Experimental Investigation on Properties of Concrete by Using Different Types of Water

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Abstract— The impact of several types of mixing water on the compressive, flexural, and tensile strength of concrete was explored in this study. The research focused on the impact of varied water quality on concrete compressive strength. The investigation focused on a concrete mix of M30 grade with a water cement ratio of 0.4. Water samples were obtained from several sources on campus, including bore well water, waste water, well water, sea water, and mineral water (packed drinking water), and utilised to cast 150mm×150mm×150mm concrete cubes and 150mm×150mm×750mm concrete beams. The cured cubes and beam were crushed after 7 and 28 days to determine compressive, flexural, and tensile strength The results revealed that the compressive strength of concrete cubes formed using mineral water, tap water, well water, and waste water increased with time and had little fluctuation. The effects of other contaminants, such as silt and suspended particles, on concrete strength were also looked at. Chemical analysis was performed on water samples from five different sources to determine their chemical composition. These water samples were used to make 150mm cube samples. The cubes were put through a compressive strength test, and the results were analysed statistically. The findings revealed that the kind of water used in concrete mixing had a considerable influence on the final concrete's compressive, flexural, and tensile strength. It ended by recommending that if tap water is inadequate, river water may be utilised for mixing. Other attributes like durability and shrinkage, on the other hand, should be addressed before usage.

Keywords: Properties of Concrete, Different Types of Water

I. INTRODUCTION

Cement is one of the most energy-intensive structural components in concrete, making it one of the most durable construction materials. The most important factors to consider when it comes to mixing water quality are its performance in both the fresh and hardened states. In the manufacture of concrete, the quality of the water is critical. Water impurities can impact the cement's setting time as well as the concrete's strength and durability. Water's chemical contents may play an active role in chemical processes, influencing the setting, hardening, and strength development of concrete. Furthermore, health concerns about the proper management of such water must be considered. Water's appropriateness can be determined based on previous service records or by testing it against performance standards such as setting times and compressive strength and durability tests.

For combining water with its constituents, such as total alkalis, chloride sulphate, and so on, limits are set. Reclaimed water, bore well water, well water, mineral water, waste water, and salt water all benefit from biological treatment and pathogen reduction. By removing the lime and alumina from cement, pure water decomposes the set cement compounds. This leaching activity continues and gradually slows down until the water is able to travel through the concrete mass constantly. There are a variety of current and new water sources that might be used to substitute potable water in concrete production completely or partially. It contains bore well water, well water, cleaned sewage water, and sea water, among other things. Water officials are working to locate new sources of water due to water shortages and scarcity in many parts of the world, including India, particularly in Maharashtra regions like Latur. Treated effluents are also utilised for irrigation in these nations, as well as concrete mixing, curing, and aggregate washing. If the water does not include brackish stuff, it can be used from a stream, river, or even the sea. One of the realities is that desalinated water is mixed with brackish ground water in dry places.

A. Objectives of the Project:

- Examine the strength of concrete by substituting different types of water for the water used to make regular concrete.
- Examine the effects of substituting different types of water for standard water.
- Find a substitute for regular water and test the strength of concrete using various types of water as well as V.S.I. sand.
- Determine the suitability of various types of water as a concrete replacement for regular water.
- Find a replacement for fundamental materials that have been used in building for many years.
- Research the characteristics of fresh and hardened concrete when produced with various types of water.

B. Significant Of the Study:

- The use of various forms of water in concrete is a relatively recent invention in the field of concrete technology, and much study is required before this material can be employed in concrete construction.
- The use of various types of water in concrete to increase its strength.
- For various water samples, an experimental investigation must be done.

II. MATERIAL USED

1) Cement: Locally available PPC 53Grade cement is used.
2) Fine Aggregate: Locally available VSI sand is used, with specific gravity 2.60, water absorption 2%

3) Coarse Aggregate: Locally available coarse aggregate from quarry is used, maximum size 20 mm, with specific gravity 2.68, water absorption of 0.705%
4) Water: Different types of water was used for the experimentation such as borewell water, well water, mineral water, waste water, sea water etc.

III. PHYSICAL PROPERTIES OF MATERIAL USED

A. Cement:

Physical properties of cement are as follows;

S. No	Property	Test results
1	Normal consistency	31.5%
2	Specific gravity	3.15
3	Initial setting time	130-160 minutes
4	Final setting time	230-260 minutes

Table 1: Physical properties of Cement

B. Fine Aggregate:

Physical properties of Fine Aggregate are as follows;

S. No	Property	Test results
1	Specific gravity	2.60
2	Fineness Modulus	2.68
3	Grading Zone	II

Table 2: Physical properties of Fine Aggregate

C. Coarse Aggregate:

Physical properties of Coarse Aggregate are as follows;

S. No	Property	Test results
1	Size	20mm
2	Specific gravity	2.68
3	Fineness modulus	7.20
4	Total water absorption	0.705%
5	Shape	Angular

Table 3: Physical properties of Coarse Aggregate

D. Water:

Properties of different types of water are as follows;

Sr. No	Property	BWT	WW	WSW	MW	SW
1	Ph	8.6	6.8	10.8	7.5	6.69
2	Tds(mg/l)	570	250	-------	380	3500
3	Total hardness (mg/l)	330	680	-------	330	330
4	Nitrates (mg/l)	34	74	0.5	2.3	15.51
5	Chloride (mg/l)	150	175	220	344	18379
6	Total suspended solids	------	-----	270	-----	530

Table 6: properties of water

IV. EXPERIMENTAL PROGRAM AND SETUP

The main aim of this experimentation is to study the effect of using different types of water in concrete and check its compressive strength, flexural strength and workability of concrete. The experimental programme is divided in four phases.

1) Concrete mix design is done as per IS 10262- 2009 for M30.
2) Casting of cubes and beams.
3) Curing of cubes and beams for 7 days and 28 days.
4) Testing of cube in compression testing machine and Beam are tested in flexural testing machine.

Each test result plotted in the Figures or given in the Tables is the mean value of results obtained from at least three specimens.

V. MIX DESIGN

Concrete mix design is done as per IS 10262-2009 for M30 grade of concrete. Material quantity required for $1m^3$ volume of work are tabulated in table no.5

S. No	Item	For 1 m^3 Concrete	Mix Ratio
1	Cement	350.00 Kg	1
2	Fine aggregate	664.00 Kg	1.992
3	Coarse Aggregate	1271.00 Kg	3.631
4	Water	140.00 Lit.	0.42

Table 7: Material Quantity for 1 m^3

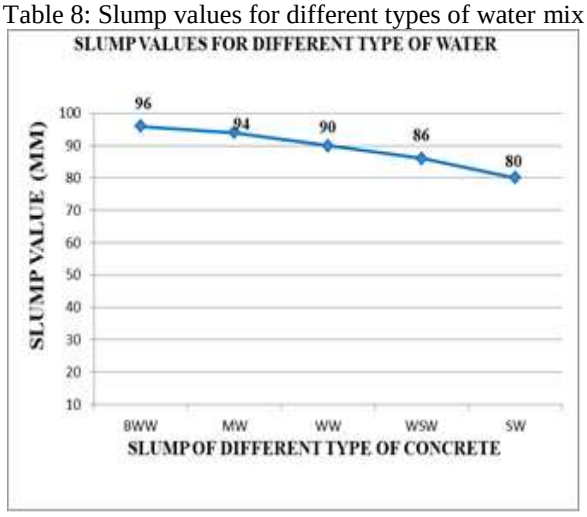
VI. WORKABILITY

The workability of M30 grade of concrete is measured by widely used empirical test i.e. slump test with w/c ratio 0.40 for addition of different types of water.

Values obtain for different types of water mix is as show in following Table 6

Different types of water	Slump value(mm)
Bore well water	96
Well water	94
Mineral water	90
Waste water	86
Sea water	80

Table 8: Slump values for different types of water mix



Graph 1: Slump Value

VII. EXPERIMENTAL METHODOLOGY

A. Compressive Strength Test:

At 7 and 28 days, compressive strength is assessed. The results show that the compressive strength of different forms

of water varies as we utilise them. That implies we can make concrete with bore well water or well water,mineral water.

B. Flexural Strength Test:

All beam specimens are subjected to two-point loading to determine their flexural strength. A hydraulic jack and a load cell were used to apply the load. A loading beam was used to transfer the load from the jack to the main specimen. The responses were handled by two roller supports, hence the loading states were two incremental bending point loads. Dial gauge is used to measure the deflection at the web's centre.

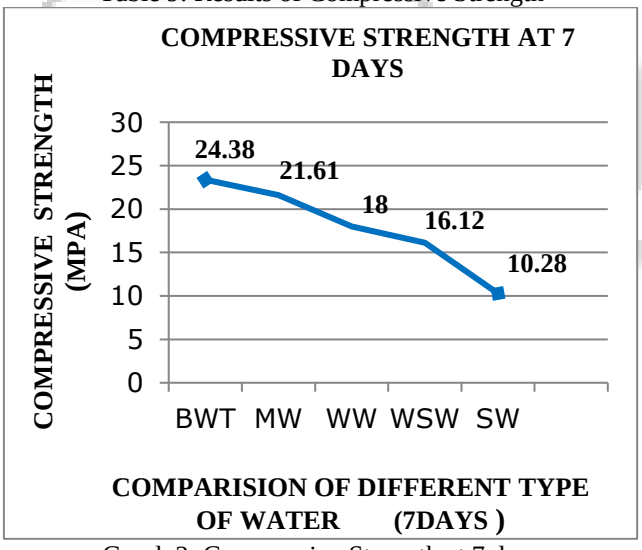
$$F_r = \frac{P \times L}{b \times d^2}$$

VIII. EXPERIMENTAL RESULTS

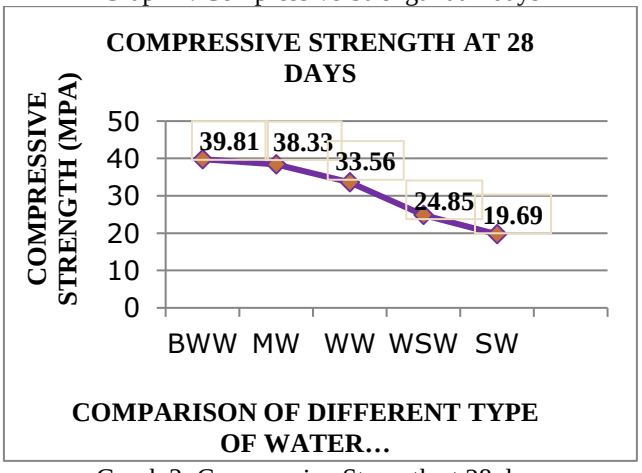
A. Compressive Strength Test:

Type of water	Compressive strength at 7 days(N/mm^2)	Compressive strength at 28 days(N/mm^2)
Bore well water	24.38	39.81
Well water	18.00	33.56
Mineral water	21.61	38.37
Waste water	16.12	24.85
Sea water	10.28	19.69

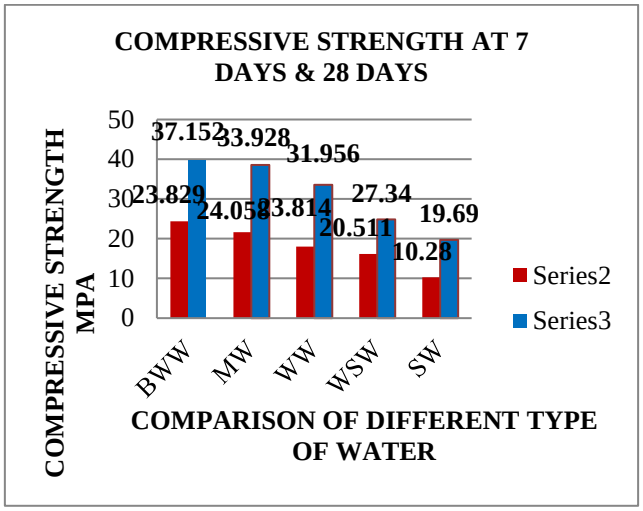
Table 9: Results of Compressive Strength



Graph 2: Compressive Strength at 7 days



Graph 3: Compressive Strength at 28 days

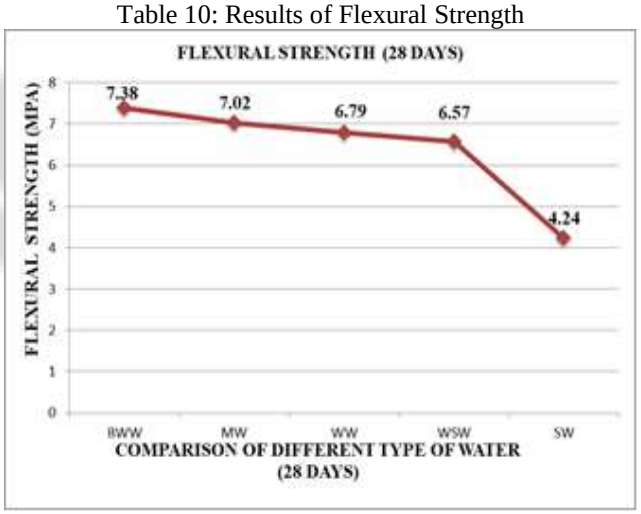


Graph 4: Compressive Strength 7 days at 28 days

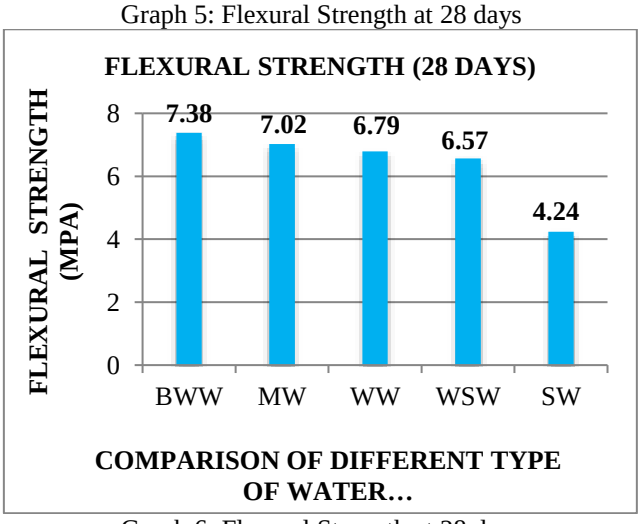
B. Flexural Strength Test:

Type of water	Flexural strength at 28 days
Bore well water	7.38
Well water	6.79
Mineral water	7.02
Waste water	6.57
Sea water	4.24

Table 10: Results of Flexural Strength



Graph 5: Flexural Strength at 28 days



Graph 6: Flexural Strength at 28 days

IX. CONCLUSION

Based on results and observation made in experimental research study. The following conclusions are drawn.

1) It's worth noting that the workability levels for various types of water varies.
2) The results show that concrete made with various types of water samples, such as bore well water, well water mineral water, waste water, and sea water, has 7- and 28-day compressive strengths of well water and mineral water that are equal to or greater than 90% of the strength of reference specimens made with clean water (bore well water) for M30 grade of concrete. (With the exception of the waste water and sea water specimens for the 28-day period.)
3) The compressive strength of concrete cubes created using packed drinking water is 13.5 percent higher than that of waste water cubes.
4) According to the results of the tests, the concrete made with questionable water sample, i.e. waste water sample with a constant water – cement ratio of 0.4, had about 7% lower compressive strength for 7 days, 15% lower compressive strength for 28 days, and 1% lower flexural strength for 28 days than the reference specimen.
5) According to the results of the tests, a well water sample with a constant aggregate-cement ratio of 5.52 had roughly 7% lower compressive strength after 7 days, 6% lower compressive strength after 28 days, and 1% lower flexural strength than a reference specimen.
6) When compared to other specimens, the concrete prepared with sea water had somewhat lower 28-day compressive and flexural strength. Compressive and flexural strength are 20 percent lower than the reference specimen.
7) Additionally, recovered waters from cities, mining, and a variety of industrial processes can be properly utilised as concrete mixing fluids.
8) It is feasible to increase the compressive and flexural strength of concrete by using well water.

ACKNOWLEDGEMENT

It gives me great pleasure in bringing out the project report entitled “Experimental investigation on properties of concrete by using different types of water” Though the following dissertation is an individual work, I could never have reached the heights or explored the depths without the help, support, guidance and efforts of lots of peoples. It gives the immense pleasure, to express my sincere and heartfelt gratitude to everyone who has contributed towards making my project work a memorable experience.

I express a deep sense of gratitude and appreciation and indebtedness to my project guide Prof. G.N. Shete & Co-ordinator of M.Tech (Structure) Asst. Prof. A.A. Hamane and Head of the Department Prof. Deshpande S.G. for their constant support and motivation throughout the project work. It was their interest and support which has leads me to this stage.

It is a genuine pleasure to express my deep sense of thanks and gratitude to my mentor, philosopher Principal Prof. B.V. Dharne, for their encouragement and motivation throughout the project work.

My sincere thanks to the Civil Engineering Staff for offering me valuable suggestions and time to time support at the time of need.

I am extremely thankful to my friends for providing me necessary technical suggestions during my project report.

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