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"Workability and Compressive Strength of Self-Compacting Concrete in Varied Water Environments: A Comprehensive Study"

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ABSTRACT: Self- compacting concrete (SCC) is a very fluid concrete and a homogeneous mixture. In this project, M40 grade of concrete mixes were made using IS 10262:2019 method. The ratio of concrete mix is (1:1.57:2.81). The fresh and harden properties of SCC was taken at the ages of 3,7 and 28 days. After experimental investigation, we can conclude that SCC was more workable than the normal concrete and it did not show any major reduction in compressive strength up to 2% replacement of Super plasticizer.
In this project, we used different types of water to cure concrete cubes for 3 days, 7 days, and 28 days. (Fresh Water, Saline water).

Keywords: Self Compacting Concrete (SCC), Compressive Strength.

I. INTRODUCTION

Self-Compacting Concrete (SCC) is a groundbreaking development in eliminating the need for vibration during compaction. It flows effortlessly to fill formwork and cover reinforcement, ensuring dense, homogeneous structures with superior durability. SCC's advantages include faster construction, reduced labour, and noise, making it increasingly popular worldwide. Its resistance to segregation, high flow ability, and homogeneous distribution of materials contribute to its economic, social, and environmental benefits. SCC's adoption is growing due to its ability to provide durable structures without the need for placing and compaction. Recently, a new innovative concrete named Self-compacting concrete (SCC) is made that does not require any vibration for these processes. It has a property to flow under its own weight, filling the complete formwork and achieving the full compaction, even in the presence of the congested reinforcement. It is dense, homogenous and has almost same engineering properties and durability as compared to the traditional vibrated concrete, when hardened. Moreover, the placement of SCC is faster and requires less labour. A cement is a binder, a chemical substance used for construction that sets, hardens, and adheres to other materials to bind them together.Self-compacting concrete offers a rapid rate of concrete placement, with faster construction times and case of flow around congested reinforcement. The fluidity and segregation resistance of SCC ensures a high level of homogeneity, minimal concrete voids and uniform concrete strength, providing the potential for a superior level of finish and durability to the structure. The improved construction practice and performance, combined with the health and safety benefits, make SCC a very attractive solution for both precast concreteandcivil engineering construction. Today durability of concrete has become the greatest concem of civil engineers. In the recent past, a few bridges have collapsed, highlighting the need for durability. Mandovi road bridge of Goa collapsed in 1986 and Poonam Chambers Bridge of Mumbai collapsed in 1997. Similarly, many other bridges like Thane Creek Road bridge Mumbai, Vasai creek road bridge Mumbai and Zuari bridge Goa have become distressed. All these bridges are on coastal regions, therefore, the needle of suspicion points to the corrosion of reinforcement. In most of the cases the primary reason for distress is not the quality of construction, but the lack of awareness of 'durability concept till recent years, our main concern was the strength of concrete indicated by cube strength. Now we have realised that in addition to cube strength, the durability of the structure is also an important. parameter which should be taken care of. In fact, the cube strength

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only indicates the strength of the structure at the time of construction whereas the durability is the long-term guarantee of same strength and servicesibility of the structure. Corrosion of reinforcement steel and carbonation of concrete are the main culprits responsible for the menace for durability.

II. MATERIAL

2.1Cement: Cement is the binding materials used in building and civil engineering construction. Cements are finely ground powders that, when mixed with water, set to a hard mass. Setting and hardening result from hydration, which is a chemical combination of the cement compounds with water that yields sub-microscopic crystals or a gel-like material with a high surface area. Because of their hydrating properties, constructional cements, which will even set and harden under water, are often called hydraulic cements.

2.2 Fine Aggregate: Fine aggregate is the essential ingredient in concrete that consists of natural sand or crushed stone. The quality and fine aggregate density strongly influence the hardened properties of the concrete. The concrete or mortar mixture can be made more durable, stronger and cheaper if you make the selection of fine aggregate on the basis of grading zone, particle shape and surface texture, abrasion and skid resistance and absorption and surface moisture.

2.3Coarse aggregate: Around 70% to 80% of the total volume of the concrete is made up from coarse aggregates. In lots of construction applications, coarse aggregates perform an integral role, for instance, as a granular base under a slab and as a component in a mixture, such as asphalt or concrete mixtures. Coarse aggregates are generally categorised as per their shape and size. Depending on the shape they can be round, irregular, angular, flaky, and elongated. Apart from that, depending on the coarse aggregate size you can have gravels.

Fig :1 Coarse Aggregate

2.4 Super plasticizers:

Super plasticizers (SPs) are also known as high range water reducers that are additive used in making high strength concrete. Plasticizers are chemical compounds that enable the production of concrete with approximately 15% less water content. Super plasticizers allow a 30% or more reduction in water content.

Fig: 2 Super plasticizers

III. RESULT &DISCUSSION:

3.1Fresh Properties of Concrete

3.1.1Workability Test:

For making concrete, we have used water-cement ratio 0.55 and also use superplasticizer replace to cement material by weight at 0%,1%, 1.5% and 2%. To check the workability of SCC use slump cone apparatus.

Table:1 Slump Cone Test Result

% Of Replacement	Slum Value (mm)
0%	65
1%	80

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1.5%	95
2%	120

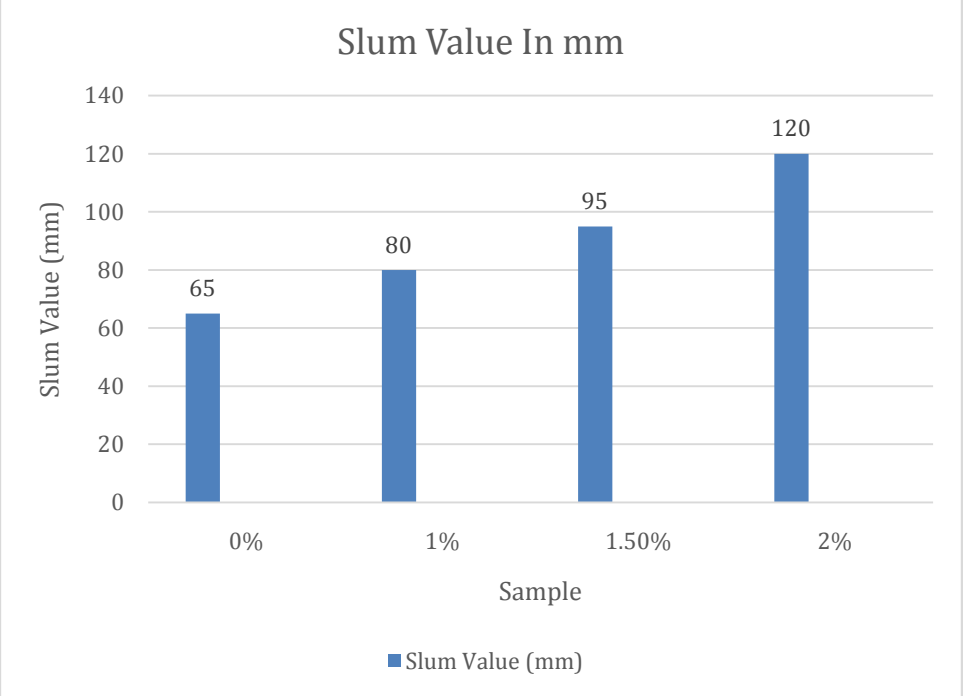

Fig:3 Slump Cone Test

The results indicate that when the super plasticizer is not replaced (0% replacement) in the concrete mix, it exhibits a lower level of workability. However, when 1% and 1.5% replacement of the super plasticizer is implemented, the concrete shows good workability. Additionally, when 2% replacement of the super plasticizer is applied, the concrete demonstrates a significantly higher level of workability.

3.2 Harden Properties:

3.2.1 Compressive Strength:

Concrete mix samples are tested for compressive strength on 3,7 and 28 day to ensure the mix design is as per calculations.

Table:2 Compressive Strength Result

Sr.No.	Type of water for curing	Compressive Strength (mpa) at various Days		
		3 Days	7 Days	28 Days
1	Normal Water	24.5	32.2	49.5
2	Saline Water	20.3	30.7	46.15

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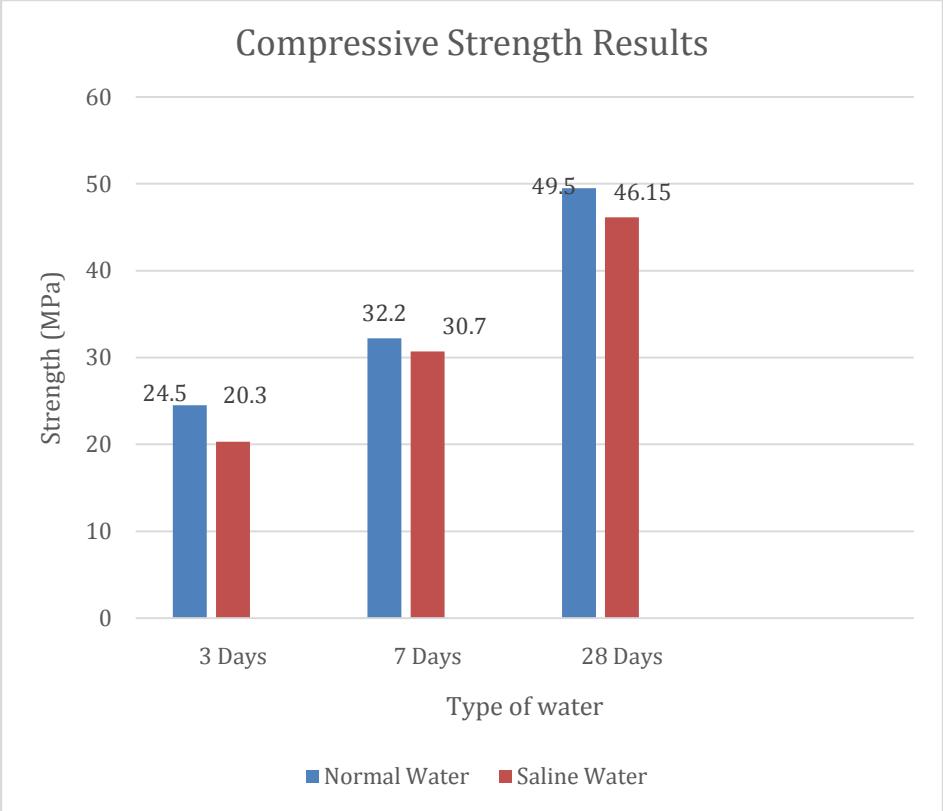

Fig:4 Compressive Strength Test

The mix design called for a target strength of 48 MPa, which all four samples successfully achieved after 28 days. Among the samples, M4, which incorporated a 2% replacement of superplasticizer, exhibited the highest compressive strength of 49.5mpa (Normal Water and 46.15(saline Water) after 28 days.

IV. CONCLUSION:

The study underscores the influence of super plasticizer replacement on both the workability and compressive strength of concrete. Lower replacements suffice for achieving acceptable workability, while higher replacements, particularly at 2%, significantly improve both workability and compressive strength.

These findings suggest the potential for optimizing concrete mix designs by adjusting the dosage of super plasticizer to meet specific project requirements, balancing workability and strength considerations effectively.

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