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# A Review of Research on the Impact of Marble Powder and Silica Fume on Concrete

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**ABSTRACT:** The study investigates the impact of incorporating marble powder and silica fume into concrete mixtures, focusing on various strength parameters such as compressive strength, tensile strength, and flexural strength. The use of industrial by-products like marble powder and silica fume is gaining attention due to their potential to enhance concrete properties while promoting sustainability. Concrete samples were prepared with varying proportions of marble powder (0%, 5%, 10%, and 15%) and silica fume (0%, 5%, 10%). Standardized tests were conducted to evaluate the mechanical properties of the concrete, including compressive strength tests at different curing ages (7, 14, and 28 days), tensile strength tests, and flexural strength tests. The results indicated that the addition of marble powder up to a certain percentage improved the compressive strength of concrete. Specifically, a mix containing 10% marble powder showed a significant increase in compressive strength compared to the control mix. Similarly, silica fume contributed positively to all tested strength parameters. The optimal combination was found to be a blend of 10% marble powder and 5% silica fume, which yielded superior performance in terms of both compressive and flexural strengths.

The findings suggest that both marble powder and silica fume can be effectively utilized as partial replacements for cement in concrete production. The pozzolanic nature of silica fume enhances the binding properties within the concrete matrix, while marble powder contributes to improved workability and durability. However, excessive amounts may lead to reduced performance due to dilution effects.

**KEYWORDS:** Marble Powder , Silica Fume , Compressive Strength, Tensile Strength, And Flexural Strength.

## I. INTRODUCTION

### Marble Powder in Concrete

Marble powder is a waste material generated during the cutting and polishing of marble stones. Incorporating marble powder into concrete has been found to have both positive and negative effects on the strength parameters of concrete.

1. Compressive Strength:

Studies have shown that the addition of marble powder in concrete can influence its compressive strength. The finer particles of marble powder can fill in the gaps between cement particles, leading to improved packing density and potentially enhancing compressive strength.

2. Flexural Strength:

The flexural strength of concrete with marble powder can also be affected. The presence of marble powder may alter the microstructure of concrete, influencing its flexural behavior.

3. Split Tensile Strength:

The split tensile strength, which measures the tensile strength perpendicular to the applied load, may also be impacted by the inclusion of marble powder in concrete mixes.

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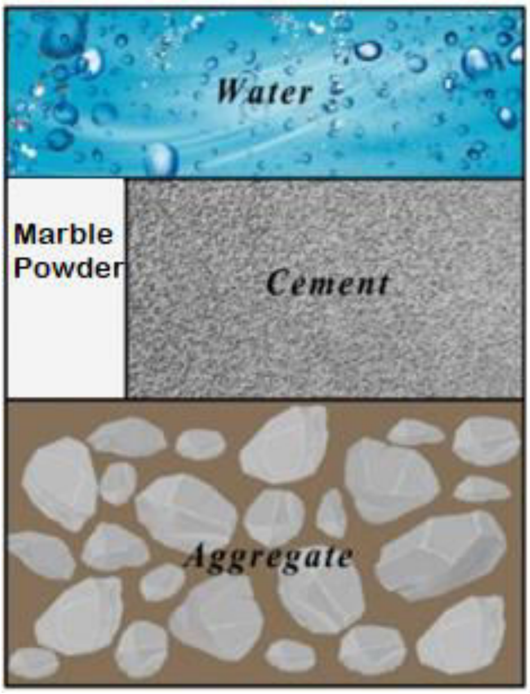


**Figure no. 1; Marble Powder in Concrete**

**Silica Fume in Concrete**
Silica fume, also known as micro silica, is a byproduct of silicon metal production. When added to concrete, silica fume can significantly alter its properties, including strength parameters.

**1. Increase in Strength:**
Silica fume is known for its ability to enhance the mechanical properties of concrete. It can lead to higher compressive strength, flexural strength, and durability due to its pozzolanic reaction with calcium hydroxide in cement paste.

**2. Reduced Permeability:**
Concrete containing silica fume exhibits reduced permeability, making it more resistant to chloride ion penetration and corrosion of reinforcement steel.

**3. Improved Durability:**
The addition of silica fume can improve the overall durability of concrete structures by reducing cracking and increasing resistance to harsh environmental conditions.

**Combined Effects of Marble Powder and Silica Fume on Concrete**
When both marble powder and silica fume are used together in concrete mixes, their combined effects on strength parameters need to be carefully evaluated. The interaction between these two additives can lead to complex changes in the properties of concrete.

In conclusion, studies on the effects of marble powder and silica fume on various strength parameters of concrete highlight the importance of understanding how these additives influence the performance of this essential construction material.

## II. LITERATURE REVIEW

Aviral Bagaria, Deepak Juneja (April 2023)
"Experimental research on influence of marble powder, silica fume and polypropylene fiber on the porous concrete" Roads are the most important part of today's system of development of the city in Terms of Infrastructure. This change can only be done when the places are connected properly and finely. Nowadays rigid pavements are in used for the roads for loads of Light Weight vehicles. This experimental article deals with the production of porous concrete for porous pavements design. Using Porous Concrete in the place of rigid pavement in order to increase the runoff coefficient of the place can be beneficial because porous concrete makes passage for water through its voids. When the

pervious concrete is designed with the conventional method referring IS 10262 it has been found that higher grade design concrete such as M40 grade exhibits lesser strength up to 28Mpa when the fines are replaced with Marble Powder, Silica Fumes and polypropylene fiber as discussed in subsequent. paragraph. It is evident that due to replacement of fine sand by marble powder, compressive strength of the concrete is reduced but at the same time hard concrete exhibits high porosity which is the objective of the study.

Avinash Kumar Padhy, N Manoj Kumar (May 2022)
Compressive strength is an integral property of concrete that play a key role in the construction industry. The present works investigates the effect of triple blend of fly ash, silica fume and steel fibers on the compressive, split tensile and flexural strength of concrete. fly ash (fa) and silica fume (sf) are introduced as a partial replacement for cement for various additions of steel fibers by volume of concrete. a replacement level of 0% fa with 0 %, 5%, 10%, 15% sf in place of cement for 0% addition of steel fibers by volume of concrete is used for the preparation of first set of samples. second set of samples were prepared with the change in fly ash proportion to 20%, keeping replacement levels of sf unchanged for 0% inclusion of steel fibers and the last set of samples were prepared with 40% fa replacement percentage without any change in the replacements of sf for the same 0% steel fibers. Likewise, the same combinations of fa and sf were repeated for 0.5% and 1% steel fibers and tested for various strength results after 28 days curing. Later, it is seen that an optimum mix of 20% fa with 10% sf for 1% inclusion of steel fibers, produced the maximum compressive strength of 81.20 n/mm2 and maximum flexural strength of 8.40 n/mm2.

Henok Abera , Stephen Jebamalai Raj ( August-2021)
For the construction of various structures, the most commonly used material is cement concrete. however, it has a number of disadvantages, including low tensile strength, brittleness, and crack propagation in an unstable state and low fracture resistance, shrinkage, and increased heat of hydration evolution as well as an increase in cost. under stress, the rapid propagation of micro fractures results in poor tensile strength and brittle collapse of the material. due to these flaws, a novel concrete composite material with steel fibres and partial fly ash replacement has been developed with enhanced structural qualities. steel fibers added to ordinary cement concrete improve structural qualities such as fracture resistance, impact resistance, thermal shock resistance, wear, fatigue resistance, spalling resistance, and compressive, flexural, tensile, shear, bond strength, ductility, and toughness. as an outcome, concrete with steel fibre reinforcement (SFRC) has been demonstrated to be a reliable and promising composite building material with superior performance attributes to ordinary concrete. SFRC is a two phase material, viz. fibers and matrix (concrete). properties and performance of SFRC are influenced by shape, size, and type of fibers, its aspect ratio, and content of fibres, mix proportions, size and content of aggregate and w-c ratio. the effects of circular corrugated steel fibres on the characteristics of concrete are investigated in this research. the findings of an experiment into the structural properties of hardened concrete partially replaced with fly ash, such as flexural strength and split tensile are reported.

Beata Figiela, Hana Šimonová, And Kinga Korniejenko ( August , 2021)
The main aim of the article is to analyze the state of the art in short steel fiber-reinforced geopolymers, taking into consideration also waste fibers. steel fibers are currently the most widely applied additive to composites in the building industry. The work is dedicated to the usage of short steel fibers and the mechanical properties of geopolymer composites. research methods applied in the article are a critical analysis of the literature sources, including a comparison of the new material with other, traditional concrete materials used in similar applications, especially in the construction industry. the results of the research are discussed in a comparative context. They indicate that the addition of fibers is an efficient method not only for improving compressive and flexural strength, but also mechanical properties such as fracture toughness. the potential applications in the construction industry as well barriers and challenges for the effective application of geopolymer materials reinforced with steel fibers are presented. further research directions are discussed.

Babar Ali , Erol Yilmaz (November 2021)
Which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. Demands for high-strength concrete (HSC) have been increasing rapidly in the construction industry due to the requirements of thin and durable structural elements. hsc is highly brittle. Therefore, to augment its ductility behavior, expensive fibers are used. These negative drawbacks of hsc can be controlled by incorporating waste materials into its manufacturing instead of conventional ones. Therefore , this study assessed the performance of HSC produced with different quantities of waste tire steel fiber (WSF) and fly ash (FA). WSF was used at two doses, namely, 0.5% and 1%, by volume in HSC, with low-to-medium volumes of FA, that is, 10%–35%. The studied durability parameters included rapid chloride permeability (RCP) and chloride penetration depth (CPD) by immersion method (28 and 120 days) and

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acid attack resistance (AAR) (28 and 120 days). Various basic mechanical properties of HSC were also analyzed, such as compressive strength (FCM), modulus of elasticity (ECM), splitting tensile strength (FCTM), and modulus of rupture (FCRM). )e results revealed that the damaging effect of WSF on the RCP resistance of HSC is probably due to the high conductivity of steel fibers. However, test results of CPD showed that WSF produced insignificant changes in chloride permeability of HSC. Furthermore, when made with fa, wsf-reinforced HSC yielded very low chloride permeability. Both WSF and FA contributed to the improvement in the AAR of HSC. WSF was highly useful to tensile properties while it showed minor effects on compressive properties (FCM and ECM). Optimum ductility and durability can be achieved with HSC incorporating 1% WSF and 10%–15% FA.

G.H.L.S.Sai Kumar, M.Jugal Kishore (2021)
Self compacting concrete which is highly flow able achieves compaction by itself without using mechanical vibration techniques. the research focused on self compacting concrete (scc) modified by a mineral admixture with the inclusion of steel fibers. the flow properties and strength properties were studied to arrive the ideal fiber content which attains the self-compacting effect. mineral admixture used is fly ash and steel fibers are rippled having aspect ratios of 27.7 and 44.44 with 0.45mm as diameter and varying lengths of 12.5mm and 20mm respectively. the dosage of steel fibers in scc varies as 0%, 1%, 2% and 3% by weight of cement and the mixes are designated as scc0, scc1, scc2 and scc3 respectively. Results indicated that the flow properties are adversely affected due to the incorporation of fibers and the l-box blocking ratio acceptance limits were failed beyond 1% fiber content. modified scc mixes achieved better strength properties than control scc and mixes with 2% fiber dosage attained higher strength values.

Hemn Qader Ahmed et al. (January 2020)
This is an open access article distributed under the creative commons attribution license, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. a construction system with high sustainability, high durability, and appropriate strength can be supplied by geopolymer concrete (gpc) reinforced with glass fibre-reinforced polymer (GFRP) bars and carbon fibre-reinforced polymer (CFRP) bars. few studies deal with a combination of gpc and frp bars, especially Sfrp bars. The present investigation presents the flexural capacity and behaviour of fly-ash-based gpc beam reinforced with two different types of frp bars: six reinforced geopolymer concrete (RFRP) beams consisting of three specimens reinforced with gfrp bars and the rest with CFRP bars. The beams were tested under four point bending with a clear span of 2000 mm. The test parameters included the longitudinal-reinforcement ratio and the longitudinal- reinforcement type, including GFRP and CFRP. Ultimate load, first crack load, load-deflection behaviour, load-strain curve, crack width, and the modes of failure were studied. The experimental results were compared with the equations recommended by aci 440.1r-15 and csa s806-12 for flexural strength and mid span deflection of the beams. The results show that the reinforcement ratio had a significant effect on the ultimate load capacity and failure mode. The ultimate load capacity of sfrprgpc beams was higher than that of GFRP-RGPC, more crack formations were observed in the sfrp-rgpc beams than in the GFRP-RGPC beams, and the crack width in the GFRP-RGPC beams was more extensive than that in the CFRP-RGPC beams. beams with lower reinforcement ratios experienced a fewer number of crack and a higher value of crack width, while numerous cracks and less value of crack width were observed in beams with higher reinforcement ratio. beams with the lower reinforcement ratios were more affected by the type of frp bars, and the deflection in gfrp-rgpc beams was higher than that in CFRP-RGPC beams for the same corresponding load level. aci 440.1r-15 and csa s806-12 underestimated the flexural strength and mid span deflection of RGPC beams.

Esakkiraj. P et al.(July 2020)
Concrete is most frequently used composite material. Concrete is homogeneous mix of fine aggregate, coarse aggregate and binding medium of concrete paste .due to `high demand of cement co2 emission is very high, it leads to global warming. so in this project high volume fly ash concrete was incorporated. fly ash is the waste material obtained from thermal power plant. in this paper we investigated about high volume fly ash in different percentage of replacement 55, 60, 75 percentage. layered pavement is incorporated with steel fiber in a different aspect ratio (15, 30, 40).layered pavement will give good thermal expansive properties. by varying fly ash content and steel fibers aspect ratio of different mixes were arrived hardened properties of these nine mixes were arrived such as compression test, split tensile test and flexural test.

Anil Kumar, Mr. Rohit Kumar, Dr.Partima Kumar (September-2018)
This paper describes the applications and feasibility of steel fiber and fly ash in the concrete industry. this paper also helps in to identify the desired percentage of steel fiber and fly ash in the concrete mix. many literature reviews have been studied deeply to carry out the proposed dissertation work in a scheduled manner and to achieve the project

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related goal. to find out the effect of steel fiber and fly ash on the strength concrete the compressive, tensile and flexural test will be conducted with the concrete mix. the final result will be compared with the control mix to find out the effect of steel fiber and fly ash on the strength properties of concrete M30.

A. Shyam, A. Anwar, Syed Aqeel Ahmad (March 2017)
In the recent past, there have been considerable attempts for improving the properties of concrete with respect to strength and durability, especially in aggressive environments. High performance concrete appears to be better choice for a strong and durable structure. A large amount of by-product or wastes such as fly-ash, copper slag, silica fume etc. are generated by industries, which causes environmental as well as health problems due to dumping and disposal. Proper introduction of silica fume in concrete improves both the mechanical and durability characteristics of the concrete. This paper present literature review on replacement of Cement by Silica Fume which includes current and future trends of research.

K.Sateesh Kumar, Rounak Hussain, K.Bhargavi (July-2016)
Concrete is very strong in compression but weak in tension. as a concrete is a relatively brittle material, when subjected to normal stresses and impact loads. the tensile strength of concrete is less due to widening of micro-cracks existing in concrete subjected to tensile stress. due to presence of fiber, the micro-cracks are arrested. the introduction of fibers is generally taken as a solution to develop concrete in view of enhancing its flexural and tensile strength. fly ash is the fine powder major waste material, which limits by the application of the material, by the addition of small amount of short randomly distributed steel fibers in concrete remedies for weaknesses of concrete, such as low growth resistance, high shrinkage cracking, low durability, the ability of excellent tensile strength, flexural strength, ductility and crack arrest. therefore, it has been applied abroad various professional fields of construction, irrigation works and architecture. this project deals with investigation for m-50 grade of concrete having mix proportion 1:1.65:3.05 with water cement ratio 0.4 to study the compressive strength, split tensile strength and flexural strength of steel fiber reinforced concrete (sfrc) containing fibers of an interval of 0%, 0.5%, 1%, 1.5% and 2.5% steel fibers of 50 aspect ratio were used. the percentage of fly ash by weight is to be increased by 10% to 20% for the replacement cement. after curing the specimen were tested as per relevant codes bis. a result data obtained has been analyzed and compared with a control specimen. a relationship between compressive strength vs. days, spilt tensile test vs. days and flexural strength vs. days represented graphically. result data clearly shows percentage increase in 3,7,28, 56 & 90days compressive strength for m-50 grade of concrete attains a maximum strength at 20% of fly ash with addition of steel fibers at the intervals of 2% it is observed split tensile strength and flexural strength are on higher side for 2.5% fibers as compared to that produced from 0%, 0.5%, 1%. 1.5% and 2% fibers using fly ash at 10% & 20%.

## III. METHODOLOGY OF PROPOSED SURVEY

Proposed Methodology of Marble Powder and Silica Fume in Concrete
The incorporation of marble powder and silica fume into concrete has gained attention due to their potential benefits in enhancing the mechanical properties and durability of concrete. The proposed methodology for utilizing these materials involves several systematic steps, which can be outlined as follows:
1. Material Selection
The first step is selecting high-quality marble powder and silica fume. Marble powder is a byproduct of the marble industry, typically consisting of fine particles obtained from the cutting and polishing processes. Silica fume, also known as microsilica, is a byproduct of silicon metal or ferrosilicon alloys production. Both materials should meet specific standards regarding particle size, chemical composition, and purity to ensure their effectiveness in concrete.

2. Characterization of Materials
Before incorporating marble powder and silica fume into concrete mixes, it is essential to characterize these materials. This includes analyzing their physical properties (such as particle size distribution, specific surface area, and density) and chemical composition (including the percentage of $SiO_2$, CaO, and other oxides). Techniques such as X-ray fluorescence (XRF), scanning electron microscopy (SEM), and laser diffraction can be employed for this characterization.

3. Mix Design
The next step involves designing the concrete mix. The proportions of cement, aggregates (fine and coarse), water, marble powder, and silica fume must be carefully calculated to achieve the desired workability, strength, and durability

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characteristics. A common approach is to replace a certain percentage of cement with marble powder (typically 5-15%) and silica fume (usually 5-10%). The total binder content should remain consistent with standard concrete practices.

4. Mixing Process
Once the mix design is finalized, the mixing process begins. It is crucial to ensure uniform distribution of all components within the mix. The recommended procedure includes:
Dry mixing all dry ingredients (cement, aggregates, marble powder, silica fume) until homogenous.
Gradually adding water while continuing to mix until achieving a workable consistency.
Using a high-shear mixer may enhance dispersion due to the fine nature of silica fume.

5. Casting Specimens
After mixing, concrete specimens should be cast for testing purposes. Standard molds can be used to create cubes or cylinders that will later undergo various tests for compressive strength, tensile strength, flexural strength, workability (using slump tests), and durability assessments.

6. Curing
Proper curing is vital for developing the desired properties in concrete containing supplementary cementitious materials like marble powder and silica fume. Curing methods may include water curing or using curing compounds that retain moisture on the surface for an extended period—typically at least 7 days—to allow hydration reactions to proceed effectively.

7. Testing & Evaluation
After curing periods are complete (usually 7 days for initial testing), various mechanical tests should be conducted on the specimens:
Compressive Strength Test: To evaluate how well the concrete withstands axial loads.
Flexural Strength Test: To assess resistance against bending forces.
Durability Tests: Including permeability tests or freeze-thaw resistance tests to determine long-term performance under environmental conditions.
Data collected from these tests will provide insight into how effectively marble powder and silica fume contribute to improving concrete's overall performance compared to conventional mixes without these additives.

8. Analysis & Optimization
Finally, based on test results analysis, further optimization may be required in terms of adjusting proportions or refining mixing techniques to enhance performance characteristics further. Continuous evaluation through experimental trials will help establish optimal percentages for both marble powder and silica fume in various applications.

## IV. CONCLUSION AND FUTURE WORK

The incorporation of marble powder and silica fume into concrete has been extensively studied, revealing significant benefits in terms of mechanical properties, durability, and sustainability.
1. Mechanical Properties: Marble powder, a byproduct of the marble industry, can enhance the compressive strength and flexural strength of concrete when used as a partial replacement for cement or fine aggregates. Studies indicate that replacing 10-15% of cement with marble powder can lead to improved strength characteristics due to its fine particle size and pozzolanic properties. Similarly, silica fume, a byproduct from the production of silicon metal or ferrosilicon alloys, is known for its high silica content and its ability to fill voids in concrete. When added at levels typically ranging from 5-10%, silica fume significantly increases the compressive strength and reduces permeability, leading to enhanced durability.

2. Durability: Both marble powder and silica fume contribute positively to the durability of concrete. The addition of these materials can reduce water absorption and increase resistance to aggressive environmental conditions such as sulfate attack and chloride penetration. This is particularly important for structures exposed to harsh environments, where long-term performance is critical.

3. Sustainability: Utilizing waste materials like marble powder and silica fume not only improves concrete properties but also promotes sustainability in construction practices. By recycling industrial byproducts, the demand for virgin materials is reduced, which helps decrease environmental impact associated with extraction and processing.

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4. Workability: The inclusion of marble powder can improve the workability of fresh concrete mixes due to its spherical shape, which enhances flowability. Silica fume may require careful management regarding water content because it can absorb more water than traditional aggregates; however, when properly adjusted, it contributes positively to the overall mix performance.

## REFERENCES

1. K.Sateesh Kumar, Rounak Hussain, K.Bhargavi (July-2016) "strength and durability properties of steel fiber reinforced concrete by partial replacement of cement using fly ash" .ijsetr.com issn 2319-8885 vol.05,issue.19 july-2016, pages:3804-3811 copyright @ 2016 ijsetr. all rights reserved.
2. Rooban Chakravarthy, Srikanth Venkatesan, And Indubhushan Patnaikuni (November 2016) "Mechanical properties of high volume fly ash concrete reinforced with hybrid fibers" school of engineering, rmit university, melbourne, vic, Australia correspondence should be addressed to srikanth venkatesan; srikanth.venkatesan@rmit.edu.au received 19 june 2016; revised 10 october 2016; accepted 9 november 2016
3. Irfaz Ur Rahman Najar , Jagdish Chand Kambooj (2016) "Combine effect of silica-fume, fly-ash and steel fibre on reinforced concrete, a review" hindawi publishing corporation advances in materials science and engineering volume 2016, article id 1638419, 7 pages http://dx.doi.org/10.1155/2016/1638419
4. Khadake S.N., Konapure C.G. (Nov-Dec. 2012), "an investigation of steel fiber reinforced concrete with fly ash" iosr journal of mechanical and civil engineering (iosr-jmce) issn: 2278-1684 volume 4, issue 5 (nov-dec. 2012), pp 01-05 www.iosrjournals.org www.iosrjournals.org 1 | page
5. B.R. Phanikumar, A. Sofi (November 2014) "Effect of pond ash and steel fibre on engineering properties of concrete" received 1 july 2014; revised 26 november 2014; accepted 12 march 2015 available online 20 april 2015 the cc by-nc-nd license (http://creativecommons.org/licenses/by-nc-nd/4.0/). ain shams engineering journal (2016) 7, 89–99
6. Muthuswamy, K.R. and Thirugnanam, G.S. Flexural Behaviour of High Performance Hybrid Fiber Reinforced Concrete Beams, Proceedings of the Seventh Structural Engineering Convention (SEC 2010), Annamalai University, Tamil Nadu, India, 08-10 December, 2010, pp. 1192-1201.
7. B. Krishna Rao, V. Ravindra (2010), "Steel Fiber Reinforced Self compacting Concrete Incorporating Journal of Engineering Science and Technology Vol. 2(9), 4936-4943.
8. Falah A. Almottiri (2011), " Physical Properties of Steel Fiber Reinforced Cement Composites Made with Fly Ash", Jordan Journal of Civil Engineering, Volume 5, No. 2.
9. Chih-Ta Tsai, Lung-Sheng Li, Chien-Chih Chang, Chao-Lung Hwang (2009), "Durability design and application of Steel Fiber reinforced Concrete in Taiwan", the Arabian Journal for Science and Engineering, Volume 34, Number 1B.
10. Osman Gencel, Witold Brostow, tea Datadhvili and Michael The d ford (2011), "Workability and Mechanical Performance of Steel Fiber-Reinforced Self-Compacting Concrete with Fly Ash, Composite Interfaces 18,169-184.
11. IS: 10262-2009, Recommended guidelines for concrete mix design, Bureau of Indian standards, New Delhi, India.
12. IS 383: 1970, Specification for coarse and fine aggregates from natural sources for concrete (second revision), Bureau of Indian standards, New Delhi, India.
13. IS: 516-1959, Indian standard methods of tests for strength of concrete, Bureau of Indian Standards, New Delhi, India.

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