An Experimental Study on Mechanical Properties of Self Compacting Concrete by using Fiber Reinforcement

Gopu Anil, Gomasa Ramesh

***Abstract:** The invention of Self Compacting Concrete has been tremendous and continuing growth in the working area over the past decade, culminating in its widespread usage in today's reality. It outperforms regular cement in application and completion,cost, work reserve funds, and solidity. The addition of strands enhances its qualities, particularly those related to SCC's post- break behaviour. The goal is to investigate the strength properties of SCC when mixed with various types of strands. Different strand types and filament speeds are among the variables studied. The essential characteristics of SCC, including strength, break energy, sturdiness, and sorptivity, must be controlled. The hydrated design and security development between fiber and blend will be examined using an electron microscope to examine the tiny building of several mixes. 12mm cut glass fiber, carbon fiber, and basalt fiber will be used in the request, as they have been for quite some time. 0.0 percent, 0.1 percent, 0.15 percent, 0.2 percent, 0.25 percent, and 0.3 percent of strands are removed based on volume. The request is broken down into two parts. The first half involves creating a planned blend for SCC of a detailed assessment, such as M30. The second half involves adding filaments such as glass, basalt, and carbon strands to the SCC blends and evaluating and verifying their plastic and hardened properties. The experiment demonstrates a modest improvement in SCC aspects by adding strands of various types and altering the volume. Carbon fiber is the most improved in the more challenging state, followed by Basalt fiber and Glass fiber, and the least improved in the plastic state due to its high-water absorption. Glass fiber fared better in the plastic state. Basalt fiber fared better in the present study regarding cost, appropriate amount, and overall viability.*

Keywords: Glass fiber, Basalt Fiber, Carbon Fiber, Fracture Energy, Sorptivity & Bond development.

I. INTRODUCTION

The origins of SCC may be traced back to Europe and Japan. Even when seen through heavily squeezed support, it's a substance that can flow and fully cover each side of the formwork with its weight, without the need for compaction. Teacher H. Okamura's invention of SCC in 1986 affected the construction industry because it overcame the challenges of newly supplied concrete, such as skilled workers, pressed support, primary area type, pumpability, isolation protection, and compaction. The SCC is expected to endure longer due to its high void content. Everything began in Japan, where a plethora of research on SCC's overall output, as well as its tiny social structure and solid characteristics, were widely disseminated. Even though the BIS has yet to establish a standard blend strategy, different structure frameworks and scientists have conducted extensive research to identify optimal blend plan preliminary stages and self-smaller capabilitytesting methods. In that it is combined with cover, totals, water, fines, and admixtures, SCC is indistinguishable from regular cement. When compared to standard concrete, the advantages of SCC include increased strength, comparable stiffness to non-SCC, slightly lower Young's modulus due to more prominent glue, marginally higher killjoy due to glue,shrinkage similar to standard cement, and enhanced security strength. SCC comes out to be more sensitive with reduced strength, as intended and given by the Concrete Society, due to the consideration of void material and super-plasticizers.As a result, SCC is extensively used to assemble pre-projected objects, spans, divider boards, and other designs in certain countries. On the other hand, different tests are performed to investigate the many highlights and underlying applicationsof SCC. Because SCC has shown to be a helpful resource, it is critical to guide the standardization of self-compacting highlights. Conduct for usage in various underlying developments, as well as in all hazardous and remote endeavor zones. SCC is a very liquid mixture that, when poured, flows successfully inside and around the formwork, can flow around blocks and corners ("passing capability"), is close to self-levelling (but no longer genuinely self-levelling), does not want vibration or packing in the wake of pouring, and follows the shape and texture of the floor. As a result, as compared to traditional concrete mixes, pouring SCC is much less paint-intensive. SCC is usually virtually equivalent to ordinary concrete till poured in settling and restoration time (obtaining power) and energy. SCC does not need a large amount of water to become liquid; in fact, SCC may contain much less water than ordinary concretes. SCC's liquid properties are derived from a significant amount of high-quality overall sand (half), as well as super-plasticizers (brought components that ensure particles scatter and don't mix inside the liquid mixture) and thickness-increasing admixtures (VEA).

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***** Correspondence Author
Gopu Anil*, M.Tech Scholar, Department of Civil Engineering, Vaagdevi College of Engineering, Warangal, India. E-mail: omganesh.srinath@gmail.com
Gomasa Ramesh, M.Tech Scholar, Department of Civil Engineering, Vaagdevi College of Engineering, Warangal, India. E-mail: rameshgomasa1@gmail.com

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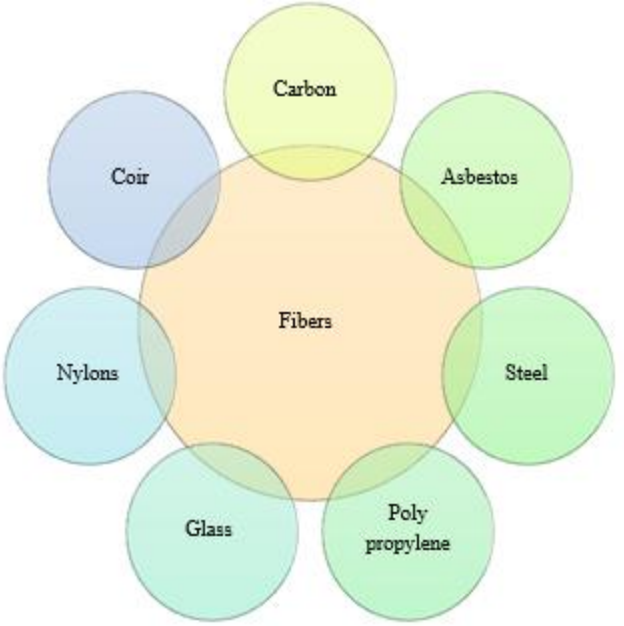
Concrete is a thick, gooey material mixed using vibration or unique methods (known as compaction) to kill air bubbles (cavitation) and honeycomb-like holes, particularly in the areas where the air was found during pouring.This kind of air content material (rather than coursed air through concrete) is unpleasant and will contaminate the solid atsome time if left uncontrolled. Regardless, vibration is inefficiently constructed and time-consuming, and improper or insufficient vibration may lead to unnoticed problems later. Furthermore, some strong forms are difficult to vibrate. Self-compacting concrete is anticipated to avoid this problem by eliminating the requirement for compaction, saving labour and time while also potentially posing innovation and quality control problems. Prof. Okamura of Ouchi University in Japan developed SCC in 1986 when skilled labour was hard to come by, causing problems in the concrete industry. The original SCC used in North America had a similar high cover content and high measures of substance admixtures, often super plasticizer, to improve stream productivity and security. Such enhanced concrete has already become a standard component in reclamation packages and projecting concrete in tight areas. SCC may be used to tackle deeply supported sections, areas where vibrators aren't available for compaction, and perplexing states of formwork that may be tough to challenge in some way or another, all while providing a far superior surface than standard concrete. The high cost of the materials used in such concrete will limit its use in many areas of the construction industry, including business development. Still, productivity financial factors will take over in achieving good execution advantages and make the industry bright. Powder growth, for example, will increase the glue's thickness, improving deformability and the glue's cohesion and urban's durability. Bringing down the concrete substance and raising the urgent thickness of substances more than eighty m, such as fly debris, may decrease the water-concrete share and the need for an HRWR. Because there wouldbe less free water, the amount of thickness upgrading admixture (VEA) required to maintain proper consistency while projecting and before solidification begins will be reduced. An absolute first-rate general fabric ("fines," usually sand) accounting for around half of the total was considered sufficient in an SCC mix. The availability of different cement and mineral admixture evaluations has recently sparked a creative revolt in the significant company. Regardless of whether there was a ridiculous change, some problems have progressed. These problems may be considered drawbacks for this cementitious compound when compared to materials like steel. Concrete's inflexibility is unimportant. In a few studies, fiber-supported sections were shown to be more practical than other types of segments. The fiber's primary function is to prevent breaking and increase the mix's break strength by expanding between small and large scope lattice fractures. Deboning, slipping, and pulling out of the strands are the cycles that control the crossing movement. The opening and triggering of breaks near the commencement of full-scale breaking are hampered and dealt with by fiber's getting overactivity. The amount of energy required for the break to propagate increases as a result of this communication. Low volumetric fiber rates heavily influence the mix's rapid adaptability. The characteristics of this remarkable concrete are enhanced by the fusion of strands at both the beginning and the end of the process. In the grand scheme of things, scientists have concentrated their efforts on evaluating the strength and durability of the fiber produced by SCC, which include:



Cement's strength is defined as its resistance to breaking when subjected to a variety of forces. It may be measured in various methods, including pressure, strain, shear, and flexure. Cement's compressive strength is one of its most important and valuable characteristics. It is used to assess the subjective qualities of hardened cement. As far as compressive strength is concerned, the significant making characteristics of various mix components are usually evaluated in this manner. The w/c proportion, quality and substance of concrete, the synthetic structure of concrete, percentage of concrete to totals, age and restoring circumstances, and reviewing of totals with its surface, form, size, strength, and hardness are all factors that affect cement strength. Furthermore, the synthetic structure of concrete and its molecular size affects cement strength. Fuel utilization, furnace activity, clinker arrangement, and concrete execution all significantly impact compound pieces. Concrete fineness has increased mainly to increase early strength. Self-compacting concrete (SCC) is a kind of concrete that may be shaped and can move past obstacles independently, without the need for vibration. Because of its obvious inherent advantages, SCC has grown in popularity in Japan, Europe, and the United States since its initial development in 1988. SCC innovation provides the opportunity to minimize or eliminate significant position problems under challenging situations, which is a vital advantage of this method. It makes an effort to avoid repeating a comparable value control test on concrete, which takes time and effort. It turns out that development and setup are both faster and easier than previously thought. It eliminates the need for vibration while also reducing noise pollution.

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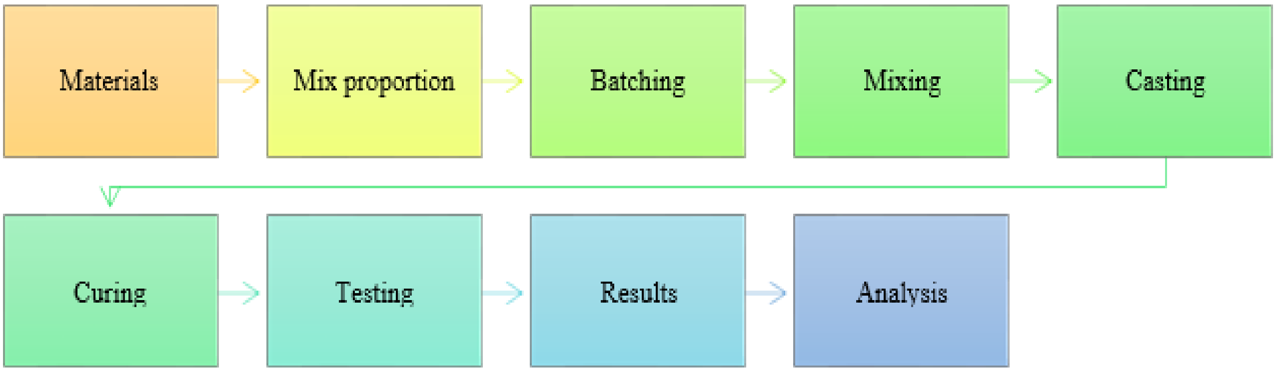
It increases the filling capacity of prominent people who are severely obstructed. SCC improves cement solidity and penetrability in those who have supportclogs. This study aims to see whether using SCC is feasible by looking at its essential characteristics and solidity attributes,such as water retention, shrinkage, and sulphate resistance.

II. METHODOLOGY



III. MATERIALS

According to industry standards, the characteristics of the ingredients used to mix concrete are established at a research facility. The materials used in this investigation included concrete, coarse aggregates, fine aggregates, silica seethe, coir fiber, steel strands, and super-plasticizer. A study of different material characteristics is used to ensure that the look satisfies code standards and allows an architect to create a concrete mix for a particular strength. The following is a list ofthe different materials used in this test.

OPC

Portland concrete is the most widely used kind of concrete in the world, and it is used as a fundamental fixing in concrete, mortar, plaster, and non-claim to fame grout. It was developed in the nineteenth century in England from several kinds of water-driven lime, and it usually originates from limestone. It's a fine powder produced by calcining limestone and earth minerals in a furnace, then granulating the clinker and adding 2 to 3% gypsum. Portland cement comes in a variety of forms. The most common kind is ordinary Portland concrete (OPC), which is black, although white Portland concrete is also available. The Name is derived from how Portland stone, which was mined on the Isle of Portland in Dorset, England, appears. It was called by Joseph Aspin, who received a patent for it in 1824. His son William Aspidin is credited with inventing "new" Portland concrete in the 1840s due to his father's work. Synthetic consumption may occur because Portland concrete is acidic. When inhaled in large amounts, the powder includes harmful components such as transparent silica, which contains hexavalent chromium, and may cause irritation or cellular breakdown in the lungs. The high energydemand required to transport, manufacture, and boat concrete and the associated air emissions, including ozone-depleting chemicals (e.g., carbon dioxide), dioxin, NOx, SO2, and particulates, are environmental concerns. Because of the accessibility and abundant stockpile of limestone, shale, and other naturally occurring minerals used in it, Portland concrete was one of the most cost-effective materials often used throughout the previous century. Concrete made with Portland cement is one of the most flexible building materials on the planet. A single parcel of 53-grade conventional Portland concrete (OPC) was used throughout the request. It was clean and free of tangles. In the table below, different estimations based on Indian Standard IS: 8112:1989 are used to assess the concrete's fundamental characteristics. Concrete is well preserved to prevent moisture communication from degrading its characteristics.

Table. Characteristics of Ordinary Portland Cement

S. No.	Characteristics	Experimental Values	IS Specification Values
1	Specific gravity	3.15	-
2	Standard consistency	2.7	-
3	Initial setting time (min.)	148	30
4	Final setting time (min.)	256	600
5	Compressive Strength (N/mm^2) 3 days 7 days 28 days	 27.7 36.6 48.6	 23 33 43

Table. Sieve analysis of aggregates

S. No.	IS Sieve	Retained Weight (gm)	% Retained	% Passing	Cumulative % Retained
1	4.75	6	0.6	99.4	0.6
2	2.36	59	5.9	93.5	6.5
3	1.18	220	22	71.5	28.5
4	600µ	159	15.9	55.6	44.4
5	300µ	316.5	31.65	23.95	76.05
6	150µ	196.5	19.65	4.3	95.70
7	Pan	43	4.3	0.0	
8	Total	1000.0		SUM	251.75
				FM	2.51

Totals are the essential component of a solid mix since they ensure that concrete is dimensionally balanced. The totals are usually employed in two or more noticeable sizes to blast the thickness of the coming together mix. The most basic purpose of the fine total is to assist in creating overall functioning and uniformity.

The ideal mixture aids the concrete glue in suspending the coarse blend trash. This movement increases blend flexibility and prevents glue and coarse complete isolation, especially when transporting the solid from the mixing plant to its final destination. The sums account for approximately 75% of the solid's casing.

Thus, their impact is minimal. If the solid is feasible, solid, reliable, and easy, it must satisfy specific requirements. Totals should have a proper structure, smooth, intense, and substantial, and thoroughly examine.

S. No.	Characteristic	Specification values
1	Colour	Grey
2	Shape	Angular
3	Maximum shape	10 mm
4	Specific gravity	2.60
5	Water absorption	0.2 – 0.35 %

A. Silica fume

Silica smoulder (CAS 69012-64-2, EINECS 273-761-1) is a non-translucent polymorph of silicon dioxide (CAS number 69012-64-2, EINECS number 273-761-1). It's an ultrafine powder made of circular particles with a normal molecular distance of 150 nanometers produced by combining silicon with ferrosilicon.

The most well-known use is as a pozzolanic component in high-end concrete. It's often mistaken with smouldering silica (otherwise called pyrogenic silica, CAS number 112945-52-5).

Smouldered silica's assembly cycle, molecular characteristics, and application areas, on the other hand, are almost identical to those of silica seethe.

B. Super plasticizers

Super plasticizers, also known as wide-reaching water reducers, are material admixtures used in applications that need all-around molecular suspension.

These polymers are used as dispersants in applications such as concrete to prevent molecular arranging (rock, coarse, and fine sands) and to develop the stream characteristics (rheology) of suspensions.

Their use of concrete or mortar considers a decrease in the water-to-cement ratio while maintaining the blend's functioning, resulting in self-uniting and superior concrete. This effect improves the consistency of the new solidifying glue. The use of super-plasticizer in trucks while travelling is a relatively new trend in the industry. By using computerized droop, the executive's frameworks like Verify, concrete producers may support droop before release without sacrificing effectiveness. Bentopolymix PCE 30000 was used to provide excellent functioning.

C. Batching, Mixing, Casting, Curing, Testing

The process of taking the number of materials needed for a project is known as batching. Weight batching and volume batching are the two most common techniques for gauging material amounts. Weight batching was used to measure the number of ingredients in the current research. I combined the ingredients according to the guidelines after measuring theamount of each component.

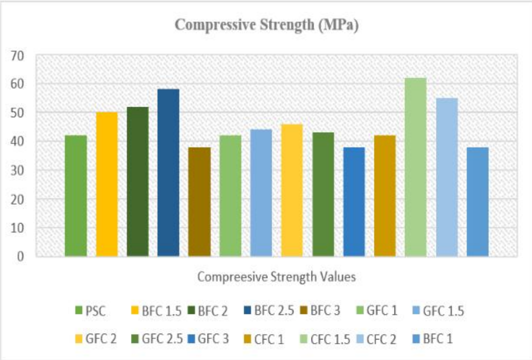
To obtain a homogeneous mix, combine coarse aggregates, fine aggregates, steel fibers, and coir fibers for a few minutes. Then add cement and silica fume to the mixture and mix for a few more minutes.

To create newly prepared concrete for M35 grade concrete, add water according to the calculations from the mix design. We must cast specimens such as cubes, cylinders, and prisms to test the strength and endurance of the concrete once it has been mixed.

For this research, we must cast 45 cubes, 45 cylinders, and 45 prisms to determine compressive strength, split tensile strength, and flexural strength after 7 days, 14 days, and 28 days of curing, as well as 15 cubes, to determine concrete durability for these five experimental mixes. We must cure the specimens for 7 days, 14 days, and 28 days of curing periods using all five trial mixtures in compressive strength, split tensile strength, and flexural strength tests. While we must cure the specimens for acid and alkaline attack tests, we must also treat them for durability.

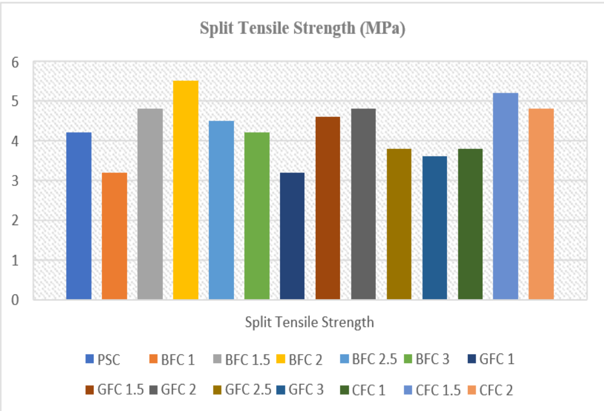
D. Compressive strength

This test was devised following the following guidelines: Concrete's compressive strength was calculated using 150x150x150mm forms. Models were stacked at a consistent rate on a CTM bearing surface with a cap of 200T until the strong shape was achieved. After noting the most severe load, the compressive quality was evaluated.



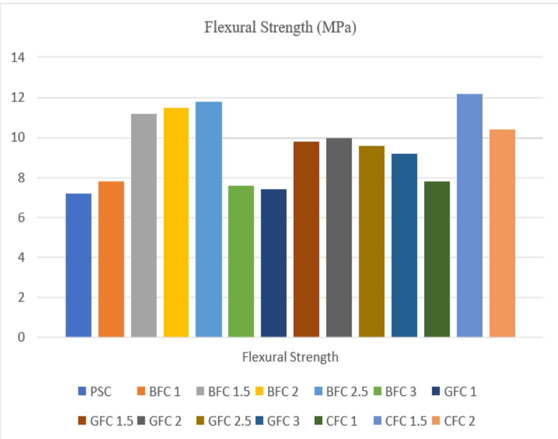
E. Tensile strength

The standard IS516-1959 was used to guide this examination. Using barrels of standard size 150mmx300mm, the consistency of cement is addressed. Models are constantly piled at the CTM bearing floor, with a weight limit of 200T, and a consistent stacking pace is linked with barrel dissatisfaction. The main load grew more visible, and the pleasure more definite. IS5816-1999 Procedure for Checking Rigidity in Splits.



F. Flexural strength

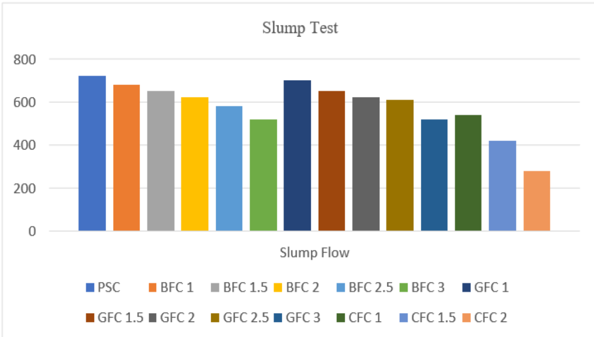
The IS 516-1959 is also used to guide this examination. The flexural strength of the beam model is measured using this test.

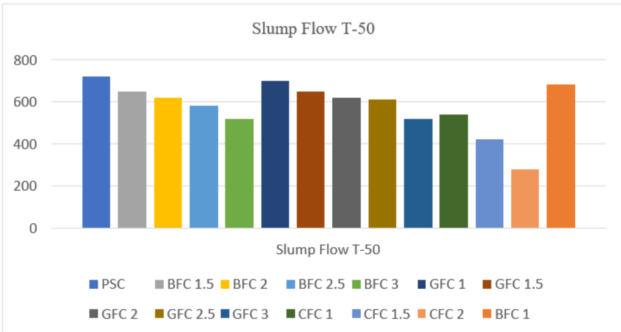


G. Slump test

The slump cone test is used to choose a newly placed cement's property. The test is a rational assessment of the new solid's utility. To be more specific, it measures the accuracy between bundles. The apparent quality of the test starts with the ease of the mechanical assembly and the straightforward process. A frustum with a cone of 300 mm stature is used for the droop test (12 in). The setup request measures 200 mm (8in) wide, with a 100 mm opening closer to the exit (4 in).

The holder is piled in three levels with concrete, and the setup request is set to a smooth floor. A standard sixteen mm (five/eight in) distance is applied through the metallic post, blunt towards the end to temp each sheet in many instances. The highest level is struck off (levelled with the structure zenith starting) by screening and rolling the temping bar after filling the form with concrete. Throughout the transaction, the structure must be immovably placed in the setup request to such a volume that it does not slide due to concrete pouring; this may be accomplished with handles or footstools brazed to the form. The cone is crafted with care and purpose. Raised vertically until the filling is complete and the black-top levelled, an unsupported cement would now droop. Slump denotes a decrease in the central height of a drooped solid. The hang is controlled by placing the cone near the drooped concrete and then positioning the temping bar above the cone to pass through it. The scale depicts the solid's and shape's relative heights. (Most measurements are rounded to the closest 5 mm (1/4 in) in most cases.)



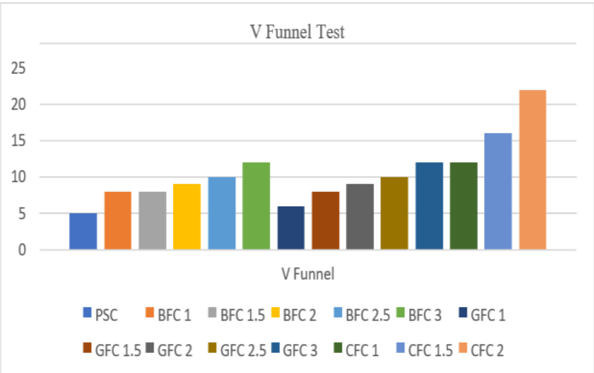


H. V Funnel Test

Ozawa used a test that was created in Japan at the University of Tokyo. As seen in the diagram, the gadget has a V-shaped channel. The V-pipe test, which was previously mentioned, is used to evaluate the filling limit (flowability) of concrete with a maximum aggregate size of 20mm. This test is used to determine the flowability of concrete; shorter stream durations indicate higher flowability.

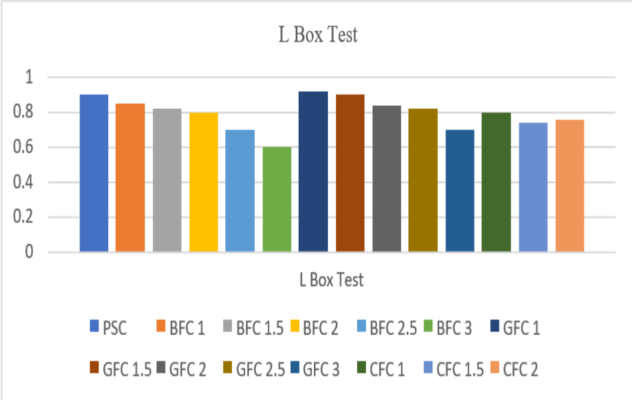
To conduct the evaluation, about 12 liters of concrete will be needed, determined at random. Find a solid surface to locate the V-channel. Soak the inner surfaces of the canal. Keep the bait entrance open to let any excess water evaporate. Cover the bait entrance with a can and place it beneath it. Fill the gear with concrete, without compacting or packing it, and then use the scoop's zenith to reach the concrete level. By unlocking the hidden door within 10 seconds after pouring the concrete, you can make it coast out under gravity. Start the timer and record the time for the release to complete once the tempt entrance is open (the take the path of least resistance time). The whole exam should take less than five minutes to complete. Close the concealed entrance after calculating the float time and top up the V-pipe as soon as possible. Look for a pail below it. Fill the device to the brim with concrete, without compacting or tapping it, then use the scoop to levelthe concrete with the top.

Open the tempting entrance 5 minutes following the channel's second fill to let gravity decrease the concrete. Start the timer as soon as the bait entrance is opened, and keep track of how long it takes forthe release to finish (the stream time at T five minutes). This is thought to be the case when direct light can be seenthrough the pipe from above. In this test, the benefit of floating together with the concrete is calculated; fewer take the route of most minor resistance occurrences indicate more flowability. For SCC, an afloat season of 10 seconds is thought to be sufficient. The modified cone structure prevents float, and the extended skim times may reveal the blend's vulnerability to shutting off. With an increase in stream time after 5 minutes of settling, concrete isolation would show less consistent accept conditions.



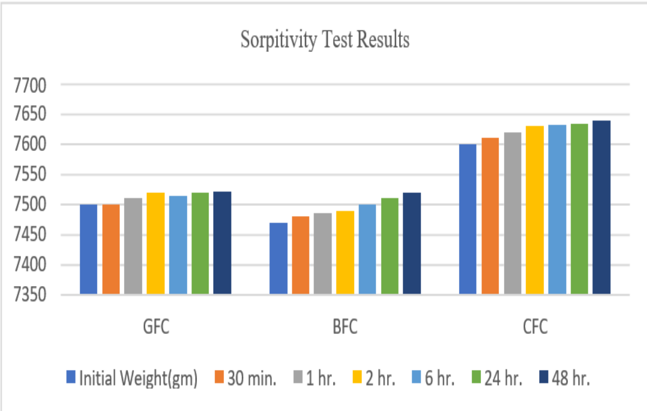
I. L box

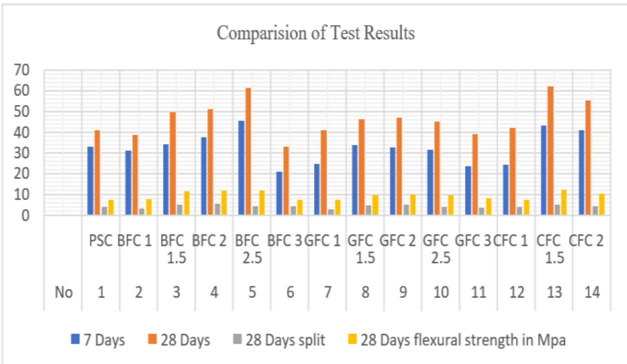
This test, which is entirely based on a Japanese concept for buried concrete, was presented with the help of Peterson. The test examines the concrete's flow and how helpless it is against the formation of barricades. The mechanical assembly is approved by Recognize 3.4. In the hardware, a rectangular-stage holder in the shape of an "L" is used, with vertical and flat sections divided by a movable door, before which vertical lengths of the building up bar are fitted. Approximately 14 liters of concrete are required for the test, which is usually inspected. Set the device's level on the organization's floor, double-check that the sliding door opens and closes freely before locking it. To remove any excess smoke, dampen the device's inner surfaces. Fill the vertical section of the gadget with the concrete example. Allow 1 second for it to come face to face with you. Lift the sliding entryways to allow the concrete to flow outwards into the flat section. Start the timer simultaneously and track how many times the concrete struck the 200 and 400mm foci. As soon as the concrete pouring stops, the lengths "H1" and "H2" are resolved. Calculate H1/H2 as the obstructing ratio. The whole exam should take less than five minutes to complete. H1/H2 = 1 if the concrete flows like water.

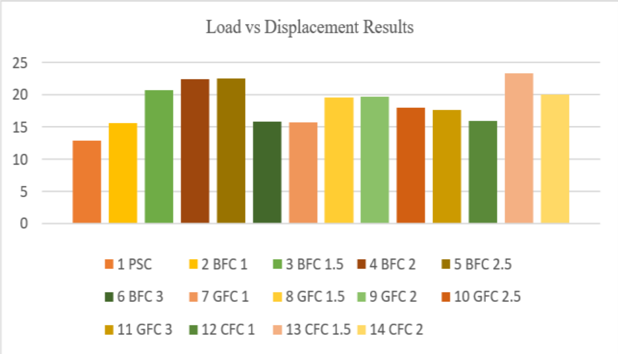


J. Sorpitivity Test

Block examples were cast to evaluate acceptable ingestion coefficients after 28 days of restoration. This test was performed to determine the fine retention of various FRSCC mortar networks, which is used to determine the solidity of various mortar grids.







IV. CONCLUSION

The following are some of the findings that may be made from the present research. The addition of fibers to SCC causes a loss of characteristics such as slump and other features owing to carbon fiber's higher water absorption than glass and basalt. Strength characteristics, on the other hand, have been found to have improved. In the matrix, 0.15 percent carbon fiber, 0.2 percent glass, and 0.25 percent basalt produced the best results. SCC flexure strengthrose by 65 percent, split tensile strength climbed by 26 percent, and compressive strength increased by 48 percent when 0.15 percent carbon fiber was added. SCC with up to 0.25 percent basalt fiber improved strength in flexure by 62%, split tensile strength by 35%, and compressive strength by 50%. Glass fiber added up to 2% to SCC improved flexure strength by 37%, split tensile strength by 21%, and compressive strength by 15%. FRSCC load vs. crack displacement graphs revealed that the fiber's crack arresting action enhanced the mixes in fracture energy. Carbon fiber outperformed basalt and glass fiber in this manner. The graph between average Ultra-pulse and compressive strength values revealed a higher correlation for basalt FRSCC (R2 =0.94), carbon FRSCC (R2=1.01), and glass FRSCC (R2 =0.95). These values indicate sound concrete with a uniform distribution of fibers and concrete components, as well as a thick structure, in all FRSCC mixes. The SEM research discovered a more significant link between matrix and fiber types. As a result, the structure of mixes is dense. The capillary absorptionof water by FRSCC mixes was assessed using a sorptivity test. Because carbon fibers absorbed more water, carbon FRSCC blends had a higher sorptivity coefficient. The lowest results were from basalt FRSCC. Glass FRSCC improved all strength metrics, especially at early ages. A higher volume proportion functioned better in the plastic environment. Its results were the cheapest in the plastic state, but it had the lowest strength and the greatest sorptivity. The microscopic examination (SEM) showed that the first kind grew bonds faster than the other two. Inboth the plastic and hardened phases, Basalt FRSCC outperforms Glass FRSCC. Compared to glass fiber and carbon fiber, basalt fiber offers the most significant overall performance since it is less costly.

REFERENCES

1. Sivakumar, V. R., Kavitha, O. R., Arulraj, G. P., & Srisanthi, V. G. (2017). An experimental study on combined effects of glass fiber and Metakaolin on the rheological, mechanical, and durability properties of self-compacting concrete. *Applied Clay Science*, *147*, 123-127. [CrossRef]
2. Ahmad, S., Umar, A., & Masood, A. (2017). Properties of normal concrete, self-compacting concrete and glass fibre-reinforced self-compacting concrete: an experimental study. *Procedia engineering*, *173*, 807-813. [CrossRef]
3. Facconi, L., Minelli, F., & Plizzari, G. (2016). Steel fiber reinforced self-compacting concrete thin slabs–Experimental study and verification against Model Code 2010 provisions. *Engineering Structures*, *122*, 226-237. [CrossRef]
4. Chen, X., Liu, Z., Guo, S., Huang, Y., & Xu, W. (2019). Experimental study on fatigue properties of normal and rubberized self-compacting concrete under bending. *Construction and Building Materials*, *205*, 10-20. [CrossRef]
5. Dubey, R., & Kumar, P. (2016). Experimental study of the effectiveness of retrofitting RC cylindrical columns using self-compacting concrete jackets. *Construction and Building Materials*, *124*, 104-117. [CrossRef]
6. Mashhadban, H., Kutanaei, S. S., & Sayarinejad, M. A. (2016). Prediction and modeling of mechanical properties in fiber reinforced self-compacting concrete using particle swarm optimization algorithm and artificial neural network. *Construction and Building Materials*, *119*, 277-287. [CrossRef]
7. Grüewald, S., & Walraven, J. C. (2001). Parameter-study on the influence of steel fibers and coarse aggregate content on the fresh properties of self-compacting concrete. *Cement and Concrete Research*, *31*(12), 1793-1798. [CrossRef]
8. Sabău, M., Pop, I., & Oneţ, T. (2016). Experimental study on local bond stress-slip relationship in self-compacting concrete. *Materials and Structures*, *49*(9), 3693-3711. [CrossRef]
9. Wu, Z., Zhang, Y., Zheng, J., & Ding, Y. (2009). An experimental study on the workability of self-compacting lightweight concrete. *Construction and Building Materials*, *23*(5), 2087-2092. [CrossRef]
10. Ferrara, L., Park, Y. D., & Shah, S. P. (2007). A method for mix-design of fiber-reinforced self-compacting concrete. *Cement and concrete research*, *37*(6), 957-971. [CrossRef]
11. Turcry, P., Loukili, A., Haidar, K., Pijaudier-Cabot, G., & Belarbi, A. (2006). Cracking tendency of self-compacting concrete subjected to restrained shrinkage: experimental study and modeling. *Journal of Materials in Civil Engineering*, *18*(1), 46-54. [CrossRef]
12. Mahmod, M., Hanoon, A. N., & Abed, H. J. (2018). Flexural behavior of self-compacting concrete beams strengthened with steel fiber reinforcement. *Journal of Building Engineering*, *16*, 228-237. [CrossRef]
13. Tangadagi, R. B., Manjunatha, M., Seth, D., & Preethi, S. (2021). Role of mineral admixtures on strength and durability of high strength self compacting concrete: An experimental study. *Materialia*, 101144. [CrossRef]
14. Aslani, F., Ma, G., Wan, D. L. Y., & Le, V. X. T. (2018). Experimental investigation into rubber granules and their effects on the fresh and hardened properties of self-compacting concrete. *Journal of cleaner production*, *172*, 1835-1847. [CrossRef]
15. Haddadou, N., Chaid, R., & Ghernouti, Y. (2015). Experimental study on steel fibre reinforced self-compacting concrete incorporating high volume of marble powder. *European Journal of Environmental and Civil Engineering*, *19*(1), 48-64. [CrossRef]
16. Sadrmomtazi, A., Gashti, S. H., & Tahmouresi, B. (2020). Residual strength and microstructure of fiber reinforced self-compacting concrete exposed to high temperatures. *Construction and Building Materials*, *230*, 116969. [CrossRef]
17. Akcay, B., & Tasdemir, M. A. (2012). Mechanical behaviour and fibre dispersion of hybrid steel fibre reinforced self-compacting concrete. *Construction and Building Materials*, *28*(1), 287-293. [CrossRef]
18. Nikbin, I. M., Beygi, M. H. A., Kazemi, M. T., Amiri, J. V., Rabbanifar, S., Rahmani, E., & Rahimi, S. (2014). A comprehensive investigation into the effect of water to cement ratio and powder content on mechanical properties of self-compacting concrete. *Construction and Building Materials*, *57*, 69-80. [CrossRef]
19. Anastasiou, E. K., Papayianni, I., & Papachristoforou, M. (2014). Behavior of self compacting concrete containing ladle furnace slag and steel fiber reinforcement. *Materials & Design*, *59*, 454-460. [CrossRef]

20. Iqbal, S., Ali, A., Holschemacher, K., & Bier, T. A. (2015). Mechanical properties of steel fiber reinforced high strength lightweight self-compacting concrete (SHLSCC). *Construction and Building Materials*, *98*, 325-333. [CrossRef]
21. Alabduljabbar, H., Alyousef, R., Alrshoudi, F., Alaskar, A., Fathi, A., & Mustafa Mohamed, A. (2019). Mechanical effect of steel fiber on the cement replacement materials of self-compacting concrete. *Fibers*, *7*(4), 36. [CrossRef]
22. Di, B., Wang, J., Li, H., Zheng, J., Zheng, Y., & Song, G. (2019). Investigation of bonding behavior of FRP and steel bars in self-compacting concrete structures using acoustic emission method. *Sensors*, *19*(1), 159. [CrossRef]
23. Mazaheripour, H. B. J. A. O., Barros, J. A., Sena-Cruz, J. M., Pepe, M., & Martinelli, E. (2013). Experimental study on bond performance of GFRP bars in self-compacting steel fiber reinforced concrete. *Composite Structures*, *95*, 202-212. [CrossRef]
24. Yehia, S., Douba, A., Abdullahi, O., & Farrag, S. (2016). Mechanical and durability evaluation of fiber-reinforced self-compacting concrete. *Construction and Building Materials*, *121*, 120-133. [CrossRef]
25. Chen, C., Chen, X., & Zhang, J. (2021). Experimental study on flexural fatigue behavior of self-compacting concrete with waste tire rubber. *Mechanics of Advanced Materials and Structures*, *28*(16), 1691-1702. [CrossRef]
26. Aslani, F., & Kelin, J. (2018). Assessment and development of high-performance fibre-reinforced lightweight self-compacting concrete including recycled crumb rubber aggregates exposed to elevated temperatures. *Journal of Cleaner Production*, *200*, 1009-1025. [CrossRef]
27. Gencel, O., Ozel, C., Brostow, W., & Martinez-Barrera, G. (2011). Mechanical properties of self-compacting concrete reinforced with polypropylene fibres. *Materials Research Innovations*, *15*(3), 216-225. [CrossRef]
28. El-Dieb, A. S. (2009). Mechanical, durability and microstructural characteristics of ultra-high-strength self-compacting concrete incorporating steel fibers. *Materials & Design*, *30*(10), 4286-4292. [CrossRef]
29. Kamal, M. M., Safan, M. A., Bashandy, A. A., & Khalil, A. M. (2018). Experimental investigation on the behavior of normal strength and high strength self-curing self-compacting concrete. *Journal of Building Engineering*, *16*, 79-93. [CrossRef]
30. Al-Hadithi, A. I., & Hilal, N. N. (2016). The possibility of enhancing some properties of self-compacting concrete by adding waste plastic fibers. *Journal of Building Engineering*, *8*, 20-28. [CrossRef]
31. Mastali, M., & Dalvand, A. (2016). The impact resistance and mechanical properties of self-compacting concrete reinforced with recycled CFRP pieces. *Composites Part B: Engineering*, *92*, 360-376. [CrossRef]
32. Tao, J., Yuan, Y., & Taerwe, L. (2010). Compressive strength of self-compacting concrete during high-temperature exposure. *Journal of Materials in Civil Engineering*, *22*(10), 1005-1011. [CrossRef]
33. Aslani, F. (2013). Effects of specimen size and shape on compressive and tensile strengths of self-compacting concrete with or without fibres. *Magazine of Concrete Research*, *65*(15), 914-929. [CrossRef]
34. Al Qadi, A. N., & Al-Zaidyeen, S. M. (2014). Effect of fibre content and specimen shape on residual strength of polypropylene fibre self-compacting concrete exposed to elevated temperatures. *Journal of king Saud university-engineering sciences*, *26*(1), 33-39. [CrossRef]
35. Siddique, R. (2011). Properties of self-compacting concrete containing class F fly ash. *Materials & Design*, *32*(3), 1501-1507. [CrossRef]
36. Bingöl, A. F., & Tohumcu, İ. (2013). Effects of different curing regimes on the compressive strength properties of self compacting concrete incorporating fly ash and silica fume. *Materials & Design*, *51*, 12-18. [CrossRef]
37. Pająk, M., & Ponikiewski, T. (2013). Flexural behavior of self-compacting concrete reinforced with different types of steel fibers. *Construction and Building materials*, *47*, 397-408. [CrossRef]
38. Mastali, M., & Dalvand, A. (2016). Use of silica fume and recycled steel fibers in self-compacting concrete (SCC). *construction and building materials*, *125*, 196-209. [CrossRef]
39. Mohseni, E., Saadati, R., Kordbacheh, N., Parpinchi, Z. S., & Tang, W. (2017). Engineering and microstructural assessment of fibre-reinforced self-compacting concrete containing recycled coarse aggregate. *Journal of Cleaner Production*, *168*, 605-613. [CrossRef]
40. Aslani, F., & Nejadi, S. (2013). Self-compacting concrete incorporating steel and polypropylene fibers: Compressive and tensile strengths, moduli of elasticity and rupture, compressive stress–strain curve, and energy dissipated under compression. *Composites Part B: Engineering*, *53*, 121-133. [CrossRef]
41. Algin, Z., & Ozen, M. (2018). The properties of chopped basalt fibre reinforced self-compacting concrete. *Construction and Building Materials*, *186*, 678-685. [CrossRef]
42. Revathi, P., Selvi, R. S., & Velin, S. S. (2013). Investigations on fresh and hardened properties of recycled aggregate self compacting concrete. *Journal of the Institution of Engineers (India): Series A*, *94*(3), 179-185. [CrossRef]
43. Aslani, F., & Nejadi, S. (2012). Mechanical properties of conventional and self-compacting concrete: An analytical study. *Construction and Building Materials*, *36*, 330-347. [CrossRef]
44. Sahmaran, M., Yurtseven, A., & Yaman, I. O. (2005). Workability of hybrid fiber reinforced self-compacting concrete. *Building and Environment*, *40*(12), 1672-1677. [CrossRef]
45. Khaloo, A., Raisi, E. M., Hosseini, P., & Tahsiri, H. (2014). Mechanical performance of self-compacting concrete reinforced with steel fibers. *Construction and building materials*, *51*, 179-186. [CrossRef]

AUTHOR'S PROFILE

Mr. Gopu Anil is M.Tech Scholar, Vaagdevi College of Engineering, Warangal, Telangana. His area of research interests includes Reinforced concrete structures, Concrete Technology and sustainable materials.

Mr. Gomasa Ramesh is Currently a Ph.D. Student at Mahindra University, Hyderabad, Telangana. His area of research interests includes structural health monitoring, Damage assessment of reinforced concrete structures, Non destructive testing methods and smart materials in Engineering.