Effect of Traditional and Accelerated Curing Method on Compressive Strength of Concrete Incorporating with Industrial Waste

[1]Kishan Patel, [2]Dr. Jayeshkumar Pitroda , [3]Prof. Amitkumar Raval
[1]Final year M. Tech. Student, B. V. M. Engineering College, V.V.Nagar, Gujarat, India
[2]Assistant Prof. Civil Engineering Department, B.V.M Engineering College, V.V.Nagar, Gujarat, India
[3]Assistant Prof. Civil Engineering Department, B&B Institute of Engineering, V.V.Nagar, Gujarat, India

Abstract : All of the beneficial properties of precast concrete, including compressive strength, durability and water tightness are enhanced through proper curing techniques. Unfortunately, the curing of precast concrete products is one of the last and perhaps most neglected steps in the manufacturing process, especially in a rapid production environment. Curing takes place immediately after concrete placing and finishing, and involves maintenance of desired moisture and temperature conditions. In this critical literature review, how the traditional and accelerated curing method affect the compressive strength of concrete are explained, in order to reach better quality in lower duration.

IndexTerms – **Precast concrete, Curing, Traditional Curing, Accelerated Curing, Compressive Strength**

I. INTRODUCTION

Indian realty majors are adopting precast technology in building their latest projects. The main advantages of precast technology are quality, speed of construction, and a value-for-money product. Precast concrete is advantageous for reduce shrinkage and creep, control dead-load deflections, improve quality control, material availability can be improved and for steel erection methods are similar to in-situ concrete and thus total construction time is significantly reduced. The use of such technology helps in saving up to 64% of the time taken for similar projects using normal construction methods and technology. In other words, if normal brick-and-mortar method takes one year to complete a project, the precast method takes about four months. But the curing of precast concrete products is one of the last and perhaps most neglected steps in manufacturing process, especially in a rapid production environment.

Curing is the maintenance of a satisfactory moisture content and temperature in concrete for a period of time immediately following placing and finishing so that the desired properties may develop. The need for adequate curing of concrete cannot be overemphasized. Curing has a strong influence on the properties of hardened concrete; proper curing will increase durability, strength, water tightness, abrasion resistance, volume stability, and resistance to freezing and thawing and deicers.

Traditional conditions for curing involve by spraying or ponding the concrete surface with water. Additional common curing methods include wet burlap and plastic sheeting covering the fresh concrete. For higher-strength applications, accelerated curing techniques may be applied to the concrete. One common technique involves heating the poured concrete with steam, which serves to both keep it damp and raise the temperature, so that the hydration process proceeds more quickly and more thoroughly.

II. CRITICAL LITERATURE REVIEW

The following are the previous research review based on effect of various curing method on concrete properties.

Richard R. Merritt and James W. Johnson(1962) surveyed a case study of Project HR-40 of the Iowa Highway Research Board, and found that at all temperatures the concrete gained strength at a diminishing rate between 18 and 66 hours of steaming. At temperatures of 175 F and 200 F the concrete lost strength by additional steaming past 42 hours. By the end of 18 hours of steaming, the rate of gain in strength of concrete steam cured at any temperature is less than the rate of gain in strength of concrete which is moist cured.[14]

M. Hulusi Ozkul (2001) stated that The accelerated strength development efficiency is higher for concretes of ordinary Portland cement than that of trass cement in general. The difference due to the cement type is less in the boiling water method than that in the warm water method. He concluded that the efficiencies of the concretes prepared by low early strength cements increase when the curing temperature is increased.[8]

Brent Vollenweider (2004) studied that purpose of accelerating the curing process of concrete can be divided into two categories: physical processes and admixtures. Increase in curing temperature will result in an increased rate of strength gain. Beyond a certain point, increases in temperature not only prove to be less efficient. Until the behavior of admixtures and their effects on other properties of concrete are readily understood, their use as primary accelerating agents in the commercial precast industry will likely remain relatively sparse.[2]

Malek Batayneh(2006) reported use of waste material in concrete mix. The waste materials considered to be recycled in the study consist of glass, plastic and demolished concrete.[9]

Myers John J.(2006) studied the shrinkage behavior of High Strength Concrete (HSC) subjected to accelerated curing. He concluded various factors which affect shrinkage behavior of HSC like Concrete Sealant, Accelerated Curing Temperature, Water to Cement Ratio, Fly Ash Replacement of Cement and how they affect on shrinkage behavior.[11]

N. Yazdani, F.ASCE; M. Filsaime, and S. Islam(2008) studied the effect of accelerated curing on silica fume concrete and stated that Steam-curing times of 12, 18, and 24 h do not seem to play a major role in controlling concrete compressive strengths. There was no consistent pattern of maximum strength displayed by samples from a single source of steam-cured duration.[12]

M. V. Krishna Rao (2010) has proved the parameters of the study include the curing period [1, 3, 7, 14 and 28 day], curing method [conventional wet curing, membrane forming compound curing and accelerated curing] and the type of cement [(OPC) 43 grade, (PPC) 43 grade and (OPC) 43 grade +10% Silica Fume(SF)] replacement for cement.[7]

Rostami Vahid(2012) investigated the performance of of the carbonation-cured concrete and steam cured concrete and found that replacing conventional steam curing of precast concretes with a carbonation curing is feasible.[15]

Akeem Ayinde Raheem(2013) studied the effect of curing method on density and compressive strength of concrete. And he was concluded that there exists a weak positive correlation between density and compressive strength of concrete specimens.[1]

Dr. G.Vijayakumar(2013) used glass powder as cement replacement in concrete and proven that Glass powder concrete increases the compressive, tensile and flexural strength effectively, when compared with conventional concrete.[3]

K.V.Krishna Reddy(2013) investigated effectiveness of different curing methods and the influence of climate on the strength properties of concrete.[6]

Shelke N.L.(2013) studied the short term performance of the concrete using accelerated curing and he found that the compressive strength obtained by using accelerated curing method is higher than normal compressive strength.[16]

Ming-Ju Lee (2014) used to investigate some accelerated curing on the strength and chloride electrical penetration of concrete. And stated that (1) The 1-day strength results show that the higher curing temperature and longer curing time produced higher early strength for all mortar mixes.(2) High early compressive strength of the steam and microwave cured mortar or concrete was obtained while its 28-day strength was slightly lower than the 28-day strength of normally water-cured ones.(3) The 28-day chloride electrical penetrability of the accelerated curing samples reduces greatly when curing them in water after the accelerated curing.[10]

Pingping H.E.(2016) investigated the effects of further water curing on the compressive strength and microstructure of CO2-cured concrete. The results showed that concrete with a residual w/c ratio of 0.25 showed the most rapid strength development rate upon further water curing.[13]

Gawatre Dinesh W.(2017) studied the curing method, where there is deficiency of water and on downhill surfaces where curing with water is problematic. And stated that the upgrading in the construction and chemical industries have lead the way for development of new curing techniques and construction chemicals such as Membrane curing compounds, Self curing agents, Water proofing compounds.[4]

Zeyad Abdullah.M.(2017) believed in that The properties of high-strength concrete (HSC) are significantly influenced by environmental conditions and the duration. After lots of experimental study he found that The wet cover and water spraying methods effectively achieved the mix design requirements at 28 day. Adding Polypropylene Fibers to HSCs could reduce the effect of hot weather on concrete properties, thus improving the compressive, indirect tensile and flexural strengths of concretes.[17]

III. CONCLUSION

From the above literature review we can conclude the following things:

1. The compressive strength obtained by using accelerated curing method is higher than normal compressive strength.
2. Using membrane curing and saturated wet covering, one can achieve 80 to 90% efficiency (in terms of compressive strength) as compared to conventional water immersion method.
3. Compound curing is found to be cost effective compared to conventional jute bag curing.
4. Using accelerated curing, production rate of precast units are increased.
5. The efficiencies of the concretes increase when the curing temperature is increased.
6. Maximum compressive strength was measured in concrete specimens cured by applying the bitumen based curing compound.
7. Glass powder concrete increases the compressive, tensile and flexural strength effectively, when compared with conventional concrete.

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VI. AUTHOR'S BIOGRAPHY

Kishan Patel received her Bachelor of Engineering degree in Civil Engineering from Vishwakarma Government Engineering College, Chandkheda, Gujarat Technological University in 2016. At present, he is a final year student of Master's Technology in Construction Engineering & Management from Birla Vishvakarma Mahavidyalaya, Gujarat Technological University.

Dr. Jayeshkumar Pitroda received his Bachelor of Engineering Degree in Civil Engineering from Birla Vishwakarma Mahavidyalaya Engineering College, Sardar Patel University in 2000. In 2009 he received his master's degree in Construction Engineering and Management from Birla Vishwakarma Mahavidyalaya Sardar Patel University. In 2015 he received his Doctor of Philosophy (Ph.D.) Degree in Civil Engineering from Sardar Patel University. He joined Birla Vishwakarma Mahavidyalaya Engineering College as a faculty in 2009, where he is Assistant Professor of Civil Engineering Department with a total experience of 17 years in the field of Research, Designing and Education. He is guiding M.E. / M.Tech (Construction Engineering and Management) thesis work in the field of Civil / Construction Engineering. He has published many papers in National / International Conferences and International Journals. He has published seven Research Books in the field of Civil Engineering, Rural Road Construction, National Highways Construction, Utilization of Industrial Waste, Fly Ash Bricks, Construction Engineering and Management, Eco-friendly Construction.

Prof. Amitkumar Raval received his Bachelor of Engineering Degree in Civil Engineering from Birla Vishwakarma Mahavidhyalaya in 2011. In 2013 he received his master's degree in Construction Engineering and Management from Birla Vishwakarma Mahavidyalaya, Gujarat Technological University. He has published many papers in various National & International Journals & in various Conferences. He has published One Book in the field of Civil Engineering.