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AN EXPERIMENTAL STUDY ON COMPRESSIVE STRENGTHS OF DIFFERENT TYPES OF PAVEMENTS BY USING NDT

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Abstract: - The objective of this study is to estimate the compressive strength of different types of pavements made by using chemical admixture polycarboxile ether (PCE SP) on OPC, PPC and PSC of three different cements and three different water cement ratio's i.e. 0.55, 0.45 & 0.35. The two most popular NDT methods used in study Rebound hammer (RH) & Ultrasonic pulse velocity (UPV) in assessing compressive strength of pavements. By keeping length and breadth are constant i.e., 450 × 350 mm. by varying depth of pavement i.e. 200, 175, 150, 125 and 100mm. were prepared, cured and subjected to RH and UPV at the end of 28, 56 and 90days.

Keywords: - Chemical admixture, Polycarboxile ether super plasticizer, Non-Destructive test, Ultrasonic pulse velocity, Rebound hammer and Pavements.

Introduction: - Concrete is mixing of ingredients and it is used as a binding material. Concrete is the one of the most traditional and widespread building types material used in the world due to its cheapest in price. Cement is a key binding material used in construction to make concrete. Fine aggregate, which is used to fill up small gaps in concrete and gives it stability and strength, is often composed of tiny, fine particles sand and clay. The major function of coarse aggregate, which is defined as crushed bigger stones, is to enhance the bulk of the concrete and lessen shrinkage of concrete. Admixture are typically used to replace water in concrete and improve workability in order to complete casting in all climatic circumstances.

Non-Destructive tests involve the identification and characterization of the exterior and internal material injury without cutting or harming a portion of the material and these are relatively simply performed. According to ACI 211 of 2010 guidelines for the mix design. A slump of 50 mm-90 mm is chosen for the concrete mix and water content of 170 kg/m^3 is considered. As per IS 456 of 2005 the maximum free water-cement ratio is 0.55 to have different grades of concrete and we also considered w/c ratio of 0.45 and 0.35. by trail and error method we obtained the dosage of the (pce sp) for obtaining of slump in the range of 50-90 mm. we obtained the dosage of super plasticizer as 0.35, 0.25 and 0.2% by mass of cement for w/c 0.55 m 0.45 and 0.35 respectively.

After completion of 28, 56 and 90 days curing period specimens of pavement are subjected in NDT test i.e Rebound Hammer and Ultrasonic Pulse Velocity is assessing compressive strength of concretes.

Literature Review: -

Chandak N. R, and Chawala Ashish: - In this paper the author likes to explained that methods, advantages and disadvantages of non-destructive techniques (NDT), including ultra sonic pulse velocity and Rebound Hammer (RH) as well as recent trends in the field. The techniques offer more information than visual inspection in this paper they also discussed about the effects of water / cement ratio, casting processing, casting direction and cement dosage on NDT readings. The purpose of this study is to present Ultrasonic Pulse Velocity, Rebound Hammer and the elements that influence the results and safety considerations that must be observed when doing NDT tests.

Ashish Chhachhina: - The research compared the design of concrete mixes using the IS, ACI and BS methodologies as its main subject of study. A number of elements influence the mix design. Almost every country has its own requirements for mix design. For the concrete mix design, the present research has discussed the accepted standards from India, Britain and America. The design and comparison of concrete grades M25, M35 and M45. Concluded that compared to other standards, the newly amended Indian standards have the lowest water / cement ratio and the highest cement quality**.**

D. Dahiru: - The author evaluated the accuracy of the UPV and RH methods in the article for determining compressive strength. At the end 1, 3, 7, 21, 28, 56 and 90 days, samples of 150mm× 150mm× 150mm concrete cubes were made, cured and tested for UPV and RH. Destructive testing was performed on the same samples. The gathered data was analyzed using a correlation test, multiple regression analysis, graphs and visual examination. The result of this using a combination of RH and UPV methods for measuring concrete's compressive strength is beneficial. Therefore, it is advised to combine RH with UPV testing concrete and use the calculation = 45.80 + 0.88 ×- 1.31 X for more precise outcomes.

Salahaldein Alsadey and Saieed Mohamed: - The impact of superplasticizer on the workability and strength of concrete was indicated by author. Temperature has a negative impact on fresh concrete's qualities which includes greater water demand, a quick setting time**,** and increased slump loss. An experimental study was conducted to establish the ideal dosage of an admixture and to examine the consequences of overdosing this admixture in order to improve these features. The dosage of the superplasticizer was 0.8, 1 and 1.2 % by weight of cement made together with a control mix. They come to the conclusion that increasing the dosage of the superplasticizer reduces the property of concrete and affects its strength.

Materials: -

Selection of Materials: -

Cement: - Locally available OPC 53 grade, fly ash based PPC and PSC were used as binding material. Specific gravity of cements are 3.05, 2.88 and 2.9

Coarse Aggregate: - Locally available of coarse aggregate were used with a maximum size of 20 mm and minimum size of 12 mm. the specific gravity of coarse aggregate is 2.6.

Fine Aggregate: - Locally available river sand which is generally available in our area was used as per ASTM C 33: 1992. Specific gravity of fine aggregate is 2.67. fine modulus of fine aggregate is 2.78

Water: - Ordinary tap water was used for both mixing of fresh concrete and curing of concrete which is available at laboratory.

Chemical Admixture: - Polycarboxile ether super plasticizer was used to entire study. The super plasticizer has specific gravity of 1.90.

Testing Equipment: - The equipment used for study those are available in Concrete Technology Lab at Aitam.

Rebound Hammer (RH) and Ultrasonic Pulse Velocity (UPV).

Physical properties: -

Physical properties	OPC	PPC	PSC
Specific Gravity	3.05	2.88	2.9
Initial Setting Time (min)	110	130	127
Final Setting Time (min)	225	345	219

Table No. 1 denotes the physical properties of materials used

Concrete Mix: -

Guidelines for mix design from ACI 211 (2010) and guidelines for durability criteria from IS 45 (2005) for concrete mix with 200 kg/m^3 of water content, a slump of 50-90mm is recommended. Following IS 456 (2005). The ratio of mix water to cement is 0.55. The water to cement ratio is 0.45 and 0.35 respectively, in order to have distinct grades of concrete.

Quantities per Kg/m^3 of concrete: -

W/C	Cement	Fine aggregate	Coarse aggregate	Water
0.55	**364**	**788**	**992**	**200**
0.45	**445**	**720**	**992**	**200**
0.35	**450**	**720**	**992**	**200**

Table No. 2 denotes the quantities for mix design in kg/m^3

RESULTS AND DISCUSSIONS

Values of Rebound number (R) of concrete at different curing ages for various types of cements and water cement ratios: -

Age of concrete samples	Rebound Number (R)								
	0.55 W/C			0.45 W/C			0.35 W/C		
	OPC	PPC	PSC	OPC	PPC	PSC	OPC	PPC	PSC
28	38.4	35.9	31	42.3	39	42.0	45.78	42.7	41.3
56	40	36.45	33.2	46.4	44.9	43.5	47	45	43.17
90	42.6	38.21	34.7	47.56	45.7	44.9	48.3	47.2	45.65

Table No. 3 denotes the Rebound Hammer Number of vario0us types of cements and w/c ratio

Values of compressive strength of concrete at different curing ages for various types of cements and water cement ratios: -

Age of concrete samples	Compressive strength N/mm^2								
	0.55 W/C			0.45 W/C			0.35 W/C		
	OPC	PPC	PSC	OPC	PPC	PSC	OPC	PPC	PSC
28	42	37	29.3	51	43.5	49	57	50.13	51
56	45.5	39	33	56.5	47	52	59	54	54
90	49	41.5	35.23	58	55	53	60.5	58	56.78

Table No. 4 denotes the Compressive strengths of Rebound Hammer Number.

Values of Ultrasonic Pulse Velocity (UPV) of concrete at different curing ages for various types of cements and water cement ratios: -

Age of concrete samples	Ultrasonic Pulse Velocity (UPV) km/s								
	0.55 W/C			0.45 W/C			0.35 W/C		
	OPC	PPC	PSC	OPC	PPC	PSC	OPC	PPC	PSC
28	4.41	4.3	4.1	4.9	4.92	4.7	5.3	5.2	5.1
56	4.6	4.57	4.39	5.2	5.0	4.8	5.5	5.27	5.18
90	4.7	4.6	4.41	5.29	5.1	4.91	5.7	5.3	5.2

Table No. 5 denotes the values of Ultrasonic Pulse Velocity for different cements and water cement ratios

Concrete Quality grading criteria based on velocity (As per IS 13311-part 1)

S.No.	cross-probing to measure the pulse rate. km/sec.	Concrete quality greading
1.	Above 4.5	Excellent
2.	3.5 to 4.5	Good
3.	3.0 to 3.5	Medium
4.	Below 3.0	Doubtful

Table No. 6 denotes the grading of concretes

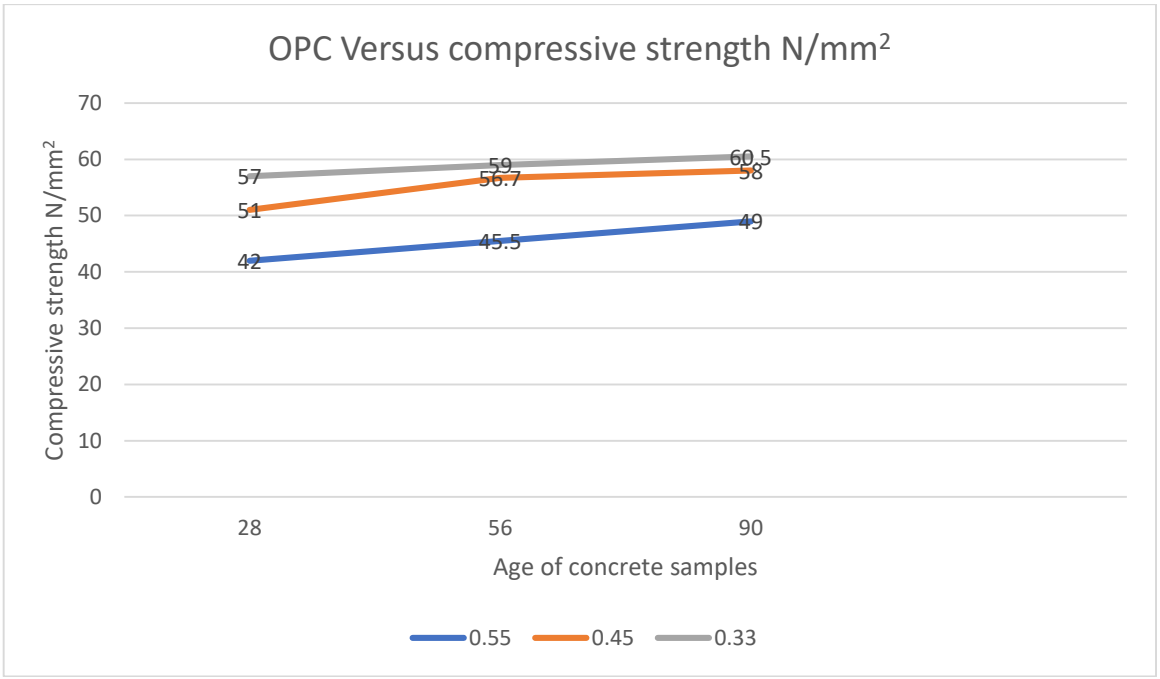

Figure 1 : Denotes the variation in concrete's compressive strength with respect to different w/c ratios using OPC

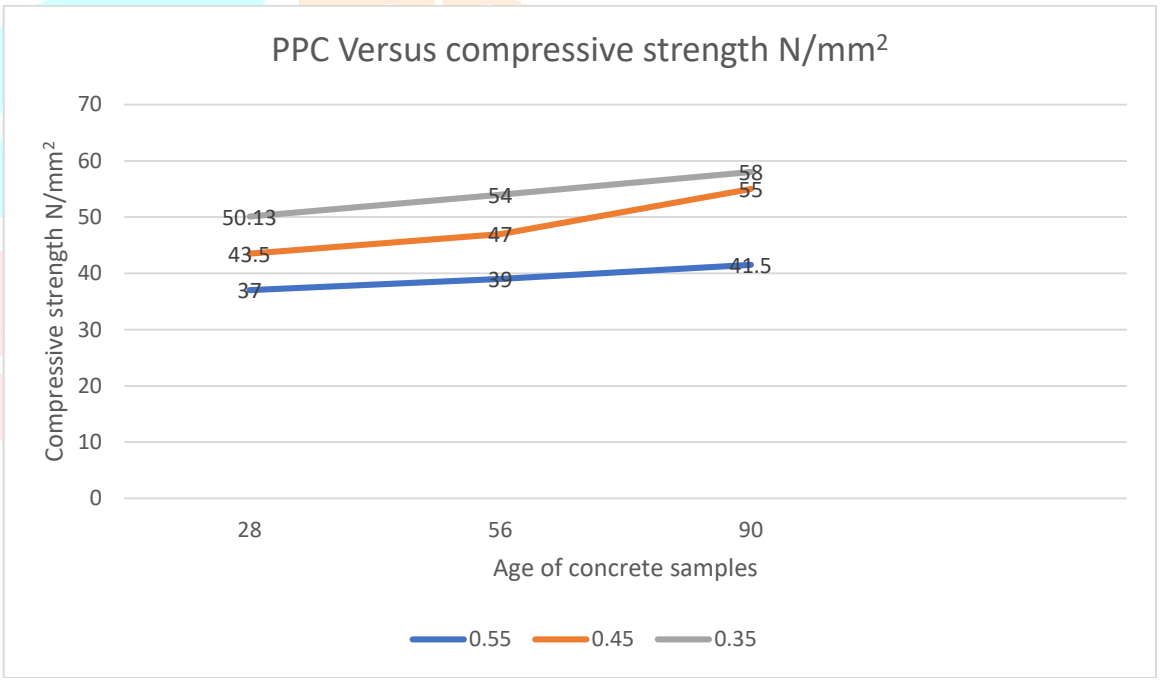

Figure 2: Denotes the variation in concrete's compressive strength with respect to different w/c ratios using PPC

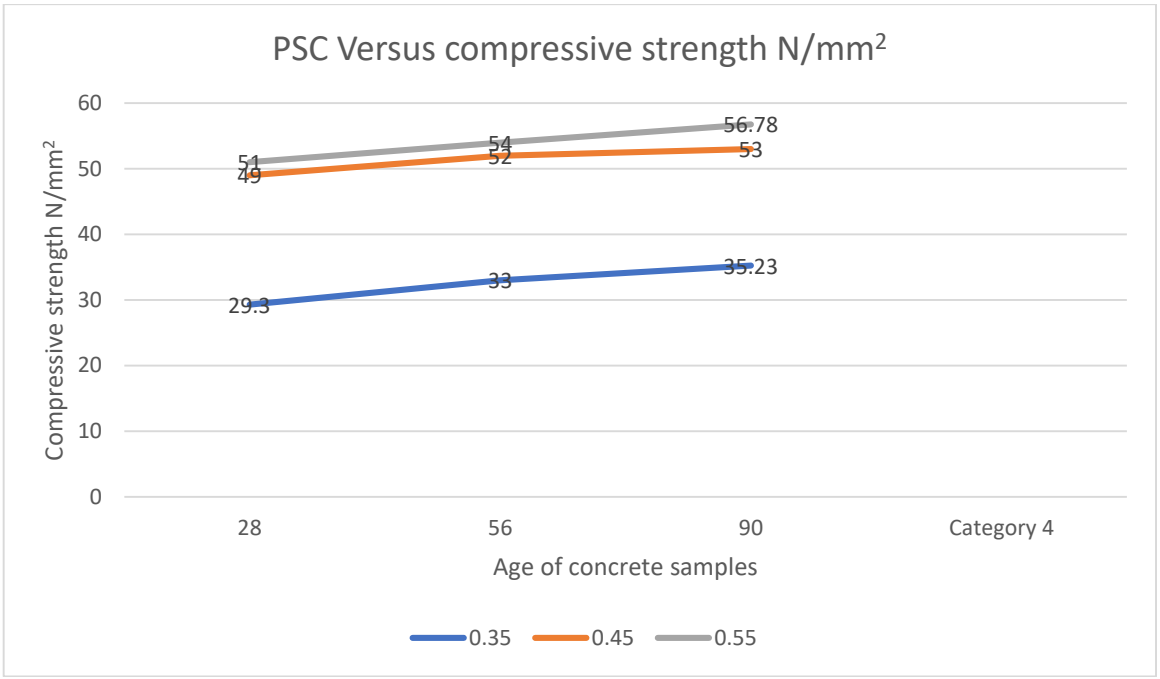

Figure 3: Denotes the variation in concrete's compressive strength with respect to different w/c ratios using PSC.

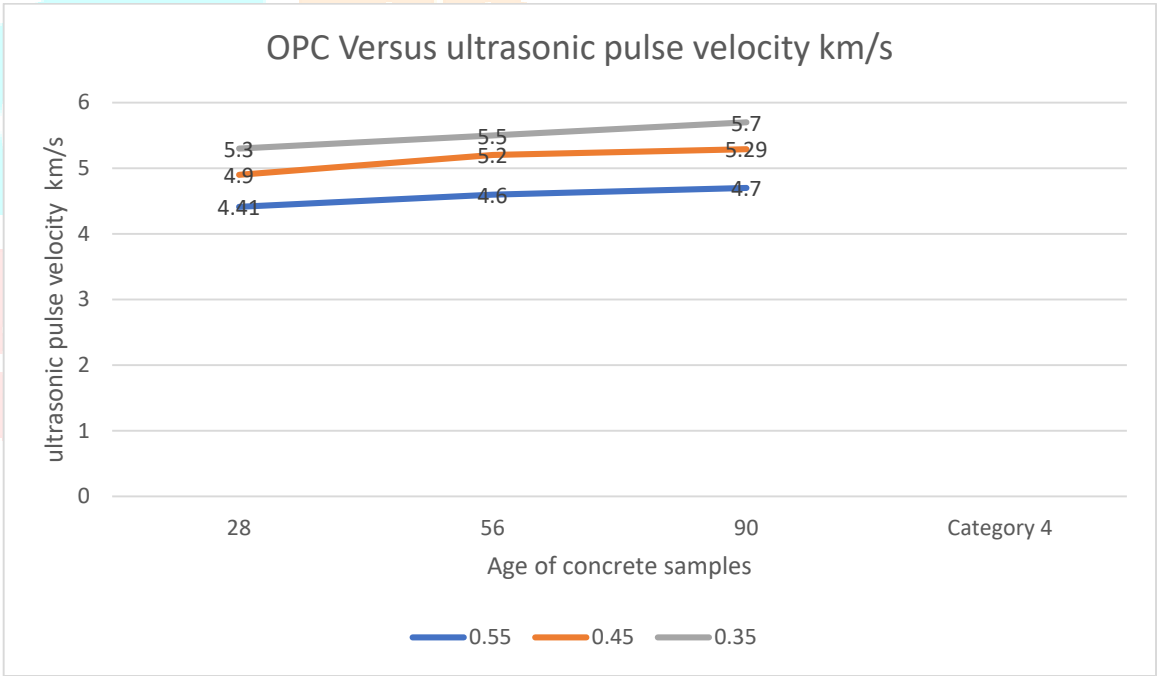

Figure 4: denotes the variation of UPV of concrete with respect to various w/c ratio using OPC

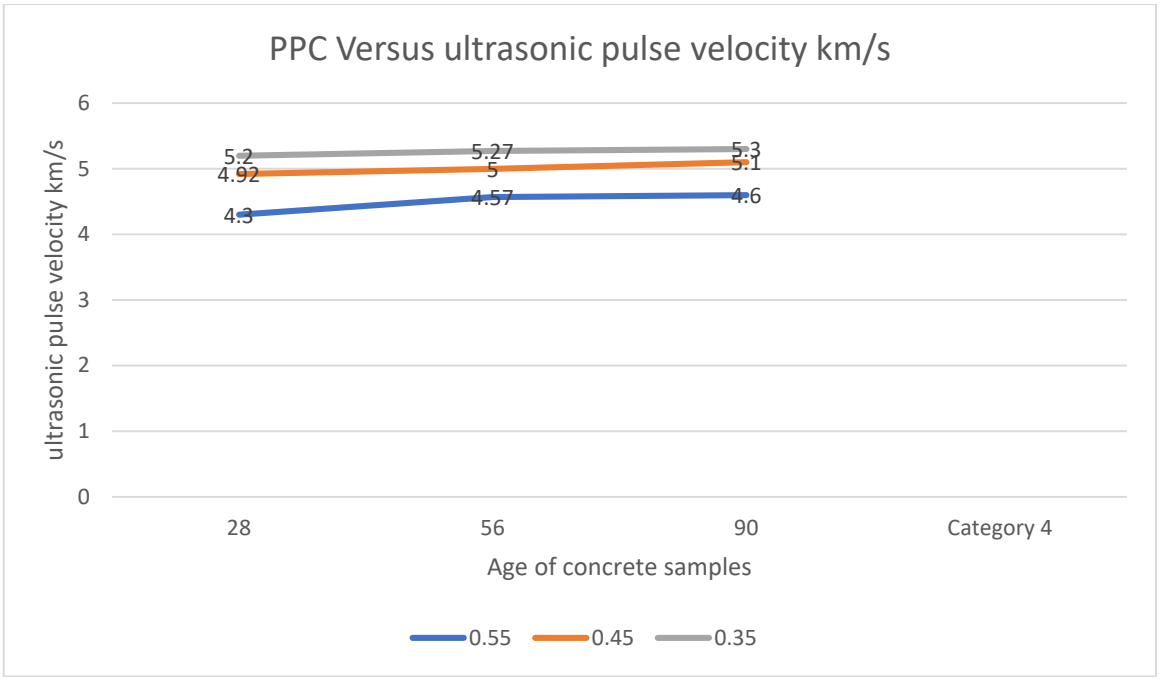

Figure 5 Denotes the variation of UPV of concrete with respect to various w/c ratio using PPC

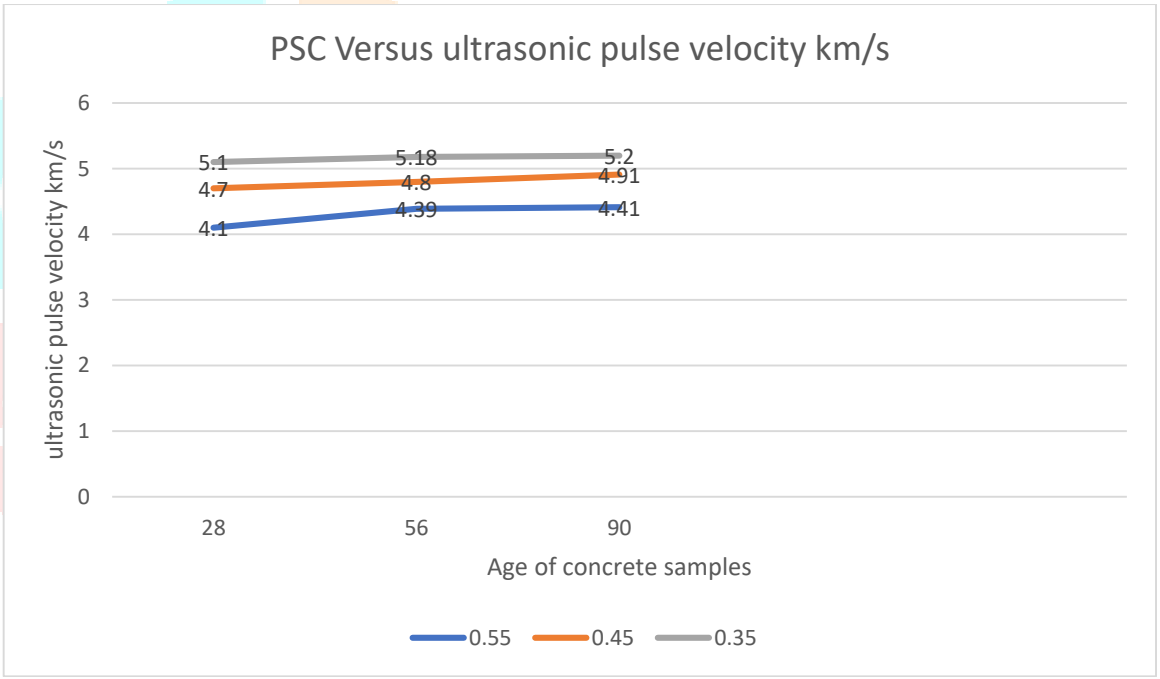

Figure 6: Denotes the variation of UPV of concrete with respect to various w/c using PSC

Conclusions: -

1) For experimental study we have used the chemical admixture for different w/c ratio in order to achieve the workability at any temperature.

2) The fact obtained the experimental study that overall different cements, OPC attained the maximum strength for all different w/c ratio.

3) The strength we obtained for w/c of 0.55, 0.45 and 0.35 are M35, M45 and M55.

4) For the experimental study we consider different heights of pavement but there is no change in compressive strength. The factors effecting the strengths are corrosion, curing and size of aggregate used in mix design.

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