

EXPERIMENTAL INVESTIGATION ON SELF CURING OF CONCRETE WITH POLYETHYLENE GLYCOL

Submitted in partial fulfilment of the requirements for the award of Bachelor
of engineering degree in Civil Engineering By

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**DEPARTMENT OF CIVIL ENGINEERING
SCHOOL OF BUILDING AND
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SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

Accredited with Grade “A” by NAAC

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BONAFIDE CERTIFICATE



This is to certify that this Project Report is the bonafide work of **VARAKALA HARISH (37200951)** who carried out the project entitled **“EXPERIMENTAL INVESTIGATION ON SELF CURING OF CONCRETE WITH POLYETHYLENE GLYCOL”** under our supervision from December 2020 to April 2021.

Internal Guide

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Submitted for Viva voce Examination held on_____

Internal Examiner

External Examiner

DECLARATION

I, VARAKALA HARISH (Reg.No.37200951) hereby declare that the Project Report entitled “EXPERIMENTAL INVESTIGATION ON SELF CURING OF CONCRETE WITH POLYETHYLENE GLYCOL” done by me under the guidance of Mr. J. VANJINATHAN is submitted in partial fulfilment of the requirements for the award of Bachelor of Engineering degree in Civil Engineering.

1.

2.

SIGNATURE OF THE CANDIDATES

DATE:

PLACE:

ACKNOWLEDGEMENT

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We thank them.

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ABSTRACT:

The aim of this research is to investigate the strength and hardness of concrete that has been handled with water-soluble polyethylene glycol as a self-curing agent. The objective of a self-curing agent is to avoid the evaporation of water from cement. It is necessary to use self-curing admixes, particularly as water resources grow more valuable by the day. Concrete was treated with polyethylene glycol in amounts of 1%,

1.5%, and 2%. (i.e., each 1m³ of concrete needed approximately 3m³ of water to construct). The most of it is for the sake of recovery. At 7, 14, and 28 days of age, concrete made from The compressive resistance, the split tensile and flexure strength were measured for the M20-grade mix and the results were comparable with normal concrete.

Key Word: Self-curing concrete, Self-curing agent, Polyethylene Glycol (PEG-400), Water retention, Compressive strength, Workability, Saving of water.

CHAPTER-1

INTRODUCTION

1.1 GENERAL

Concrete is the most commonly used building tool on the planet. Many aspects of our daily lives depend on real, whether expressly or indirectly. Concrete is manufactured by mixing widely available materials such as cement, concrete, and water. Concrete is unique to large building materials because it is particularly engineered for complex structural project engineering. Concrete is a building material that consists of granular materials such as coarse concrete, linked by a mortar or binder filling and holding them together within the spaces between the particles. Concrete is widely utilised in the construction and renovation of facilities around the world. Finding suitable alternatives for concrete planning is becoming more challenging. As a consequence, natural aggregate sources other than sand and gravel are becoming more relevant.

1.2 CONCRETE

Concrete is a composite medium in which an inert particle of well-graded fine and coarse concrete is bonded together by a binding material mixed in water and solidified.

1.3 CLASSIFICATION OF CONCRETE

Concrete are classified into different types:

- According to binding materials used in concrete
- According to design of concrete

1.3.1 CLASSIFICATION ACCORDING TO BINDING MATERIAL

According to binding material used concrete are two types

- Cement concrete
- Lime concrete

1.3.1.1 CEMENT CONCRETE

Cement concrete is a form of concrete that is made up of cement, sand, and coarse aggregate mixed with water in the proper proportions. In this kind of concrete, cement is used as a binding medium, sand as fine aggregates and gravel, and ground stone as coarse aggregate. Cement concrete is often used in bridges and other important infrastructure programmes where dependability and durability are critical.

1.3.1.2 LIME CONCRETE

Lime, fine aggregate, and rough aggregate are combined with water in the proper proportions to make cold concrete. Hydraulic lime is a typical binding material in this form of concrete. Sand and cinder are examples of fine aggregates, while broken bricks and gravel are examples of coarse aggregates. To save capital, lime concrete is widely used in base and underfloor building. Except in places where cement is not readily available in adequate quantity, the roof may be installed.

1.3.2 CLASSIFICATION ACCORDING TO DESIGN OF CONCRETE

- Plain cement concrete
- Reinforced cement concrete
- Pre-stressed concrete

1.3.2.1 PLAIN CEMENT CONCRETE

Simple cement concrete, also known as mass cement concrete, is a form of cement concrete that contains no reinforced steel. This kind of concrete absorbs compressive stresses well but not so well tensile stresses. In certain cases, plain cement concrete is used for foundation and flooring work in houses.

1.3.2.2 REINFORCED CEMENT CONCRETE

Reinforced cement concrete is a kind of reinforced cement concrete that has tensile stress embedded in it. In this type of concrete, steel reinforcement in the form of circular bars with diameters ranging from 8mm to 32mm can be used. This concrete is similarly resistant to tensile, compressive, and shear stresses. RCC may also be used to design slabs, pillars, columns, floors, and pre-cast concrete.

1.3.2.3 PRE-STRESSED CEMENT CONCRETE

Pre-stressed cement concrete is a form of cement concrete that has a high compressive stress created artificially before it is used. Pretensioning the reinforcement causes high compressive stresses in this type of cement concrete, which are then released as the concrete reaches its final setting temperature. This kind of concrete can endure high tensile and compressive pressures without cracking. The volume of insulation will be greatly reduced when using this concrete.

1.4 SCOPE

- To find out how polyethylene glycol affects the power of self-curing concrete.
- To evaluate the effect of polyethylene glycol on mechanical systems that have been experimentally studied.
- To use as less water as possible during the curing period.

1.5 OBJECTIVE

- An experimental programme was developed to explore the power of self-curing concrete by applying Polyethylene glycol.
- Polyethylene glycol in various percentages is included in the concrete blends.
- This concrete is in contrast to standard concrete.
- To keep the project as cost-effective as possible.
- To research the impact on the strength of concrete of various healing substances.

CHAPTER 2

LITERATURE REVIEW

2.1 GENERAL

The literature studies of self-curing concrete with poly ethylene have been described in this part.

2.2 LITERATURE STUDY

B.Hemanthakumaret al(2017) Because of its compressive strength and resilience, béton is today the most used material for building. Different amounts of cement, fine aggregates, rough aggregates and water are mixed according to the nature of the work. Concrete needs a pleasant environment with plenty of moisture for at least 28 days in order to hydrate and strengthen properly. If the curing process is sloppy, the strength and durability of concrete will suffer. Self-curing concrete is one of the few concretes that can be used to address inadequate curing caused by human error. Water scarcity in arid regions, structural lack of access in difficult areas and areas where the presence of fluoride in water has an adverse impact on concrete properties. Many experiments on the use of self-curing concrete have been carried out. In comparison with m25 and m35, the effect of the admixture Poly-ethylene glycol-400 has been investigated and compared to M25 and M35. mixes at different percentages. We also looked into how acid and water absorption affected concrete self-curing. The current study provided a straightforward cooperative image of PEG-400's strengths and tension strain action.

Akshara O.S(2016) The concrete is still the most frequently used construction tool because of its high compression strength and toughness. Because water conservation is a daily necessity, the use of self-curing admixtures is critical (3m3 of water in the building, most of which are used for curing, are required for each cubic meter of cement). The project aims to study the mechanical and durable characteristics of concrete in aquatic polyethylene glycol (PEG-400). In this study, the mechanical characteristics of self-treatment concrete are examined and contrasted with conventionally treated concrete. In terms of cement weight, the number of self-curing agents used ranges from 0.5% to 2.0%.According to test results, self-curing concrete outperforms conventionally cured concrete. The

optimum PEG-400 dose for full strengths was discovered to be 1%.

Soorya Tharshini et al (2018) Concrete is the most widely used construction material nowadays due to its compressive power and hardness. Plain concrete is made by using cement, fine aggregate, coarse aggregate, and water in different proportions based on the form of operation. Plain concrete necessitates a friendly atmosphere of enough moisture for at least 28 days in order to adequately hydrate and reach the desired intensity. If the curing method is sloppy, the quality and hardness of the concrete can suffer. Self-curing concrete is one of the only concretes that can be used to cope with insufficient curing triggered by human error. Water shortage in arid areas, inaccessibility of buildings in difficult terrains, and regions where fluoride deposition in water will negatively impact the properties of concrete, which helps with self-curing, hydration, and thus strength. PEG 400 has been found to help self-curing by delivering strength comparable to conventional curing. It was also discovered that 1% PEG 400 by weight of cement was ideal for M20 grade concretes, while 0.5 percent was ideal for M40 grade concretes for achieving maximum strength without sacrificing workability. As water becomes a limited resource, there is an urgent need to undertake water management studies in concrete and construction. Curing concrete relates to the process of maintaining a consistent moisture content in the early stages of its production in order to produce the best properties.

G.Thrinatheal(2017) There is now a planet-wide preference for concrete as the world's most durable and long-lasting building material. Since concrete curing is critical for achieving good strength, we use the self-curing concrete concept rather than immersion or sprinkle curing to prevent water shortages. Water solvent polymers, such as polyethylene glycol, have been discovered to be useful as a self-curing agent (PEG-400). Different amounts of PEG-400 in cement weight as curing agent were added to the effect of admixture polyethylene glycol (PEG-400) on compression, split strength and bending strength. in this research,ranging from zero to two percentages. The results of the M30 concrete mix tests were analysed. The ideal PEG-400 proportion for compressive and break tensile strength was estimated to be 1%. As the PEG-400 dosage is raised to more than 1%, the compressive and split tensile pressure decreases. The maximum PEG-400 percentage for flexural strength, on the other hand, was discovered to be 0.5 percent. As the dosage of PEG-400 is raised by more than 0.5 percent, the flexural resistance decreases.

Shikha Tyagi(2015) Concrete is the most commonly used building material due to its

weight, resilience, and durability. When exposed to the elements, the water used to evaporate and the amount of water remaining in the concrete is inadequate for proper hydration. If dehydration persists, the water lost by absorption and evaporation must be replenished through drinking more water. A number of precautions must be taken in order to prevent water from penetrating the cement foundation. As a consequence, cure can be viewed as the development of a favourable environment for sustained hydration throughout the early stages. Shrinkage-reducing admixtures such as POLYETHYLENE GLYCOL (PEG 400) are used in this study as an internal curing compound. This curing agent is used in concrete to increase hydration and self-curing, resulting in higher compressive strength. They trap moisture within the structure, keeping it from evaporating spontaneously like it does due to hydration. In this study, the impact of the curing compound on workability (slump and compaction factor) and compressive strength is studied. The dosage of internal curing compound in this study was set at a percentage of PEG by weight of cement varying from 0% to 2%. The M25 and M40 blend test results were compared. This study discovered that PEG 400 helps self-curing by supplying strength comparable to conventional curing processes, as well as improved workability.

Basil M Joseph(2019) Curing concrete relates to the process of maintaining a consistent moisture content in the early stages of its production in order to produce the best properties. In certain cases, though, adequate treatment is not always possible. As a result, several researchers were interested in the need to develop self-curing agents. The concept of minimising water evaporation in concrete by combining self-curing agents. As a consequence, when compared to standard concrete, the water carrying capacity of concrete is expanded. Water-soluble polymers have been shown to be efficient self-curing agents in concrete. Concrete with self-curing agents will be a new breakthrough of concrete manufacturing in the twenty-first century. The aim of this research is to determine how well water-soluble polymeric glycol performs as a self-curing agent. the use of a self-curing admixture Since water sources are becoming extremely inadequate, curing admixtures are important (e.g., each 1 m³ of concrete requires approximately 3 m³ of water for construction). The most of it is used for curing). For desert areas, where water is scarce, the benefits of self-healing admixtures are more important. In this analysis, tested and compared to standard concrete specimens at different polyethylene glycol percentages.

Sathanandham.T (2013) It is the strongest and toughest of the traditional

construction materials, which is why concrete is used in almost all buildings. Plain concrete is made based on the form of operation. Plain concrete necessitates a friendly atmosphere of enough moisture for at least 28 days in order to adequately hydrate and reach the desired intensity. Curing has a major effect on cement hydration, which influences the properties of hardened concrete, including hardness. If the treatment method is sloppy, the cement's consistency and hardness can suffer. Self-healing concrete is a single material that can be used to address the problem of insufficient healing due to human error. Water scarcity in arid areas, building inaccessibility on difficult terrain, and regions where fluoride deposition in water has a negative impact on concrete assets. This research will look into the use of a shrinkage-reducing polyethylene glycol (PEG 4000) mixture in concrete to help it cure, hydrate, and thus gain strength. The percentage of PEG per weight affects the impact of admixture, which ranges from 0% to 2%. (PEG 4000) on compressive force, break tensile strength, and modulus of rupture for M20 was investigated. PEG 4000 has been found to help self-curing by delivering strength comparable to conventional curing. It was also discovered that 1 percent PEG 4000 by weight of cement was ideal for achieving maximum strength without sacrificing workability in M20 grade concretes.

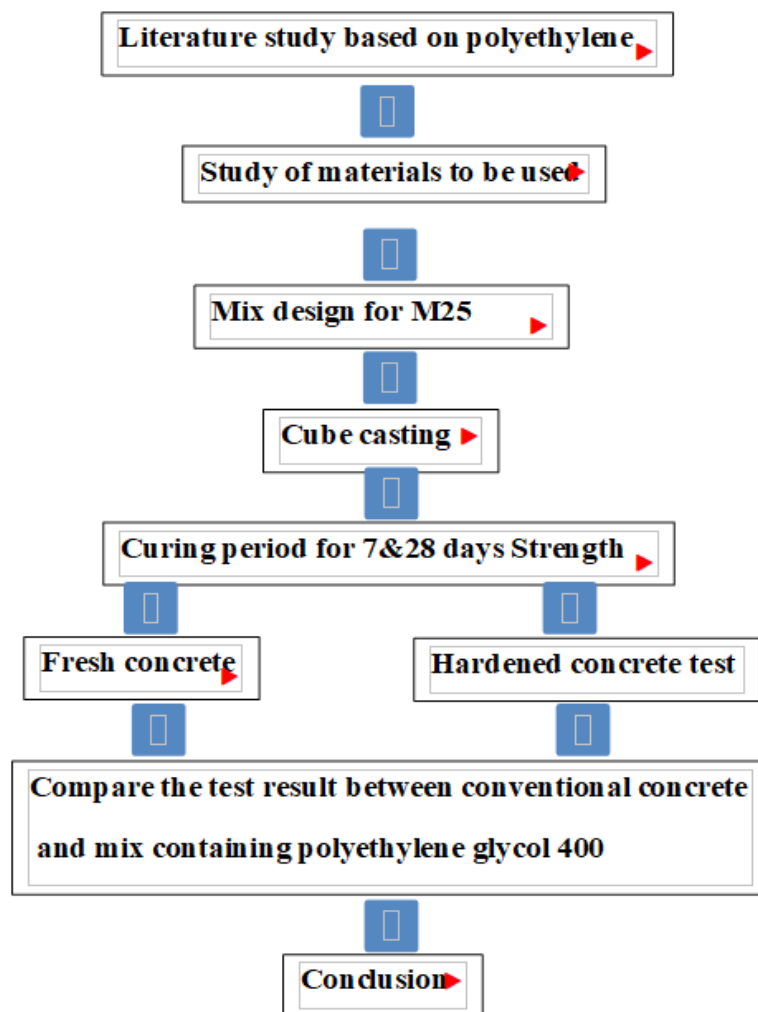
R.Sethuraman,S.Srumathi.(2020) Self-curing concrete extracts water from the environment to help the cement in the concrete hydrate. It solves the problem of hydration in cement concrete induced by improper or no curing of the concrete by utilising self-curing agents such as polyacrylic acid, which provides the moisture needed by the concrete. PEG is an industrial-to-medicinal polyether compound with many uses. Due to its molecular weight it was often known as polyethylene oxide. A superplasticizer (complast sp 430) is used to improve workability without the usage of water.

CHAPTER-3

METHODOLOGY

3.1 METHODOLOGY

It describes about the workflow of the project as follows:



3.2 MIX DESIGN

3.2.1 STIPULATION FOR PROPORTIONING

Grade designation	: M25
Type of cement	: OPC 53 confirming IS 8112
Nominal size of aggregate	: 20mm

Max. Cement content	: 383.2 kg/m ³
Min. water content ratio	: 0.5
Workability	: 50-75 mm (slump)
Chemical admixture type	: Polyethylene Glycol 400
Type of aggregate	: Crushed angular

3.2.2 TEST DATA FOR MATERIALS

Cement used	: OPC53 grade confirming IS 8112
Specific gravity of cement	: 3.15
Specific gravity of Fine aggregate	: 2.65
Specific gravity of Coarse aggregate	: 2.67
Fine aggregate	: NIL
Coarse aggregate	: NIL

3.2.3 TARGET STRENGTH FOR PROPORTIONING

$$f_{ck}^* = f_{ck} + 1.65S$$

Where,

f_{ck}^* = Target Average Compressive Strength at 28 days

f_{ck} = Characteristic Compressive Strength at 28 days

S = Standard deviation

For table 1, standard deviation

$$S = 4 \text{ N/mm}^2$$

$$\text{Therefore target strength} = 25 + (1.65 * 4)$$

$$f_{ck}^* = 31.6 \text{ N/mm}^2$$

3.2.4 SELECTION OF WATER CONTENT

For table 2, Maximum Water content for 20mm aggregate = 186 litres

For 50mm slump add 3%

$$= 186 + (3/100 * 186)$$

$$= 192 \text{ litres}$$

3.2.

5 CALCULATION OF CEMENT CONTENT

$$\text{Water cement ratio} = 0.50$$

$$\text{Cement content} = 192 / 0.50$$

$$= 383.2 \text{ Kg/m}^3$$

For table 5 IS 456 minimum cement content ever exposure condition

$$= 320 \text{ Kg/m}^3$$

$$383.2 \text{ Kg/m}^3 > 320 \text{ Kg/m}^3$$

3.2.6 MIX CALCULATION

Mix calculation per unit volume of concrete shall be follow.

$$\begin{aligned}
 \text{Volume of concrete} &= 1\text{m}^3 \\
 \text{Volume of cement} &= \text{mass of cement /SG of Cement} \times 1/100 \\
 &= 383.2/3.15 \times 1/1000 \\
 &= 0.122\text{m}^3 \\
 \text{Volume of water} &= \text{mass of water /SG of water} \times 1/1000 \\
 &= 192/1 \times 1/1000 \\
 &= 0.196\text{m}^3 \\
 \text{Volume of total aggregate} &= (A-(B+C)) \\
 &= 1-(0.122+0.196) \\
 &= 0.6864\text{m}^3 \\
 \text{Mass of coarse aggregate} &= (0.6864 \times 0.62 \times 2.67 \times 1000) \\
 &= 1136.26\text{kg/m}^3 \\
 \text{Mass of fine aggregate} &= (0.6864 \times 0.38 \times 2.65 \times 1000) \\
 &= 691.2\text{kg/m}^3
 \end{aligned}$$

CEMENT	FINE AGGREGATE	COARSE AGGREGATE
383.2	691.2	1136.26
1	1.8	2.96

Table 3.1 Mix Proportion

CHAPTER-4

MATERIAL USED

4.1 GENERAL

The ingredients' purity and properties are largely responsible for the concrete's durability. Concrete should be manufactured from high-quality, well graded products. Aggregates must be sieved with the correct sieves. Until being used in concrete, each part should be carefully inspected. The required power could only be obtained by careful selection, measurement, and proportioning. The following section discusses the different kinds of materials used in concrete, as well as their properties and selection criteria.

4.2 CEMENT

Cement is the main component of concrete. The grade of the cement, the form of the cement, the colour, the fineness of the cement, the heat of hydration, and the alkali content of the cement are all important factors to consider when selecting a cement. Ordinary Portland cement, available in grades 33, 43, and 53, is the most commonly used type of cement. The grade results indicate the compressive strength of the cement.

S.NO	COMPOSITION	PERCENTAGE
1	Al_2O_3	6.6
2	SiO_2	21.8
3	Fe_2O_3	4.1
4	CaO	63.1

Table 4.1: Chemical composition of cement

The cement should be very cool and clear of lumps. The cement should be greenish grey in colour and set in a dry location. The cement has a specific gravity of 3.15.

4.3 FINE AGGREGATE

River sand and crusher sand are used to make fine aggregate. Fine aggregate should be carefully sieved using a 2.36mm sieve before use. Fine aggregate is graded into zones I through IV based on the sieve scale. The fine aggregates' properties were tested using the IS 393-1970 codal provision. In general, zone II

aggregate is used for concrete, with sizes ranging from 4.75 to 2.36 mm. The absolute gravity of the fine aggregate is 2.65.

4.4 COARSE AGGREGATE

The coarse aggregate has a significant impact on the consistency of concrete. It is the least porous and more chemically resistant material. As coarse aggregate is used, drying shrinkage and other dimensional differences in concrete are minimised. The properties of coarse aggregate were evaluated using the IS 393- 1970 codal provision. The coarse aggregate should have a height of 20mm. The basic gravity varies between 2.65 and 2.7.

4.5 WATER

Water is the most important aspect of aggregate. And the quality of the concrete is affected by the temperature of the water. Salts and other highly harmful compounds should be removed from the water. Efflorescence occurs in reinforced concrete due to the presence of salt in water. Portable water is used for concrete construction. The strength of the concrete is determined by its water content. A higher water content in the concrete increases its power, whereas a lower water content increases its workability.

4.6 POLYETHYLENE GLYCOL 400

The polyethylene glycol (PEG 400) is a low polyethylene glycol of low molecular weight. It's a clear, viscous, colorless material. PEG 400 is widely used in a number of drug formulations because of its low toxicity. The hydrophilicity of PEG 400 is high. According to the PEG 400 partition coefficient for water and hexane, only 15 hexane parts per million parts are available 400 PEG in the water crust. PEG 400 is also soluble in air, acetone, alcohols, glycerine, glycols, and aliphatic hydrocarbons. PEG 400 is being used as an inactive ingredient of the pharmaceutical industry as a cleaner, plasticizer, surfactant, ointment, pill, and pill. The properties of PEG are discussed further below. Molar mass = 380- 420 g/mol

Density = 1.128 g/cm³

Melting point= 4 to 8°C

Viscosity = 90.0 cst at 25° C

Flash point = 238° C

Chemical formula = C_{2n}H_{4n+2}O_{n+1}

CHAPTER-5

MATERIAL TESTING

5.1 TEST ON FINE AGGREGATE

- Fineness modulus test
- Specific gravity test
- Moisture content test

5.1.1 FINENESS MODULUS TEST

The fineness modulus was used to calculate the fineness of the aggregates. Sieve analysis is used in this test. One kilogramme of fine aggregate was obtained. The sieve sets were positioned with the pan at the bottom and ranging in size from 4.36mm to 75 micron. The aggregate sample was placed in a 4.36mm sieve, capped, and run for 10 minutes. The weight of each sieve's preserved sample was recorded after 10 minutes.

S.NO	Sieve size mm	Wt of sand retained(X) G in gram	Percentage weight retained (X/W)x100	Cumulative Percentage retained 'y'	Percentage finer n=100-y
1	4.750	25.3	2.53	25.3	
2	2.360	42.7	4.27	6.80	97.47
3	1.180	128.4	12.84	19.84	93.2
4	0.600	140.6	14.06	33.70	80.36
5	0.425	118.2	11.82	45.52	66.30
6	0.300	109.4	10.94	56.46	54.48
7	0.150	234.9	23.49	79.95	43.50
8	0.075	103.5	10.35	90.30	20.54
9	Pan	97	9.70	100	0

Table 5.1 Fineness modulus of fine aggregate

Weight of the sample taken =1000Kg From the graph:

$$D_{10}=0.08, D_{30}= 0.30, D_{60}=0.52$$

$$\begin{aligned} \text{Coefficient of curvature } C_c &= \frac{D_{30}^2}{D_{10} \times D_{60}} \\ &= \frac{(0.3)^2}{0.08 \times 0.52} = 2.16 \end{aligned}$$

$$\begin{aligned} \text{Uniformity coefficient } C_u &= \frac{D_{60}}{D_{10}} \\ &= \frac{0.52}{0.08} = 6.5 \end{aligned}$$

Result:

Uniformity coefficient =6.5

Percentage of gravel (>4.75mm)= 2.53%

Percentage of sand (4.75-0.075mm)= 90.30%

Percentage of silt and clay = 9.7%

5.1.2 SPECIFIC GRAVITY TEST

A precise gravity test was carried out using a pycnometer. First, w1 is the pycnometer's empty weight with cover. The pycnometer's weight, which had been filled with 400g of sand, was then recorded as w2. The weight was recorded as w3 after filling the pycnometer up to the lid with water. The pycnometer was then properly washed and filled with water as w4. The exact gravity of fine aggregate was determined using the measurements mentioned below

S.NO	w1(g)	w2(g)	w3(g)	w4(g)	G
1	684.5	1268.4	1860.5	1499.6	2.64
2	684.5	1303.6	1894.4	1501.9	2.73
3	684.5	1275.6	1846.5	1487.7	2.54

Table 5.2 Specific gravity of the fine aggregate

$$\text{Specific gravity } G = \frac{w_2 - w_1}{(w_2 - w_1) - (w_3 - w_4)}$$

w1- Empty weight of pycnometer w2- Weight of pycnometer with sand w3- Weight of pycnometer with sand and water w4- Weight of pycnometer with water Calculation

$$G = \frac{1268.4 - 684.5}{(1268.4 - 684.5) - (1860.5 - 1499.6)} = 2.65$$

Result:

Specific gravity of the fine aggregate = 2.65

5.1.3 MOISTURE CONTENT TEST

Empty weight of pan = 31.8g

Weight of sand with pan = 70.6g

Weight of sand w1 = 38.8g

Weight of dry sand with pan = 70.2g

Weight of dry sand w2 = 38.2g

$$\text{Moisture content of fine aggregate} = \frac{w_1 - w_2}{w_2} = \frac{38.8 - 38.2}{38.2} = 0.015$$

Result:

Moisture content of fine aggregate = 0.01

5.2 TEST ON COARSE AGGREGATE

- Specific gravity test
- Fineness modulus test
- Water absorption test

5.2.1 SPECIFIC GRAVITY TEST

A pyrometer is sometimes used to calculate the precise gravity of coarse aggregate. A third of the pycnometer was filled with coarse aggregate sieved through a 20mm sieve.

S.NO	TRAIL	w1(g)	w2(g)	w3(g)	w4(g)	G
1	1	620	825	1640	1510	2.73

2	2	620	815	1630	1510	2.65
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Table 5.3 Specific gravity of coarse aggregate

$$\text{Specific gravity } G = \frac{w_2 - w_1}{(w_2 - w_1) - (w_3 - w_4)}$$

Where,

w₁-Empty weight of pycnometer

w₂-weight of pycnometer

w₃- weight of pycnometer

w₄-weight of pycnometer with water

Calculation:

$$G = \frac{810 - 620}{(810 - 620) - (1630 - 1510)} = 2.67$$

Result:

Specific gravity of coarse aggregate = 2.67

5.2.2 FINENESS MODULUS TEST

Fine aggregate is graded into four grading zones according to IS 383- 1970, ranging from coarser and (zone1) to fines sand (zone 4)

S.NO	Sieve size mm	Wt of particles	% of wt retained	Cumulative % of wt retained	% fineness
1	20	P1 0.385	19.25	19.25	80.75
2	16	0.780	39	58.25	41.75
3	12.5	0.630	31.50	89.75	50.25
4	10	0.155	7.75	97.50	2.50
5	6.3	0.050	2.50	100	0
6	4.75	-	-	-	-

7	Pan	-	-	-	-
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Table 5.4 Sieve analysis of coarse aggregate

$$\begin{aligned}
 \text{Fineness modulus} &= (\sum \text{ of cumulative \% of weight retained })/100 \\
 &= 364.75/100 \\
 &= 3.64
 \end{aligned}$$

5.2.3 WATER ABSORPTION TEST

A water absorption examination is used to assess the water absorption value of coarse aggregate. Light weight aggregate has a greater absorption value than standard weight aggregate. The absorption value of the aggregate varies from 5 to 20%. As a consequence, evaluating aggregate absorption value is important.

2 kg of sample was taken for the examination and put in a bucket mesh before being soaked in water for 24 hours and the weight of the oven dried sample was calculated.

The adsorption value was calculated using the following method:

$$\text{Percentage of water absorption} = w_3/w_1 \times 100$$

S.NO	Wt of saturated aggregate w ₁ kg	Wt of oven dried aggregate w ₂ kg	Wt o water absorbed aggregate w ₃ =(w ₂ w ₁)kg	% of water absorption w ₃ /w ₁ ×100
1	2.090	1.970	0.120	6%
2	2.170	1.940	0.200	11.5%

Mean = 8.7%

Table 5.5 Water absorption test of coarse aggregate

Result:

Water absorption value of coarse aggregate = 8.7%

5.3 TEST ON CEMENT

- Consistency test
- Initial and final setting time

5.3.1 Consistency of cement

The volume of water used to make the cement paste is referred to as the cement's regular consistency. This paste is used to assess the initial and final setting times of cement, as well as its soundness. The Vicat apparatus is used to determine the consistency of the cement paste.

The following technique was used for this exam. 500g of cement was mixed with water to produce the cement paste. The paste was filled into the Vicat mould in 3 minutes, and the air was released by shaking the mould. The Vicat apparatus is then used to keep the mould in place.

Vicat plunger with 10mm diameter and 50mm length was quickly brought down to reach the top of the paste, then released and allowed to penetrate the paste under its own weight. The depth of penetration was determined.

S.NO	Water cement ratio	Water content (ml)	Depth of penetration (mm)
1	0.30	150	26.0
2	0.32	160	29.2
3	0.34	170	31.5
4	0.36	180	34.5

Table 5.6 Standard consistency test

This study was conducted for various water cement ratios until the value reached a depth of 33-35mm from the top. The amount of water required to reach a depth of 33-35mm was then used to calculate the strength of cement. A depth of 33-35mm was achieved in 180 ml of water. As a consequence, the normal cement consistency was 180ml.

Result:

Standard consistency value = 180ml.

5.3.2 INITIAL SETTING TIME

The vicat apparatus was often used to determine the initial setting time of cement. 500g of cement and usual quality water content is used to make cement paste.

After that, the paste was put in a vicat mould and left in place. The Vicat needle was

put on the surface of the cement paste and then released. It was recorded how long it took to hit a depth of 33-35mm.

Result:

Initial setting time of the cement was 35minutes.

CHAPTER – 6

TEST ON CONCRETE

6.1 TEST ON FRESH CONCRETE

6.1.1 SLUMP CONE TEST

The slump cone scale, which employs a 30cm slump cone, is used to assess the intensity of fresh concrete. The slump cone was refilled with new concrete and tamped 15 times. When the concrete has been poured, the slump cone is removed vertically and the concrete is able to remain alone. The concrete would then settle and the height of the subsided concrete will be measured. This experiment was repeated many times with various water cement ratios.

S.NO	Water cement ratio	Initial height of slump h1 in cm	Height of subsided h2 in cm	Slump h1-h2 in cm	Type of slump
1	0.40	30	30	0	Zero
2	0.50	30	28	2	True
3	0.55	30	24	6	Shear
4	0.60	30	21	9	Shear
5	0.65	30	18	12	Shear
			Average	5.8	Shear

Table 6.1 Slump cone test

Result:

Slump cone test of the concrete = 5.8cm

6.1.2 COMPACTION FACTOR TEST

The compaction element is often used to evaluate the workability of fresh concrete. A compaction factor unit is used in this study. To begin, new concrete with a lower water cement ratio was mixed. The compaction factor machine is made up of an upper hopper, a lower hopper, and a cylinder. At the lower part of the hoppers, trap doors are provided. The empty weight of the cylinder was determined.

After that, the upper hopper is packed with concrete and compacted. The trap door in the upper hopper was then opened, allowing concrete to spill into the lower hopper. After that, the lower trap door was opened, allowing the concrete to fall on the cylinder. The surface of the cylinder was rubbed clean, and the weight was taken. Following that, concrete was poured and compacted into the upper hopper, and the process was repeated. The findings of this experiment, which was conducted with a variety of water cement ratios, were published.

S.NO	Water cement ratio	Wt of concrete with partial compacted w1 kg	Wt of concrete with fully compacted w2 kg	Compaction factor (w1/w2)x100
1	0.40	10.99	12.32	89
2	0.50	12.10	12.46	97
3	0.55	12.50	13.49	92
4	0.60	12.92	13.78	93
5	0.65	13.25	14.01	94
			Average	93

Table 6.2 Compaction factor test

Result:

Compaction factor of concrete = 93%

6.1.3 FLOW TABLE TEST

The flow table test is used to assess the workability of concrete. The same slump cone mould was used for this test. When fresh concrete was poured, the slump cone sat on the flow table. The mould was then sliced vertically, and the initial thickness of the concrete was measured. For 5 minutes, the pump vibrated the asphalt. The final diameter of the concrete was measured after vibration. The findings of this experiment, which was conducted with a variety of water cement ratios, were published.

S.NO	Water cement ratio	Initial diameter in cm	Spread diameter in cm	Percentage of flow
1	0.40	19	38	52
2	0.50	19	39	56
3	0.55	20	41	64
4	0.60	20	42	68
5	0.65	20	43	74
			Average	62.8

Table 6.3 Flow table test

Calculation

$$\text{Flow percentage} = \frac{\text{spread diameter in cm} - 25}{25} \times 100$$

$$= \frac{38 - 25}{25} \times 100 = 52$$

Result:

Flow percentage of the concrete = 62.8%

6.2 TEST ON HARDENED CONCRETE

6.2.1 COMPRESSIVE STRENGTH

This metric determines the compressive strength of reinforced concrete. The compressive strength of concrete is shown by the compressive test in optimal circumstances. The compressive strength of concrete is an indicator of its strength once it has hardened. Testing should be carried out with care. The test was carried out at a standardised stress of 140 kg/cm²/minute after the specimen was centred in the measurement unit. Loading continued until the dial gauge needle simply reversed its movement. The needle's path has been redirected, meaning that the specimen failed. The dial gauge reading at the time, which was maximum load, was registered. The ultimate cube compressive power is proportional to the ultimate load separated

by the specimen's cross sectional area. The compressive strength of concrete reveals information about the material's general quality.

The test specimen is cubical in shape and measures 150mmx150mmx150mm. If the highest normal dimension of the aggregate is less than 20mm, 10mm cubes would be used instead. Compressive strength checks are conducted on specimens of proven age, ideally from different batches made for each age of processing. All of the cubes were tested in a saturated condition after the surface moisture was removed. At 7 days and 28 days of self-curing, each trial mix mixture three cube was tested using a compression measuring machine with a capacity of 2000KN according to IS 516-1959.

S.NO	MIX	MATERIAL USED	STRENGTH ON 7 th DAY (N/mm ²)	STRENGTH ON 28 th DAY (N/mm ²)
1	M25	Conventional concrete	17.1	26.6
2	M25	PEG 400 - 1%	22.9	41.7
3	M25	PEG 400-1.5%	24.5	35

Table 6.4 Compression Strength on cubes

FIGURE 6.1 Compressive Strength

FIGURE 6.2 Compressive Strength Reading

6.2.2 SPLIT TENSILE STRENGTH OF CONCRETE

Tensile strength is one of the most basic and essential properties of concrete. Concrete is typically supposed to survive direct stress due to its low tensile strength and translucent appearance. On the other side, the load at which the concrete members will fail. Aside from the flexural measure, there are two techniques for calculating concrete tensile strength: (a) direct method and (b) indirect method. The direct solution has a number of advantages, including holding the specimen properly in the measurement machine without inducing tension accumulation and adding a

free-of-eccentricity uniaxial tensile load to the specimen. The cylinder measures 150 mm in diameter and 300 mm in height. Splitting tests, also known as break tensile strength of concrete, are well-known indirect tests for determining concrete performance. According to an elastic analysis, compression loading produces tensile strength that is almost uniform around the entire filled diameter. The estimate establishes the degree of tensile stress (IS 5816-1970).

S.NO	MIX	MATERIAL USED	STRENGTH ON 7 th DAY (N/mm ²)	STRENGTH ON 28 th DAY (N/mm ²)
1	M25	Conventional concrete	5.2	6.9
2	M25	PEG 400 - 1%	7.05	17.1
3	M25	PEG 400-1.5%	5.15	9.9

Table 6.5 Split tensile strength on the cylinder

FIGURE 6.3 Split Tensile Strength

FIGURE 6.4 Split Tensile Strength Reading

6.2.3 FLEXURAL STRENGTH

Concrete tensile strength can be assessed in a variety of forms, one of which is flexural strength. It refers to an unreinforced concrete beam's or slab's capacity to tolerate bending loss. It is measured by stretching 6x6-inch (100x100x500mm) concrete beams at least three times their width. Flexural power is measured using standard ASTM C293 research methods and is expressed as modulus of rupture (MR) in psi (Mpa) (center-point loading)

Flexural MR will vary from 10% to 20% of compressive strain, depending on the coarse aggregate scale and volume used. Laboratory trials with specific products and blend configurations have the greatest association. The MR calculated using third-point loading is always 15% lower than the MR calculated using center-point loading.

S.NO	MIX	MATERIAL USED	STRENGTH ON 7 th DAY (N/mm ²)	STRENGTH ON 28 th DAY (N/mm ²)
1	M25	Conventional concrete	2.24	3.86
2	M25	PEG 400 - 1%	2.65	4.65
3	M25	PEG 400-1.5%	2.48	4.10

Table 6.6 Flexural Strength on prism

FIGURE 6.5 Flexural Tensile Strength

FIGURE 6.6 Flexural Tensile Strength Reading

CHAPTER- 7

RESULT AND DISCUSSION

7.1 Compressive strength

In this study, the M25 grade mix proportion is used, with a mix ratio of 1:1.8:2.96. To assess compressive force, 16 cubes were cast. The average compressive force at 150mm x 150mm x 150mm scale cubes was measured by comparing three specimens over seven and twenty-eight days. After 28 days, the compressive strengths of simple concrete and self-curing concrete are 26.7 and 41.7 MPa, respectively. As a consequence, self-curing concrete has much greater compressive strength than standard concrete. The optimum PEG-400 dosage for compressive strength was determined to be 1%. As the percentage of PEG-400 rises to more than 1%, the intensity of concrete begins to decrease. We discovered that a dosage of 1.5 percent PEG-400 achieves the desired strength of 35 Mpa.

7.2 Split Tensile strength

To decide split tensile capacity, a total of 16 cylinders were cast. The average split tensile strength of a 300mm X 150mm cylinder was measured by combining three specimens over seven and twenty-eight days. After 28 days, simple concrete has a

split tensile strength of 6.9 MPa, while self-curing concrete has a split tensile strength of 17.1 MPa, which is considerably greater than standard concrete. The optimal dosage for achieving the maximum split tensile intensity was estimated to be 1%. If more than 1% PEG-400 is applied, the strength of the concrete is lowered, and we found that the PEG-400 1.5 percent split tensile strength is 9.9 Mpa, which is better than the traditional concrete's 6.9 Mpa.

7.3 Flexural strength

To test flexural capacity, a total of 16 prisms were cast. The average flexural amplitude was assessed on 500mm X 100mm X 100mm scale prisms by averaging three specimens over seven and twenty-eight days. Traditional concrete has a flexural strength of 3.8 Mpa after 28 days, while self-curing concrete has a flexural strength of 4.65 Mpa after 28 days, which is slightly greater than conventional concrete. The maximal dosage for maximum flexural pressure events was discovered to be 1%. If the percentage of PEG-400 in the concrete increases, the flexural consistency decreases. Flexural strength values are 4.10 Mpa as PEG-400 is applied at a pace of 1.5 percent, which is more than the 3.28 Mpa of standard concrete.

CHAPTER – 8

CONCLUSION

- The compressive force rises as 1 percent PEG-400 is applied, and as more than 1 percent PEG-400 is introduced, the compressive strength decreases.
- When 1% PEG-400 is added, the split tensile strength increases; when more than 1% PEG-400 is added, the intensity decreases.
- Flexural pressure rises as 1.5 percent PEG-400 is applied, and power decreases as more than 1.5 percent PEG is added.
- The PEG-400 optimum ideal dose with the highest compressive strength and split tensile strength was discovered to be 1% of the PEG-400 optimum ideal dosage.
- A workability analysis shows that the percentage of PEG-400 in concrete improves as the percentage of PEG-400 rises.

- Self-curing concrete is the alternative where there is a larger scarcity of water.
- For curing in the study, cast cubes, rods, and prisms were kept at room temperature.

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