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A Comparative Study between Special Concrete and Conventional Cement Concrete in Bridges and Precast Structures

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Abstract: India is growing fast, especially in construction. Transportation is key for the country's progress. Bridges and elevated roads are crucial for smooth traffic. They need strong concrete to bear heavy loads for years. Regular concrete isn't always strong or long-lasting enough. This paper aims to make bridges and precast structures stronger, last longer, cost less, and be more eco-friendly. It compares normal concrete with special concrete. Special concrete has extra stuff like micro silica, polypropylene fiber, and bacillus subtilis. These boost concrete's strength and durability. The paper looks at how adding these things affects concrete's strength, how much water gets through it, and its tensile strength. Tests on different types of concrete show that special concrete is much better than regular concrete. This study looks closely at these special ingredients and how they make concrete better. It shows how each one helps concrete become stronger, last longer, and improve overall quality.
Keywords: Concrete, Cracks, Strength, Durability, Self-healing.

I. INTRODUCTION

India is growing fast, especially in construction. Bridges and elevated viaducts are super important for keeping traffic flowing smoothly in any country's transportation system. When it comes to building bridges, the precast method using concrete is the top choice. Bridges have to handle big loads for a long time, so they need really strong, durable concrete. Nowadays, there's a big demand for high-strength concrete, especially for making bridges and viaducts that can handle a lot of weight.

One big problem with bridges is that they often develop cracks over time. These cracks let water and salts seep in, which causes corrosion and makes the concrete weaker. Regular concrete isn't strong enough for these heavy bridges and can't keep them strong for long. That's why there's a need to develop a special kind of concrete just for bridges. This special concrete has to be tough enough to handle heavy loads and make sure the structures last a long time without getting weak.

II. MATERIAL AND METHODS

A. Special Concrete

Special ingredient concrete combines high-quality materials to enhance standard concrete, ensuring it meets the strength and durability needs of heavy structures like bridges and precast components. It's specially engineered for these purposes to ensure smooth functionality. One remarkable feature is its ability to self-heal, where cracks are filled with calcite in moist conditions. Additionally, micro silica boosts compressive strength and reduces water permeability due to its fine particles. Polypropylene fiber integration enhances concrete integrity, improving flexural strength and reducing micro-cracks.

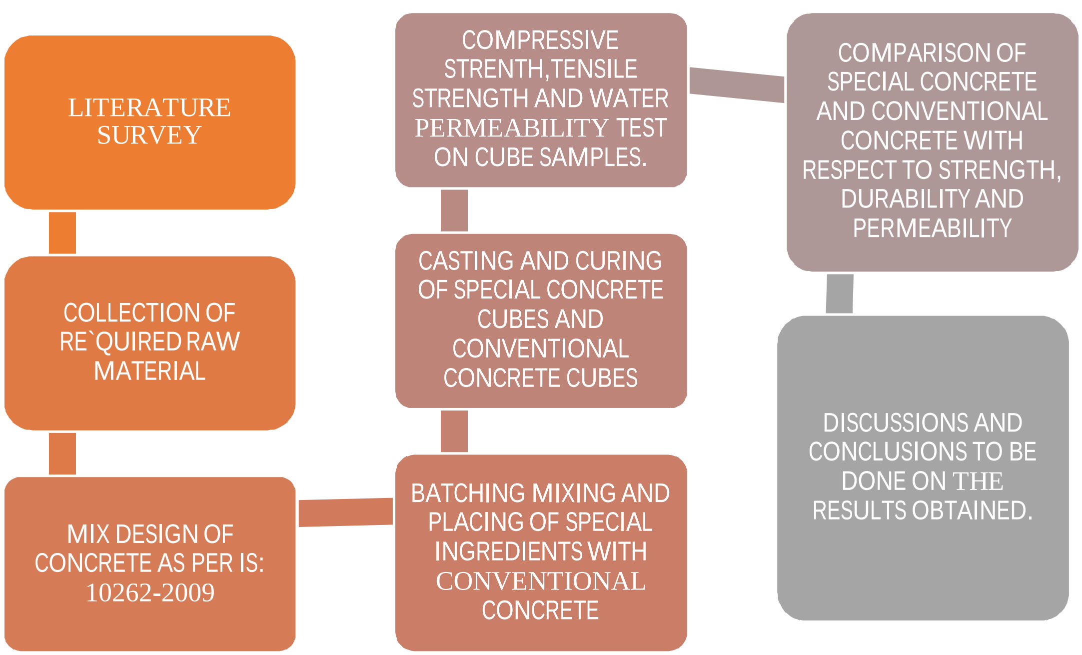
MATERIAL	PROPERTIES
Cement	• OPC – 53 Grade (IS:12269-1987)
Fine Aggregate	• River sand passing through 4.75mm IS sieve (IS:383-1987). • Specific gravity of sand - 2.31
Coarse aggregate	• Crushed stone of max. size 20mm and retained on 4.75mm. • Specific gravity of aggregate – 3.13
Water	• Potable water free from silt, salt, oil and greases.
Bacillus Subtilis	• Microorganism bacteria from variety bacillus species ‘Bacillus subtilis’ is bar molded structure an intense defensive end spores permitting it to endure outrages environmental condition.

	• It can acclimate to antacid (alkaline) state of concrete for creation of calcium carbonate. • Crystallization of calcium carbonate minerals heals the pores and crack in concrete.
Polypropylene fiber	• Fibers improve rigidity, flexural quality and durability of concrete by means of improving post-cracking, ductility, and control cracking. • For fiber reinforced concrete several fiber materials in various shape and sizes have been developed. • Among these fibers the polypropylene fibers has been most successful commercial application in concrete. • Unique properties of polypropylene fiber make them suitable for reinforcement in concrete.
Micro silica	• Silica rage is an exceptionally fine non- crystalline sio2, is a result of Ferro-silicon industry. • It is made at temperature of around 2000 deg.C and its molecule size is very finer than cement. Hence, can be acts as an excellent pore filling material. • It can be utilized in various extent ranging from 5% to 10% in concrete as a solid blend. • Micro silica emerges as one of the best material to blend with concrete to improves the compressive strength of concrete.

III. METHODOLOGY

In our experiment, we made two types of concrete: regular M30 grade and a special one with added ingredients. We followed specific guidelines for both. We mixed them together and let them harden. After 28 days, we tested cubes made from each type to see how strong they were. This helped us decide if the special concrete could be used for building bridges. By comparing the results of the tests, we could tell which type of concrete would be better for building sturdy bridges that can handle heavy loads and last a long time.

IV. EXPERIMENTAL PROCEDURE



PROCEDURE	PROPERTIES
1. Mix design	• Concrete mix design of grade M30 as per IS:10262-2009.
2. Test on cement	• Normal consistency test • Initial and final setting time test • Specific gravity test • Fineness test
3. Test on aggregate	• Water absorption test • Sieve analysis test • Water content test • Specific gravity test
4. Addition of special concrete	• Special ingredients (bacillus subtilis, poly- propylene fiber, microsilica) were batched, mixed and placed in conventional concrete.
5. Slump test	• Slump cone test is carried out of freshly prepared concrete to determine the workability of concrete.
6. Cube casting	• Concrete cubes specimen of special and normal concrete were casted separately as per mix design.
7. Curing	• 28 days water curing were carried out of cube specimen.
8. Compression test	• Compressive strength is measure of each cube specimen after completion of curing period by compression testing machine.
9. Tensile test	• Tensile strength were measured of both sample by testing the cylindrical concrete specimen of diameter 150mm and length 300mm.
10. Water permeability test	• Water permeability test measures the depth of water penetrated under pressure.
11. Results comparison	• Test results of special concrete specimen were compared with conventional concrete to evaluate the suitability of concrete.

V. RESULTS

A. *Compressive strength Test*

Table-1: Compressive strength test

DESCRIPTION	SAMPLE - A	SAMPLE - B
BACILLUS SUBTILIS (%)	0	5
MICRO SILICA (%)	0	10
PP FIBER (%)	0	1
COMPRESSIVE STRENGTH (N/mm^2)	32.23	38.76
REMARKS	Conventional concrete	Special concrete

B. *Tensile Strength Test*

Table-2: Tensile strength test

DESCRIPTION	SAMPLE - A	SAMPLE - B
BACILLUS SUBTILIS (%)	0	5
MICRO SILICA (%)	0	10
PP FIBER (%)	0	1
Tensile STRENGTH (N/mm^2)	3.42	4.38
REMARKS	Conventional concrete	Special concrete

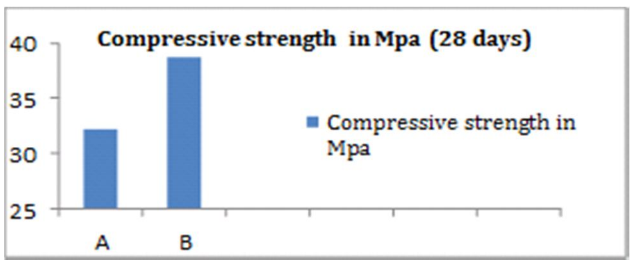
C. *Water Permeability Test*

Table-3: Water Permeability test

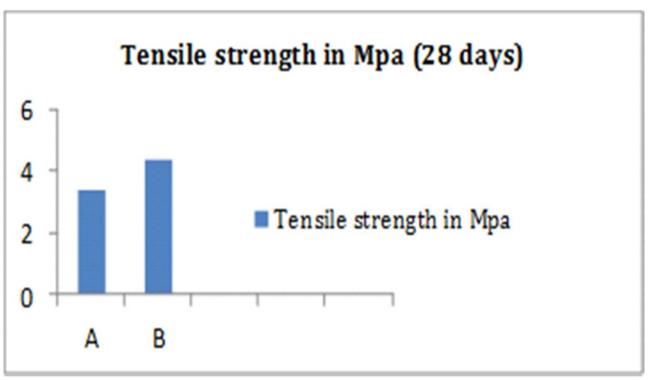
DESCRIPTION	SAMPLE - A	SAMPLE - B
BACILLUS SUBTILIS (%)	0	5
MICRO SILICA (%)	0	10
PP FIBER (%)	0	1
WATER PENETRATION DEPTH (mm)	4.4	2.9
REMARKS	Conventional concrete	Special concrete

VI. GRAPHICAL REPRESENTATION

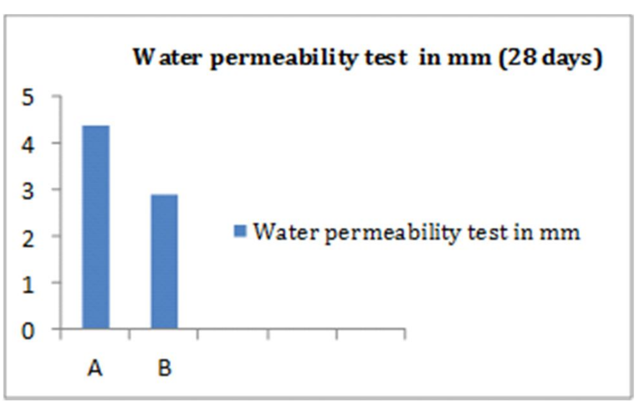
A. *Compressive Strength Test*



B. *Tensile Strength Test*



C. *Water Permeability Test*



VII. DISCUSSION

In this study, we improved the engineering properties of regular concrete by adding special ingredients, enhancing strength, durability, and structure integrity. Our main goal was to create a special concrete suitable for bridges and precast structures, comparing it to regular concrete. Testing cubes from both types showed the special concrete had significantly higher compressive strength than regular concrete of the same grade. Tensile strength and water permeability tests also favored the special concrete. However, the special ingredients are more expensive, raising the initial cost of the structure. Despite the higher cost, the improved properties make the special concrete a promising choice for long-lasting and robust structures like bridges.

VIII. CONCLUSION

Adding special ingredients to regular concrete greatly boosts its strength and durability. Experimental studies confirm these ingredients significantly enhance concrete properties, making it ideal for heavy structures like bridges and precast units. This enhanced concrete shows improved compressive strength and structural durability, crucial for supporting heavy loads and ensuring long-term stability in such constructions.

It was found that addition of combination of these ingredients increases the compressive strength by 20%, increases tensile strength by 28% and decreases water permeability by 34% as compared with conventional concrete of M30 grade. From complete comparative study it can be said that the special concrete found feasible for heavy bridge and precast concrete structure.

REFERENCES

[1] Aditya Dhagat, Manav Mittal; “Effect of Micro silica and fly ash on the strength of concrete” International Journal of Science Engineering and Research (IJSER) Volume 4, Issue 8, 2013 ISSN 2229-5518.
[2] Ajay Verma, Chandak Rajeev, and R. K. Yadav "Effect of micro silica on the strength of concrete with ordinary Portland cement." Research Journal of Engineering Sciences (RJES) ISSN 2278 (2012): 9472.
[3] Akshaykumar hirapara, Brijesh ramani, Kaushal kathiriya, Jatinkumar patel; “Use of Micro silica in concrete” International Research Journal ofEngineering and Technology (IJIRST) Volume 2 | Issue 11 |.
[4] Alavi Nia .A ., M. Hedayatian ., and M. Nili., “An experimental and numerical study on how steel and polypropylene fibers affect the impact resistance in fiber-reinforced concrete”, International Journal of Impact Engineering, January 2012, pp.62-73.
[5] Amarkhail, N. (2015),”Effect of micro silica fume on high strength concrete”, International Journal of Technical Research and Applications, 13-19.
[6] Amsa M, Ariyannan P; “Experimental study on polypropylene fiber reinforced concrete” International Research Journal of Engineering and Technology (IRJET) Volume: 05 Issue: 04, Apr-2018.
[7] Amudhavalli, N. K. & Mathew, J. (2012). “Effect of silica fume on strength and durability parameters of concrete”, International Journal of Engineering Sciences & Emerging Technologies, 28-35.