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Economical Curing Method by Curing Pad for Beam

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Abstract: ***Efficient uninterrupted curing is a key to quality concrete. Proper curing of concrete is crucial to obtain design strength and maximum durability considering the cost of curing. Curing is designed primarily to keep the concrete moist, by preventing the loss of moisture from the concrete during the period in which it gains strength. Due to rising problem of scarcity of water and expensive conventional methods of curing, it had become necessary to build-up a new method for concrete curing. This paper represents the experimental work related to a newly developed, effective and economical method of beam curing. This method consists of a technology namely 'Curing Pad' that not only absorbs and retains water for an extended period of time but also reduces evaporation losses. Concrete pad consists of 3 layers. The top layer is of a reflector material that reduces evaporation losses. The middle layer comprises of an absorbent material that stores and transmits water to the concrete beam. Bottom layer is binding or packing layer that holds all three layers together. Various tests are performed to check the durability of Curing Pad as well as its performance on concrete beam. These test results are compared to those of ponding method of beam curing.***

Keywords: strength, scarcity of water.

I. INTRODUCTION

Cement is a binder, a substance used for construction that sets, hardens, and adheres to other materials to bind them together. Raw materials used in cement are heated to a temperature up to 1450 °C and then cooled. This heat gets stored in the cement and on the addition of water it reacts with the water forming an exothermic reaction which evolves heat.Heat of hydration induces thermal gradient due to higher rate of loss of heat from outer surface than from inner core. This thermal gradient causes cracking in concrete due to non-uniform expansion of concrete within the body. Curing is the process of controlling the rate and extent of moisture loss from concrete during cement hydration. It may be either after it has been placed in position (or during the manufacture of concrete products), thereby providing time for the hydration of the cement to occur. Since the hydration of cement does take time – days, and even weeks rather than hours – curing must be undertaken for a reasonable period of time if the concrete is to achieve its potential strength and durability. Curing may also encompass the control of temperature since this affects the rate at which cement 2 hydrates. The curing period may depend on the properties required of the concrete, the purpose for which it is to be used, and the ambient conditions, i.e. the temperature and relative humidity of the surrounding atmosphere. Curing is designed primarily to keep the concrete moist, by preventing the loss of moisture from the concrete during the period in which it is gaining strength. Curing may be applied in a number of ways and the most appropriate means of curing may be dictated by the site or the construction method.

Normal concrete was prepared with a water-cement ratio of 0.50. cube specimens were cast for testing the compressive strength at 7 and 28 days of curing respectively using three curing methods namely immersion, sprinkling and Plastic sheeting, curing to cure the cube specimens until the day of testing. Test results indicates that water curing (WAC) as well as sprinkling (spraying) curing provided much better results than membrane (Plastic Sheeting) method of curing. The rate of drying was significant when the specimens were subjected to membrane (Plastic sheeting) method of curing. This thus hampered the hydration process and thus affected the compressive strength property of the hardened concrete. The overall finding of this study suggests that concrete should be cured by water curing to achieve a better compressive strength. The properties of hardened concrete, especially the durability, are greatly influenced by curing since it has a remarkable effect on the hydration of the cement. The advancements in the construction and chemical industry have paved way for the development of the new curing techniques and construction chemicals such as Membrane curing compounds, Self-curing agents, Wrapped curing, Accelerators, Water proofing compounds etc. With the growing scale of the project conventional curing methods have proven to be a costly affair as there are many practical issues and they have been replaced by Membrane curing compounds and Self-curing agents up to some extent as they can be used in inaccessible areas, Vertical structures, Water scarce areas etc .It is most practical and widely used curing method. Concrete curing is one of the most important and final steps in concrete construction though it is also one of the most neglected and misunderstood procedures.

Curing is the name given to the procedures used for promoting the hydration of the cement, and consists of a control of temperature and of moisture movement from and into the concrete. It is the treatment of newly placed concrete during the period in which it is hardening so that it retain enough moisture to immunize shrinkage and resist cracking Curing of concrete is a pre requisite for the hydration of the cement content. Curing allows continuous hydration of cement and consequently continuous gain in the strength, once curing stops strength gain of the concrete also stops. With insufficient water, the hydration will not proceed and the resulting concrete may not possess the desirable strength and impermeability. The continuous pore structure formed on the near surface may allow the ingress of deleterious agents and would cause various durability problems. Moreover due to early drying of the concrete micro-cracks or shrinkage cracks would develop on surface of the concrete. When concrete is exposed to the environment evaporation of water takes place and loss of moisture will reduce the initial water cement ratio which will result in the incomplete hydration of the cement and hence lowering the quality of the concrete. Various factors such as wind velocity, relative humidity, atmospheric temperature, water cement ratio of the mix and type of the cement used in the mix. Evaporation in the initial stage leads to plastic shrinkage cracking and at the final stage of setting it leads to drying shrinkage cracking. The necessity for curing arises from the fact that hydration of cement can take place only in water-filled capillaries. This is why loss water must be prevented. Furthermore, water lost internally by self-dedication has to be replaced by water from outside, i.e. Ingress of water into the concrete must take place.. Thus, for complete and proper strength developments, the loss of water in concrete from evaporation should be prevented, and the water consumed in hydration should be replenished. This the concrete continues gaining strength with time provided sufficient moisture is available for the hydration of cement which can be assured only by creation of favourable conditions of temperature and humidity. This process of creation of an environment during a relatively short period immediately after the placing and compaction of the concrete, favorable to the setting and the hardening of concrete is termed curing.

A. Types of Curing Method

1) Ponding and Immersion
2) Fogging and Sprinkling
3) Wet Coverings
4) Membrane-Forming Curing Compounds
5) Steam Curing

II. METHEODOLOGY

A. Layers in Curing Pad

Various construction sites were visited to inspect the traditional way of curing used for column beam and slabs. We found that gunny bags and ponding method used for column, beam and slabs respectively. This type of curing method which is used since last years. Data was collected pertaining to available methodologies and applications of ponding method for curing of slab. The collected data were used for separation of traditional and new method of curing. On the basis of data we have decided to make curing pad of three layers. Based on collected data analysis was made to find out the most suitable materials for: -

- Upper Layer: - To prevent evaporation losses
- Middle Layer: - Material having capacity to absorb and hold water
- Bottom Layer: - Durable material to transmit water from middle layer to concrete slab below.

This three layers in one pad which will help to keep the surface moist for long time.

1) Layer 1 (Innermost Layer)

The innermost layer consists of a NET for allowing the water to come in contact with the concrete of the respective member. This layer of pad is help to percolate the water from middle layer to the surface of concrete. This layer also help for proper connection of water to the surface of concrete without any obstacles

Fig 1. Net material used at innermost layer to curing pad

2) Layer 2 (Middle Layer)

This layer consists of material which is TEXTILE INDUSTRY WASTE. The material used in this layer having good water absorption properly to resist water and percolate for curing.

Fig 2. Textile Industry waste used in curing pad

3) Layer 3 (Outermost Layer)

The outermost layer is the PLASTIC layer. Plastic layer is provided in order to control the loss of water from the second layer due to evaporation. This layer of Curing pad also helps to increase the service life of curing pad to make method effectively.

Fig.3. Plaster used in curing pad to prevent water from evaporation

B. Process of Making Curing Pad

1) Take a plastic sheet, net material, textile Industry waste.
2) First place plastic sheet then spread textile waste over it and cover textile Industry waste with net material
3) This three layer kept carefully and stitch by needle and thread.
4) And the efficient curing pad is ready to use

Fig 4. Efficient curing pad for curing to concrete

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III.RESULTS

A. *Result of Compressive Strength Test*

Following table compares the strength of concrete block of M20 mix for three different methods of curing

Days of Curing	Immersed Curing (N/mm2)	Pad Curing (N/mm2)	Conventional curing (N/mm2)
3 Days	10.2 9.8	9.4 8.75	8.9 8.7
7 Days	16.3 16.2	15.8 15.4	12.2 14
28 Days	20.9 20	19.2 17.9	18 18.3

Table No. 1 Result of compressive strength

B. *Result of Spitting Tensile Strength of Concrete*

Days of Curing	Immersed Curing (N/mm2)	Pad Curing (N/mm2)	Conventional curing (N/mm2)
3 Days	5.628 5.670	5.605 5.611	5.509 5.513
7 Days	5.918 5.890	5.870 5.821	5.801 5.793
28 Days	6.116 6.201	5.965 6.014	5.840 5.878

Table No. 4 Splitting tensile strength Result

C. *Application*

Amount of water saved using Curing Pads:
The conventional practice used for curing of column and the approximate amount of water required for curing of the column is given below.
Assume the size of column=0.3 m x 0.45 m
Assume the floor to floor height=4.575m
Therefore, total surface area= (2x0.3x4.575) +(2x0.45x4.575)
=6.8625 m²
Assume the water is applied in 2mm thickness.
Therefore, volume of water to be applied = 6.8625 x 2 x 10-3=13.725 m² = 13.725Litres
litres + wastage = 35 litres
During the entire day water is spread for at least 3 times,
Hence, total amount of water required per day per column=35 x 3=105 litres

For Curing Pads
By calculation the pad to be used for column of area 6.8625 m2 will absorb about 53.91 liters.

Amount of water saved as compared to conventional curing = 105 lit- 53.91 lit
=51.09 lit/column/day.

Also, using the curing pad we need to water the beam on every alternate days, so instead of applying water for 7 days using conventional practice we need to apply water for 3 days only.

Let us assume a 2-storied building with 10 beams on each floor.
By conventional practice, water required
= 105 x 10 x 2
= 2100 litres.

By using curing pad,
Water required=53.91 x 10 x 2=1079 litres.

Therefore, water saved= 2100-1079
= 1021 litres

Hence, we require almost 2 times less amount of water for curing using the curing pad.
By using curing pads, the evaporation losses are reduced to a large extent and also, we can apply water to the column on alternate days resulting in improved strength and a large amount of water being saved.
From the test results and observation, it has been observed that about 2 times less water is required for each column and hence a large amount of water can be saved for an entire site.

IV. CONCLUSIONS

This curing pad is made in three layers inner most layer made from net cloth, middle layer is made from textile industry waste which capacity to absorb water and third upper layer is made up from plastic which helps to prevent evaporation. This curing pad is economically and eco-friendly. This curing pad achieve strength of concrete nearby immersed Curing strength of concrete. It helps to avoid water losses due to evaporation and other reasons this water can save in this curing pad . This curing pad also helps to avoid repetition of curing in construction. Due to this method required less workers to curing work because water is available in curing pad for long time by textile material which absorb the large quantity of water in it. This method can use to gain proper strength to structure. This method required less water as compared to other methods due to this we can save water expenses, it can helps to economical construction. And life of this curing pad is more as compared to gunny bag or other methods.

Based on the research results presented, the following conclusions were drawn:

1) The concrete cubes cured in water tank and those cured by curing pads showed similarity in their relative compressive strength development.
2) The use of the following curing methods: Immersion in lime water; covering with curing pads; and immersion in water, should be limited to the 28-day curing period.
3) Strength of concrete by using curing pads is more than the conventional ponding method.
4) It is a one type investment that is only buying cost of pads which is useful for different floors.
5) Curing pads helps to reduce amount of water for curing.
6) It is effective, environmental friendly and economical method of curing of slab.

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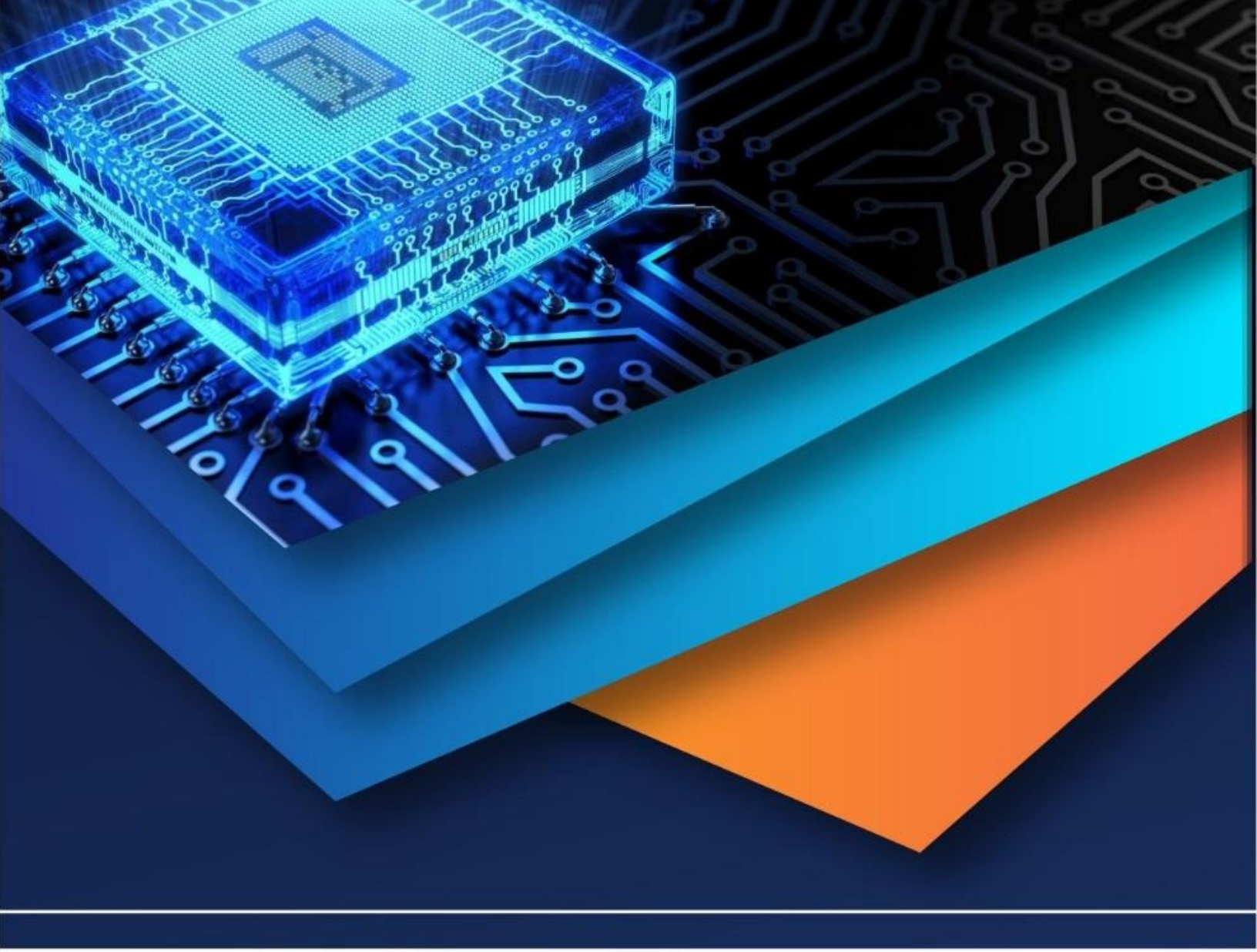

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