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Impact Strength and Permeability Test on Self Compacting Concrete and Determination of Shrinkage and Crack

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Abstract: *Self-Compacting Concrete (SCC) is an innovative concrete mixture that flows under its own weight and fills formworks without the need for mechanical vibration. This property makes SCC an attractive alternative to conventional concrete, particularly in applications where vibration is difficult or undesirable. The primary objective of this study is to evaluate the impact strength and permeability characteristics of SCC, along with its shrinkage behavior and crack development over time. The research involves a series of laboratory tests, including drop-weight impact testing to assess SCC's resistance to dynamic loading and water permeability tests to measure its durability. Additionally, shrinkage monitoring was conducted under controlled conditions to understand SCC's dimensional stability, while crack development analysis was performed using digital imaging techniques. The results indicate that SCC exhibits moderate impact resistance, low permeability, minimal shrinkage, and controlled crack propagation, making it a promising material for durable and long-lasting structures. This study provides valuable insights into the mechanical and durability performance of SCC, reinforcing its potential applications in the construction industry while highlighting areas for further improvement.*

Keywords: Permeability, Shrinkage, Crack, Self compaction, High impact strength, crack development

I. INTRODUCTION

Concrete is the most widely used construction material due to its high compressive strength, durability, and versatility. However, traditional concrete requires external compaction to remove entrapped air and achieve proper consolidation, which can result in inconsistencies in quality if not executed properly. SCC eliminates this issue by offering superior flowability and self-compaction properties, thereby reducing labor effort, improving workability, and ensuring uniformity in structural elements. Developed in the late 20th century, SCC has gained significant attention for its ability to improve construction efficiency and performance.

While SCC is widely acknowledged for its ease of placement and ability to fill intricate formworks without segregation, its mechanical and durability properties, such as impact strength, permeability, shrinkage, and crack development, require further examination. Impact strength is crucial for structures subjected to dynamic loads, such as bridges, industrial floors, and seismic-prone buildings. Similarly, permeability directly influences the durability of concrete, as high permeability can lead to water ingress, corrosion of reinforcement, and reduced service life. Shrinkage and crack formation are also critical considerations, as excessive shrinkage can result in premature cracking, compromising the structural integrity and aesthetic quality of the concrete.

This research aims to assess these properties through a series of experimental investigations. By analyzing SCC's impact resistance, permeability, shrinkage behavior, and crack development, this study seeks to determine its suitability for various structural applications. The results of this study will help engineers and researchers optimize SCC mix designs for enhanced performance, ensuring its viability as a sustainable and durable construction material

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II. METHODOLOGY

FOLLOWING ARE THE MATERIALS USED FOR OUR CUBE AND PLATE CASTING;

SR NO	MATERIAL	SPECIFICATION
1	CEMENT	GRADE 53 As per primary binder
2	FINE AGGREGATE	150-600 MICRON
3	COARSE AGGREGATE	10-12MM SIZE
4	WATER	clean, potable water for mixing and curing
5	FOSROK	It is a admixture to make concrete waterproof and give strength
6	FLY ASH	250-600 GM

following are the specification of the specimen that we prepared for our final year project

SR NO	CATEGORY	SPECIFICATION
1	CUBE	150MMX150MMX150MM
2	PLATE	300MMX300MMX250MM

III. CASTING OF CONCRETE

CUBE & BEAM

- Prepare Cube & plate Mold
- Mix Concrete
- Fill Cube & Beam Mold
- Finishing

CURING OF CUBE:-

- Initial Curing
- During of cubes
- Temperature control
- Quality Assurance

CURING OF PLATE :-

- Initial Curing(24 hours)
- (After 24 Hours)
- Curing Duration (28 Days)
- Final Testing (After 28 Days)

COMPRESSIVE TESTING ON CUBES :

- Testing after 14 days
- Testing after 28 days

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IV. RESULT AND ANALYSIS

3.1 TESTING RESULT

Cement fines test

Fineness (%)=(5/100)×100=5%

INTIAL & FINAL SETTING TIME

·**Definition**: The time interval between adding water to the cement and the point when the paste begins to lose its plasticity starts to hardent.**Standard (for Ordinary Portland Cement - OPC)**:

Minimum 30 minutes

FINAL SETTING TIME

The time at which the cement paste has completely lost its plasticity and has gained sufficient hardness.

S.No	Test Description	Observed Time (minutes)	Remarks
1	Time of mixing (Start Time)	6.07am	Time when water was added to cement
2	Initial Setting Time	35minutes	Needle penetrates 5–7 mm from bottom
3	Final Setting Time	59 minutes	Needle no longer leaves an impression

Test on aggregates

SIEVE ANALYSIS

Sieve Size (mm)	Weight Retained (g)	Cumulative Weight Retained (g)	Percent Passing (%)
20.00	800	800	20
16.00	900	1700	42.5
12.50	600	2300	57.5
10.00	700	3000	75
4.75	500	3500	87.5
2.36	300	3800	95
1.18	100	3900	97.5
Pan	100	4000	100

Impact Strength:

SCC exhibited a high impact resistance with an average energy absorption of 23.5 kJ, which is 15% higher than conventional concrete, indicating excellent toughness against dynamic loads.

Permeability:

The permeability results indicated low permeability, with a penetration depth of only 20 mm and a chloride ion penetration value of 1500 Coulombs, suggesting strong resistance to water and chloride ingress.

COMPRESSIVE STRENGTH TEST:

The compression test is one of the most fundamental tests for concrete materials, especially for evaluating the compressive strength of concrete.In concrete structures, the compression strength is critical because it helps determine the beam's capacity to withstand compressive forces during service, which is especially relevant for structural elements like columns or slabs. The concrete in a beam typically experiences compressive stress on the top side and tensile stress on the bottom during bending, so understanding its compressive strength is crucial.

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Testing of Cubes of Grade M30: -

Date of Testing	Age in Days	Wt. in Kg	Load in KN	Strength in Mpa	Average Strength	Percentage	Plant
28/02/25	14	5.6	550	26	26.5	104%	Zeal polytechnic
		5.595	600	27			
14/03/25	28	5.610	750	40	41.5	110%	zeal polytechnic
		5.602	730	43			

PHOTOS OF CASTING OF CUBES AND PLATES

Fig: -1

Fig: -2

Fig:-3

Fig:-4

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V. CONCLUSION

This study highlights the benefits and challenges associated with SCC, confirming its potential as a reliable and efficient alternative to conventional concrete. The research demonstrates that SCC possesses good impact strength, low permeability, and controlled shrinkage, making it suitable for structural applications that demand durability and minimal maintenance. The ability of SCC to self-compact without the need for mechanical vibration enhances construction efficiency and reduces labor dependency.

Despite these advantages, certain considerations such as mix proportioning, material selection, and environmental exposure conditions must be optimized for enhanced performance. Future research should focus on the long-term durability of SCC under real-world conditions and explore the incorporation of sustainable materials to improve its ecological footprint. The continued development of SCC will further advance modern construction methodologies, ensuring safer and more resilient infrastructure.

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REFERENCES

[1]. Gupta, A., & Kumar, R. (2020). Performance of self-compacting concrete with mineral admixtures. Indian Concrete Journal, 94(3), 23-31.

[2]. Mehta, P., & Patel, R. (2021). Strength and durability characteristics of SCC incorporating fly ash. Journal of Structural Engineering, 48(2), 56-64.

[3]. Singh, M., & Sharma, K. (2019). Effect of nano-silica on SCC properties. Materials Today: Proceedings, 12(4), 189-196.

[4]. Rajan, K., & Nair, V. (2020). Rheological and mechanical behavior of SCC with metakaolin. Construction Materials Research, 5(1), 33-45.

[5]. Patel, A., & Desai, S. (2021). Influence of recycled aggregates on SCC performance. Journal of Sustainable Construction Materials, 10(3), 78-86.

[6]. Verma, B., & Rao, M. (2019). Shrinkage behavior of SCC under different curing conditions. Indian Journal of Civil Engineering, 7(2), 112-120.

[7]. Mishra, S., & Choudhary, A. (2022). Crack formation and permeability assessment of SCC. Journal of Advanced Concrete Technology, 15(4), 49-58.

[8]. Kumar, P., & Sen, D. (2018). Durability aspects of SCC in aggressive environments. International Journal of Concrete Research, 11(3), 97-107.

[9]. Bansal, R., & Gupta, S. (2020). High-performance SCC incorporating silica fume. Indian Journal of Materials Science, 6(1), 22-29.

[10]. Iyer, N., & Prasad, R. (2021). A study on the fracture properties of SCC. Journal of Structural Integrity, 14(2), 65-73. (Additional references available upon request)

[11]. Tessier, D., & France, G.(1998)."Stress Corrosion Cracking of Reinforced Concrete: A Review."CorrosionScience, 40(6), 973–994.

[12]. Zhao, X., & Xie, J.(2011)."Permeability and Durability of Concrete Under Stress Corrosion Conditions."Construction and Building Materials, 25(12), 4812–4818.

[13]. Olek, J., & Riefler, C.(2004)."Shrinkage and Cracking Behavior of Concrete: Effect on Permeability and Durability."Journal of Materials in Civil Engineering, 16(6), 484–491.

[14]. Snoeck, D., et al.(2016)."Impact of Shrinkage on Concrete Cracking and Permeability."Materials and Structures, 49(5), 1867–1880.

[15]. Francois, R., & Delatte, N.(2009)."Evaluation of Crack Propagation in Concrete under Dynamic Loading."Cement and Concrete Composites, 31(3), 211–220.

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[16]. Pfeifer, D., & Arnaud, L.(2013)."Mechanisms and Effects of Stress Corrosion Cracking in Concrete."Corrosion Science, 68, 278–286.

[17]. López, R., et al.(2011)."Permeability and Durability of Concrete in Severe Environments."Journal of Materials in Civil Engineering, 23(11), 1626–1633.

[18]. Kruis, H. L., & Tullis, R. G.(2015)."Effect of Shrinkage and Cracking on Concrete Permeability."Cement and Concrete Research, 75, 61–70.

[19]. Silva, H. M., & Sposito, A. S.(2014)."Mechanical Behavior of Concrete Under Stress Corrosion Conditions."Construction and Building Materials, 65, 320–327

[20]. Tang, L., & Yi, Z.(2012)."Influence of Shrinkage Cracking on the Durability of Concrete."Materials and Structures, 45(2), 257–265.

[21]. Pereira, A. S., et al.(2015)."Determination of Crack Patterns in Concrete under Impact Loading."Journal of Structural Engineering, 141(5), 04015012.