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Advanced Water Curing for Concrete: A Review

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Abstract: ***This paper reviews research conducted on Different types of curing of Concrete. Various techniques are used worldwide for Residential and commercial structure for curing of concrete. Advancement in water curing for concrete is one of the good enhancements for continuous and proper curing for concrete in minimum cost. This paper represents the review on that analysis of different types of curing techniques. For curing purpose very much amount of water is required. There is a requirement of alternative curing system from which maximum amount of water is saved.***
Key Words: curing, concrete structure, curing techniques.

I. INTRODUCTION

A Process of keeping concrete surface in wet condition for certain period to getting more reactions in between water and cementious material which produce heat of hydration is known as curing. It is a process of reducing the heat of hydration from all element of structure and prevents it from generation of cracks for getting more strength to the concrete structure. Due to this the durability up to lifespan of structure will increase. Curing plays an important role on strength development, durability and sustainability of concrete structure. Curing takes place after 24 hours by placing and finishing of concrete in formwork, mould or after removing formwork and moulds, and it involves maintenance of desired moisture and temperature conditions, both at depth and near the surface, for extended periods of time. Curing also ensures to maintain an adequate temperature of concrete in its early ages, as this directly affects the rate of hydration of cement and eventually the strength gain of concrete or mortars.

The process serves two major purposes: It prevents the loss of moisture from the concrete; it maintains a favorable temperature for hydration to occur for a definite period. Curing of concrete is done to maintain the Optimum moisture content (OMC) i.e. to prevent the loss of water which is required for the hydration of cement, to avoid shrinkage cracks and premature stressing or disturbance in concrete. Concrete is most important construction material all the structure depends on concrete only. that's why proper curing of concrete is very important parameter. For analysis there are various methods available like shading concrete work, covering concrete surfaces with hessian or gunny bags, sprinkling of water, ponding method, membrane curing, steam curing etc.

A. Types of Curing

1) *Shading of Concrete:* This is an object of shading concrete work is to prevent an evaporation of water from the surface even before setting is adopted mainly in case of large concrete surfaces such as road slabs etc. This is an essential in dry weather to protect the concrete from heat to avoid direct sun rays and wind to concrete surfaces. It also protects the surface from rain. In cold weather shading helps in preserving the heat of hydration of cement thereby preventing freezing of concrete under mild frost conditions. Shading may be achieved by using canvas stretched on frames. But the disadvantage of this method is that this is uneconomical as compared to others.
2) *Covering Concrete Surfaces with Hessian or Gunny Bags:* This is a widely used method for concrete curing. Thus exposed surface of concrete is prevented from drying out by covering it with hessian, canvas or empty cement bags. The covering over vertical and sloping surfaces should be secured properly. These are periodically wetted. The interval of wetting will depend upon the rate of evaporation of water. It should be ensured that the surface of concrete is not allowed to dry even for a short time during the curing period.
3) *Sprinkling of Water:* Sprinkling or continuously on the concrete surface provides an efficient curing. It is mostly used for curing floor slabs, beam, columns, walls etc. The concrete should be allowed to set sufficiently before sprinkling is started i.e. minimum 24 hours from casting period. The spray can be obtained by using hand or electrical pumps. On small jobs sprinkling of water may be done by hand using pipes. Vertical and sloping surfaces can be kept continuously wet by sprinkling water on top surfaces and allowing it to run down between the forms and the concrete. For this method of curing the water requirement is higher as well as maximum water losses take place at site.

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4) *Ponding Method:* This is the best method of water curing. It is suitable for curing horizontal surfaces such as floors, roof slabs, roads and air field pavements. The horizontal top surfaces of wide beams can also be ponded. After placing the concrete, its exposed surface is first covered with moist hessian or canvas. After 24 hours, these covers are removed and small ponds of clay, sand or lean concrete are built across and along the pavements. The area is divided into a number of rectangles. Then water fills in between the ponds. The filling of water in these ponds is done twice or thrice a day, depending upon the atmospheric conditions and leakages losses. This method is very efficient. Ponds easily break and water flows out. But the disadvantage of this method is that it is difficult to clean the clay.
5) *Membrane Curing:* The methods of curing described above come under the category of moist curing. It is one of the method of curing is to cover the wetted concrete surface by a layer of water proof material, which is kept in contact with the concrete surface for seven days. This method of curing is termed as membrane curing. A membrane will prevent the evaporation of water from the concrete surface area. It can be either in solid or liquid form. These methods are also known as sealing compounds. Bituminized water proof papers, wax emulsions, bitumen emulsions and plastic films are the common types of membrane used. Whenever bitumen is applied over the surface for curing, it should be done only after 24 hours curing with gunny bags. The surface is allowed to dry out so that loose water is not visible and then the liquid asphalt sprayed throughout. The moisture in the concrete is thus preserved. It is quite enough for curing. The main advantage of this method of curing is it does not need constant supervision. It is adopted with advantage at places where water is not available in sufficient quantity for water. This method of curing is not efficient as compared with wet curing because rate of hydration is less. Moreover the strength of concrete cured by any membrane is less than the concrete which is moist cured. When membrane is damaged the curing is badly affected.
6) *Steam Curing:* Steam curing and hot water curing is sometimes adopted in cold areas. With these methods of curing, the strength development of concrete is very rapid and faster work take place. Generally, these methods are used in pre cast concrete work. In steam curing the temperature of steam should be restricted to a maximum up to 75^0C as in the absence of proper humidity (about 90%) the concrete may dry too soon. In case of hot water curing, temperature may be raised to any limit, ay 100^0C, at this temperature; the development of strength is about 70% of 28 days strength after 4 to 5 hours. In both cases, the temperature should be fully controlled to avoid non-uniformity. The concrete should be prevented from rapid drying and cooling which would form cracks. But the disadvantage of this method is that the cost is very high and well trained employees have required.

II. PREVIOUS STUDIES ON CURING

S. Klinge et al.[1] In this paper a particular model for curing of polymers is studied, including the different effects arising at the late stages of the process. This model is Depend on the different parameters of civil engineering. Manish A. Kewalramani [2] studied different types of fly ash mixtures incite meticulous study of curing method is observed. In this paper the study of curing of concrete with coloured polythene sheets are observed. Abdullah M. Zeyad [3] studied the properties of high-strength concrete are significantly influenced by environmental conditions and the duration of the hot weathered curing method. Ulku SultanYilmaz [4] has done most important invention in concrete technology, i.e., the use of curing materials during concrete production, has favorable effects on concrete strength and provides better curing conditions for concrete. In this paper some chemical curing materials used in concrete production, to provide the curing conditions of concrete which have been got better strength as compared to normal curing strength. SilviaWeberAHans et.al **[5]** has given literature and site data on the efficiency of curing were controversial regarding its effect on the mechanical properties of high strength concrete. The traditional methods of curing may fail in cases of concrete with a low water/binder ratio. Hydration proceeds quickly, the hydrated cement paste is very dense, and water from the outside cannot reach the interior of the concrete to achieve complete hydration. Yash Nahata [6] has studied that Advancements in construction and chemical industry have paved a way for development of new curing techniques. Emma Mcfarlane [7] researches that aid the New Zealand construction industry in understanding the benefits of curing precast concrete products and the effects of different curing practices. Mokarram Hossain et.al. [8] the curing process of polymers are studied in the presence of a magnetic load. In this curing process the particles align with the application of a magnetic field during the curing process are observed. Dalibor Kocab et.al.[9] did project to establish a correlation between maturity development and degree of hydration of cement and to establish equivalent curing methods for concrete specimens that can accurately represent the curing conditions of concrete in pavement. Falah M Wagien [10] published an article on the effects of curing to concrete with seawater on the compressive, tensile, flexural and bond strengths of concrete are invest. D Ye et al [11] said that Curing of concrete has an effect on hardened concrete properties and overall long-term performance of Portland cement concrete (PCC) pavement. Their report synthesizes to findings from the literature review, including the relative humidity measuring techniques. Nurcan Ozakar et.al. [12] did an experiment for find out the results to

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determine the influence of different curing conditions on the mechanical performance of concrete made with coarse recycled aggregate from crushed concrete. Ahmed Shaban et al. [13] reseches that recycled concrete aggregate is used in new concrete production is good utilization of concrete waste. He done the experimental study and result to evaluate the effects of recycled concrete aggregate under different curing conditions.. Renata Kotynia et al.[14] concluded that the different curing temperature of commercially available epoxy adhesives used for structural strengthening. Katarzyna Łaskawiec et al. [15] studied that the effect of different additional cementitious materials (silica fume, fly ash, slag, and their combinations) on strength and durability of concrete cured for a short period of time—14 days. Muddassir Bora et al. [16] discussed on importance of curing and how to protect the loss of water. A.A. Amadia et al. [17] studied that Combined treatment techniques have been adopted by many pavement designers and site engineers to improve the strength and stability of foundation of black cotton soils. The research was conducted to investigate the effect of curing time on strength development of black cotton soil stabilized with 10% quarry fines and varying percentages(0–16%) of cement kiln dust. Horianto et.al. [18] was wrote a paper on the optimum temperature and duration of curing is essential in geopolymerization reaction to achieve higher strength. Ulku Sultan Yilmaz et al. [19] said that the use of curing materials during concrete production has favorable effects on concrete strength and provides better curing conditions for concrete. for that study they used some chemical curing materials used in concrete production, to provide and improve the curing conditions of concrete. Ratthasak Prommas et al. [20] concluded that the MWs curing method and processes for rapid thermal curing application of concrete which could be implement in a good way to improve the rate of strength development.

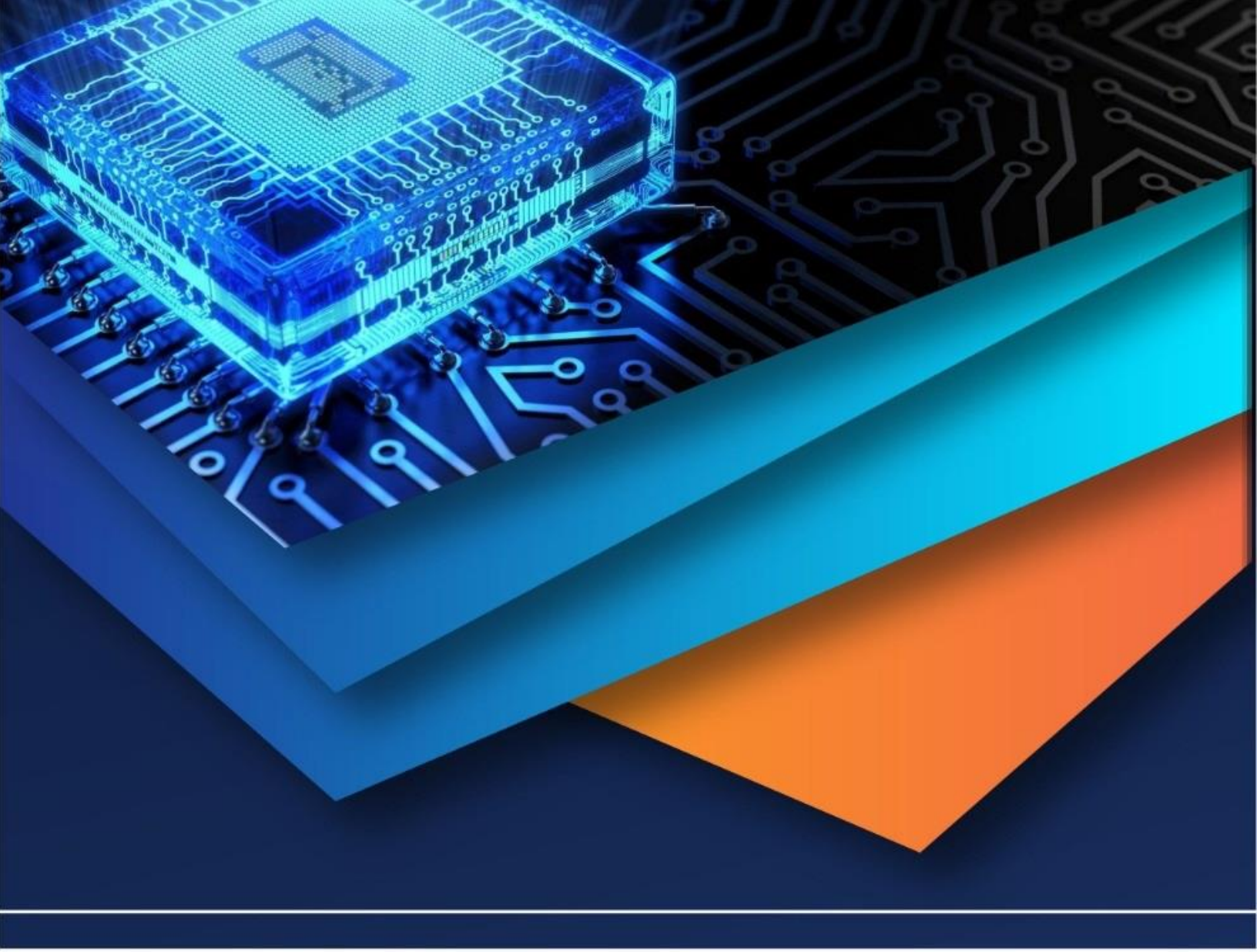
III. CONCLUSIONS

Results of an experimental and analysis researches shows that curing plays an important role in strength of concrete. Proper curing of concrete structure is important to meet performance and durability requirement. Performance results are depending on the different type of curing as per types of concrete and weather conditions. The most frequently measured concrete properties are strength, ductility and permeability, These are important properties; however, in PCC pavement, volume change potential affected by curing effectiveness is as important for its performance. The curing period may depend on the prssoperty required, material used for making concrete, the purposed for which it is used, and ambient condition i.e. temperature and relative humidity of atmosphere.

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