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Comparative Study on the Effects of Seawater and Normal water on Concrete with fly-ash class C

Mr.Sakthivel.R[1], Dr.V. Murugaiyan[2]

[1]Research Scholar, [2]Professor
[1,2] Department of Civil Engineering, Pondicherry Engineering College, Puducherry, India
E-mail: [1]sakthi091089@gmail.com

Abstract: **In this work, the comparative study of the effect of seawater and normal water on concrete was investigated. This paper represents the speculation research on compressive strength and non-destructive test of concrete in addition with fly-ash class C 20% and 30%. Concrete cubes were cast using normal water for a mix of M-20 & M-30 with 0.45 water cement ratio. This concrete cubes were cured using normal water and seawater. A total specimen of 72 cubes for reference concrete was cast forM-20 & M-30 mix and exposed to a period of 28thday and 84th day. The reference concrete was prepared with OPC-43 grade in addition with fly-ash class C 20% and 30% using normal water and seawater for curing. Further, the displayed measured results; show that the diffusivity for sea water contents decreases with increasing 20 % fly-ash class C in M30 grade of concrete.**

Keywords: **Fly ash, Seawater, Compressive Strength, Non-destructive test.**

1. INTRODUCTION

Concrete is one of the major building materials used in modern day construction, because of its durability to cost ratio. Today's concrete is prepared using Portland cement, coarse aggregate, fine aggregates and water.

It is difficult to find out alternate materials for construction which is as suitable as that of such material from durability and economic point of view. Out of that water plays an important role a in preparation of concrete. Water is main ingredient of concrete as it actively participates in chemical reactions with cement. In construction sector, Potable water is used in large Quantity. Investigation on saving Potable is seriously required. As world consist of more than 70% land covered by oceanic water in which oceanic water having salty naturehaving total salinity about 3.5% per litre of seawater

The primary chemical constituents of seawater are the ions of chloride, sodium, magnesium, calcium and potassium. The concentrations of major salt constituents of seawater we are given in weight % of salts. Water containing large quantities of chlorides (sea water) tends to cause persistent dampness and surface efflorescence.

In the present investigation, the effects of salt water and normal water in addition with fly ash 20% & 30% on Compressive strength of concrete and NDT are determined. M-20 and M-30 grades of concrete are used to determine the effect on salt water and normal water on concrete.

2. MATERIALS USED

The following concrete ingredient such as cement, coarse aggregate, fine aggregate, fly ash 20% & 30% and water are used in the experimental investigation. Coarse aggregate, fine aggregate and cement purchased from nearest place.

2.1 Coarse aggregate

Crushed granite stone aggregate of maximum size 20mm of 60% and 12 mm of 40% confirming to IS 383-1970 was used. The coarse aggregate with specific gravity of 3.2 used in investigation.

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2.2Fine aggregate

The fine aggregate with specific gravity of 2.95 passing through 4.75 mm sieve used in this investigation. The fine aggregate used for the investigational planned was locally procured and conformed to grading zone II as per IS: 3831970.

2.3 Water

Ordinary clean potable water free from suspended particles and chemical substances was used for curing of concrete but specimens are cast with Normal water.

2.4 Sea water

Seawater has a salinity of about 3.5%. The concentrations of major salt constituents of seawater are given in weight % of salt as 78%NaCl, 10.5%MgCl, 5%$MgSO_4$, 3.9%$CaSO_4$, 2.3%K2SO_4, and 0.3% KBr.

2.5 Fly ash

Fly ash is a by-product of burning pulverized coal in electric power plant. Two types of fly ash are commonly used in concrete; class C and class F. In this work we use class C, it has high calcium fly ashes with carbon content less than 2%.

3. LITERATURE REVIEW

O.O. Akinkurolere [(1)] et.al in 2007 suggested that the compressive strength of concrete is shown to be increased by the presence of salt or ocean salt in the mixing & curing water. The rate of strength gain is also affected when the concrete is cast & cured with salt water & vice versa. Mixing concrete with salt water increases the compressive strength rapidly & the strength was still increasing at 28 days.

P.Krishnam Raju [(2)] et.al in2014 suggested that there is no quantitative reduction in compressive strength compared to target strength when the concrete is exposed to both “potable water mixing and sea water curing” and “mixing and curing by sea water”. There is an increase in 7 days Split tensile strength of concrete for “Potable water mixing and sea water curing” in M30 and M35.

Shetty, M. S. [(3)] in 2002 determined successful performance of a marine structure depends to a great extent on its durability against the aggressive marine environment. Disintegration of concretes in marine environments is mostly caused by chemical deterioration such as sulphate attack, chloride attack and leaching. Physical deterioration from crystallization of soluble hydrated salts in pores of the concrete, erosion and abrasion promotes further disintegration. The overall results of these attacks on concrete are softening, cracking and partial removal of cover concrete. This in turn exposes a fresh surface for further attack.

Mehta, P. K. [(4)] in 1985 suggested that the Coastal and offshore sea structures are exposed to the simultaneous action of a number of physical and chemical deterioration processes, which provide an excellent opportunity of understand the complexity of concrete durability problems in practice. Second, oceans make up 80 percent of the surface of the earth, therefore, a large number of structures are exposed to seawater either directly or indirectly as winds can carry seawater spray up to a few miles inland from the coast. Most sea waters are fairly uniform in chemical composition, which is characterized by the presence of about 3.5% soluble salts by weight. The ionic concentration of Na+ and Cl- are highest typically 11,000 and 20,000 mg/litre, respectively. However, from the standpoint of aggressive action to cement hydration products, sufficient amount of Mg2+ and SO4 are present, typically 1400 and 2700 mg/litre, respectively. The pH of seawater varies between 7.5 and 8.4., the average value in equilibrium with the atmospheric CO2 being 8.2. Under exceptional conditions, pH value lower than 7.5 may be encountered. These are usually due to a higher concentration of dissolved CO2, which would make the seawater more aggressive to Portland cement concrete.

4. OBJECTIVES

1. To study the effect of Compressive strength and non- destructive test on concrete.
2. To study the variation of M20 & M30 grade of concrete by plotting graph compressive strength and non-destructive strength versus curing time (in days 28 and 84).
3. Comparing series of cubes cast with normal water and cured with normal water as well as sea water.

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5. METHODOLOGY

1. To educate about the salinity of seawater.
2. Gathering of several materials required for development from different outsources.
3. To design a concrete mix for M20 and M30 grades as per Indian standards.
4. To cast cubes by using a various ingredients as per mix design.
5. To test the casted cubes for strength after 28 and 84 days of curing.
6. To perform various test like Compressive test, Rebound Hammer test, Ultra sonic Pulse Velocity.

6. EXPERIMENTAL SETUP

To investigate the effects of salt water and Normal water on concrete specimen. The concrete cubes were cured with normal water as well as with sea water. The details of the concrete specimen preparation are given below table

Table 1: Description

NWM20	Normal water with M20 grade
NWM30	Normal water with M30 grade
SWM20	Seawater with M20 grade
SWM30	Seawater with M30 grade
NWFC20M20	Normal water with M20 grade in replacement of fly-ash class c 20%
NWFC30M20	Normal water with M20 grade in replacement of fly-ash class c 30%
NWFC20M30	Normal water with M30 grade in replacement of fly-ash class c 20%
NWFC30M30	Normal water with M30 grade in replacement of fly-ash class c 30%
SWFC20M20	Seawater with M20 grade in replacement of fly-ash class c 20%
SWFC30M20	Seawater with M20 grade in replacement of fly-ash class c 30%
SWFC20M30	Seawater with M30 grade in replacement of fly-ash class c 20%
SWFC30M30	Seawater with M30 grade in replacement of fly-ash class c 30%

7. RESULTS

The test was carried out empowering to IS 516-1959 to find compressive strength, rebound hammer test and ultra-sonic pulse velocity of concrete at the age of 28^{th} and 84^{th} day. Testing of concrete cubes using rebound hammer is such that the cubes were placed and loaded in the CTM and with this holded axial load rebound hammer readings are taken for the three concrete cubes with horizontal orientation of hammer. The result of compressive strength is shown on Fig (a) 28^{th}day's strength (b) 84^{th}day's strength.

Table 2. Qualities of concrete according to Rebound hammer:

Average rebound number	**Quality of concrete**
>40	Very good hard layer
30-40	Good layer
20-30	Fair
<20-0	Poor concrete delaminated

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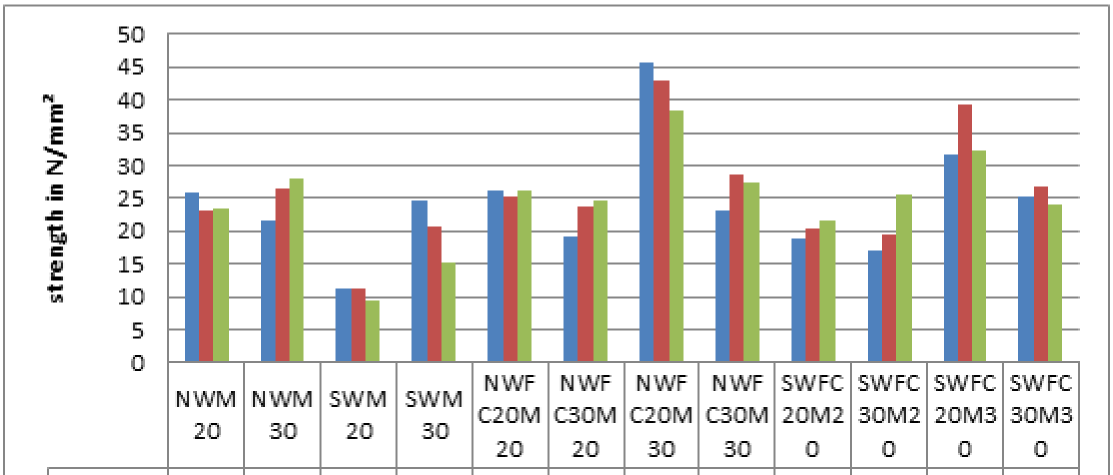
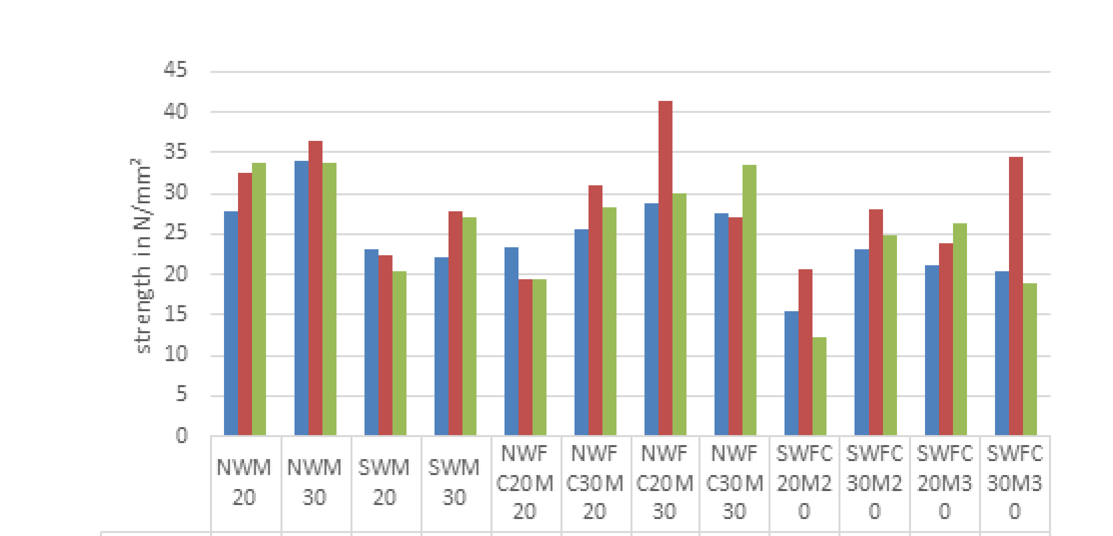


	NWM 20	NWM 30	SWM 20	SWM 30	NWF C20M 20	NWF C30M 20	NWF C20M 30	NWF C30M 30	SWFC 20M20	SWFC 30M20	SWFC 20M30	SWFC 30M30
SAMPLE 1	25.9	21.6	11.11	24.62	26.26	19.28	45.68	22.97	18.84	17.06	31.64	25.2
SAMPLE 2	23.2	26.4	11.28	20.57	25.28	23.6	42.88	28.48	20.35	19.37	39.42	26.7
SAMPLE 3	23.3	27.9	9.5	15.24	26.26	24.62	38.26	27.46	21.68	25.55	32.4	24.17

Figure 1: Compressive Strength at 28th day



	NWM 20	NWM 30	SWM 20	SWM 30	NWF C20M 20	NWF C30M 20	NWF C20M 30	NWF C30M 30	SWFC 20M20	SWFC 30M20	SWFC 20M30	SWFC 30M30
SAMPLE 1	27.7	33.86	23.11	22.08	23.24	25.46	28.85	27.55	15.55	23.15	21.15	20.48
SAMPLE 2	32.53	36.31	22.35	27.86	19.28	30.88	41.25	27.15	20.62	27.91	23.82	34.35
SAMPLE 3	33.64	33.64	20.44	26.97	19.28	28.22	30.05	33.37	12.13	24.93	26.22	18.93

Figure 2: Compressive Strength at 84th day

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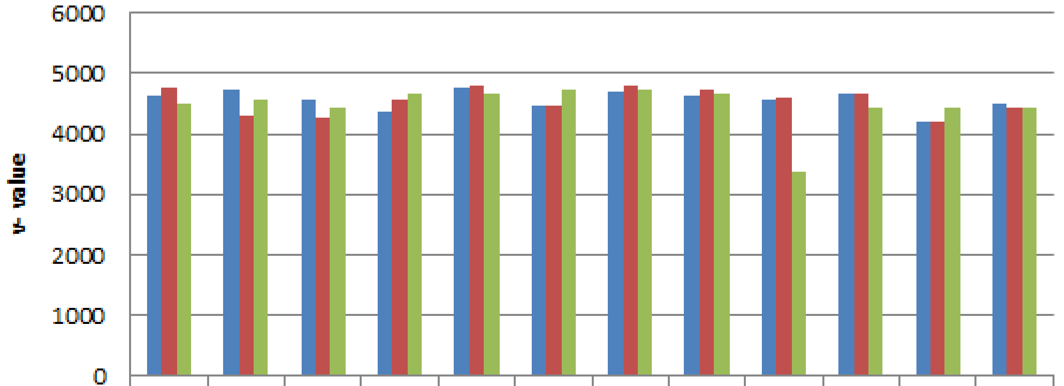
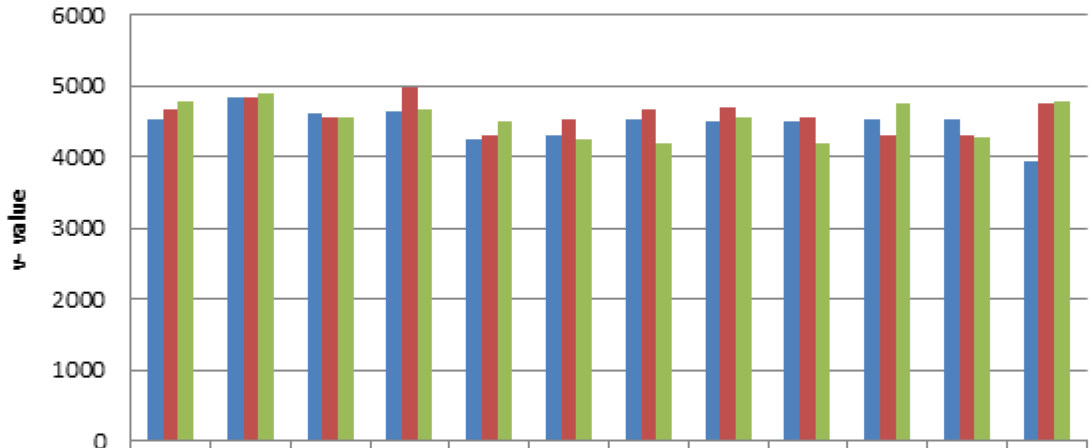


	NWM 20	NWM 30	SWM 20	SWM 30	NWF C20M 20	NWF C30M 20	NWF C20M 30	NWF C30M 30	SWFC 20M20	SWFC 30M20	SWFC 20M30	SWFC 30M30
SAMPLE 1	4640	4750	4570	4370	4780	4480	4690	4640	4560	4660	4200	4490
SAMPLE 2	4780	4290	4270	4570	4790	4460	4790	4750	4590	4670	4200	4430
SAMPLE 3	4490	4560	4450	4670	4670	4750	4720	4660	3390	4440	4440	4430

■ SAMPLE 1 ■ SAMPLE 2 ■ SAMPLE 3

Figure 3: UPV at 28th day



	NWM 20	NWM 30	SWM 20	SWM 30	NWFC 20M20	NWFC 30M20	NWFC 20M30	NWFC 30M30	SWFC 20M20	SWFC 30M20	SWFC 20M30	SWFC 30M30
SAMPLE 1	4520	4840	4600	4640	4260	4310	4520	4490	4510	4530	4536	3940
SAMPLE 2	4670	4840	4570	4970	4300	4530	4660	4700	4560	4290	4290	4750
SAMPLE 3	4780	4900	4570	4670	4510	4250	4200	4560	4190	4750	4270	4790

■ SAMPLE 1 ■ SAMPLE 2 ■ SAMPLE 3

Figure 4: UPV at 84th day

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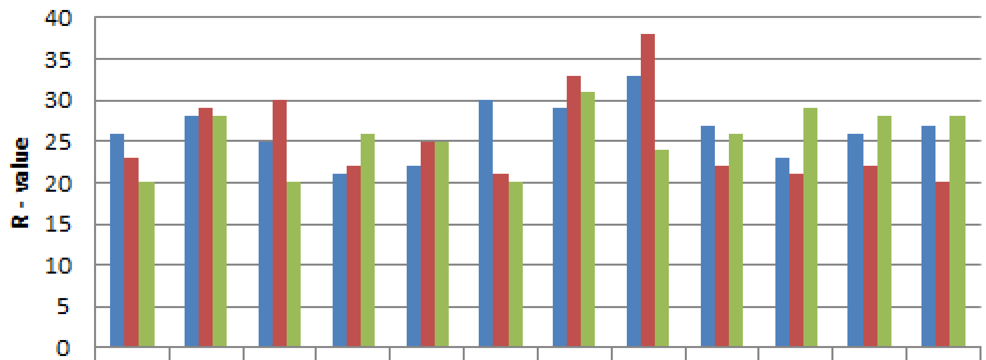
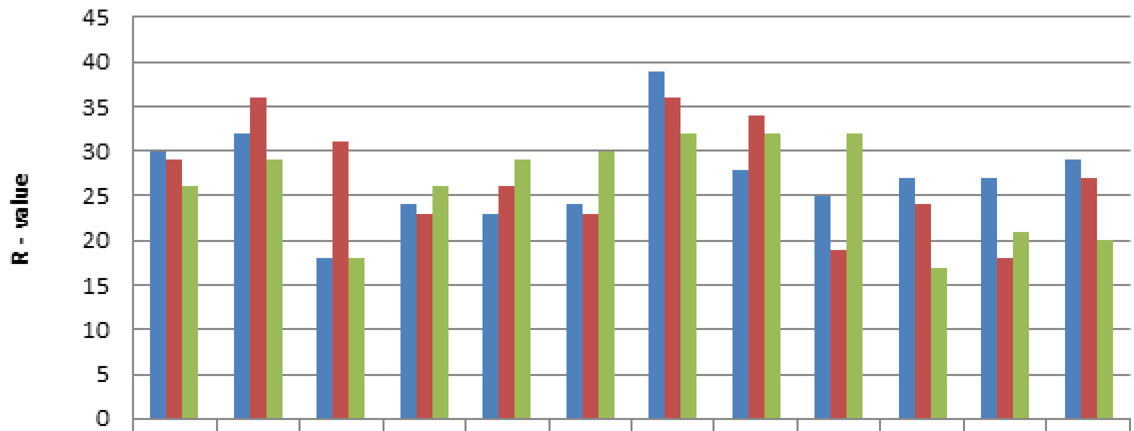


	NW M20	NW M30	SWM 20	SWM 30	NWF C20 M20	NWF C30 M20	NWF C20 M30	NWF C30 M30	SWF C20 M20	SWF C30 M20	SWF C20 M30	SWF C30 M30
SAMPLE 1	26	28	25	21	22	30	29	33	27	23	26	27
SAMPLE 2	23	29	30	22	25	21	33	38	22	21	22	20
SAMPLE 3	20	28	20	26	25	20	31	24	26	29	28	28

SAMPLE 1 SAMPLE 2 SAMPLE 3

Figure 5: R at 28th day



	NWM 20	NWM 30	SWM20	SWM30	NWFC20M20	NWFC30M20	NWFC20M30	NWFC30M30	SWFC20M20	SWFC30M20	SWFC20M30	SWFC30M30
SAMPLE 1	30	32	18	24	23	24	39	28	25	27	27	29
SAMPLE 2	29	36	31	23	26	23	36	34	19	24	18	27
SAMPLE 3	26	29	18	26	29	30	32	32	32	17	21	20

SAMPLE 1 SAMPLE 2 SAMPLE 3

Figure 6: R at 84th day

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8. CONCLUSION

1. The rebound hammer test results indicated that the concrete used has sufficiently gained strength to satisfy the requirement of M20 grade concrete on average basis of M30.

2. The optimum percentage replacement of cement by fly-ash class c is 20% which showed increment in compressive strength for M20 and M30 grade concrete.

3. It is found that there was 15% increment in compressive strength for M20 grade concrete for optimum percentage replacement.

4. We have put forth a simple step to minimize the costs for construction with usage of fly-ash and which is cheaply available.

5. The results shows that 20% replacement of cement by the fly-ash class C induced higher compressive strength and the workability of concrete decreases as replacement increases in sea water .

6. The ultra-pulse velocity test results show the velocity of the concrete specimens in several of it velocity in 28^{th} day and 84^{th} day.

7. From the experimental study, it is concluded that the fly-ash class C can be used as a replacement for cement and it can prove by compressive strength and NDT test.

REFERENCES

[1] O.O. Akinkurolere , Cangru Jiang, O.M. Shobola , "The influence of salt water on the compressive strength of concrete", Journal of Engineering & applied Science,pp412-415, 2007 .

[2] P. Krishanam Raju, V. Ravindra, M. Bhanusingh "Investigation on strength of concrete for marine works using opc & sea water", SSRG International Journal of Civil Engineering,1(1), Feb2014 .

[3] Mehta, P. K. and Monteiro, P. J. M. (1985). Concrete Structure, Properties and Materials, 2nd Edition, Prentice Hall, Englewood, Glifs. Narver, D. L. (1964).

[4] Shetty, M. S. (2002). Concrete Technology, Theory and Practice, Fifths Revised Edition, S. Chand & Company Ltd, New Delhi. Steinour, H. H. (1960). "Concrete mix water, how impure can it be?" J. Research Development labs, 2.

[5] P. Krishnam Raju, V. Lakshmi, S. Bhanu Pravallika "An investigation on fly ash blended cement concrete using sea water", International Journal of Advanced Scientific & Technical Research, 2(4) April-2014.

[6] Jen-Chei Liu, Mou-Lin Sue and Chang-Huan Kou, Estimating the Strength of Concrete Using Surface Rebound Value and Design Parameters of Concrete Material, Tamkang Journal of Science and Engineering, Vol. 12, No. 1, pp. 1_7 (2009)

[7] Kaushal Kishore, Non-destructive Testing Of Concrete By Rebound Hammer, Civil Engineering Portal Method of Non-destructive Testing of Concrete – Ultrasonic Pulse Velocity, IS 13311 Part 1 (1992), Bureau of Indian Standards, New Delhi.

[8] Method of Non-destructive Testing of Concrete –Rebound Hammer, IS 13311 Part 2 (1992), Bureau of Indian Standards, New Delhi.

[9] Indian Standard code of practice for plane reinforced concrete structures, IS 456 (2000), Bureau of Indian Standards, New Delhi.

[10] J.C. Agunwambaa, T. Adagbab , "A comparative analysis of the rebound hammer and ultrasonic pulse velocity in testing concrete", Nigerian Journal of Technology (NIJOTECH) Vol. 31, No. 1, March, 2012, pp. 31{39}.

[11] American Society for Testing and Materials. Test Methods for Rebound Number of Hardened Concrete. ASTM C805 -02, West Conshohocken, PA, ASTM International, 2004.

[12] B. B. Maruthi Sridhar, T. L. Chapin, R. K. Vincent, M. J. Axe, and J. P. Frizado, Apr. 2008, "Identifying the effects of Various construction practices on the spectral characteristics of concrete," Cem. Concr. Res., vol. 38, no. 4, pp. 538–542.

[13] M.S. ShettyConcrete Technology Theory and PracticeS. Chand & Company Ltd., New Delhi (2006).