COMPARISON OF COMPRESSIVE STRENGTH OF CONVENTIONAL SELF COMPACTING CONCRETE AND STEEL FIBER REINFORCED SELF COMPACTING CONCRETE

G.Vishnu Vardhan[1], T.S Lakshmi[2*]

Article History: Received: 12.12.2022 **Revised:** 29.01.2023 **Accepted:** 15.03.2023

Abstract

Aim: The predominant goal of research is to evaluate compressive strength of self compacting concrete and novel steel fiber reinforced self compacting concrete and evaluate its houses. There are agencies taken for the have a look at and every group incorporates 18 cubes. **Materials and methods:** Self compacting concrete includes 43 grade Ordinary Portland Cement, satisfactory combination (Msand), coarse combination (20mm), water cement ratio 0.45, and 0.6% superplasticizer brought in line with weight of cementitious material. In novel steel fiber reinforced self compacting concrete consists of 3% of steel fiber introduced to the weight of cementitious material and the opposite materials continue to be the same as in the case of self compacting concrete. Total range of sample results are calculated using clinical software through adopting the values from previously published research papers. The impartial pattern T-test has been carried out the usage of SPSS software program model 26 which suggests a clean increment in compressive strength behavior of novel steel fiber reinforced self compacting concrete as compared with self compacting concrete.The calculation is carried out utilizing a G-strength of 0.8 with alpha and beta qualities are 0.05, and 0.2 with a confidence interval of 95%. Independent sample T-Test (=.001) value ($p<0.05$) i.e. $p=0.0321$. **Results:** Using SPSS software revealed that the compressive strength of conventional concrete is 28.12 N/mm^2. The compressive strength of steel fiber concrete is 41.88 N/mm^2. The significance value of 0.009 ($p<0.5$) and standard deviations are 1.833 and 2.846 respectively. **Conclusion:** The steel fiber reinforced self compacting concrete with superplasticizer had more compressive strength when in comparison to the conventional self compacting concrete.

Keywords: Compressive Strength, Self Compacting Concrete, Strength Behavior, Steel Fiber, Ordinary Portland Cement, Steel Fiber Reinforced Self Compacting Concrete.

[1]Research Scholar, Department of Civil Engineering, Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, Tamil Nadu, India, Pincode: 602105. [2*]Project Guide, Corresponding Author, Department of Civil Engineering, Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, Tamil Nadu, India, Pincode:602105.

1. Introduction

Comparison of compressive strength of conventional self compacting concrete with steel fiber reinforced self compacting concrete and its properties and to increase the strength of concrete. Steel fiber Reinforced self compacting concrete is an material mixture of fine aggregate, coarse aggregate, admixtures, steel fiber, and water with a proper measurement called design (Basava Raju 1979).The design mix of M20 grade concrete is used and 3% of steel fibers are added according to the cementitious material to increase the compressive strength strength of the concrete and 20mm aggregate are used in the concrete as coarse aggregate, M-sand is used as fine aggregate (Yancey and Cattaneo 1978),the admixtures like super plasticizer is added to concrete to reduce the water-cement ratio and having benefits like increased density, increase the bond strength, better volume stability and decrease the shrinkage cracking (Kelechi et al. 2022).The material is converted into a cubes shape of measurement are 15 cm each side.which is used to calculate the compressive strength strength (Abdallah and HERCULES INC MAGNA UTAH. 1984).and it is compared by self compacting concrete with a design mix of M20 grade, as same of steel reinforced self compacting concrete the self compacting concrete is called as self-consolidating concrete, is a mostly used concrete in present days, due to its self-compacting characteristics and strength. SCC has a higher flow ratio than other concrete (Bachtiar, n.d.), there is no non-segregating, it is a type of special concrete that can settle into formworks, and encapsulates heavily reinforced, narrow and deep sections by means of its own weight(American Concrete Institute 1965). Unlike conventional concrete, self compacting concrete does not need tamping and vibration equipment (Drescher 1996).

Our institution is keen on working on latest research trends and has extensive knowledge and research experience which resulted in quality publications (Rinesh et al. 2022; Sundararaman et al. 2022; Mohanavel et al. 2022; Ram et al. 2022; Dinesh Kumar et al. 2022; Vijayalakshmi et al. 2022; Sudhan et al. 2022; Kumar et al. 2022; Sathish et al. 2022; Mahesh et al. 2022; Yaashikaa et al. 2022). There are a lot of research was done during the last five years on steel fiber reinforced concrete.Total no.of articles on this topic over the fast five years in google scholar -nearly 98 and american concrete institute 26 production and most cited papers 1.placement of self-compacting concrete. Self compacting concrete using steel Fiber (www. 1clicktong.com 2019). Behavior of high-strength steel fiber-reinforced self-compacting concrete exposed to high temperatures as they did for fiber reinforced concrete with the superplasticizer with less amount (Yun, Jeong, and Choi 2021; Singh 2016). We finished by adding 3% of fibers and we used m sand as a fine aggregate (Abid et al. 2020). Unanswered problem/gap of the existing research: in the research, they do not find results in the combination m20 grade self compacting concrete with combinations of the 0.6% of superplasticizer, and 3% steel fiber reinforcement. This combination of the concrete can change the strength of values, to find the result of those combinations this experiment established (Sengul, Akkaya, and Tasdemir, n.d.). To find the compressive strength of the admixtures by curing 28 days and testing the compressive strength of the specimens prepared from the superplasticizer, steel and to get higher strength of the concrete (Sapeai 2021).

2. Materials and Methods

These experiments were done in the concrete technology laboratory, saveetha school of engineering, saveetha institute of medical and technical sciences (SIMATS). In this research two groups were taken, In that one group, self compacting M20 grade concrete with 0.6% of super plasticizer, aggregates and water added as aer design mix of M20 grade of self compacting concrete and other groups of the concrete specimens were done by the 0.6% of the superplasticizer, 3% of steel fiber reinforced self compacting concrete and aggregates and water added as aer design mix of M20 grade of self compacting concrete. The calculation is carried out utilizing a G-power of 0.8 with alpha and beta qualities are 0.05, and 0.2 with a confidence interval of 95%. Independent sample T-Test (=.001) value ($p<0.05$) i.e. $p=0.04$. . The standard ordinary portland cement of 43-Graded bharathi cement acquired from a single batch throughout the research, changed into use. The premium quality cement. The normal cement contents of argillaceous and calcareous materials other materials like gypsum. A fine aggregate is obtained from regionally available M-sand, which is passed via A 4.75 mm sieve. The fineness modulus of fine aggregate turned into 2.74 and particular gravity became 2.63. Coarse aggregate which is used in the project of 20mm size of the sieve passes through 80mm, 40mm, 20mm etc. this quarry crushed stone and that is broken into small sizes and irregular in shape. Normal tap water is available in the region and without any debris and drinkable water is used for the mixing of the water of 0.45 water-cement ratio. This study was done in the concrete lab, department of civil engineering, saveetha school of engineering two groups of experiments were done.

In that one group of the concrete is conventional concrete of m20 grade as Per I.S standards and other groups of the concrete specimens were done by the 1% of the superplasticizer, 3% steel fiber of and cement, aggregates and water added as per the m20 grade.

STATISTICAL ANALYSIS

The results of the analysis were done by the spss, version 21 software, samples T-Test was done separately to find the analytical difference between the conventional and steel fiber reinforced group. There was no dependent variable for the study, whereas the compressive strength, grade of concrete, water/cement ratio, grade of cement, days of curing were independent variables. Mean, standard deviation, standard error of mean were also calculated with this tool for compressive strength.

3. Result

The mean compressive strength of conventional concrete. The 29.8500N/mm², whereas the compressive strength of steel fiber reinforced was 41.8939N/mm². The standard deviation of the compressive strength of conventional concrete was 1.83342 while the compressive strength of the steel fiber reinforced concrete compressive strength by levene's test for equality of variances was compressive strength values of 18 samples with the addition of steel fiber with the superplasticizer are detailed in table 6 whereas, table 4 displays the compressive strength values of 18 samples without samples T-Test results were presented in the table 5. The comparison of mean accuracy values for two groups steel concrete with p-value 0.05 and error bar 95% with the effective prediction was shown in fig. The error bars with the mean accuracy detection +/- 1 Sd.of superplasticizer was 6.318.

4. Discussion

The percentage increase in compressive strength of the steel fiber reinforced concrete with additional superplasticizer was found to be 25%. The addition of fibers decreases the permeability of concrete and the compressive strength increases of the concrete. The standard deviation of the compressive strength of steel fiber reinforced with silica fume superplasticizer was found to be higher than that of conventional concrete. It shows the deviation of compressive strength from its mean and superplasticizer. There was no statistical significance observed for compressive strength in an independent sample T-Test P=0.057 which was found to be greater than P = 0.05. As our threshold limit was 0.05, no statistical significance between the groups for compressive strength. Value is more for the steel fiber reinforced concrete with the silica fume. It's a modern M20 grade concrete variant that was developed as part of a research project. That was created and tested in a 28-day compressive strength test.

5. Conclusion

The mean compression strength of steel Reinforced self compacting concrete With 0.6% of Superplasticizer which according to cement weight Of M20 Grade self compacting concrete 41KN . The compression strength of conventional self compacting concrete is less than 20 KN.

Declarations

Conflicts Of Interest:

The author of this paper declare no conflict of interest.

Author's contribution:

Data collection, data analysis and paper writing have all been done by author TSC. Author pr project coordinator TSL was engaged in the manuscript's development, guidance and critical review.

Acknowledgment

The authors are thankful to saveetha school of engineering, saveetha institute of medical and technical sciences (also known as saveetha university) for providing the necessary infrastructure to complete this research successfully.

Funding

We would like to thank the following organizations for their financial contributions that helped complete the experimental study.

1. Astra Chemicals
3. Saveetha Institute for Medical and Technical Sciences
4. Saveetha School of Engineering

6. References

Abdallah, M. G., and HERCULES INC MAGNA UTAH. 1984. State of the Art of Advanced Composite Materials: Compression Test Methods.

Abid, Sallal R., Munther L. Abdul-Hussein, Nadheer S. Ayoob, Sajjad H. Ali, and Ahmed L. Kadhum. 2020. “Repeated Drop-Weight Impact Tests on Self-Compacting Concrete Reinforced with Micro-Steel Fiber.” Heliyon 6 (1): e03198.

American Concrete Institute. 1965. Recommended Practice for Evaluation of Compression Test Results of Field Concrete.

Bachtiar, Erniati. n.d. "KARAKTERISTIK SELF COMPACTING CONCRETE (SCC) TANPA CURING (CHARACTERISTIC OF SELF COMPACTING CONCRETE (SCC)WITHOUT CURING)." https://doi.org/10.31227/osf.io/5u2y8.

Basava Raju, B. 1979. Elevated-Temperature Application of the IITRI Compression Test Fixture for Graphite/polyimide Filamentary Composites.

Dinesh Kumar, M., V. Godvin Sharmila, Gopalakrishnan Kumar, Jeong-Hoon Park, Siham Yousuf Al-Qaradawi, and J. Rajesh Banu. 2022. "Surfactant Induced Microwave Disintegration for Enhanced Biohydrogen Production from Macroalgae Biomass: Thermodynamics and Energetics." Bioresource Technology 350 (April): 126904.

Drescher, Andrew. 1996. Reassessment of Diametrical Compression Test on Asphalt Concrete: Final Report.

Kelechi, Sylvia E., Musa Adamu, Abubakar Mohammed, Yasser E. Ibrahim, and Ifeyinwa I. Obianyo. 2022. "Durability Performance of Self-Compacting Concrete Containing Crumb Rubber, Fly Ash and Calcium Carbide Waste." Materials 15 (2). https://doi.org/10.3390/ma15020488.

Kumar, J. Aravind, J. Aravind Kumar, S. Sathish, T. Krithiga, T. R. Praveenkumar, S. Lokesh, D. Prabu, A. Annam Renita, P. Prakash, and M. Rajasimman. 2022. "A Comprehensive Review on Bio-Hydrogen Production from Brewery Industrial Wastewater and Its Treatment Methodologies." Fuel. https://doi.org/10.1016/j.fuel.2022.123594.

Mahesh, Narayanan, Srinivasan Balakumar, Uthaman Danya, Shanmugasundaram Shyamalagowri, Palanisamy Suresh Babu, Jeyaseelan Aravind, Murugesan Kamaraj, and Muthusamy Govarthanan. 2022. "A Review on Mitigation of Emerging Contaminants in an Aqueous Environment Using Microbial Bio-Machines as Sustainable Tools: Progress and Limitations." Journal of Water Process Engineering. https://doi.org/10.1016/j.jwpe.2022.102712.

Mohanavel, Vinayagam, K. Ravi Kumar, T. Sathish, Palanivel Velmurugan, Alagar Karthick, M. Ravichandran, Saleh Alfarraj, Hesham S. Almoallim, Shanmugam Sureshkumar, and J. Isaac JoshuaRamesh Lalvani. 2022. "Investigation on Inorganic Salts K2TiF6 and KBF4 to Develop Nanoparticles Based TiB2 Reinforcement Aluminium Composites." Bioinorganic Chemistry and Applications 2022 (January): 8559402.

Ram, G. Dinesh, G. Dinesh Ram, S. Praveen Kumar, T. Yuvaraj, Thanikanti Sudhakar Babu, and Karthik Balasubramanian. 2022. "Simulation and Investigation of MEMS Bilayer Solar Energy Harvester for Smart Wireless Sensor Applications." Sustainable Energy Technologies and Assessments. https://doi.org/10.1016/j.seta.2022.102102.

Rinesh, S., K. Maheswari, B. Arthi, P. Sherubha, A. Vijay, S. Sridhar, T. Rajendran, and Yosef Asrat Waji. 2022. "Investigations on Brain Tumor Classification Using Hybrid Machine Learning Algorithms." Journal of Healthcare Engineering 2022 (February): 2761847.

Sapeai, Martinus Pramanata. 2021. "The Effect of Carbon Fiber Reinforced Polymer Restraints on Self Compacting Concrete Using Recycled Coarse Aggregates on Concrete Behavior." MEDIA KOMUNIKASI TEKNIK SIPIL. https://doi.org/10.14710/mkts.v26i2.29213.

Sathish, T., V. Mohanavel, M. Arunkumar, K. Rajan, Manzoore Elahi M. Soudagar, M. A. Mujtaba, Saleh H. Salmen, Sami Al Obaid, H. Fayaz, and S. Sivakumar. 2022. "Utilization of Azadirachta Indica Biodiesel, Ethanol and Diesel Blends for Diesel Engine Applications with Engine Emission Profile." Fuel. https://doi.org/10.1016/j.fuel.2022.123798.

Sengul, C., Y. Akkaya, and M. A. Tasdemir. n.d. "FRACTURE BEHAVIOR OF HIGH PERFORMANCE FIBER REINFORCED SELF COMPACTING CONCRETE." Measuring, Monitoring and Modeling Concrete Properties. https://doi.org/10.1007/978-1-4020-5104-3_21.

Singh, Harvinder. 2016. Steel Fiber Reinforced Concrete: Behavior, Modelling and Design. Springer.

Sudhan, M. B., M. Sinthuja, S. Pravinth Raja, J. Amutharaj, G. Charlyn Pushpa Latha, S. Sheeba Rachel, T. Anitha, T. Rajendran, and Yosef Asrat Waji. 2022. "Segmentation and Classification of Glaucoma Using U-Net with Deep Learning Model." Journal of Healthcare Engineering 2022 (February): 1601354.

Sundararaman, Sathish, J. Aravind Kumar, Prabu Deivasigamani, and Yuvarajan Devarajan. 2022. "Emerging Pharma Residue Contaminants: Occurrence, Monitoring, Risk and Fate Assessment – A Challenge to Water Resource Management." Science of The Total Environment.

https://doi.org/10.1016/j.scitotenv.2022.153897.

Vijayalakshmi, V. J., Prakash Arumugam, A. Ananthi Christy, and R. Brindha. 2022. "Simultaneous Allocation of EV Charging Stations and Renewable Energy Sources: An Elite RERNN-m2MPA Approach." International Journal of Energy Research. https://doi.org/10.1002/er.7780.

www. 1clicktong.com. 2019. China Standard: GB/T 7314-2017 Metallic materials—Compression Test Method at Room Temperature. Risk Management 1 Click Tong.

Yaashikaa, P. R., P. Senthil Kumar, S. Jeevanantham, and R. Saravanan. 2022. "A Review on Bioremediation Approach for Heavy Metal Detoxification and Accumulation in Plants." Environmental Pollution 301 (May): 119035.

Yancey, C. W. C., and Louis E. Cattaneo. 1978. The Development of an Improved Compression Test Method for Wall Panels,.

Yun, Hyun-Do, Gwon-Young Jeong, and Won-Chang Choi. 2021. "Shear Strengthening of High Strength Concrete Beams That Contain Hooked-End Steel Fiber." Materials 15 (1). https://doi.org/10.3390/ma15010017.

Preethi, P. S., Hariharan, N. M., Vickram, S., Manian, R., Manikandan, S., Subbaiya, R., ... & Awasthi, M. K. (2022). Advances in bioremediation of emerging contaminants from industrial wastewater by oxidoreductase enzymes. Bioresource Technology, 127444.

Tables and Figures

Table 1: Properties of the Cement Used

S.No	Properties(Test For The Cement)	Result
1	Finess	90 Micron
2	Specific gravity	3.1
3	Standard Consistency	30%
4	Initial Setting	30 Min
5	Final Setting	600 Min

TABLE 2: Properties Of The Fine Aggregate

S.No	Name Of The Test	Result
1	Size	4.75
2	Sieve Analysis	2.59
3	Water Absorption	3%
4	Specific Gravity	2.65

TABLE 3: Properties Of The Coarse Aggregate

S.No	Name Of The Test	Result
1	Size	20 mm
2	Sieve Analysis	20 mm
3	Water Absorption	3.14%
4	Specific Gravity	2.68

TABLE 4: Compressive Strength of the Conventional Concrete

S.No	Weight(Kg)	Strength(Kn)	Compressive Strength ((N/mm^2)
1	8.132	590	26.222
2	8.543	672	29.866
3	8.231	659	29.288
4	8.987	680	30.222
5	9.011	674	29.955
6	8.654	685	30.44
7	8.256	725	32.22
8	8.987	689	30.622
9	9.231	617	27.422
10	8.765	693	30.08
11	9.043	662	29.42
12	8.798	653	29.022
13	8.675	696	30.933
14	8.793	699	31.066
15	9.045	720	32
16	8.894	650	28.88
17	9.406	597	26.53
18	9.654	746	33.155

TABLE 5: Compressive Strength Of The Steel Fiber Reinforced Concrete

S.No	Weight (kg)	Strength (kn)	Compressive Strength ((N/mm^2)
1	8.256	896	39.822
2	8.592	983	43.688
3	8.243	880	39.11
4	8.998	1024	45.488
5	9.134	956	42.488

6	8.723	920	40.88
7	8.367	890	39.55
8	9.023	987	43.866
9	9.321	994	44.177
10	8.782	861	38.266
11	9.123	1034	45.955
12	8.812	985	43.77
13	8.762	856	38.44
14	8.832	865	38.044
15	9.432	870	38.66
16	8.976	973	43.244
17	9.432	946	42.044
18	9.678	1045	46.44

TABLE 6:

Compressive strength	**Group**	**N**	**Mean**	**Std deviation**	**Std error means**
	Without Fiber	18	29.8500	1.83342	0.43214
	With Fiber	18	41.8939	2.84688	0.67102

TABLE 7:

	Independent Samples T-Test								
	t-test for Equality of Means								
Compressive Strength	**Levene's Test for Equality of Variances**							**95% Confidence Interval of the Difference**	
	F	sig	t	df	Sig (2-tailes)	Mean difference	Std Error Difference	Lower	Upper

Equal variances assumed	7.763	.009	15.090	34	.000	12.04389	0.79813	13.66588	10.42190
Equal variances not assumed			15.090	29.032	.000	12.04389	0.79813	13.67617	10.41161

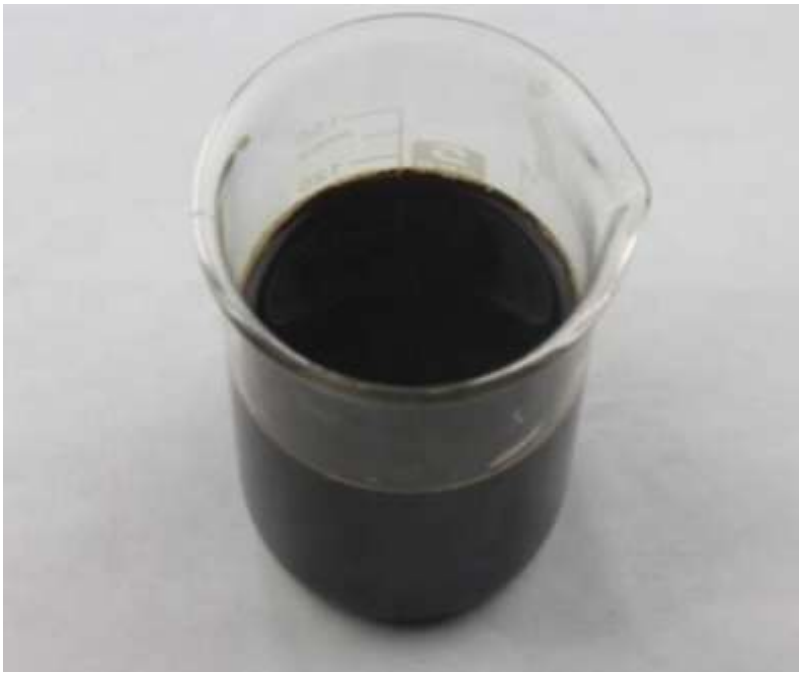

Fig 1 : Superplasticizer

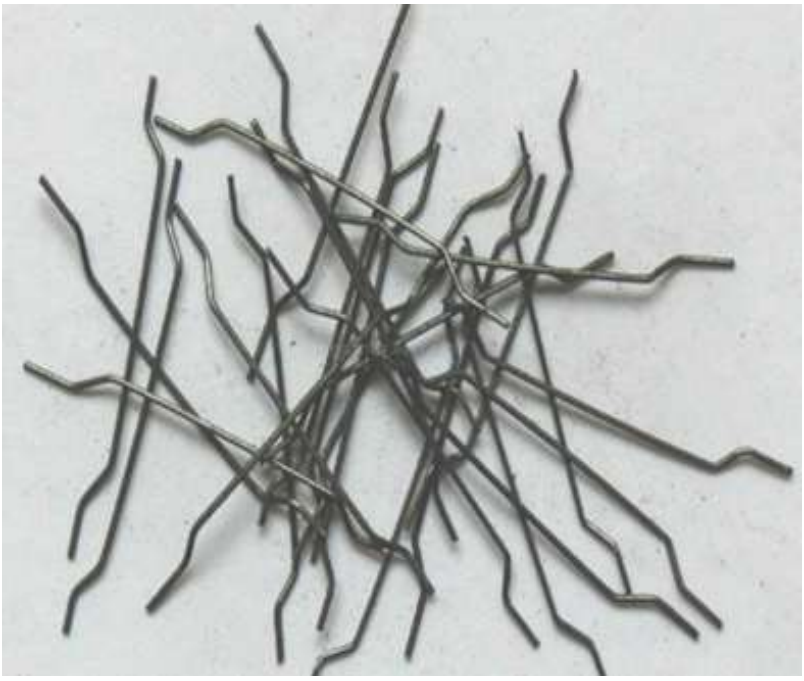

Fig 2 : Steel fiber

Fig 3 : Conventional Concrete Mix

Fig 4 : Universal Testing Machine

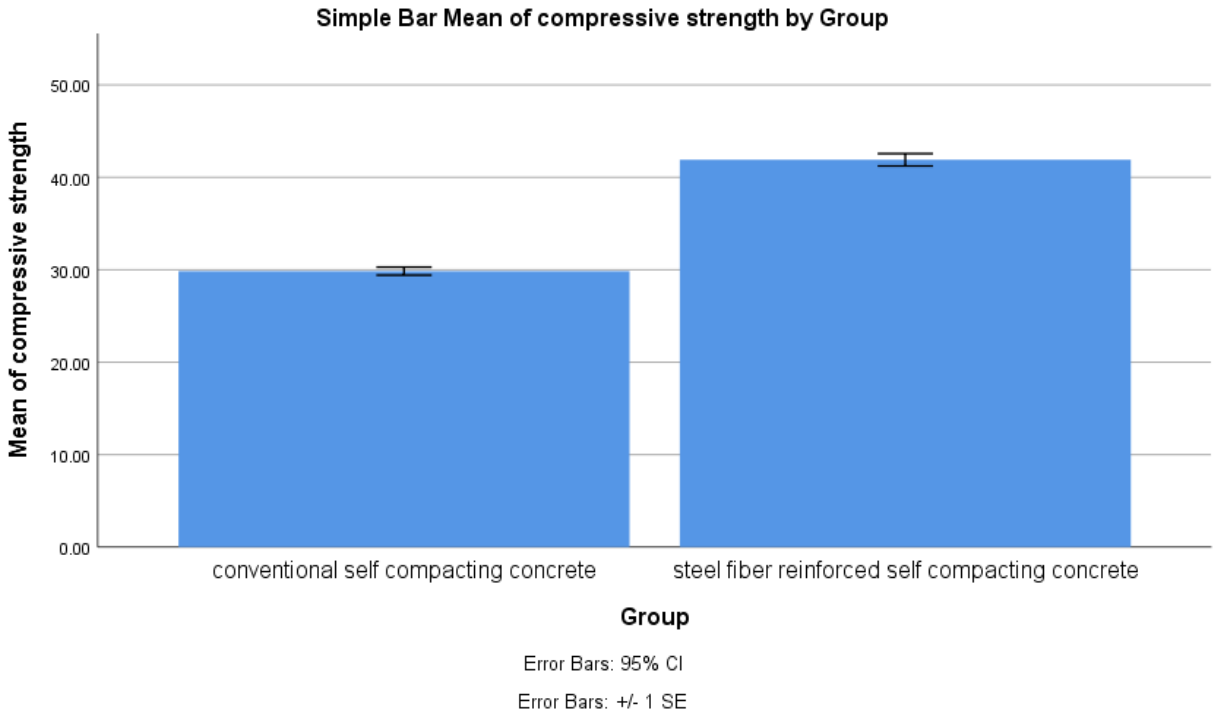

Fig 5: Bar graph indicating the comparison of mean compressive strength for conventional concrete and the steel fiber reinforced concrete with the addition of superplasticizer. Compressive strength value increases later in addition to superplasticizer. With the standard deviation of +/-1. X-axis: comparison between the conventional and steel fiber reinforced concrete y-axis: mean compressive strength ± 1 sd.