International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 13 Issue: 10 | Oct 2026 www.irjet.net p-ISSN: 2395-0072

Influence of Sugar content on concrete

Krishna .S. Suryawanshi[1], Jayesh .S. Patil[2], Rahul .R. Kadhare[3], Sakshi .S. Desale[4], Swarali .S. Pawar[5], Ganesh .V. Tapkire[6]

[1,2,3,4,5] *Student Department of Civil Engineering R. C. Patel Institute of Technology Shirpur*
[6] *Faculty Member Department of Civil Engineering R. C. Patel Institute of Technology Shirpur*

Abstract – *sugar is commonly recognized as a retarding agent that influences the setting time and strength development of concrete. The present study investigates the influence of sugar content on the fresh and hardened properties of concrete by incorporating different proportions of sugar into the concrete mix. The primary objective is to evaluate the effect of sugar on the setting time, workability, compressive strength, and overall performance of concrete. Experimental investigations can be conducted by adding varying percentages of sugar by weight of cement and comparing the result with conventional concrete without sugar addition. The workability of fresh concrete can be assessed through the slump test, while compressive strength can be determined at different curing ages, such as 7, 14, 28 days. Sugar can delay cement hydration by interfering with the early formation of hydration products, thereby increasing the setting time. Depending on its dosage, sugar may improve workability and influence early-age and later-age strength development. However, excessive sugar content may cause significant retardation and adversely affect concrete performance. Therefore, identifying an appropriate dosage is essential for achieving desirable concrete properties without compromising structural safety. The study highlights the importance of controlled sugar dosage and systematic experimental evaluation to understand its potential application as a concrete retarding admixture. The findings may contribute to improved understanding of hydration behaviour and support further research into economical concrete admixtures.*

Key Words: Sugar Content, Concrete, Compressive Strength, Cement Hydration, Setting Time, Sugar Admixture, M25 Grade Concrete, Concrete Properties.

1. INTRODUCTION

Concrete is one of the most widely used construction material due to its strength, durability, versatility, and economical production. Its performance depends on several factors, including the properties of cement, aggregates, water, mix proportions, curing conditions, and the use of chemical admixtures. Among these factors, the setting time and workability of concrete are particularly important for achieving the desired quality during transportation, placing, compaction, and finishing. Sugar, commonly available as sucrose, has attracted attention as a potential retarding agent because small quantities can influence cement hydration and delay the setting of concrete.

The addition of sugar to concrete may modify the hydration process of cement, particularly the early formation of hydration products. Depending on its dosages, sugar may increase the setting time and provide additional time for handling and placing concrete in hot weather or during long-distance transportation. However, its effect is highly dosage-dependent. While a suitable quantity may improve workability and delay setting, excessive sugar content can cause significant retardation and adversely affect early-age strength development. Therefore, determining the appropriate dosage is essential for evaluating its suitability for concrete applications.

For systematic evaluation, relevant Indian standards should be followed throughout the experimental investigation. IS 10262:2019 provides guidelines for concrete mix proportioning, while IS 456:2000 specifies requirements for plain and reinforced concrete. The workability and setting behaviour of concrete can be investigated using the applicable parts of the IS 119 series, and compressive strength can be evaluated using the relevant parts of the IS 516 series. IS 9103:1999 provides requirements for chemical admixtures; however, sugar should not automatically be considered a compliant admixture without appropriate evaluation and verification.

The present study aims to investigate the influence of different sugar dosages on the properties of concrete by comparing modified mixes with conventional concrete. The investigation focuses on workability, setting time, and compressive strength at selected curing ages. The results may help establish whether controlled sugar addition has potential for applications requiring delayed setting, such as concrete transportation, large-scale concreting, and construction under hot- weather conditions. Experimental validation is essential before recommending any dosage for practical structural applications.

Relevant Indian Standards

1. IS 10262:2019 – Concrete Mix Proportioning: Guidelines.
2. IS 456:2000 – Plain and Reinforced Concrete : Code of Practice.
3. IS 1199 series – Hardened concrete : Methods of Testing.
4. IS 9103: 1999 – Specification for Concrete Admixtures.

2 LITERATURE REVIEW

2.1 Effect of sugar on cement hydration and setting time

Ahmad, Lawan, and AI-Osta (1) investigated the influence of sugar dosage on the setting time, microstructure, and strength of Type I and Type V Portland cement. Their 2020 study demonstrated that adding sugar at dosages up to 0.05% by weight of cement significantly increased setting time. However, further increases in dosage changed the setting response, demonstrating that sugar does not behave as a conventional retarder at every concentration. The author recommended a dosage range of 0.05-0.1% for the particular cements investigated, subject to their experimental conditions. They also observed reductions in early-age mortar strength with increasing sugar content. They also observed reductions in early-age mortar strength with increasing sugar content. These findings establish dosage selection as a critical factor in the use of sugar in cementitious materials.

The mechanism of sugar-induced retardation is associated with interactions between dissolved sugar molecules and cement hydration products. Sugar can influence the dissolution of cement constituents and the formation of early hydration products, thereby delaying the development of a rigid cementitious, cement composition, and experimental conditions. The finding from the direct sugar-dosage study therefore indicate that both initial and final setting times must be measured rather than assuming that increasing sugar content with continuously increase retardation.

2.2 Research on sugarcane bagasse ash in concrete

Thomas et al. (2) reviewed the use of sugarcane bagasse ash as a supplementary cementitious material. Their review reported that appropriately processed ash can improve the performance of concrete at suitable replacement level. The principal mechanisms involve pozzolanic reactions, microstructure refinement, and reduced permeability. Jittin, Minnu, and Bahurudeen (3) compared bagasse ash with rice husk ash and discussed its influence on workability, strength, and durability. Their findings indicated that the performance of ash-containing concrete depends strongly on its characteristics and replacement level.

Khalil, Aslam, and Ahmad (4) examined the utilization of sugarcane bagasse ash as a partial cement replacement for sustainable concrete production. Kolawole et al. (5) subsequently presented a state-of -the-art review emphasizing the importance of ash processing, chemical composition, and particle characteristics. Both studies indicate that the performance of sugar-derived materials in concrete cannot be evaluated solely by their origin; their physical and chemical properties must also be considered.

Jagadesh, Murthy, and Murugesan (6) investigated processed sugarcane bagasse ash in blended mortar, including its mechanical and fracture properties. Their findings supports the potential use of properly processed ash in cementitious composites. However, these results should not be directly interpreted as evidence of the effect of ordinary sucrose on concrete, because the ash functions through different mechanisms.

2.3 Mechanical strength, workability, and microstructure

Amin et al. (7) investigated sugarcane bagasse ash in sustainable engineered cementitious composites, highlighting its potential to improve mechanical performance when appropriately incorporated Murugesan, Vidjeapriya, and Bahurudeen (8) examined the combined use of sugarcane bagasse ash and marble slurry dust in concrete produced with crusher sand. Prabhath et al (9) reviewed the optimization of mechanical properties in bagasse-ash-integrated concrete and identified ash-processing parameters as importance determinants of performance.

Li et al. (10) reviewed the utilization of sugarcane bagasse ash in construction technology, considering its processing, workability, mechanical properties, durability, and microstructure. Farrant, Babafemi, and Kolawole, (11) investigated the influence of bagasse ash and silica fume on the mechanical and durability properties of concrete. Agwa et al. (12) examined the use of bagasse ash as a supplementary cementitious material and discussed the influence of replacement percentage on fresh and hardened properties. Collectively, these studies emphasize that concrete performance depends on the nature of the incorporated material, its dosage, and the resulting microstructure.

2.4 Recent experimental investigations

Singh and Patel (13) investigated the replacement of fine aggregate with sugarcane bagasse ash using experimental and machine-learning approaches. Kumara, Sivapullaiah, and Murthy (14) studied the strength of concreted containing different proportions of bagasse ash. Their work examined compressive and tensile strength, demonstrating the importance of evaluating multiple mechanical properties rather than relying on compressive strength alone.

Olapade and Ngene (15) evaluated untreated sugarcane bagasse ash replacement percentage reduced compressive strength under the investigated conditions, although the setting behaviour also changed. In 2014, kalasur and Dwivedi (16) reviewed the use of bagasse ash as a partial cement replacement, while Ghosh (17) examined its use in concrete. Elawadly and Sanad (18) investigated workability, mechanical strength, and microstructure in concrete incorporating bagasse ash in 2025. These investigations demonstrate that the properties of sugar-industry by-products are highly dependent on processing, dosage. And the intended application.

2.5 Research gap and need for the present study

The reviewed literature identifies a significant gap between research on directly added sugar and research on sugarcane bagasse ash. Although the direct sugar-dosage study by Ahmad et al. (1) provides evidence of dosage-dependent setting retardation ad strength changes, further systematic investigation is required to establish how sugar content affects concrete under different mix proportions and curing conditions.

The present study should therefore investigate a control mix and several sugar dosages by weight of cement. The experimental programme should asses workability, initial and final setting time, and compressive strength at 7, 14, 28 days. Recording both early-age and later-age strength is essential to distinguish temporary retardation from persistent strength loss.

The principal contribution of the study will be to determine whether a suitable sugar dosage can delay setting without unacceptably compromising concrete strength. The findings should be validated for the selected cement, aggregate grading, water-cement ratio, and concrete grade before any practical recommendation is made.

3. METHODOLOGY

The main objective of this experimental study is to investigate the influence of sugar content on the properties of concrete in its fresh and hardened states. The experimental is conducted by preparing concrete specimens with different quantities of sugar and comparing their performance with normal concrete.

First, the required materials, such as cement, fine aggregated (sand), coarse aggregate, water and sugar, and sugar, are collected. The materials are measured according to the selected concrete mix proportion. A control mix is prepared without adding sugar, while other concrete mixes are prepared with different sugar dosages.

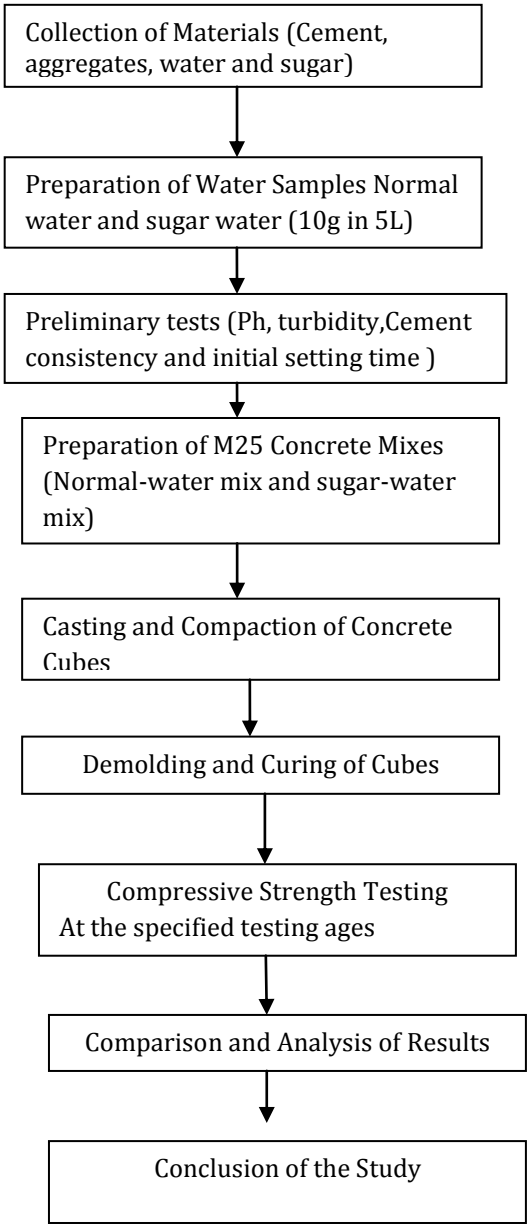
Next, the required quantity of sugar is dissolved in the mixing water to ensure uniform distribution throught the concrete. The sugar solution is then added , and the concrete is mixed until a uniform mixture is obtained.

The fresh concrete is tested for workability using the slump test. After that, the concrete is placed into standard cube moulds, typically measuring 150mm X 150mm X 150mm. The concrete is compacted properly to remove air voids and improve specimen quality.

After approximately 24 hours, The specimens are removed from the moulds and placed in a curing tank. The cubes are cured for the specified periods, commonly 7 and 28 days.

After curing, the compressive strength of each specimen is determined using a compression testing machine.

Finally, The test results are recorded, tabulated, and comparerd with those of the control mix. The influence of sugar content on workability, setting behaviour, and compressive strength is evaluated. The results are used to identify how sugar dosage affects concrete performance and to determine whether its effects are beneficial or harmful at the tested dosages.



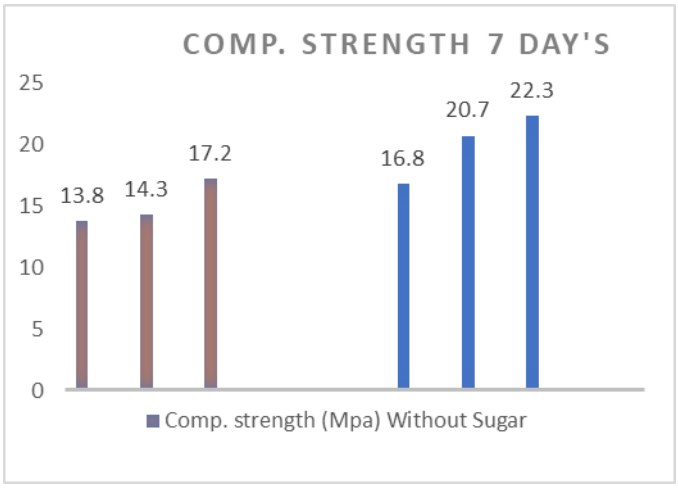
4 OBSERVATION

7 Day's

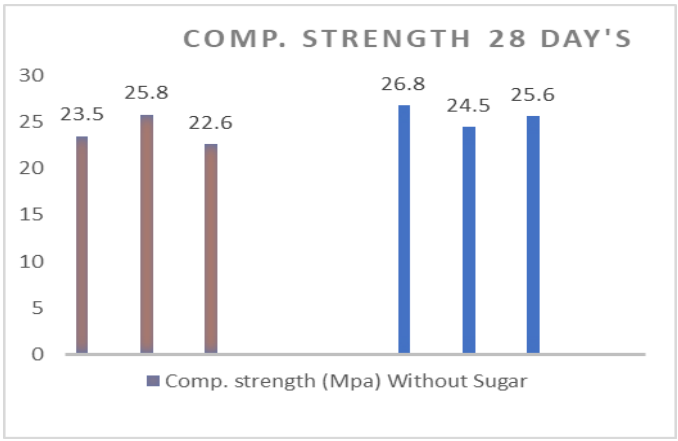
Sr. No.	Date of casting	Date of Testing	Load (KN)	Comp. strength (Mpa)
Without Sugar				
1	15/09/2026	22/09/2026	310.5	13.8
2	15/09/2026	22/09/2026	32108	14.3
3	15/09/2026	22/09/2026	388.1	17.2
				Average = 15.1
With Sugar				
1	15/09/2026	22/09/2026	378.4	16.8
2	15/09/2026	22/09/2026	467.0	20.7
3	15/09/2026	22/09/2026	502.4	22.3
				Average = 29.9

28 Day's

Sr. No.	Date of casting	Date of Testing	Load (KN)	Comp. strength (Mpa)
Without Sugar				
1	15/09/2026	13/10/2026	528.76	23.5
2	15/09/2026	13/10/2026	580.5	25.8
3	15/09/2026	13/10/2026	508.5	22.6
				Average = 23.96
With sugar				
1	15/09/2026	13/10/2026	603	26.8
2	15/09/2026	13/10/2026	551.25	24.5
3	15/09/2026	13/10/2026	576.0	25.6
				Average = 25.63



7 Days : Sugar-added concrete shows higher comp. strength than concrete without sugar.

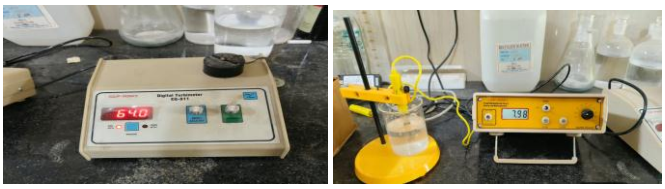


28 Days: Sugar-added concrete shows slightly higher average comp. strength than concrete without sugar.

5 PHOTOGRAPHY



For Normal water Ph and Turbidity test



For sugar water Ph and Turbidity test



Mixing Concrete



For Initial setting time



For Normal Cube



For Sugar Cube



For curing 7 Day's and 28 Day's



Testing in cube 7 Day's and 28 Day's

3. CONCLUSIONS

1. The experimental investigation indicates that the addition of sugar to concrete has a positive influence on its compressive with convetional concrete without sugar addition.
2. At 7 days, sugar-added concrete exhibited a higher average compressive strength of 29.9 Mpa compared with 15.1 Mpa for normal concrete, as reported in the observation table. This indicates improved early-age strength development in the tested specimens.
3. At 28 days, sugar-added concrete achieved an average compressive strength of 25.63 Mpa, compared with 23.96 Mpa for conventional concrete, showing a slight improvement in compressive strength.
4. Study suggest that controlled sugar addition has the potential to influence the strength development of M25 concrete. However, further experimental investigations using different sugar dosages, setting- time measurements, and durability test are necessary to establish the optimum dosage and confirm its suitability for practical construction applications.

REFERENCES

[1] S. Ahmad, A. Lawan, and M. Al-Osta, "Effect of sugar dosage on setting time, microstructure and strength of Type I and Type V Portland cements," Case Studies in Construction Materials, vol. 13, Art. no. e00364, 2020, doi: 10.1016/j.cscm.2020.e00364.

[2] B. S. Thomas et al., "Sugarcane bagasse ash as supplementary cementitious material in concrete—A review," Materials Today Sustainability, vol. 15, Art. no. 100086, 2021, doi: 10.1016/j.mtsust.2021.100086.

[3] V. Jittin, S. N. Minnu, and A. Bahurudeen, "Potential of sugarcane bagasse ash as supplementary cementitious material and comparison with currently used rice husk ash," Construction and Building Materials, vol. 273, Art. no. 121679, 2021, doi: 10.1016/j.conbuildmat.2020.121679.

[4] M. J. Khalil, M. Aslam, and S. Ahmad, "Utilization of sugarcane bagasse ash as cement replacement for the production of sustainable concrete—A review," Construction and Building Materials, vol. 270, Art. no. 121371, 2021, doi: 10.1016/j.conbuildmat.2020.121371.

[5] J. T. Kolawole, A. J. Babafemi, E. Fanijo, S. C. Paul, and R. Combrinck, "State-of-the-art review on the use of sugarcane bagasse ash in cementitious materials," Cement and Concrete Composites, vol. 118, Art. no. 103975, 2021, doi: 10.1016/j.cemconcomp.2021.103975.

[6] P. Jagadesh, A. Ramachandra Murthy, and R. Murugesan, "Effect of processed sugar cane bagasse ash on mechanical and fracture properties of blended mortar," Construction and Building Materials, vol. 262, Art. no. 120846, 2020, doi: 10.1016/j.conbuildmat.2020.120846.

[7] M. N. Amin et al., "Role of sugarcane bagasse ash in developing sustainable engineered cementitious composites," Frontiers in Materials, vol. 7, Art. no. 65, 2020, doi: 10.3389/fmats.2020.00065.

[8] T. Murugesan, R. Vidjeapriya, and A. Bahurudeen, "Sustainable use of sugarcane bagasse ash and marble slurry dust in crusher sand based concrete," Structural Concrete, 2021, doi: 10.1002/suco.202000215.

[9] N. Prabhath et al., "A review on the optimization of the mechanical properties of sugarcane-bagasse-ash-integrated concretes," Journal of Composites Science, vol. 6, no. 10, Art. no. 283, 2022, doi: 10.3390/jcs6100283.

[10] Y. Li, J. Chai, R. Wang, X. Zhang, and Z. Si, "Utilization of sugarcane bagasse ash (SCBA) in construction technology: A state-of-the-art review," Journal of Building Engineering, vol. 56, Art. no. 104774, 2022, doi: 10.1016/j.jobe.2022.104774.

[11] W. E. Farrant, A. J. Babafemi, and J. T. Kolawole, "Influence of sugarcane bagasse ash and silica fume on the mechanical and durability properties of concrete," Materials, vol. 15, no. 9, Art. no. 3018, 2022, doi: 10.3390/ma15093018.

[12] I. S. Agwa et al., "A comprehensive review on the use of sugarcane bagasse ash as a supplementary cementitious material to produce eco-friendly concretes," Materials Today: Proceedings, vol. 65, pt. 2, pp. 688–696, 2022, doi: 10.1016/j.matpr.2022.03.264.

[13] R. Singh and M. Patel, "Experimental and machine learning approaches to investigate the application of sugarcane bagasse ash as a partial replacement of fine aggregate for concrete production," Journal of Building Engineering, vol. 77, Art. no. 107168, 2023, doi: 10.1016/j.jobe.2023.107168.

[14] G. D. Kumara, P. V. Sivapullaiah, and A. Sreenivasa Murthy, "Performance evaluation of sugar cane bagasse ash on the strength of concrete: A sustainable approach," Materials Today: Proceedings, vol. 75, suppl., pp. 106–111, 2023, doi: 10.1016/j.matpr.2022.11.335.

[15] S. Olopade and E. Ngene, "Performance evaluation of untreated sugarcane bagasse ash as partial replacement of cement on setting time and compressive strength of M15 concrete," Journal of Applied Research and Technology, vol. 22, no. 5, pp. 654–661, 2024, doi: 10.22201/icat.24486736e.2024.22.5.2236.

[16] P. Kalasur and A. K. Dwivedi, "A review on use of sugarcane bagasse ash as a partial replacement of cement in concrete," AIP Conference Proceedings, vol. 3146, Art. no. 020003, 2024, doi: 10.1063/5.0224927.

[17] B. Ghosh, "Sugarcane bagasse ash as a partial replacement for cement in concrete," AMC Indian Journal of Civil Engineering, vol. 7, no. 1, pp. 30–34, 2024, doi: 10.17010/ijce/2024/v7i1/174039.

[18] N. Elawadly and S. A. Sanad, "Sustainable concrete incorporating sugarcane bagasse ash: A study on workability, mechanical behavior, and microstructure," Innovative Infrastructure Solutions, vol. 10, Art. no. 401, 2025, doi: 10.1007/s41062-025-02177-6.

[19] "Characterization of bagasse ash and its sustainable use in concrete as a supplementary binder—A review," Construction and Building Materials, vol. 322, Art. no. 126391, 2022, doi: 10.1016/j.conbuildmat.2022.126391.

[20] G. D. Kumara, P. V. Sivapullaiah, and A. Sreenivasa Murthy, "Performance evaluation of sugar cane bagasse ash on the strength of concrete: A sustainable approach,"

Materials Today: Proceedings, vol. 75, suppl., pp. 106–111, 2023, doi: 10.1016/j.matpr.2022.11.335.

[21] "Assessing the influence of sugarcane bagasse ash for the production of eco-friendly concrete: Experimental and machine learning approaches," Case Studies in Construction Materials, vol. 20, Art. no. e02839, 2024, doi: 10.1016/j.cscm.2023.e02839.

[22] A. A. Avasthi, K. C. Khare, and S. D. Apte, "Sugarcane bagasse ash as a supplementary cementitious material in concrete to enhance the compressive strength and reduce the permeability and corrosion," International Journal of Environment and Waste Management, 2025, pp. 127–139, doi: 10.1504/IJEWM.2025.144238.

[23] M. E. Nzugua, E. P. Mukhokosi, and S. O. Kinyera, "Structural, chemical, and mechanical properties of concrete developed from a binder composite of sugarcane bagasse ash and Portland cement," Discover Materials, vol. 5, Art. no. 95, 2025.

[24] W. A. Omerzai et al., "Experimental investigation on the use of bagasse ash as a partial cement and fine aggregate replacement in concrete," Advances in Research, vol. 26, no. 6, pp. 329–344, 2025, doi: 10.9734/air/2025/v26i61553.

[25] M. K. H. Meghana and A. Madhukumar, "Experimental study on mechanical strength of green concrete using sugarcane bagasse ash and bovine faeces ash as partial replacement of fine aggregate," Next Research, 2025, Art. no. 101255, doi: 10.1016/j.nexres.2025.101255.