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Volume 07, Issue 04, Pages: 42–48.
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COMPARATIVE STUDY ON BEHAVIOUR OF MAGNETIZED WATER CONCRETE WITH NORMAL CONCRETE

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Abstract— Concrete is most widely used man made building material. The reaction of OPC with water results in hydration, which glue the reacting cement together to form a hardened cement paste. When cement and water are mixed with fine and coarse aggregate the resulting product is called concrete. Till now potable (Normal) water is used for mixing different ingredients of concrete. It is expected that in the near future, the civil engineering community will have to produce structures in harmony with the concept of sustainable development through the use of high-performance materials with low environmental effects that are produced at a reasonable cost. Magnetic water concrete, synthesized from the normal materials used in manufacturing of concrete, provides one route towards this objective. This thesis presents the effect of addition of magnetised water on behaviour of concrete under different curing conditions.Total number of specimen casted are 12 cubes and 6 cylinders of Normal water concrete normal curing, 12 cubes and 6 cylinders of Magnetised water concrete normal curing, 3 cubes and 6 cylinders of Normal water concrete Accelerated curing, 3 cubes and 6 cylinders of Magnetised water concrete accelerated curing each of M20 and M25 grade of concrete determining compressive strength and splitting tensile strength.

Index Terms—Magnetised water concrete, Normal water concrete, Magnetised water, Normal water, Normal curing, Accelerated curing.

I. INTRODUCTION

Cement mortar and concrete are most widely used construction materials. Concrete is made by using Portland cement, fine aggregates, coarse aggregates and water. The hydration products act as binder to hold all the aggregates together to form concrete. The hydration is an exothermic reaction which liberates considerable quantity of heat and this is to be dissipated for continuing hydration process. Curing is generally done by immersion, spraying, ponding water on concrete surface. It is very difficult to choose another construction material which is as versatile as concrete.

II. MATERIALS

A. Cement

Locally available 53 grade ordinary Portland cement has been used in the present investigation work for all concrete mixes.

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TABLE I
PHYSICAL PROPERTIES OF ORDINARY PORTLAND CEMENT

Name of the test	Result	I.S Recommended values	I.S code
Finess of cement	3.5%	<10%	IS269-1976
Standard consistency	32%	From bottom 5 to 7mm	IS4031-1968
Specific gravity	3.02	3.15	IS2720 Part3
Soundness of cement	3mm	<10mm	IS269-1989
Compressive strength of cement (28 days)	53.5N/mm^2	>=53N/mm^2	IS269-1976

B. Magnets

In the present investigation, magnets were obtained from a scientific store. The shape of the magnets are rounded. The average magnetic strength of magnets is 985 gauss.

Figure 1. Magnets

C. Fine aggregates

In the present investigation, river sand available in the local market was used as fine aggregate. The physical properties of fine aggergates were tested in accordance with IS 2386.

TABLE II
PHYSICAL PROPERTIES OF FINE AGGREGATE

Properties	Result
Fineness	2.88
Specific gravity	2.74
Bulk density in loose state	1550 kg/m^3

Fine aggregate conform to zone-II in accordance with IS: 383-1970.

D. Coarse aggregate

In the present investigation, crushed coarse aggregate of 10mm size obtained from local crushing plants is used. The physical properties of coarse aggregate were tested in accordance with IS 2386.

TABLE III
PHYSICAL PROPERTIES OF COARSE AGGREGATES

Properties	Result
Finess Modulus	5.314
Specific Gravity	2.77
Bulk Density	1332 kg/m^3

E. Magnetised water

Magnetised water is obtained by placing 1liter beakers filled with water over the magnets for a period of 24 hours. During this time magnetic field is going to penetrate through the glass into the water, which absorbs the magnetism and this magnetised water is used for preparing concrete.

Figure 2. One liter beakers placed over magnets

III. Mix Design

In the present investigation, M20 and M25 grade concrete mix trials were done on procured material. The Indian standard mix design procedure is adopted as per the IS: 10262-2009.

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TABLE IV
M20 GRADE CONCRETE PROPORTION QUANTITIES
PER CUBIC METER

Target strength f_{ck}	26.6N/mm^2
Volume of concrete	1m^3
Weight of water	220.48kg
Weight of cement	400.48kg
Weight of fine aggregate	957.03kg
Weight of coarse aggregate	824.17kg
W/C ratio	0.55
Mix proportion	1:2.38:2.05

TABLE V
M25 GRADE CONCRETE PROPORTION QUANTITIES
PER CUBIC METER

Target strength f_{ck}	31.6N/mm^2
Volume of concrete	1m^3
Weight of water	220.48kg
Weight of cement	440.96kg
Weight of fine aggregate	937.35kg
Weight of coarse aggregate	807.233kg
W/C ratio	0.5
Mix proportion	1:2.125:1.83

IV. Results and Discussions

Effect of magnetised water on workability of concrete mixes.Workability tests are conducted for different concrete mixes with normal water and magnetised water.

TABLE VI
WORKABILITY TESTS ON M20 GRADE CONCRETE

Workability tests	Normal water	Magnetised water
Slump cone test (mm)	35	55
Compaction factor	0.936	0.94
Vee-bee consistometer (sec)	6.2	5.13

TABLE VII
WORKABILITY TESTS ON M25 GRADE CONCRETE

Workability tests	Normal water	Magnetised water
Slump cone test (mm)	35	55
Compaction factor	0.936	0.94
Vee-bee consistometer (sec)	6.2	5.13

Compressive strength of Normal Water Concrete (NWC) and Magnetised Water Concrete (MWC) of M20 grade concrete cubes. (Normal Curing)

TABLE VIII
COMPRESSIVE STRENGTH OF M20 GRADE
NWC AND MWC.

Days	Compressive strength of NWC	Compressive strength of MWC
7	18.48	27.16
28	25.43	31.4
60	30.05	34.76
90	35.01	39.82

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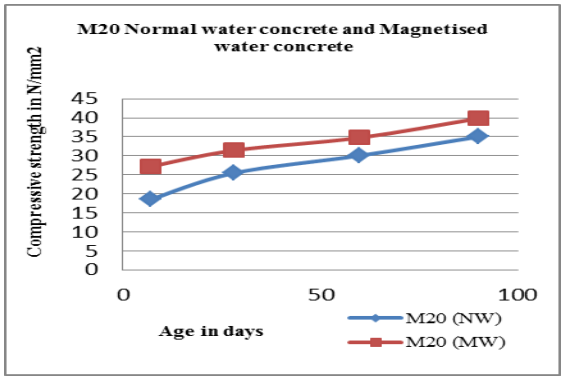

Figure 3. Compressive strength of M20 grade NWC and MWC.

Compressive strength of Normal Water Concrete (NWC) and Magnetised Water Concrete (MWC) of M25 grade concrete cubes. (Normal Curing)

TABLE IX
COMPRESSIVE STRENGTH OF M25 GRADE
NWC AND MWC

Days	**Compressive strength of NWC**	**Compressive strength of MWC**
7	21.56	30.43
28	30.22	35.1
60	34.64	39.3
90	38.66	42.76

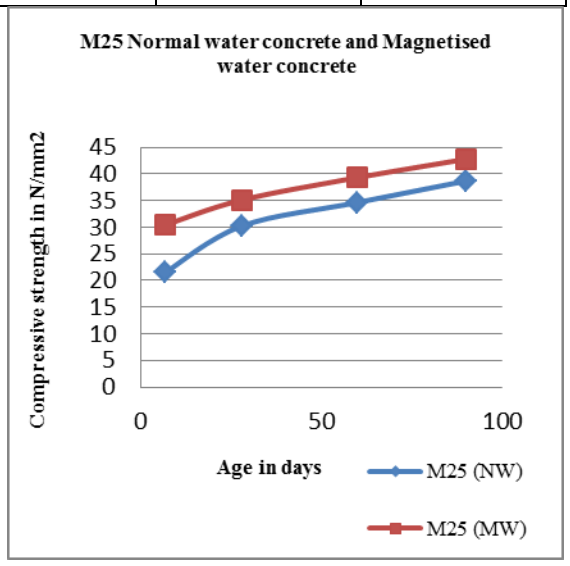

Figure 4. Compressive strength of M25 grade NWC and MWC.

Compressive strength of Normal Water Concrete (NWC) and Magnetised Water Concrete (MWC) of M20 grade concrete cubes. (Accelerated Curing)

TABLE X
COMPRESSIVE STRENGTH OF M20 GRADE
NWC AND MWC

Compressive strength of NWC	Compressive strength of MWC
11.3	14.3
R28(strength at 28days)=8.09+1.64(Ra)	
26.62	32.36

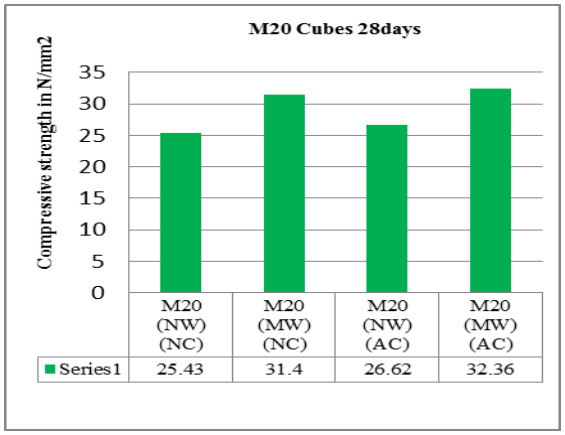

Figure 5. Compressive strength of M20 grade NWC and MWC.

Compressive strength of Normal Water Concrete (NWC) and Magnetised Water Concrete (MWC) of M25 grade concrete cubes. (Accelerated Curing)

TABLE XI
COMPRESSIVE STRENGTH OF M25 GRADE
NWC AND MWC

Compressive strength of NWC	Compressive strength of MWC
13.7	16.8
R28(strength at 28days)=8.09+1.64(Ra)	
30.55	35.65

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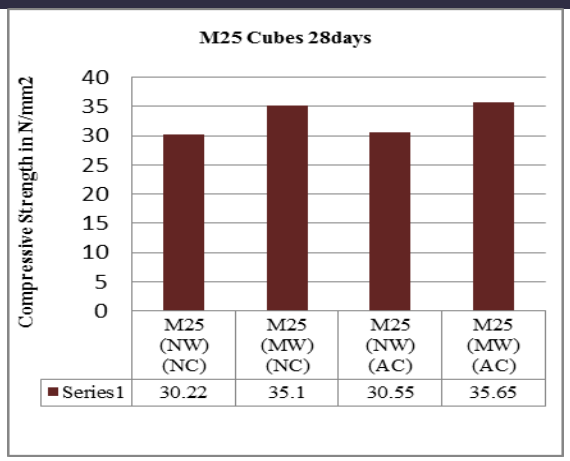

Figure 6. Compressive strength of M25 grade NWC and MWC.

Compressive strength of Normal Water Concrete (NWC) and Magnetised Water Concrete (MWC) of M20 and M25 grade concrete cylinders 28days. (Normal Curing)

TABLE XII
COMPRESSIVE STRENGTH OF NWC AND MWC
CYLINDERS

Grade	Days	Compressive strength of NWC	Compressive strength of MWC
M20	28	18.6	21.4
M25	28	20.8	23.6

Compressive strength of Normal Water Concrete (NWC) and Magnetised Water Concrete (MWC) of M20 and M25 grade concrete cylinders. (Accelerated Curing)

TABLE XIII
COMPRESSIVE STRENGTH OF NWC AND MWC
CYLINDERS

Grade	Compressive strength of NWC	Compressive strength of MWC
M20	8.1	10.4
M25	9.8	12.2
R28(strength at 28 days)=8.09+1.64(Ra)		
M20	21.37	25.14
M25	24.16	28.09

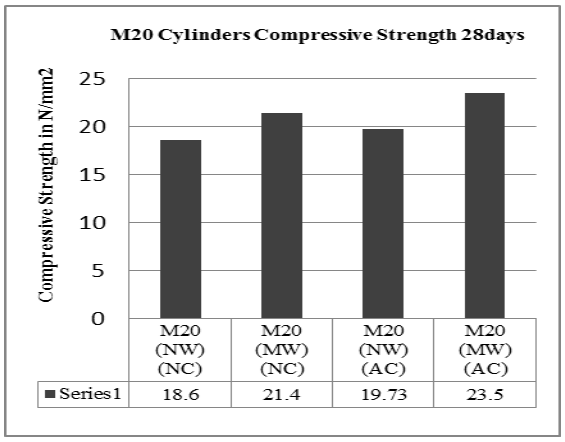

Figure 7. Compressive strength of M20 grade NWC and MWC cylinders.

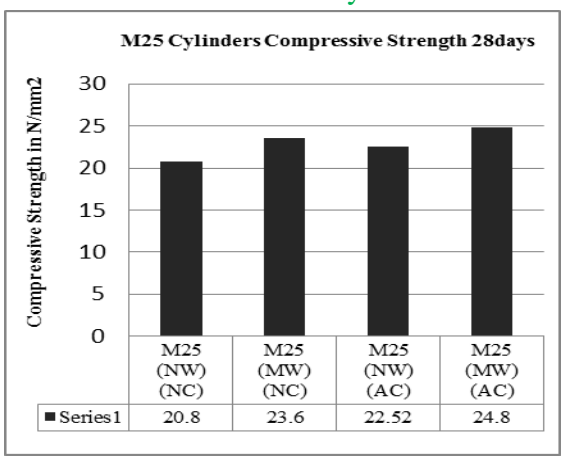

Figure 8. Compressive strength of M25 grade NWC and MWC cylinders.

Split tensile strength of Normal Water Concrete (NWC) and Magnetized Water Concrete (MWC) of M20 and M25 grade concrete cylinders 28days.

TABLE 14
SPLIT TENSILE STRENGTH

Grade	Split tensile strength of NWC (NC)	Split tensile strength of MWC (NC)	Split tensile strength of NWC (AC)	Split tensile strength of MWC (AC)
M20	2.64	3.36	2.3	3.18
M25	2.9	3.62	2.57	3.4

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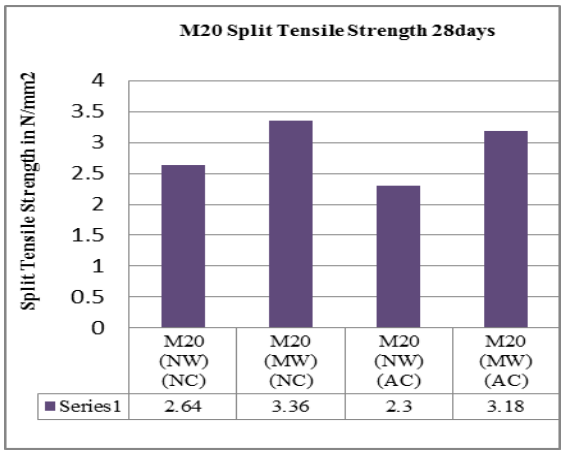

Figure 9. Split tensile strength of M20 grade concrete.

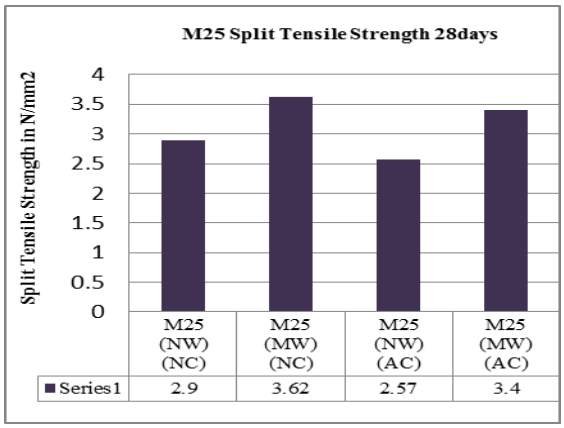

Figure 10. Split tensile strength of M25 grade concrete.

V. Conclusions

In this investigation, the behaviour of magnetised water concrete on compressive strength and split tensile strength are studied.

1. The workability of magnetised water concrete is slightly more than that of normal water concrete.
2. The compressive strength of concrete with two types of water in the mix, Normal water (Normal Curing and Accelerated Curing) is less than Magnetised water (Normal Curing and Accelerated Curing).
3. The split tensile strength of concrete with two types of water in the mix, Normal water (Normal Curing and Accelerated Curing) is less than Magnetised water (Normal Curing and Accelerated Curing).
4. Accelerated curing gives high early ge strength which enables the removal of the formwork within 24hours, thereby reducing the cycle time, resulting in cost-saving benfits.
5. The increase of strengths of concrete when MW is used as mixing water in concrete is due to filling up of the voids(pores) in concrete with more products of hydration.
6. The strength studies show that MWC also behaves like a NWC in strength development i.e., developing very high strengths at early ages and less strength at later ages.

Acknowledgment

I owe a great many thanks to a great many people who helped and supported me during the project work.

I express my earnest gratitude to my internal guide, Mr. V.Naveen Kumar, Assistant Professor, Department of Civil Engineering, for his constant support, encouragement and guidance. I am grateful for his cooperation and his valuable suggestions.

I express my thanks to Dr. T. Muralidhara Rao, Head of the Department of Civil Engineering for the encouragement and support given to me.

I thank my friends Mr. Sumith Kumar, Mr. Farooq Mohammad, Mr. Naveen Sharma, Mr. Goli Sandeep for helping me while casting the concrete and support given to me.

Finally, I express my gratitude to all other members who are involved either directly or indirectly for the successfulcompletion of this project.

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