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Experimental Investigation on the Compressive Strength of Concrete by Curing With Saline Water and Normal Water

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Abstract: ***The main purpose of this study is to acknowledge and be aware of the dissimilarities of compressive strengths in concrete after being cured by normal and as well as by saline water. Here we will be figuring it out whether there is increment or decrement in compressive strengths and will also be determining whether salinity of water does have any effect on it! By doing this study we can deduce or arrive to a conclusion that how the civil infrastructures nearest to the sea coast would be affected and which measures should be adopted at that condition where there is scarcity of normal water and how can we diminish the consumptions of fresh water in curing using alternatives likes saline water or is there going to be any deleterious impact on concrete we will be witnessing that. Presently, concrete is most widely used construction material due to its good compressive strength and durability. It is estimated that the consumption of concrete in the world is around 12 billion tons every year. The strength and durability of concrete will be fully developed only if it is cured. Curing of concrete structure is essential if it is to perform the intended function over the design life of the structure. Concrete is needed to be provided with moisture for a minimum period of 28 days for good hydration and to attain desired strength. Any laxity in curing will badly affect the strength and durability of concrete. An area like sea side, or the area where saline water is available for the curing, is a scarcity of pure water where curing with normal water is difficult and in cases where large areas like pavements have to be cured.***
Keywords: Curing, Durability, Strength, Salt, Concrete, Saline water, Compressive Strength

I. INTRODUCTION

Concrete is major building material used in construction. Concrete is used in large quantities due to its excellent structural performance and durability. Concrete is used for numerous purposes in construction such as construction of buildings, dams, foundations, highways, parking structures, pipes, and poles. Also, the use of concrete offshore drilling platforms and oil storage tanks is already on the increase. Concrete piers, decks, break-water, and retaining walls are widely used in the construction of harbors and docks. Floating offshore platforms made of concrete are also being considered for location of airports, power plants, and waste disposal facilities in order to relieve land from pressures of urban congestion and pollution. It is very tough to find an option for concrete in construction, which is durable and economic. The durability of concrete is generally regarded as its ability to resist the effects and influences of the environment, while performing its desired function. Concrete is a composite material composed mainly of water, aggregate, and cement. Water is an important ingredient of concrete as it actively participates in chemical reaction with cement. Proper curing of concrete structures is important to meet performance and durability requirements. In conventional curing this is achieved by external curing applied after mixing, placing and finishing.

II. DIFFERENCES BETWEEN FRESH WATER AND SALINE WATER

1) *Salinity:* Salt water contains salt or sodium chloride fresh water may contain small amounts of salts , but not enough to be considered salt water. Ocean water has an average salinity of 3.5 % , That means there 35 grams of salt dissolved in every liter of sea water.
2) *Density:* Salt water is denser than fresh water due to the sodium chloride dissolved in it . That means a specific volume of salt water is heavier than the same volume of fresh water.
3) *Freezing Point:* Both the freezing and boiling points of ocean water differ from fresh water , but only the freezing point is of concern in nature.
4) *Tonicity:* Salt water is hypertonic(having a higher osmotic pressure than a particular fluid) where as fresh water is hypotonic.(having lower osmotic pressure than a particular fluid) In order to ensure desired compressive strength, RCC fencing poles should be compacted with the help of plat from vibrator. Surface shall be uniform and free from voids. The concrete cover over the reinforcement shall not be less than 15mms.

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III. MATERIALS

The detail of various required materials for the testing are following:-

1) *Cement:* PPC (Ultratech cement) was used of 53 grade.
2) *Coarse Aggregate:* Crushed granite stone aggregate size 40mm(60%) & 20mm(40%) were used confirming to IS 383-1970 we used. The specific gravity were found to be 2.83 for 20mm size of particle and 2.72 for 20mm size of particle.
3) *Fine Aggregate:* The fine aggregate used in this investigation those sand which passing through 2.36mm sieve(2.36mm passing amd 1.8mm retain) with specific gravity of 2.65. IInd as per Indian standard specification.
4) *Saline Water:* moderate saline water is used. This means that every kilogram (roughly one liter by volume) of saline water has approximately 35 grams of dissolved salts (Sodium (Na^+) and Chloride (Cl^-) ions). The cubes were prepared using 35 of salts in one liter of water.
5) *Fresh Water:* Ordinary clean portable water free from suspended particles and chemical substances was used curing of concrete cubes cast with fresh water.



IV. METHODOLOGY

A. *Experimental System*

To investigate the effect of salt water on compressive strength of concrete, Concrete cubes were made, in which half of concrete cubes cast and cured with fresh water and remaining Concrete cubes were cast and cured with salt water. The amount of salt (NaCl) used in water was kept as 35g/liter. The concrete cube size measuring 150×150×150 mm in dimension was used. The batching of the concrete was carried out by weight. Mixture was proportioned for a target cube strength of 25N/mm2 and had a cementations material content of 372kg/m3, a fine aggregate content of 669.68kg/m3, a coarse aggregate content of 1230.6kg/m3 and a water cement ratio of 0.45. When the concrete was properly mixed using the salt water and fresh water respectively, the concrete cubes mould were filled to one third of their height and compacted 25 times. The cube mould were later filled to two third of their height and finally filled completely. In each of the layer, the concrete cubes were compacted 25 times respectively. The concrete cubes were cast and cured for 7, 14 and 28 days respectively.

V. COMPRESSIVE STRENGTH OF CONCRETE AT VARIOUS DURATION

Duration	Strength
1	16%
3	40%
7	65%
14	90%
28	99%

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VI. MATERIAL CALCULATION

Water cement ratio - 0.5%
Assumption for 1cum concrete:-
1 bag of cement - 50kg
weight of cement/density - 1440kg/m^3
Weight of water - 0.5X50 = 25kg or liters
#Means 1bag of cement required 25liters of water.
For M25 - (1cum)
Mix ratio- 1:1:2=4
Conversion wet vol. to dry vol.-1X1.54(54% of wet vol =1.54)
Volume of cement=1/4X1.54=0.38m^3
Weight of cement=0.38X1440=554.4kg
No. of bags=554.4/50=11.088~12
Weight of water=25X12=300kg or litres



VII. RESULT AND DISCUSSION

A. (Curing By Normal Water)

Cube	load in CTM in KN	Compressive strength value =(LOAD/AREA) in N/mm2	Cross check whether it's passed/failed
1	670 KN	670 x 10^3/(150x150) = 30.66	(25x65)/ 100 =16.25=17(P)
2	450KN	450 x 10^3 / (150x150) = 20	(25x65)/ 100 =17 (P)
3	490KN	490 x 10^3 /(150x150) = 21.77	(25x65)/ 100 =17 (P)

(7DAYS)

Cube	load in CTM in KN	Compressive strength value =(LOAD/AREA) in N/mm2	Cross check whether it's passed/failed
1	670 KN	670 x 10^3 /(150x150) = 29.77	(25x90)/100 =22.5 (P)
2	680 KN	680 x 10^3 / (150x150) = 30.22	(25x90)/100 =22.5 (P)
3	690 KN	690x 10^3 /(150x150) = 30.66	(25x90)/100 =22.5 (P)

(14 DAYS)

Cube	load in CTM in KN	Compressive strength value =(LOAD/AREA) in N/mm2	Cross check whether it's passed/failed
1	730 KN	730 x 10^3 /(150x150) = 32.44	(25x99)/100 =24.75~25 (P)
2	740 KN	740 x 10^3/ (150x150) = 32.88	(25x99)/100 =24.75~25 (P)
3	710 KN	710 x 10^3/(150x150) = 31.55	(25x99)/100 =24.75~25 (P)

(28 DAYS)

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B. (Curing Saline Water)

Cube	load in CTM in KN	Compressive strength value =(LOAD/AREA) in N/mm2	Cross check whether it's passed/failed
1	400 KN	400 x 10^3 /(150x150) = 17.77	(25x65)/100 =16.25 (P)
2	360 KN	360 x 10^3/ (150x150) = 16	(25x65)/100 =17 (F)
3	410 KN	410 x 10^3/(150x150)=18.2	(25x65)/100 =17 (P)

(7DAYS)

cube	Load in CTM in KN	Compressive strength value =(LOAD/AREA) in N/mm2	Cross check whether it's passed/failed
1	500 KN	500 x 10^3/150x150 =22.22	(25 x 90)/100=22.5
2	360 KN	360 x 10^3/150x150 =16	22.5
3	430.5 KN	430.5 x 10^3/150 x 150 =19.13	22.5

(14 DAYS)

cube	Load in CTM in KN	Compressive strength value =(LOAD/AREA) in N/mm 2	Cross check whether it's passed/failed
1	735K N	735X10^3/150X150 =37.2	(25 x 99)/100=24.5 ~25
2	703K N	31.24	25
3	705K N	31.33	25

(28 DAYS)

VIII. CONCLSION

The following conclusions are drawn from the experimental investigations Cubes were cast and cured in fresh water and in salt water as per the relevant IS code of practice. The cubes were tested at different ages i.e. 7,14 and 28 days.

Based on the result following conclusion can be drawn:-

1) The strength of concrete cubes cast and cured in fresh water at 7,14 and 28 days was found as 27.23N/mm2 , 30.21N/mm2 and 32.92N /mm2 respectively.

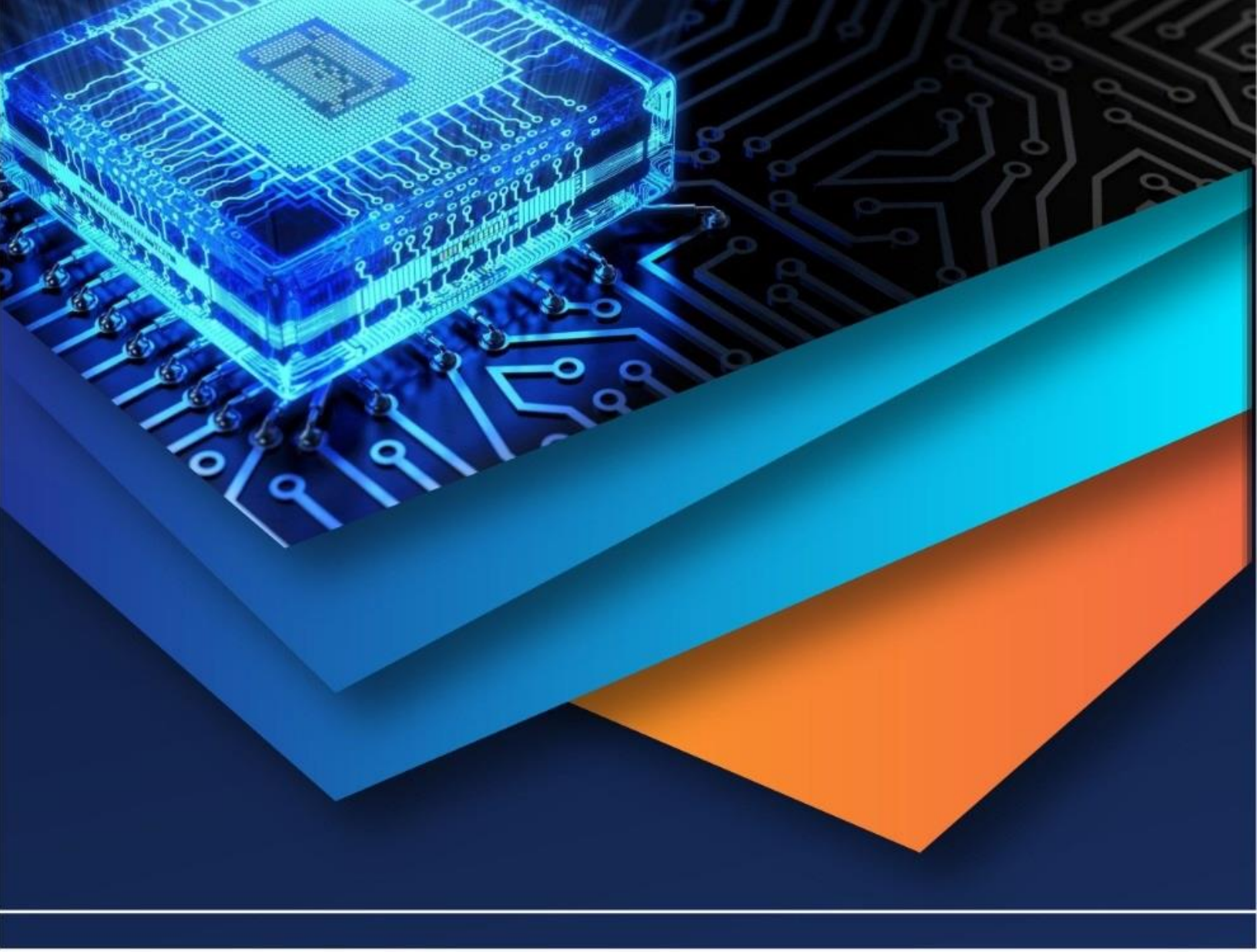
2) The strength of concrete cubes cast and cured in salt water at 7,14 and 28 days was found as 17.32N/mm2 , 19.11N/mm2 and 34.71 N /mm2 respectively.

So concrete mix and cured normal water have a higher compressive , tensile flexure and bond strengths than concretes mixed and cured in saline water in early ages at 7 and 14 days. The strengths after 28 days for concrete mixes mixed and cured in fresh water increased in a gradual manner.

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