. Chaohua Jiang, Ke Fan, Fei Wu, Da Chen, "Experimental study on the mechanical properties and microstructure of chopped basalt fibre reinforced concrete", Materials and Design 2014.

14. MG Alberti, A Enfedaque, JC Gálvez, "The Mechanical Properties & Fracture Behavior of Polyefin Fiber-Reinforced Self-Compacting Concrete" Construction and building materials, Elsevier, Vol. 55, 2014.

15. Fathima Irine I .A," Strength Aspects of Basalt Fiber Reinforced Concrete", International Journal of Innovative Research in Advanced Engineering (IJIRAE) ISSN: 2349-2163, Volume 1, Issue 8, pp 192-198, September 2014.

16. Rajesh Kumar S, Amiya K Samanta, Dilip K. Singha Roy, "An experimental study on the mechanical properties of alccofine based high grade concrete", International Journal of Multidisciplinary Research and Development.

17. Saurabh Gupta, Sanjay Babu Sharma, Er. Devinder Sharma, "A Review on Alccofine : A supplementary cementitous material", International Journal of Modern Trends in Engineering and Research.

18. Biswajit Jena and Bipin Bihari Mohanty, "A study on mechanical properties and flexural behavior of chopped steel fiber reinforced self-compacting concrete" IJRET: International Journal of Research in Engineering and Technology.

19. S. Ramanjaneya Gupta, E.V.Chandrasekhar, "Study On Mechanical Properties and Fracture Behavior of Chopped Glass Fiber Reinforced Self-Compacting Concrete", International Journal of Engineering Sciences & Research Technology, March 2017.

20. Mahim Mathur and Ashish Mathur, "Performance of Concrete by Partial Replacement of Alccofine -1203", International Journal of Civil Engineering and Technology (IJCIET), 2018.

21. Aylin Ozodabas, "Investigation of the Effect of Basalt Fiber on Self- Compacting Concrete", International Journal of Research Granthaalayah, Vol. December 2018.

22. Zeya "Concrete Using Basalt Fibre and Basalt Reinforcement", International Journal of Scientific Research in Science, Engineering and Technology (IJSRSET),Print ISSN: 2395-1990, Online ISSN : 2394- 4099 Volume 4 ,Issue 4 , March 2018, pp 1437-1441, April 2018.

23. Mohit Akshay.H.S, Agadi kishan and Sejal Kshirsagar, "Use of Alccofine 1203 in Concrete Roads", International Journal of Applied Engineering Research ISSN 0973-4562 Volume 13, Number 7 (2018) pp. 299-301

24. Suganya R and Lathamaheswari R, "Experimental Investigation on Alccofine Concrete", International Journal of Engineering Research and Technology, Volume 8, 2019.

25. Kavya, "Experimental Study on Partial Replacement of Cement Using Alccofine", International Journal of Engineering Research and Technology, Volume 8, 2019.

26. Boris Mahltig, "Basalt Fiber", Inorganic and Composite Fibers, 2018.

27. Hugo S. Armelin and Paulo Helene, "Physical and Mechanical Properties of Steel-Fiber Reinforced Dry-Mix Shotcrete", International Concrete Abstracts Portal, 1995.

28. Tamas Deak and Tibor Czigany, "Chemical Composition and Mechanical Properties of Basalt and Glass Fibers: A Comparison", JAGE Journals, May 2009.

29.https://www.google.com/search?q=Physical+Properties+of+alccofine+1203&source=lnms&tbm=isch&sa=X&ved=2ahUKEwiynPmK9azsAhVzxzgGHS3rDbcQ_AUoAXoECBEQAw&biw=1366&bih=657#imgrc=wgAhhSO_pjhnAM

30.https://www.google.com/search?q=checmicalProperties+of+alccofine+1203&tbm=isch&ved=2ahUKEwjb9omM9azsAhXDFisKHYnLBlIQ2cCegQIABAA&oq=checmicalProperties+of+alccofine+1203&gs

31. Baoguo Han and Jinping Ou, "Compositions of Self-Sensing Concrete", Science Direct, 2014.

32. U.S Department of Transportation, Federal Highway admiration.

33. Aqib Nazir and Shree Prakash, "Effect of Admixture on Durability And Strength Of Concrete", International Journal For Technological Research In Engineering, Vol. 5, Issue 11, July-2018.

34. IS 456-2000, Code of Practice for Plain and Reinforced Concrete, Bureau of Indian Standards, New Delhi, India.

35. IS 10262-1982, Recommended Guidelines for Concrete Mix Design, Bureau of Indian Standards, New Delhi, India.

36. IS 1199-1959, Methods of Sampling and Analysis of Concrete, Bureau of Indian Standards, New Delhi, India.

37. IS 8112:1989, 43 Grade Ordinary Portland cement Specification (First Revision), IS 8112:1989, Bureau of Indian Standards, New Delhi.

38. IS 516-1959, Indian standard methods of tests for strength of concrete, Bureau of Indian Standards, New Delhi, India.

39. IS 1489(Part-I)-1991, Portland - Pozzolana Cement Specification, Bureau of Indian Standards, New Delhi, India.

40. IS 10262. (2009). Concrete mix proportioning. New Delhi: BIS

41. IS 4031 (Part-4). (1988). Determination of consistency of standard cement paste. New Delhi: BIS.

42. IS 4031 (Part-5). (1988). Initial & final setting time. New Delhi: BIS