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A Project Report On Comparative and Experimental Study on Self Curing Concrete

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ABSTRACT: High-performance concrete is defined as concrete that meets special combinations of performance and uniformity requirements that cannot always be achieved routinely using conventional constituents and normal mixing, placing, and curing practices. Ever since the term high-performance concrete was introduced into the industry, it had widely used in large-scale concrete construction that demands high strength, high flow ability, and high durability. A high-strength concrete is always a high-performance concrete, but a high-performance concrete is not always a high-strength concrete.

Durable concrete Specifying a high-strength concrete does not ensure that a durable concrete will be achieved. It is very difficult to get a product which simultaneously fulfills all of the properties. So the different pozzolanic materials like Ground Granulated Blast furnace Slag (GGBS), silica fume, Rice husk ash, Fly ash, High Reactive Metakaolin, are some of the pozzolanic materials which can be used in concrete as partial replacement of cement, which are very essential ingredients to produce high performance concrete. So we have performed XRD tests of these above mentioned materials to know the variation of different constituent within it. Also it is very important to maintain the water cement ratio within the minimal range, for that we have to use the water reducing admixture i.esuperplasticizer, which plays an important role for the production of high performance concrete. So we herein the project have tested on different materials like rice husk ash, Ground granulated blast furnace slag, silica fume to obtain the desired needs. Also X-ray diffraction test was conducted on different pozzolanic material used to analyse their content ingredients. We used synthetic fiber (i.eRecron fiber) in different percentage i.e 0.0%, 0.1%, 0.2%, 0.3% to that of total weight of concrete and casting was done. Finally we used different percentage of silica fume with the replacement of cement keeping constant fiber content and concrete was casted. In our study it was used two types of cement, Portland slag cement and ordinary Portland cement. We prepared mortar, cubes, cylinder, prism and finally compressive test, splitting test, flexural test are conducted. Finally porosity and permeability test conducted. Also to obtain such performances that cannot be obtained from conventional concrete and by the current method, a large number of trial mixes are required to select the desired combination of materials that meets special performance.

CHAPTER 1

1. INTRODUCTION

1.1 Curing

Curing is the process of controlling the rate and extent of moisture transport 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 in days, and even weeks rather than hours curing must be undertaken for a reasonable period of time, if the 1concrete is to achieve its potential strength and durability. Curing may also encompass the control of temperature since this affects the rate at which cement 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.

Conventional Curing Methods

Methods of curing concrete fall broadly into the following categories:

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Minimise moisture loss from the concrete, for example by covering it with a relatively impermeable membrane. Prevent moisture loss by continuously wetting the exposed surface of the concrete. Steam curing. Ponding or spraying the surface with water. Difficulties in conventional curing methods For the vertical member it is not possible to keep the surface moist as in case of the flat surfaces.In the places where there is scarcity of water.In the places where manual curing is not possible. A human error may leads to the cracking in the member and also decreases its strength i.e. when curing water is not provided at the right time.

1.2 Self Curing

Curing of concrete is maintaining satisfactory moisture content in concrete during its early stages in order to develop the desired properties. However, good curing is not always practical in many cases. Several investigators explored the possibility of accomplishing self curing concrete. Therefore, the need to develop self-curing agents attracted several researchers. The concept of self-curing agents is to reduce the water evaporation from concrete, and hence increase the water retention capacity of the concrete compared to conventional concrete. It was found that water soluble polymers can be used as self-curing agents in concrete. Concrete incorporating self-curing agents will represent a new trend in the concrete construction in the new millennium. Curing of concrete plays a major role in developing the concrete microstructure and pore structure, and hence improves its durability and performance. The concept of self-curing agents is to reduce the water evaporation from concrete, and hence increase the water retention capacity of the concrete compared to conventional concrete. The use of self-curing admixtures is very important from the point of view that water resources are getting valuable every day (i.e., each 1cu.m of concrete requires about 3cu.m of water for construction most of which is for curing).

Excessive evaporation of water (internal or external) from fresh concrete should be avoided; otherwise, the degree of cement hydration would get lowered and thereby concrete may develop unsatisfactory properties. Curing operations should ensure that adequate amount of water is available for cement hydration to occur. This investigation discusses different aspects of achieving optimum cure of concrete without the need for applying external curing methods. The effect of curing, particularly new techniques such as "self-curing", on the properties of high performance concrete is of primary importance to the modern concrete industry.

1.3 Definition of self curing

Conventionally, curing concrete means creating conditions such that water is not lost from the surface i.e., curing is taken to happen ‘from the outside to inside’. In contrast, ‘internal curing’ is allowing for curing ‘from the inside to outside’ through the internal reservoirs (in the form of saturated lightweight fine aggregates, superabsorbent polymers, or saturated wood fibres) Created. ‘Internal curing’ is often also referred as ‘Self–curing.

"Self-curing concrete" means that no labour work is required to provide water for concrete, or even no any external curing is required after placing which the properties of this concrete are at least comparable to and even better than those of concrete with traditional curing.

Self-curing is an "internal curing system" where a water- soluble polymer is added to the concrete mix. This method overcomes the difficulty in ensuring that effective curing procedures are employed by the construction personnel as the internal curing composition is a component of the mix.

1.4 Potential Materials For Self Curing

The following materials can provide internal water reservoirs:

Lightweight Aggregate (natural and synthetic, expanded shale), LWS Sand (Water absorption =17 %)

LWA 19mm Coarse (Water absorption = 20%)

Super-absorbent Polymers (SAP) (60-300 mm size)

SRA (Shrinkage Reducing Admixture)

Wood powder.

1.5 Chemicals To Achieve Self–Curing

Some specific water-soluble chemicals added during the mixing can reduce water evaporation from and within the set concrete, making it ‘self-curing.’ The chemicals should have abilities to reduce evaporation from solution and to improve water retention in ordinary Portland cement matrix.

Following are the list of some chemicals which are hydrophilic in nature.

- Polyvalent alcohol
- Polyethylene glycol (peg)
- Poly-acrylic acid
- Xvlitol, sorbitol
- Glycerine
- Phytosterols

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- Hyaluronic acid
- Polyxyelhylene (poe)
- Sodium pyrrolidone carboxylate (pca-na),
- Stearyl alcohol
- Cetyl alcohol
- Thermosetting polymers
- Urethanes

1.6 Classification Of Aggregates

For the purpose of this report, the following classifications are adopted.

1.6.1 Natural Aggregate

Construction aggregates produced from natural sources such as gravel and sand, and extractive products such as crushed rock, some of the examples are Crushed rock, Sand and gravel, Crushed river gravel.

1.6.2 Manufactured Aggregate

Aggregates manufactured from selected naturally occurring materials, by-products of industrial processes or a combination of these, some of the examples are Foamed Blast Furnace Slag (FBS), Fly Ash Aggregate, Manufactured Sand, Polystyrene Aggregate (PSA), Expanded Clays, Shale's and Slates.

1.6.3 Recycled Aggregate

Aggregates derived from the processing of materials previously used in a product and/or in construction, some of the examples are Recycled Concrete Aggregate (RCA), Recycled Concrete and Masonry (RCM), Reclaimed Aggregate (RA), Reclaimed Asphalt Pavement (RAP), Reclaimed Asphalt Aggregate (RAA), Glass Cullet, Scrap Tyres, Used Foundry Sand.

1.6.4 Reused By-product

Aggregates produced from by-products of industrial processes, some of the examples are Air-cooled BF Slag (BFS), Granulated BF Slag (GBS), Electric Arc Furnace Slag (EAF), Steel

Furnace Slag (BOS), Fly Ash (FA), Furnace Bottom Ash (FBA), Incinerator Bottom Ash (IBA), Coal Washer Reject (CWR), Organic Materials, Crusher fines, Mine tailings.

1.7 Sources of Recycled Aggregate

Traditionally, Portland concrete aggregate from the demolition construction are used for landfill. But now days, Portland concrete aggregate can be used as a new material for construction usage. According to recycling of Portland Cement Concrete, recycled aggregates are mainly produced from the crushing of Portland concrete pavements and structures building. The main reason for choosing the structural building as the source for recycled aggregate is because a huge amount of crushed demolition Portland cement concrete can be produced.

1.8 Applications of Recycled Aggregate

General, applications without any processing include:

- Many types of general bulk fills
- Bank protection
- Base or fill for drainage structures
- Road construction
- Noise barriers and embankments

Most of the unprocessed crushed concrete aggregate is sold as 37.5 mm or 50 mm fraction for pavement sub-bases.

After removal of contaminants through selective demolition, screening, and /or air separation and size reduction in a crusher to aggregate sizes, crushed concrete can be used as :

- New concrete for pavements
- Shoulders
- Median barriers
- Sidewalks
- Curbs
- Gutters
- Bridge foundations
- Structural grade concrete
- Soil-cement pavement bases
- Lean-concrete bases
- Bituminous concrete
- Paving blocks, building blocks

1.9 The Use of Recycled Aggregate in Concrete

The use of crushed aggregate from either demolition concrete or from hardened leftover concrete can be regarded as an alternative coarse aggregate, typically blended with natural coarse aggregate for use in new concrete. The use of 100% recycled coarse aggregate in concrete, unless carefully managed and controlled, is likely to have a negative influence on most concrete properties – compressive strength, modulus of elasticity, shrinkage and creep, particularly for higher strength concrete. Also the use of fine recycled aggregate below 2 mm is uncommon in recycled aggregate concrete because of the high water demand of the fine material smaller than 150 µm, which lowers the strength and increases the concrete shrinkage significantly. Many overseas guidelines or specifications limit the percentage

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replacement of natural aggregate by recycled aggregate.

In general left over concrete aggregate can be used at higher replacement rates than demolition concrete aggregate. With leftover concrete aggregate, information will generally be known about the parent concrete – strength range and aggregate source etc., whereas for demolition concrete very little information may be known about the parent concrete, and the resulting aggregate may be contaminated with chlorides or sulphates and contain small quantities of brick, masonry or timber which may adversely affect the recycled aggregate concrete. Often the sources of material from which a recycled aggregate came (and there could be more than one source), are unknown and the variability and strength of the recycled aggregate concrete could be adversely affected in comparison with a recycled aggregate concrete where the recycled aggregate came from one source with a known history of use and known strength.

Fig: 1.9 Use of Recycled Aggregate in Concrete

It is therefore necessary to distinguish between the properties of recycled aggregate concrete made using demolition concrete aggregate and that using leftover concrete aggregate. Nevertheless, recycled aggregate concrete can be manufactured using recycled aggregate at 100% coarse aggregate replacement where the parent concrete, the processing of the recycled aggregate and the manufacture of the recycled aggregate concrete are all closely controlled. However as target strengths increase, the recycled aggregate can limit the strength, requiring a reduction in recycled aggregate replacement.

1.10 Need of Present Work

Curing of concrete is maintaining satisfactory moisture content in concrete during its early stages in order to develop the desired properties. However, good curing is not always practical in many cases. Several investigators explored the possibility of accomplishing self curing concrete. Therefore, the need to develop self-curing agents attracted several researchers. The concept of self-curing agents is to reduce the water evaporation from concrete, and hence increase the water retention capacity of the concrete compared to conventional concrete

A self-curing concrete is provided to absorb water from atmosphere to achieve better hydration of cement in concrete. It solves the problem that the degree of cement hydration is lowered due to no curing or improper curing, and thus unsatisfactory properties of concrete.

It is now widely accepted that there is a significant potential for reclaiming and recycling demolished Debris for use in value added applications to maximize economic and environmental benefits. At present converts low value waste into secondary construction materials such as a variety of aggregate grades, road materials and aggregate fines (dust). Often these materials are used in as road construction, backfill for retaining walls, low-grade concrete production, drainage and brickwork and block work for low-cost housing. Due to issues relating to sustainability and limited natural resources, it is clear that the use of recycled and secondary aggregates (RSA)

1.11 Mechanism of Self-Curing

The mechanism of self-curing can be explained as follows:

Continuous evaporation of moisture takes place from an exposed surface due to the difference in chemical potentials (free energy) between the vapour and liquid phases. The polymers added in the mix mainly form hydrogen bonds with water molecules and reduce the chemical potential of the molecules which in turn reduces the vapourpressure.This reduces the rate of evaporation from the surface.

1.12 Objectives

The objective of the investigation is to use the water soluble polymeric glycol, selected from a group consisting of polyethylene glycol (PEG) of average molecular weight (M.W) from 200 to 10000 as self curing agent and to decide the optimum dosage for different curing conditions under arid atmospheric conditions.

Two concrete mixes of Ordinary Portland Cement (OPC) were considered for the study. Polyethylene glycol (PEG) of molecular weight 6000 was used as a self curing agent in concrete. The concrete mix with and without Self curing agent(S.C.A) were subjected to different types of curing i.e. conventional and indoor curing to study the above mention parameters.

Other objective is to compare the use of different coarse aggregate (i.e. M35, M45 of normal coarse aggregate and recycled aggregate) and to find out optimum strength.

In this study water retention, compacting factor and compressive strength of concrete containing self-curing agent is investigated and compared with conventional curing. Concrete weight loss with time was carried out in order to evaluate the water retention ability for different dosages of self-curing agent and for different conditions

In this study compacting factor and split tensile strength of concrete containing self-curing agent is investigated and compared with conventional curing. Concrete weight
loss with time was carried out in order to evaluate the water retention ability for different dosages of self-curing agent and for different conditions.

In this study compacting factor and flexural strength of concrete containing self-curing agent is investigated and compared with conventional curing. Concrete weight loss with time was carried out in order to evaluate the water retention ability for different dosages of self-curing agent and for different conditions.

In this study comparing the natural coarse aggregate and recycled coarse aggregate of different dosages of self-curing agent and for different conditions.

2. LITERATURE SURVEY

A.S. El-Dieb, T.A. El-Madawy and A.A.M. Mahmoud (2007) [1]

The study investigates using laboratory synthesized water-soluble polymers: polyethylene glycol (PEG) and polyacrylamide (PAM) as self-curing agents and its effect on the degree of hydration, water absorption, permeable pores and microstructural characteristics of Portland cement mixtures without and with 8% silica fume replacement. Portland cement mixtures including PEG or PEG+PAM as self-curing agents showed a better quality compared to that of the non-cured mixtures. Mixtures incorporating 8% silica fume including a mixture of PEG and PAM as self-curing agent had a better quality compared to that of the mixture including only PEG especially at later ages.

Polyethylene-glycol (PEG) was used alone with a dosage of 0.02% by weight of cement. Polyacrylamide (PAM) was used in conjunction with PEG as a second alternative for self-curing agent. The dosage of PEG and PAM was 0.02% by weight of the cement, PEG dosage was 0.013% and that of PAM was 0.007%.

Conclusions

Effectiveness of the self-curing agents is affected by the cementitious type used (i.e. OPC or OPC+silica fume).

The use of high molecular weight water-soluble polymers (PAM) together with low molecular weight polymers (PEG) had better performance in retaining water for longer period and releasing it slowly with time than using PEG only.

Better water retention for self-curing mixtures including silica fume showed the tendency of improving hydration at 28 days of age.

Water absorption and permeable pores for self-curing mixtures were lower than those of the conventional non-cured mixtures.

Self-curing mixtures exhibited denser microstructure compared to conventional non-cured mixtures.

Silica fume self-curing mixtures suffered less self-desiccation compared to conventional non-cured mixtures.

ROLAND TAK YONG LIANG AND ROBERT KEITH SUN (2002) [2]

The objective of the research was to produce self curing concrete by using hydrophilic chemicals like polyethylene glycol and paraffin wax. Many experiments have done on ordinary concrete like compressive strength at different days of curing and also at different proportions of PEG and wax. The investigation was done using three internal curing compositions and is as follows:-

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Curing material	Curing membrane	Internal curing Composition 1	Internal curing Composition 2	Internal curing Composition 3
Base material	Solvent borne Resin with dye	Water, wax Emulsion and High MW Polyethylene oxide	Water, paraffin Wax & Polyethylene glycol	Water based polyether's

Claims on Internal Curing Compositions 2

A cementitious mix comprising of cement and aggregate, further including an internal curing concentrate which includes a glycol, a wax and water.

The cementitious mix wherein the glycol was a polyethylene glycol of molecular weight 200 and wax was selected from the group consisting of paraffin wax.

A cementitious mix including an internal curing concentrate wherein the internal curing concentrate comprises about 10% polyethylene glycol, about 57% paraffin wax, and about 33% water.

A cementitious mix wherein the internal curing composition was present in the cementitious mixing an amount of about 5 l/m3.

Internal curing composition 2 of the present invention exhibits moisture retention characteristics similar to those of the solvent-borne resin membrane and performs better than 3-day water curing.

At dosages from 2 to 5 l/m^3 the strength development of the three internal curing compositions are compared. Internal curing compositions 1 and 2 give compressive strengths similar to those of a high quality solvent- borne resin membrane. However, internal curing composition 3 appears to show a significantly lower strength, particularly at the highest dosages.

Internal curing compositions of the present invention provide significant advantages over the known compositions and provide for the first time a reliable means of
ensuring that proper curing is carried out. They allow the elimination of the need for external curing procedures.

Self Curing Concrete: Water Retention, Hydration And Moisture Transfer [3] A.S. El- Dieb (2007)

The objective of the research was to find out the water retention capacity and degree of hydration and moisture transport by using self-curing agent and compare to conventional curing of concrete.The self-curing agent used in this study was water soluble polymeric glycol (polyethylene glycol). The dosage of self curing agent was 0.02% by weight of cement. The dosage was kept constant for all the self curing concrete mixes.

The investigation aimed at studying on concrete with different quantities of cement (350-450kg/m3) at different water- cement ratios (0.3-0.4) both for self, conventional and air-curing concrete and compare the results for different test.

Conclusions

The following could be concluded from the results obtained in this study.

- Water retention for the concrete mixes incorporating self-curing agent is higher compared to conventional concrete mixes, as found by the weight loss with time.
- Self-curing concrete suffered less self-desiccation under sealed conditions compared to conventional concrete.
- Self-curing concrete resulted in better hydration with time under drying condition compared to conventional concrete.
- Water transport through self-curing concrete is lower than air-cured conventional concrete.
- Water sorptivity and water permeability values for self curing concrete decreased with age indicating lower permeable pores percentage as a result of the continuation of the cement hydration.

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3. EXPERIMENTAL PROGRAMME

The experimental programme was planned as the following-

Total 120 cubes, 120 cylinders,120 prisms were cast which involves different dosages (0%,0.5%, 1% and 2%) of self-curing agent PEG-6000 for four different mixes (Mix A1,A2 and Mix B1,B2), under different curing conditions (indoor, conventional). The compaction factor test was conducted for all mixes to know the fresh property of concrete. Compressive strength test was conducted at 7and 28 days of curing and to investigate the water retentivity capacity the cubes were weighed for every three days from the date of casting. The accuracy of the digital weighing machine used is 5 gm. Strength graph is plotted against percentage of self-curing agent; water retentivity graph is plotted for average weight loss verses number of days of curing.

In this investigation the maximum dosage of self-curing agent is restricted to 2% and minimum dosage is of 0.5% is decided as per the literature available. The flow chart for experimental programme is shown in fig.3.1.

FLOW CHART OF EXPERIMENTAL PROGRAMME FOR CONCRETE

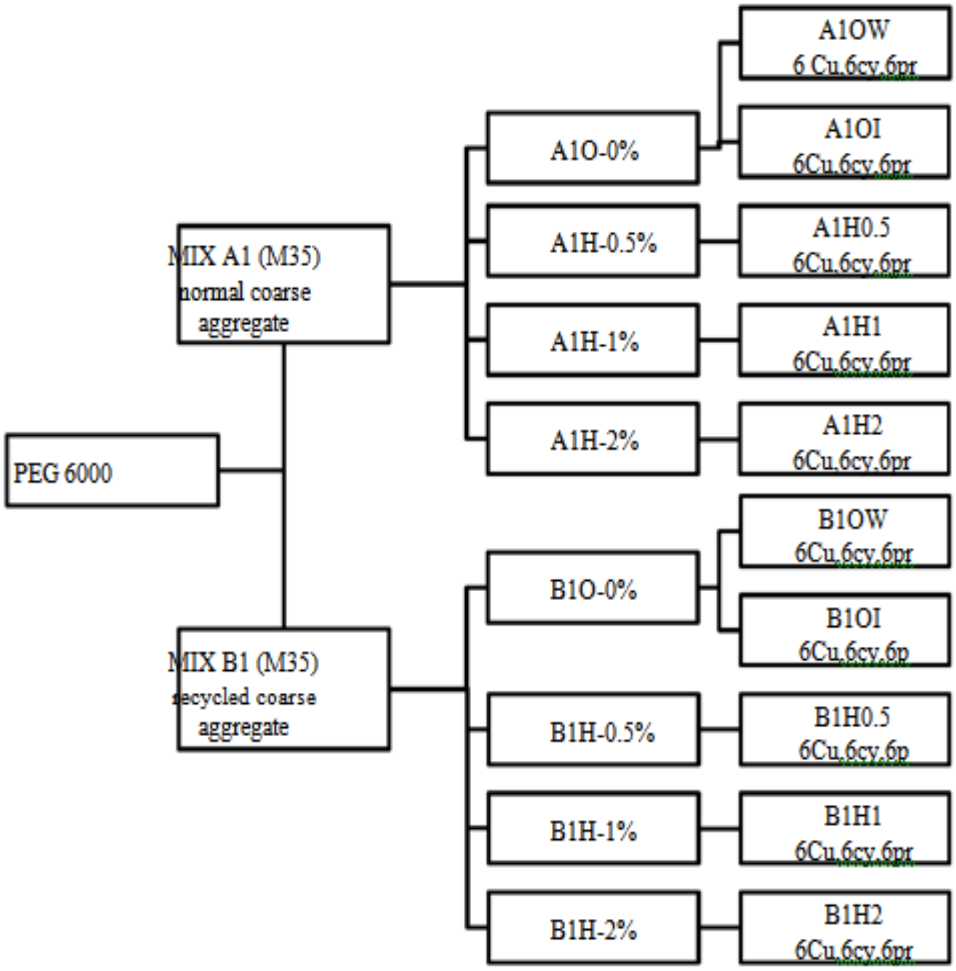

Fig: 3.1.1 Experimental Programme for Concrete

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FLOW CHART OF EXPERIMENTAL PROGRAMME FOR CONCRETE

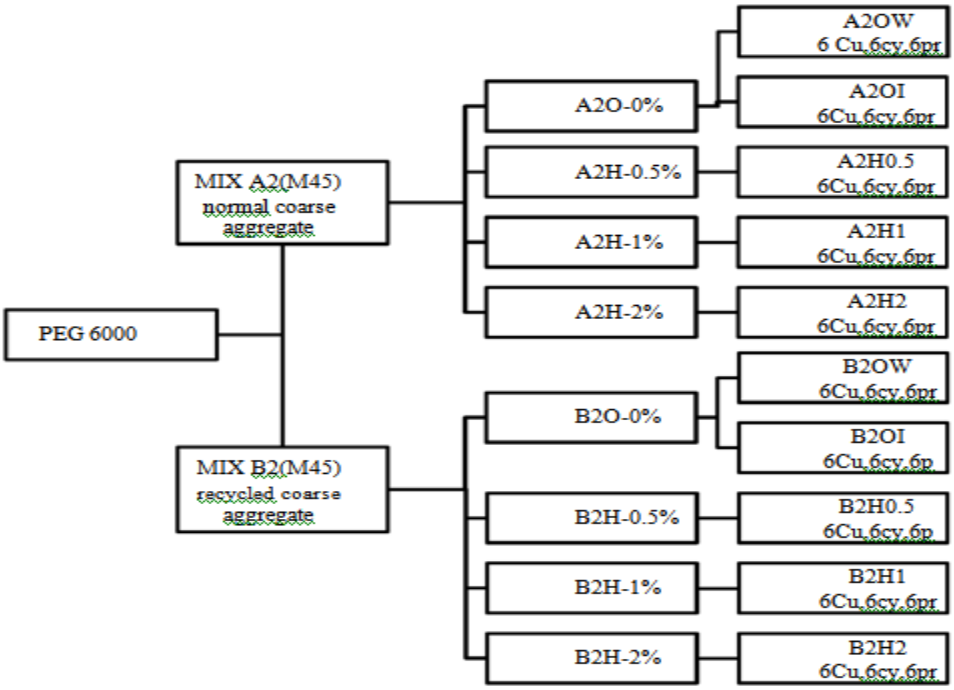

Fig: 3.1.2 Flow Chart of Experimental Programme for Concrete

Nomenclature for Specimen
MIX A- normal coarse aggregate (A1- M35, A2-M45 grades)
MIX B- recycled coarse aggregate (B1-M35, B2-M45 grades)
O-Ordinary Portland cement (OPC)
H-PEG 6000(Higher Molecular Weight)
I-Indoor Curing
W-Wet/Conventional Curing
elf-Curing Agent(S C A)

For example sample with name A1OW represents Mix A with PEG 6000 and dosage of 0% by weight of cement subjected to wet curing.
Sample A1OI represents Mix A1 with PEG 6000 and dosage of 0% by weight of cement subjected to indoor curing.
Sample A1H1 represents Mix A1 with PEG 6000 and dosage of 1% by weight of cement subjected to indoor curing.

- Cement
- Fine Aggregate
- Coarse aggregate
- Recycled coarse aggregate
- Water
- Polyethylene glycol (PEG)

The cement used in the investigation was 53-grade ordinary Portland cement conforming to IS 12269-1987. It was taken from a single lot and stored properly throughout the programme. The physical properties of cement are shown in table 3.2.1

Specific gravity	3.14
Initial setting time	75 min
Final setting time	215 min

Fine Aggregate

The fine aggregate that falls in zone-II conforming to IS 383-1970 was used. The fine aggregate used was obtained from a nearby river course. The sand obtained from quarry was sieved through all the sieves (i.e. 2.36mm, 1.18mm, 600µ,

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300µ and150µ). Sand retained on each sieve was filled in different bags and stacked separately for use. To obtain zone- II sand correctly, sand retained on each sieve is mixed in appropriate proportion.The physical properties of fine aggregate and proportion in which each size fraction is mixed is shown in table 3.2.2&3.2.3 respectively.

Table 3.2.2 Physical Properties of fine aggregate

:

Fineness modulus	2.80
Bulk density	1.37gm/cc
Specific gravity	2.60

Table 3.2.3

Proportions of different size fractions of sand obtain zone-II sand

Different size fractions of sand obtain zone-II sand

Sieve size (mm)	% Passing Recommended by IS:383	Adopted Grading.	Cumulative (%) weight Retained	%Weight Retained	Weight Retained in (gm)
10	100	100	-	-	-
4.75	90-100	100	-	-	-
2.36	75-100	85	15	15	150
1.18	55-90	70	30	15	150
600µ	35-59	45	55	25	250
300µ	8-30	10	90	35	350
150µ	0-10	0	100	10	100

Coarse Aggregate

The coarse aggregate used is from a local crushing unit having 20mm nominal size. 20mm well-graded aggregate according to IS-383 is used in this investigation. The coarse aggregate procured from quarry was sieved through all the sieves (i.e. 16mm, 12.5mm. 10mm and 4.75mm). The material retained on each sieve was filled in bags and stacked separately. To obtain 20mm well-graded aggregate, coarse aggregate retained on each sieve is mixed in appropriate proportions. The physical properties and proportions in each fraction are shown in table 3.2.4& 3.2.5 respectively. Table for physical properties of coarse aggregate.

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Table 3.2.4 physical properties of coarse aggregate

Fineness modulus	7.4
Bulk density	1.60gm/cc
Specific gravity	2.7

Proportions for CA to obtain 20mm well- graded aggregate

TABLE 3.2.5 Proportions for CA to obtain 20mm well- graded aggregate.

Sieve size (mm)	% Passing Recommended by IS-383	Adopted Grading	Cumulative (%)Weight Retained	% Weight Retained	Weight Retained In(gm)
40	100	100	-	-	-
20	95-100	100	-	-	-
16	67-82	70	30	30	1500
12	42-66	45	55	25	1250
10	25-55	30	70	15	750
4.75	0-10	0	100	30	1500

Recycled coarse aggregate

The Recycled coarse aggregate used is from a lab crushing unit having 20mm nominal size. 20mm well-graded aggregate according to IS-383 is used in this investigation. The Recycled coarse aggregate procured from lab was sieved through all the sieves (i.e. 16mm, 12.5mm. 10mm and 4.75mm). The material retained on each sieve was filled in bags and stacked separately. To obtain 20mm well-graded aggregate, recycled coarse aggregate retained on each sieve is mixed in appropriate proportions. The physical properties and proportions in each fraction are shown in table 3.2.6 & 3.2.7 respectively.

Table 3.2.6 physical properties of recycled coarse aggregate

Fineness modulus	7.37
Bulk density	1325.93 kg/m3
Specific gravity	2.3

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Table 3.2.7 Proportions for RCA to obtain 20mm well- graded aggregate

Sieve size (mm/µ)	Wt. retained (gm)	Wt passed	% Wt. retained	cumulative % Wt. retained	100-cumulative % Wt. Retained
80mm	0	5000	0	0	500
40mm	0	5000	0	0	500
20mm	1598	3402	31.96	30	340.2
10mm	3310	92	66.2	98.16	9.2
4.75mm	92		1.84	100	0
2.36mm	0		0	100	0
1.18mm	0		0	100	0
600 µ	0		0	100	0
300 µ	0		0	100	0
150 µ	0		0	100	0
	5000			730.12	
	Fineness Modulus of Coarse Aggregate				7.3012

Water

The water, which is used for making concrete should be clean and free from harmful impurities like oil, alkalis, acids etc. Ordinary potable water available in the laboratory was used for making and curing concrete. The quality of water was found to satisfy the requirements of IS: 456 –2000.

Polyethylene glycol (PEG)

Polyethylene glycol is a condensation polymers of ethylene oxide and water with the general formula H $(OCH_2CH_2)_n$ OH, where n is the average number of repeating oxyethylene groups typically from 4 to about 180. The low molecular weight members from n=2 to n=4 are diethylene glycol, triethylene glycol and tetraethylene glycol respectively, which are produced as pure compounds. The low molecular weight compounds up to 700 are colourless, odourless viscous liquids with a freezing point from 10ºC (diethylene glycols), while polymerized compounds with higher molecular weight than 1,000 are wax like solids with melting point up to 56-61ºC for n 180. The abbreviation (PEG) is termed in combination with a numeric suffix which indicates the average molecular weights. One common feature of PEG

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appears to be water-soluble. The specifications of PEG6000 are shown in table 3.2.8.It is soluble also in many organic solvents including aromatic hydrocarbons (not aliphatic). They are used to make emulsifying agents and detergents, and as plasticizers, humectants, and water-soluble textile lubricants. The wide range of chain lengths provides identical physical and chemical properties for the proper application selections directly or indirectly in the field .

Alkyd and polyester resin preparation to enhance water dispersability and water-based coatings.

Anti dusting agent in agricultural formulations.

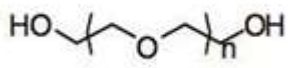
Brightening effect and adhesion enhance in electroplating and electroplating process. Cleaners, detergents and soaps with low volatility and low toxicity solvent properties. Coupling agent, humectants, solvent and lubricant in cosmetics and personal care bases.

Dimensional stabilizer in wood working operations. Dye carrier in paints and inks. Heat transfer fluid formulation and deformer formulations.

Low volatile, water soluble and noncorrosive lubricant without staining residue in food and package process. Paper coating for anti-sticking, colour stabilizing, good gloss.

Plasticizer to increase lubricant and to impart a humectants property in ceramic mass, adhesives and binders. Softener and antistatic agent for textiles Soldering fluxes with good spreading property.

Polyethylene glycol is non-toxic, odourless, neutral, lubricating, non-volatile and no irritating and is used in a variety of pharmaceuticals and in medications as a solvent, dispensing agent, ointment and suppository bases, vehicle, and tablet excipient. Chemical structure of PEG is shown below.



Polyethylene glycol is produced by the interaction of ethylene oxidewith water, ethylenegly colorethy lene glycol poligomers.

Table 3.2.8 Specifications of PEG 6000

S.No.	Specification	PEG 6000
1	Mol Wt.	5500-6500
2	Appearance	white flake
3	Colour, Boha	10 max
4	Moisture	0.5% max
5	Hydroxyl Value	16-23 (mg KOH/g)
6	Ph	5 – 7
7	Specific Gravity	1.08 - 1.09
8	Dioxane	1ppm max

3.3:Specimensmoulded

Cube specimens -

Cube size: cube moulds of 150 x 150 x 150 mm size.

Total number of cubes casted: 96.

Cylinder specimens -

Cylinder size: cylinder moulds of 150 mm diameter x 300 mm length.

Total number of cylinders casted: 96.

Prism specimens -

Prism size: prism moulds of 100 mm x 100 mm x 500 mm size.

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Total number of prisms casted: 96.
Material quantity was shown in the table 3.3

3.4 Preliminary Investigation
3.4.1 Cement
Test for Properties of Cement by Using Self Curing Agent (PEG)
3.4.1. a) Standard Consistency of Cement

For finding out initial setting time, final setting time and soundness of cement, and strength a parameter known as standard consistency has to be used. The standard consistency of a cement paste is defined as that consistency which will permit a Vicat plunger having 10 mm diameter and 50 mm length to penetrate to a depth of 33-35 mm from the top of the mould. The apparatus is called Vicat Apparatus. This apparatus is used to find out the percentage of water required to produce a cement paste of standard consistency. This percentage is usually denoted as P. In this study, consistency test is performed as per standard procedures using Vicat apparatus.

3.4.1. b) Initial and Final Setting Time of Cement

An arbitrary division has been made for the setting time of cement as initial setting time a final setting time. It is difficult to draw a rigid line between these two arbitrary divisions. Initial Setting Time

The time elapsed between the moments that the water is added to the cement, to the time that the paste starts losing its plasticity.

Final Setting Time
The time elapsed between the moment the water is added to the cement, and the time when the paste has completely lost its plasticity and has attained sufficient firmness to resist certain definite pressure.

In actual construction dealing with cement paste, mortar or concrete certain time is required for mixing, transporting, placing, compacting and finishing. During this time cement paste, mortar, or concrete should be in plastic condition. The time interval for which the cement products remain in plastic condition is known as the initial setting time. Normally a minimum of 30 minutes is given for mixing and handling operations. The constituents and fineness of cement is maintained in such a way that the concrete remains in plastic condition for certain minimum time. Once the concrete is placed in the final position, compacted and finished, it should lose its plasticity in the earliest possible time so that it is least vulnerable to damages from external destructive agencies. This time should not be more than 600 minutes. In this study initial and final setting time tests are performed as per standard procedures

3.5 Detailed Investigation On Concrete
3.5.1 Mix Design
In this study, mix design is done by three methods

IS CODE

In order to obtain strength around 35Mpa and 45Mpa for Mix A1& B1 and Mix A2& B2 respectively. Number of trails were conducted to obtain the desired strength and to maintain good workability (slump of about 100mm) and finally acquired four mix proportions as Mix A1 (M35), A2 (M45) and Mix B1 (M35), B2 (M45). To obtain good workability and desired strength the optimum water cement ratio used in Mix A is 0.40 and super-plasticizer is used in the mix and in Mix B the optimum water cement ratio is 0.38 and no super-plasticizer is used in the mix.

3.5.2 Test for Fresh Properties of Concrete
Workability Test

3.5.2. a) Slump Test

Slump test is the most commonly used method of measuring workability of concrete. It is not a suitable method for very wet or very dry concrete. It does not measure all factors contributing to workability. In this case study slump test is done according to IS 456-2000 Specifications.

3.5.2. b) Compacting Factor Test

It is more precise and sensitive than the slump test and is particularly useful for concrete mixes of very low workability as are normally used when concrete is to be compacted by vibration. Such dry concrete are insensitive to slump test. As shown in Fig 3.5.2(b)

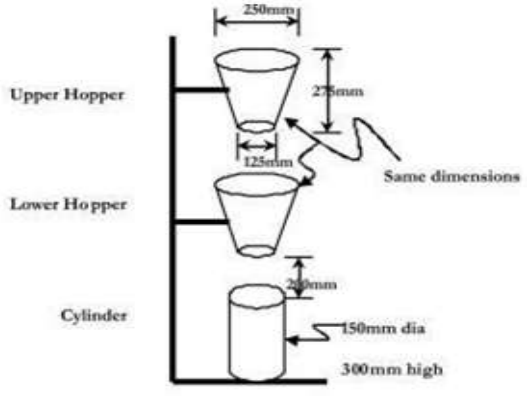

Fig **3.5.2 (b).** Compacting Factor apparatus

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This test works on the principle of determining the degree of compaction achieved by a standard amount of work done by allowing the concrete to fall through a standard height. The degree of compaction, called the compacting factor is measured by the density ratio i.e., the ratio of the density actually achieved in the test to density of same concrete fully compacted.

3.5.2 c) Test for Properties of Concrete
Water Retentivity Test
Water Retentivity is the ability of the substance to retain water.
To perform the water retentivity test, the cubes were weighed for every 3 days from the date of casting. Weight loss for the specimens in indoor curing, and weight gain for theconventional curing are noted and their behaviour is plotted in graph against number of days of curing. As shown in the plate 7 and 8.

3.6 Testing Of Specimens
After the specimen prepared for testing on universal testing machine to find the Mechanical properties such as compressive strength on cubes, flexural strength on prisms, split tensile strength on cylinders.

3.6.1 Testing Procedure for Compressive Strength
The specimens were tested in accordance with IS 516:1969, the testing was done on universal compression testing machine of 2000kN velocity. The machine has the facility to control the rate of loading with a control valve. The machine has been calibrated to the required standards. The platens are cleaned oil level is checked and kept ready in all respects for testing. As shown in the plate 4 and 11.

It is placed on the machine such that the load is applied centrally the smooth surfaces of the specimen are placed as the bearing surfaces. The top plate is brought in contact with the specimen by rotating the handle. The oil pressure valve is closed and the machine is switched ON. A uniform rate of loading 140lg/sq.cm/min is maintained. The maximum load at failure at which the specimen breaks and the average value is taken as the mean strength.

The compressive strength is taken as the load applied on the specimen divided by the area of the load bearing surface of the specimen (P/A).

3.6.2 Testing Procedure for Flexural Strength
Flexural strength is expressed in terms of modulus of rupture, which is the maximum stress at the extreme fibres in bending. It is calculated by flexure formula. After removal of the beam specimen from the indoor curing, they are tested on the load frame of 20kN capacity in accordance with IS 9399:1679. The load frame is provided with two rollers at a distance of 400mm apart at the base. The load is applied through two similar rollers mounted at the third point of the supporting span spaced 133mm apart and centrally with the respect to the base rollers. As shown in plate 9.

The axis of the specimen is carefully aligned with the axis of the loading frame. The load is applied gradually without shock increasing continuously such that the extreme fiber stresses increase at a rate of 7kg/ sq.cm/min. i.e., application of load it at the rate of 4000N/min. the load is divided equally between the two roller points and it increased until the specimen fails. The load is measured by a load gauge (proven ring) mounted on top of the loading rollers the modulus of rupture is calculated for the maximum load taken by the member.

The modulus of rupture is
$fb = pl/bd^2$ for a > 133mm
$fb = 3pa/bd^2$ for 133mm > a > 100mm

Where,
p = maximum load applied to the specimen in kg.
l = length of the span on which the specimen is supported in cm.
b = measured width of the specimen in cm.
a = the distance between the line of facture and the nearer support, measured on the centre line of the tension side of the specimen in cm.
d = measured depth of the specimen in cm.

3.6.3 Testing Procedure for Splitting Tensile Strength
The specimens were tested in accordance with IS 5816:1999. The load shall be applied without shock and increased continuously at a nominal rate within the range 1.2 N/ (mm^2/min) to 2.4 N/ (mm^2/min). Maintain the rate, once adjusted, until failure. On manually controlled machines as failure is approached the loading rate will decrease; at this stage the controls shall be operated to maintain as far as possible the specified loading rate. As shown in plate 5 and 10.

The maximum load applied shall then be recorded. The appearance of concrete and any unusual features in the type of failure shall also be noted. The rate of increase of load may be calculated from the formula: (1.2 to 2.4) x $\pi/2$ x I x d N/min. In this test, a 150mm diameter by 300mm height cylinder is subjected to compression loads along two axial lines which are diametrically opposite. The load is applied continuously at a

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constant rate until the specimen fails. The compressive stress procedure is a transverse tensile stress, which is uniform along the vertical diameter. The splitting tensile strength is computed by the formula.

$f_t = 2p/\pi ld$

Where,
p = maximum load applied to the specimen in N.
l = length of the specimen in mm.
d = diameter of the specimen in mm.

4. RESULTS AND ANALYSIS

As per Experimental programme results for different experiments were obtained. They are shown in table format or graph, which is to be presented in this chapter.

4.1. Studies on Concrete

4.1.1. Compaction Factor Test

The compaction factor test is performed to calculate the compaction factor, and to know more about workability. The test results are shown in table 4.1. The plot of the compaction factor and different dosage of PEG 6000 is shown in Figure 4.1. The following are the observations on Compaction factor test.

In case of specimens with PEG 6000 of Mix A it is clear that compaction factor for 0.5% dosage of self curing agent is less when compared to other dosages 1% and 2%.

In case of specimens with PEG 6000 of Mix B 1% dosage compaction factor is more compared to other dosages (1% and 2%).

It is also clear that compaction factor is more for Mix B in 1% and 2% when compared to Mix A.

It is also observed that in Mix A the compaction factor is increased with increase of % of PEG 6000. But in Mix B it is increased from 0.5% to 1% and then it is decreased.

4.2 Water Retentivity Test

4.2.1. Water Retentivity Test Results for Mix A1

Concrete with high molecular weight PEG subjected to indoor curing was studied by weighing the samples at regular intervals of 3 days, with digital weighing machine of accuracy 5gms up to 28 days. The results were recorded in table 4.2.The analysis of results or average weight loss of individual specimen is shown in table 4.3.The average weight loss is shown in Fig.4.2. The following are the observations on water retentivity of concrete.

It is clear that 0% dosage of self curing agent is losing more weight when compared to other dosages (0.5%, 1% and 2% of self curing agent).

It is also observed that 2% dosage of self curing agent shows lower weight loss when compared to other dosages (0%, .5% and 1% of self curing agent).

4.2.2. Water Retentivity Test Results for Mix A2

Concrete with high molecular weight PEG subjected to indoor curing was studied by weighing the samples at regular intervals of 3 days, with digital weighing machine of accuracy 5 gm up to 28 days. The results were recorded in table 4.4. The analysis of results or average weight loss of individual specimen is shown in table 4.5.The average weight loss is shown in fig.4.3. The following are the observations on water retentivity of concrete.

It is clear that 0% dosage of self curing agent is losing more weight when compared to other dosages (0.5%, 1% and 2% of self curing agent).

It is also observed that 1% dosage of self curing agent shows lower weight loss when compared to other dosages (0%, .5% and 2% of self curing agent).

4.2.3. Water Retentivity Test Results for Mix B 1

Concrete with high molecular weight PEG subjected to indoor curing was studied by weighing the samples at regular intervals of 3 days, with digital weighing machine of accuracy 5 gm up to 28 days. The results were recorded in table 4.6. The average weight loss is shown in Fig.5.6.The analysis of results or percentage weight loss of individual specimen are shown in table 4.7. The following are the observation on water retentivity of concrete.

It is clear that conventional concrete with indoor curing is losing more weight when compared to other dosages 0.5%, 1% and 2% of self curing agent.

It is also clear that 2 % dosage of S.C.A result is almost nearer when compared to the dosages of conventional concrete with indoor curing. But it is not appreciable when compared with 0.5%.

It is also observed that 2 % dosage of S.C.A shows less weight loss when compared to other dosages.

4.2.4.WaterRetentivity Test Results for Mix B 2

Concrete with high molecular weight PEG subjected to indoor curing was studied by weighing the samples at regular intervals of 3 days, with digital weighing machine of accuracy 5 gm up to 28 days. The results were recorded in table 4.8.The average weight loss is shown in fig4.5.The analysis

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of results or percentage weight loss of individual specimen are shown in table 4.9. The following are the observation on water retentivity of concrete.
It is clear that conventional concrete with indoor curing is losing more weight when compared to other dosages 0.5%, 1% and 2% of self curing agent.

It is also clear that 1 % dosage of S.C.A result is almost nearer when compared to the dosages of conventional concrete with indoor curing. But it is not appreciable when compared with 2%.
It is also observed that 1% dosage of S.C.A shows less weight loss when compared to other dosages.

4.3 Comparison of Mix A1 and Mix B1
As per the figure 5.14 and 5.15 the following are the observations on strength of concrete for indoor curing with different dosages of PEG 6000.
The compressive strength is more for Mix A1 at 7 and 28 days when compared to Mix B1.
The compressive strength is more for Mix A1 at 2% of SCA and it is very low at same 0.5% of SCA for Mix B1 at 7 days.
The compressive strength is nearly same for 0% and 0.5% of SCA for Mix B1 at 7 days.
The compressive strength is nearly same for Mix B1 at 28 days for 0% and 0.5% of SCA.
The compressive strength is more for 2% of SCA for Mix A1 at 28 days of age. The compressive strength is more for 1% of SCA for Mix B1 at 28 days of age.
The split tensile strength is more for Mix A21at 7 and 28 days when compared to Mix B1.
The split tensile strength is more for Mix A1 at 2% of SCA and it is very low at same 0.5% of SCA for Mix B1 at 7 days.
The split tensile strength is nearly same for 0% and 0.5% of SCA for Mix B1 at 7 days.
The split tensile strength is nearly same for Mix B1 at 28 days for 0% and 0.5% of SCA.
The split tensile strength is more for 2% of SCA for Mix A1 at 28 days of age. The split tensile strength is more for 1% of SCA for Mix B1 at 28 days of age.
The flexural strength is more for Mix A1at 7 and 28 days when compared to Mix B1. The flexural strength is more for Mix A1at 2% of SCA and it is very low at same
0.5% of SCA for Mix B1 at 7 days.
The flexural strength is nearly same for 0% and 0.5% of SCA for Mix B1 at 7 days.
The flexural strength is nearly same for Mix B1 at 28 days for 0% and 0.5% of SCA. The split tensile strength is more for 2% of SCA for Mix A at 28 days of age
The split tensile strength is more for 1% of SCA for Mix B1 at 28 days of age

4.3.1 Comparison of Mix A2 and Mix B2
As per the figure 4.11 the following are the observations on strength of concrete for indoor curing with different dosages of PEG 6000.
The compressive strength is more for Mix A2 at 7 and 28 days when compared to Mix B2.
The compressive strength is more for Mix A at 2% of SCA and it is very low at same 0.5% of SCA for Mix B at 7 days.
The compressive strength is nearly same for 0% and 0.5% of SCA for Mix B2 at 7 days.
The compressive strength is nearly same for Mix B2 at 28 days for 0% and 0.5% of SCA.
The compressive strength is more for 2% of SCA for Mix A2 at 28 days of age. The compressive strength is more for 1% of SCA for Mix B2 at 28 days of age.
The split tensile strength is more for Mix A2 at 7 and 28 days when compared to Mix B2.
The split tensile strength is more for Mix A at 2% of SCA and it is very low at same 0.5% of SCA for Mix B at 7 days.
The split tensile strength is nearly same for 0% and 0.5% of SCA for Mix B2 at 7 days.
The split tensile strength is nearly same for Mix B2 at 28 days for 0% and 0.5% of SCA.
The split tensile strength is more for 2% of SCA for Mix A2 at 28 days of age. The split tensile strength is more for 1% of SCA for Mix B2 at 28 days of age.
The flexural strength is more for Mix A2 at 7 and 28 days when compared to Mix B2. The flexural strength is more for Mix A at 2% of SCA and it is very low at same 0.5%
of SCA for Mix B at 7 days.
The flexural strength is nearly same for 0% and 0.5% of SCA for Mix B2 at 7 days. The flexural strength is nearly same for Mix B2 at 28 days for 0% and 0.5% of SCA. The split tensile strength is more for 2% of SCA for Mix A at 28 days of age.
The split tensile strength is more for 1% of SCA for Mix B2 at 28 days of age. Table 3.3.1 Materials Required for Mix A1

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SL.NO.	Nomenclature of Mix	No. of cubes			Cement (kg)	FA (kg)	CA (kg)	Water (Lit)	PEG 6000 (gm)
		Cubes	cylinders	prisms					
1	A1OW	6	6	6	44.25	65.4	89.6	17.7	0
2	A1OI	6	6	6	44.25	65.4	89.6	17.7	0
3	A1H0.5	6	6	6	44.25	65.4	89.6	17.7	221
4	A1H1	6	6	6	44.25	65.4	89.6	17.7	442
5	A1H2	6	6	6	44.25	65.4	89.6	17.7	884

Table 3.3.2 Materials Required for Mix A2

SL.NO.	Nomenclature of Mix	No. of cubes			Cement (kg)	FA (kg)	CA (kg)	Water (Lit)	PEG 6000 (gm)
		cubes	cylinders	prisms					
1	A2OW	6	6	6	49.6	53.2	93.1	17.8	0
2	A2OI	6	6	6	49.6	53.2	93.1	17.8	0
3	A2H0.5	6	6	6	49.6	53.2	93.1	17.8	248
4	A2H1	6	6	6	49.6	53.2	93.1	17.8	496
5	A2H2	6	6	6	49.6	53.2	93.1	17.8	992

Table 3.3.3 Materials Required for Mix B1

SL.NO.	Nomenclature of Mix	No. of cubes			Cement (kg)	FA (kg)	CA (kg)	Water (Lit)	PEG 6000 (gm)
		Cubes	cylinders	Prisms					
1	B1OW	6	6	6	44.25	65.4	91.6	17.2	0
2	B1OI	6	6	6	44.25	65.4	91.6	17.2	0
3	B1H0.5	6	6	6	44.25	65.4	91.6	17.2	221
4	B1H1	6	6	6	44.25	65.4	91.6	17.2	442

5	B1H2	6	6	6	44.25	65.4	91.6	17.2	884

Table 3.3.4 Materials Required for Mix B2

SL.NO.	Nomenclature of Mix	No. of cubes			Cement (kg)	FA (kg)	CA (kg)	Water (Lit)	PEG 6000 (gm)
		Cubes	cylinders	Prisms					
1	B2OW	6	6	6	49.6	53.2	94.5	17.5	0
2	B2OI	6	6	6	49.6	53.2	94.5	17.5	0
3	B2H0.5	6	6	6	49.6	53.2	94.5	17.5	248
4	B2H1	6	6	6	49.6	53.2	94.5	17.5	496
5	B2H2	6	6	6	49.6	53.2	94.5	17.5	992

Table 4.1 Compaction Factor for different percentages of PEG 6000

Compacting Factor

Percentage Dosage of PEG	AH	BH
0.5	0.98	0.934
1	0.988	0.976
2	0.996	0.956

Table 4.2.2 Avg weight of cylinders at different ages(kg)

DESIGNATION	0	3	7	10	14	20	28
A10W	13.07	13.02	13.02	13.05	13.02	13.01	13.00
A10I	13.01	13.05	13.03	13.04	13.01	12.9	12.78
A1H 0.5	13.02	13.0	13.15	13.14	13.12	13.00	12.83
A1H 1	13.09	13.01	13.00	13.10	13.01	13.02	12.99
A1H 2	13.20	13.11	13.15	13.09	13.12	13.09	13.1

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DESIGNATION	0	3	7	10	14	20	28
A10W	12.550	12.5	12.597	12.586	12.517	12.59	12.65
A10I	12.433	12.336	12.327	12.390	12.395	12.391	12.2
A1H 0.5	12.636	12.493	12.620	12.628	12.597	12.543	12.545
A1H 1	12.541	12.538	12.511	12.560	12.525	12.523	12.500
A1H 2	12.579	12.658	12.542	12.593	12.560	12.559	12.555

Table 4.2.3 Avg weight of prisms at different ages (kg)

Table 4.3.1 Avg Weight Loss for Mix A1(cubes) for different percentage of PEG 6000

Designation	Curing Period, Days							Weight loss Ratio
	0	3	7	10	14	20	28	
A1OW	0	-.022	-0.025	-0.33	-0.034	-0.036	-0.037	
A1OI	0	0.058	0.057	0.067	0.069	0.077	0.080	1
A1H 0.5	0	0.019	0.024	0.027	0.029	0.035	0.035	0.75
A1H1	0	0.023	0.018	0.20	0.022	0.025	0.025	0.61
A1H2	0	0.018	0.019	0.020	0.024	0.024	0.025	0.52

Table 4.3.2 Avg Weight Loss for Mix A1(prisms) for different percentage of PEG 6000

Designation	Curing Period, Days							Weight loss Ratio
	0	3	7	10	14	20	28	
A1OW	0		-0.025		-0.035		-0.023	
A1OI	0	0.038	0.0437	0.0457	0.049	0.0517	0.0544	1
A1H0.5	0	0.022	0.025	0.027	0.029	0.032	0.035	0.44
A1H1	0	0.023	0.028	0.03	0.032	0.035	0.035	0.34
A1H2	0	0.016	0.017	0.017	0.019	0.0210	0.025	0.24

Table 4.4 Water Retentivity Test for Mix A2 for different percentages of PEG 6000

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Designation	0	3	7	10	14	20	28
A20W	8.540	8.50	8.497	8.51	8.54	8.55	8.58
A20I	8.493	8.436	8.427	8.450	8.445	8.41	8.39
A2H 0.5	8.616	8.593	8.600	8.628	8.597	8.58	8.48
A2H 1	8.561	8.538	8.541	8.560	8.525	8.50	8.49
A2H 2	8.589	8.558	8.562	8.593	8.560	8.51	8.50

Table 4.4.1. Average weight of cubes at different ages (kg)

Designation	0	3	7	10	14	20	28
A20W	13.07	13.09	13.08	13.12	13.19	13.2	13.24
A20I	13.1	13.05	13.03	13.50	13.01	13.1	12.8
A2H 0.5	13.02	13.0	13.18	13.18	13.12	13.1	12.8
A2H 1	13.09	13.01	13.01	13.0	13.01	13.0	12.9
A2H 2	13.2	13.11	13.12	13.09	13.12	13.11	13.1

Table 4.4.2.Avg weight of cylinders at different ages (kg)

Designation	0	3	7	10	14	20	28
A20W	12.510	12.51	12.497	12.49	12.517	12.52	12.53
A20I	12.493	12.436	12.427	12.450	12.445	12.4	12.2
A2H 0.5	12.616	12.593	12.600	12.628	12.597	12.59	12.58
A2H 1	12.561	12.538	12.541	12.560	12.525	12.48	12.52
A2H 2	12.589	12.558	12.562	12.593	12.560	12.5	12.53

Table 4.4.3 Avg weight of prisms at different ages (kg)

Table 4.5 Average Weight Loss for Mix A2 for different percentage of PEG 6000

Designation	Curing Period, Days							Weight loss Ratio
	0	3	7	10	14	20	28	

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A2OW	0	-0.2	-0.025	-.03	-0.035	-.029	-0.023	
A2OI	0	0.058	0.067	0.067	0.069	0.077	0.084	1
A2H 0.5	0	0.022	0.025	0.026	0.027	0.035	0.035	0.656
A2H1	0	0.023	0.028	0.03	0.032	0.040	0.025	0.641
A2H2	0	0.011	0.014	0.016	0.023	0.020	0.02	0.426

Table 4.5.1 Avg Weight Loss for Mix A2(cubes) for different percentage of PEG 6000

Table 4.5.2 Avg weight Loss for MixA2(cylinders) for different percentage of PEG 6000

Designation	Curing Period, Days							Weight loss Ratio
	0	3	7	10	14	20	28	
A2OW	0		-0.025		-0.035		-0.023	
A2OI	0	0.08	0.06	0.07	0.09	0.77	0.84	1
A2H0.5	0	0.022	0.021	0.021	0.027	0.031	0.025	0.741
A2H1	0	0.023	0.023	0.033	0.032	0.041	0.020	0.541
A2H2	0	0.013	0.014	0.014	0.017	0.018	0.018	0.1

Table for calculating Avg Weight Loss for Mix A2(prisms) for different percentage of PEG 6000

Designation	Curing Period, Days							Weight loss Ratio
	0	3	7	10	14	20	28	
A2OW	0	-0.019	-0.025	-0.028	-0.030	-0.033	-0.034	
A2OI	0	0.07	0.069	0.079	0.079	0.071	0.069	1
A2H0.5	0	0.02	0.05	0.026	0.027	0.035	0.015	.57
A2H1	0	0.023	0.028	0.03	0.032	0.040	0.020	0.48
A2H2	0	0.019	0.020	0.0236	0.239	0.0250	0.025	0.3

Table 4.5.3 Avg Weight Loss for Mix A2(prisms) for different percentage of PEG 6000

Table 4.6. Water Retentivity Test for Mix B2 for different percentages of PEG 6000

Designation	0	3	7	10	14	20	28

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B10W	8.32	8.35	8.38	8.39	8.43	8.45	8.48
B10I	8.326	8.317	8.315	8.314	8.311	8.303	8.307
B1H 0.5	8.318	8.310	8.314	8.308	8.295	8.285	8.280
B1H 1	8.418	8.415	8.413	8.401	8.403	8.403	8.402
B1H 2	8.19	8.109	8.059	8.011	8.014	8.013	7.990

Table 4.6.1 Average weight of cubes at different ages(kg)

Designation	0	3	7	10	14	20	28
B10W	13.36	13.45	13.46	13.47	13.49	13.56	13.60
B10I	13.29	13.25	13.19	13.19	13.09	13.01	12.98
B1H 0.5	13.35	13.28	13.26	13.25	13.25	13.20	13.15
B1H 1	13.10	13.08	13.05	13.03	12.98	12.96	12.95
B1H 2	13.09	13.05	13.03	13.01	12.91	12.85	12.90

Table 4.6.2 Avg weight of cylinders at different ages(kg)

Designation	0	3	7	10	14	20	28
B10W	12.54	12.59	12.61	12.63	12.65	12.70	12.73
B10I	12.48	12.41	12.38	12.26	12.23	12.19	12.15
B1H 0.5	12.49	12.47	12.39	12.35	12.33	12.31	12.30
B1H 1	12.47	12.45	12.43	12.41	12.37	12.33	12.30
B1H 2	12.43	12.40	12.35	12.30	12.30	12.28	12.27

Table 4.6.3 Avg weight of prisms at different ages(kg)

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Table 4.7 Average Weight Loss for Mix B1 for different percentage of PEG 6000

Table 4.7.1Avg Weight Loss for Mix B2 (cubes) for different percentage of PEG 6000

Designation	Curing Period, Days							Weight loss Ratio
	0	3	7	10	14	20	28	
B1OW	0	-0.490	-0.500	-0.51	-0.517	-0.519	-0.520	
B1OI	0	0.509	0.516	0.522	0.527	0.539	0.546	1
B1H0.5	0	0.505	0.513	0.521	0.52 1	0.526	0.530	0.694
B1H1	0	0.486	0.498	0.509	0.51 0	0.515	0.520	0.436
B1H2	0	0.470	0.483	0.496	0.51 4	0.517	0.524	0.543

Table 4.7.2 Avg Weight Loss for Mix B2(cylinders) for different percentage of PEG 6000

Designation	Curing Period, Days							Weight loss Ratio
	0	3	7	10	14	20	28	
B1OW	0	-0.46	-0.490	-0.499	-0.507	-0.510	-0.513	
B1OI	0	0.50	0.51	0.52	0.527	0.53	0.549	1
B1H0.5	0	0.47	0.48	0.49	0.51	0.52	0.53	0.773
B1H1	0	0.486	0.489	0.490	0.495	0.50	0.502	0.663
B1H2	0	0.470	0.483	0.496	0.509	0.509	0.51	0.700

Table 4.7.3 Avg Weight Loss for Mix B2(prisms) for different percentage of PEG 6000

Designation	Curing Period, Days							Weight loss Ratio
	0	3	7	10	14	20	28	
B1OW	0	-0.450	-0.500	-0.514	-0.511	-0.52	-0.526	
B1OI	0	0.519	0.516	0.522	0.527	0.539	0.546	1
B1H0.5	0	0.515	0.513	0.520	0.523	0.526	0.530	0.500
B1H1	0	0.486	0.498	0.509	0.510	0.515	0.520	0.423
B1H2	0	0.497	0.498	0.506	0.513	0.519	0.525	0.450

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Table 4.8 Water Retentivity Test for Mix B1for different percentages of PEG 6000
Average weight of cubes at different ages(kg)

Designation	0	3	7	10	14	20	28
B20W	8.223		8.373		8.300		8.358
B20I	8.230	8.147	8.135	8.141	8.110	8.143	8.137
B2H 0.5	8.219	8.114	8.124	8.114	8.114	8.115	8.085
B2H 1	8.152	8.066	8.072	8.033	8.031	8.043	8.020
B2H 2	8.129	8.059	8.059	8.011	8.014	8.013	7.990

Table 4.8.1 Average weight of cubes at different ages(kg)
Avg weight of cylinders at different ages(kg)

Designation	0	3	7	10	14	20	28
B20W	13.12		13.23		13.25	13.25	13.3
B20I	13.21	13.2	13.18	13.18	13.12	13.1	12.8
B2H 0.5	13.09	13.08	13.07	13.08	13.05	13.05	13.01
B2H 1	13.11	13.1	13.08	13.06	13.06	13.04	13.04
B2H 2	13.11	13.09	13.07	13.08	13.08	13.07	13.07

Designation	0	3	7	10	14	20	28
B20W	12.59	12.6	12.6	12.61	12.639	12.659	12.96
B20I	12.68	12.65	12.6	12.58	12.58	12.50	12.48
B2H 0.5	12.65	12.60	12.60	12.585	12.55	12.52	12.5
B2H 1	12.63	12.60	12.57	12.55	12.55	12.53	12.53
B2H 2	12.55	12.55	12.52	12.56	12.59	12.54	12.53

Table 4.9 Average Weight Loss for Mix B1 for different percentage of PEG 6000

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Avg Weight Loss for Mix B1(cubes) for different percentage of PEG 6000

Designation	Curing Period, Days							Weight loss Ratio
	0	3	7	10	14	20	28	
B2OW	0		-0.500		-0.517		-0.520	
B2OI	0	0.509	0.516	0.522	0.527	0.539	0.539	1
B2H0.5	0	0.505	0.513	0.521	0.521	0.526	0.530	0.956
B2H1	0	0.508	0.508	0.509	0.510	0.515	0.520	0.735
B2H2	0	0.517	0.518	0.519	0.520	0.522	0.524	0.801

Table 4.9.1 Avg Weight Loss for Mix B1(cubes) for different percentage of PEG 6000

Table 4.9.2.Avg Weight Loss for Mix B1(cylinders) for different percentage of PEG 6000

Designation	Curing Period, Days							Weight loss Ratio
	0	3	7	10	14	20	28	
B2OW	0		-0.561		-0.537		-0.550	
B2OI	0	0.519	0.516	0.522	0.527	0.539	0.546	1
B2H0.5	0	0.505	0.515	0.521	0.524	0.526	0.530	0.732
B2H1	0	0.496	0.499	0.509	0.510	0.515	0.520	0.532
B2H2	0	0.519	0.523	0.520	0.523	0.527	0.527	0.601

Avg Weight Loss for Mix B1(prisms) for different percentage of PEG 6000

Designation	Curing Period, Days							Weight loss Ratio
	0	3	7	10	14	20	28	
B2OW	0		-0.500		-0.517		-0.520	
B2OI	0	0.519	0.516	0.522	0.527	0.559	0.056	1
B2H0.5	0	0.505	0.513	0.521	0.519	0.516	0.520	0.730
B2H1	0	0.486	0.489	0.493	0.497	0.501	0.502	0.564
B2H2	0	0.470	0.483	0.496	0.493	0.497	0.512	0.623

Table 4.9.3 Avg Weight Loss for Mix B1(prisms) for different percentage of PEG 6000

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Table 4.10.1 Compressive Strength for MIX A1(Cubes)
Compressive Strength at Different Ages

Designation		7 DAYS	28 DAYS
A1OW	S1	35.9	44.9
	S2	35.5	43.8
	S3	35.8	42.6
Average		35.73	43.76
A1OI	S1	31.0	38.8
	S2	27.4	40.1
	S3	31.1	39.3
Average		29.83	39.4
A1H0.5	S1	32.4	41.9
	S2	32.1	40.7
	S3	32.9	41.4
Average		32.46	41.33
A1H1	S1	33.7	42.84
	S2	34.3	41.16
	S3	33.3	42.19
Average		33.73	42.06
A1H2	S1	35.1	44.91
	S2	35.9	43.72
	S3	35.8	42.1
Average		35.6	43.57

Table 4.10.2 Split tensile strength for MIX A1 (CYLINDERS)
Split tensile strength at Different Ages

Designation		7 DAYS	28 DAYS
A1OW	S1	2.37	3.1
	S2	2.36	3.2
	S3	2.4	3.3
Average		2.37	3.2
A1OI	S1	2.04	3.01
	S2	2.0	2.8
	S3	2.1	2.9
Average		2.04	2.9

A1H0.5	S1	2.1	2.9
	S2	2.2	3.08
	S3	2.2	3.2
Average		2.16	3.06
A1H1	S1	2.1	3.2
	S2	2.3	3.0
	S3	2.2	3.0
Average		2.2	3.06
A1H2	S1	2.3	3.3
	S2	2.48	3.2
	S3	2.3	3.0
Average		2.36	3.16

Table 4.10.3 Flexural Strength for MIX A1 (Prisms)

Flexural Strength at Different Ages

Designation		7 DAYS	28 DAYS
A10W	S1	3.8	4.2
	S2	3.75	4.38
	S3	3.82	4.4
Average		3.79	4.3
A10I	S1	3.5	3.91
	S2	3.62	3.7
	S3	3.56	3.9
Average		3.56	3.83
A1H0.5	S1	3.66	4.11
	S2	3.73	4.18
	S3	3.62	3.9
Average		3.67	4.06
A1H1	S1	3.82	4.2
	S2	3.75	3.9
	S3	3.8	4.2
Average		3.79	4.1
A1H2	S1	3.88	4.1
	S2	3.9	4.3
	S3	3.85	4.4

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Average 3.87 4.2

Table 4.11.1 Compressive Strength for MIX A2 (Cubes)
Compressive Strength at Different Ages

Designation		7 DAYS	28 DAYS
A2OW	S1	49.9	53.9
	S2	49.2	54.3
	S3	48.6	53.9
Average		49.23	54.03
A2OI	S1	45.3	50.93
	S2	46.7	51.5
	S3	45.0	49.9
Average		45.6	50.7
A2H0.5	S1	45.93	52.44
	S2	49.93	52.92
	S3	45.0	51.9
Average		46.95	52.42
A2H1	S1	46.9	52.33
	S2	47.8	52.04
	S3	47.5	53.97
Average		47.4	52.78
A2H2	S1	48.9	54.04
	S2	47.8	53.96
	S3	49.5	53.1
Average		48.73	53.7

Table 4.11.2 Split tensile Strength for MIX A2 (Cylinders)
Split Tensile strength at Different Ages

Designation		7 DAYS	28 DAYS
A2OW	S1	2.7	3.4
	S2	3.1	3.3
	S3	2.6	3.4
Average		2.8	3.37
A2OI	S1	2.4	2.7
	S2	2.3	3.0
	S3	2.1	2.5

Average		2.2	2.73
A2H0.5	S1	2.1	3.0
	S2	2.6	3.1
	S3	2.2	3.1
Average		2.3	3.06
A2H1	S1	2.2	3.0
	S2	2.7	3.29
	S3	2.4	3.33
Average		2.43	3.20
A2H2	S1	2.9	3.3
	S2	2.9	3.2
	S3	2.4	3.4
Average		2.78	3.3

Table 4.11.3 Flexural Strength for MIX A2 (Prisms)

Flexural Strength at Different Ages

Designation		7 DAYS	28 DAYS
A20W	S1	4.95	4.7
	S2	4.12	5.9
	S3	4.75	4.5
Average		4.6	5.03
A20I	S1	3.9	4.26
	S2	3.7	4.56
	S3	3.8	4.7
Average		3.84	4.50
A2H0.5	S1	4.10	4.76
	S2	4.15	4.56
	S3	4.30	4.75
Average		4.18	4.69
A2H1	S1	4.18	4.77
	S2	4.29	4.8
	S3	4.6	4.6
Average		4.35	4.72
A2H2	S1	4.92	5.38
	S2	4.78	4.9
	S3	4.95	4.8

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Average 4.88 5.02

Table 4.12.1Compressive Strength for Mix B1 (Cubes)

Compressive Strength at Different Ages

Designation		7 DAYS	28 DAYS
B10W	S1	33.96	39.45
	S2	33.26	38.96
	S3	32.64	40.4
Average		33.28	39.6
B10I	S1	32.63	36.96
	S2	29.86	37.63
	S3	28.65	36.45
Average		30.38	37.01
B1H0.5	S1	33.64	37.61
	S2	32.96	38.9
	S3	31.65	36.12
Average		32.75	37.54
B1H1	S1	33.36	39.47
	S2	34.64	39.51
	S3	34.46	38.26
Average		34.15	39.08
B1H2	S1	34.76	39.7
	S2	32.37	37.4
	S3	31.69	39.6
Average		32.94	38.9

Table 4.12.2 split tensile strength for Mix B1 (Cylinders)

Split Tensile Strength at Different Ages

Designation		7 DAYS	28 DAYS
B10W	S1	2.45	3.06
	S2	2.5	3.05
	S3	2.6	3.09

Average		2.51	3.06
B10I	S1	2.1	2.7
	S2	2.0	2.8
	S3	2.2	2.9
Average		2.1	2.8
B1H0.5	S1	2.2	2.91
	S2	2.3	3.0
	S3	2.1	3.0
Average		2.2	2.97
B1H1	S1	2.5	3.0
	S2	2.1	3.03
	S3	2.7	3.01
Average		2.46	3.01
B1H2	S1	2.3	2.9
	S2	2.5	3.00
	S3	2.2	3.02
Average		2.33	2.97

Table 4.12.3 Flexural Strength for Mix B1 (Prisms)

Flexural Strength at Different Ages

Designation		7 DAYS	28 DAYS
B10W	S1	3.45	4.29
	S2	3.51	4.23
	S3	3.30	4.19
Average		3.42	4.23
B10I	S1	3.16	3.85
	S2	3.25	3.76
	S3	3.12	3.6
Average		3.17	3.73
B1H0.5	S1	3.26	4.00
	S2	3.36	3.95
	S3	3.16	3.91

Average		3.26	3.95
B1H1	S1	3.25	4.11
	S2	3.5	4.23
	S3	3.4	4.11
Average		3.38	4.15
B1H2	S1	3.13	4.03
	S2	3.35	4.13
	S3	3.46	4.11
Average		3.31	4.09

Table 4.13.1 Compressive Strength for Mix B2 (Cubes)

Compressive Strength at Different Ages

Designation		7 DAYS	28 DAYS
B20W	S1	42.65	51.48
	S2	45.85	50.35
	S3	44.47	52.93
Average		44.32	51.58
B20I	S1	40.95	47.65
	S2	40.64	49.36
	S3	41.75	49.78
Average		41.11	48.93
B2H0.5	S1	41.67	50.88
	S2	42.48	49.63
	S3	40.98	48.72
Average		41.71	49.74
B2H1	S1	42.98	52.25
	S2	44.72	51.4
	S3	42.52	50.68
Average		43.40	51.44
B2H2	S1	42.36	50.93
	S2	41.88	50.35

	S3	41.41	50.48
Average		41.88	50.58

Table 4.13.2 Split Tensile Strength for Mix B2 (Cylinders)

Split Tensile Strength at Different Ages

Designation		7 DAYS	28 DAYS
B20W	S1	2.30	3.10
	S2	2.20	2.90
	S3	2.30	3.5
Average		2.26	3.16
B2OI	S1	2.1	2.6
	S2	2.00	2.30
	S3	2.02	2.50
Average		2.03	2.46
B2H0.5	S1	2.1	2.90
	S2	2.1	2.56
	S3	2.0	2.95
Average		2.06	2.8
B2H1	S1	2.2	3.16
	S2	2.2	3.12
	S3	2.3	3.20
Average		2.23	3.16
B2H2	S1	2.23	2.90
	S2	2.03	3.12
	S3	2.05	3.20
Average		2.1	3.07

Table 4.13.3 Flexural Strength for Mix B2 (Prisms)

Flexural Strength at Different Ages

Designation		7 DAYS	28 DAYS
B20W	S1	3.90	4.7
	S2	3.90	4.97

	S3	3.65	4.78
Average		3.81	4.76
B20I	S1	3.56	3.99
	S2	3.1	3.80
	S3	3.15	3.50
Average		3.27	3.76
B2H0.5	S1	3.40	3.98
	S2	3.45	3.99
	S3	3.30	3.91
Average		3.38	3.76
B2H1	S1	4.25	4.78
	S2	4.1	4.9
	S3	3.15	4.68
Average		3.83	4.78
B2H2	S1	4.0	4.29
	S2	3.55	3.99
	S3	3.35	3.9
Average		3.63	4.06

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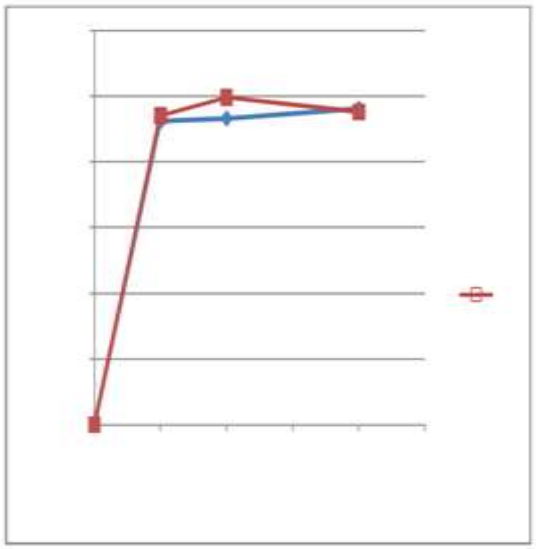

Fig 4.1 Compaction factor for different percentages of PEG 6000

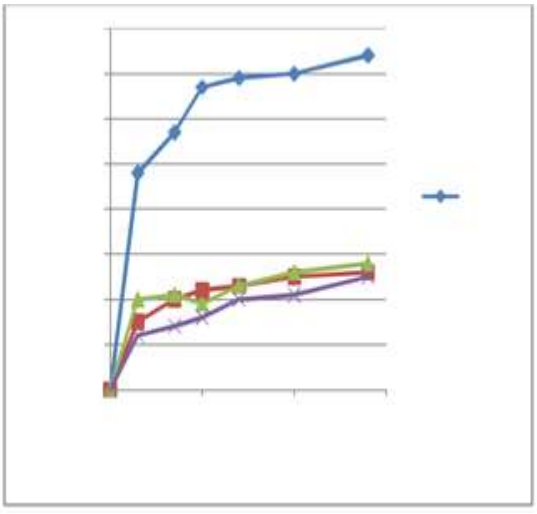

Fig:4.2.2 Avg Weight Loss for Mix A2 (CYLINDERS) For the Different Dosages of PEG 6000

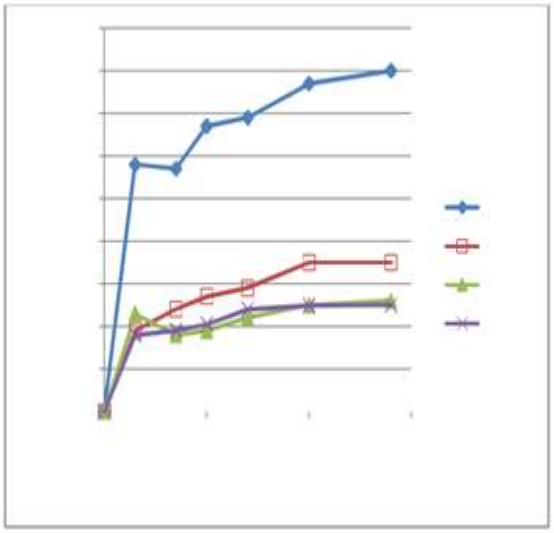

Fig:4.2.1.Avg Weight Loss for Mix A2 (CUBES) For the Different Dosages of PEG 6000

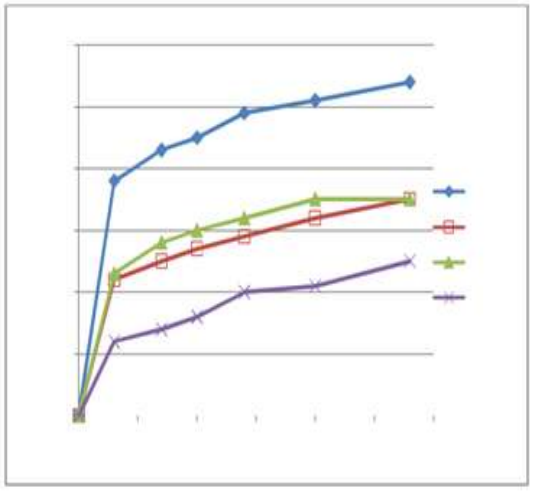

Fig:4.2.3.Avg Weight Loss for Mix A2(PRISMS) For the Different Dosages of PEG 6000

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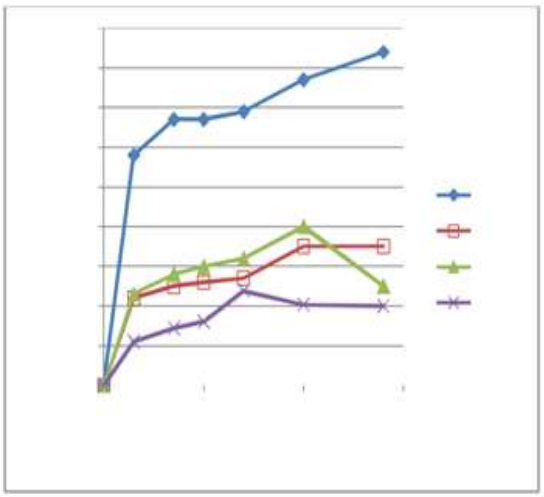

Fig.4.3.1. AVG Weight loss for Mix A1 (cubes) for the different dosages of PEG6000

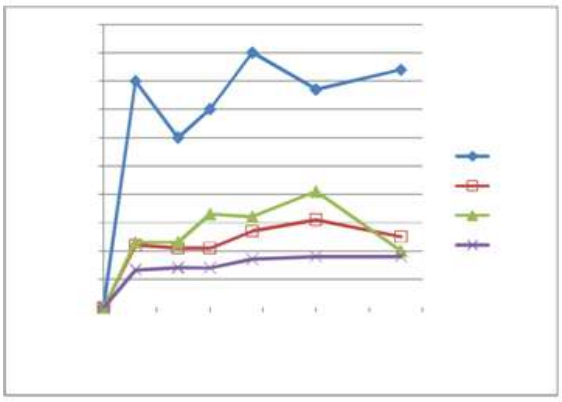

Fig 4.3.2 AVG Weight loss for Mix A1 (cylinders) for the different dosages of PEG6000

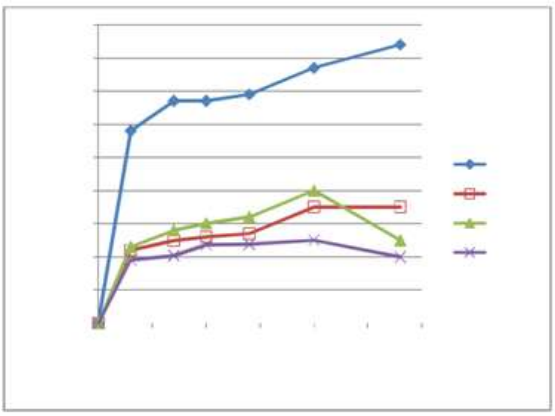

Fig 4.3.3 AVG Weight loss for Mix A1 (prisms) for the different dosages of PEG6000

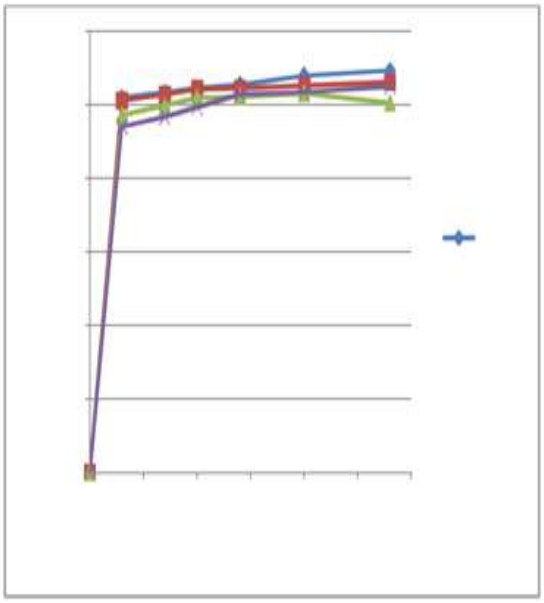

Fig: 4.4.1 Avg Weight Loss for MixB2 (CUBES) For the Different Dosages of PEG 6000

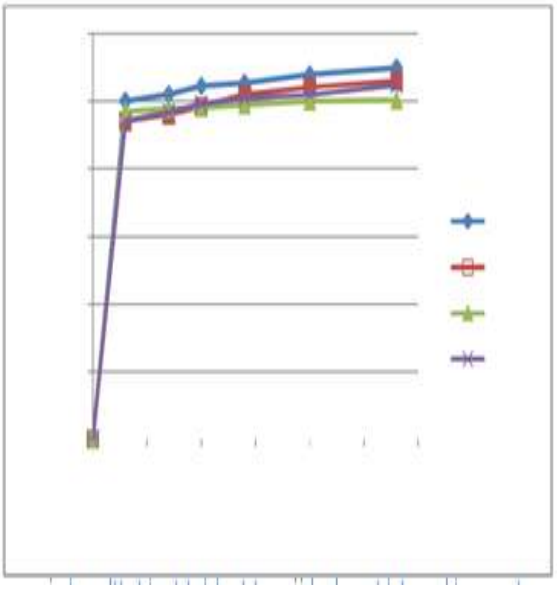

Fig: 4.4.2 Avg Weight Loss for MixB2 (CYLINDERS) For the Different Dosages of PEG 6000

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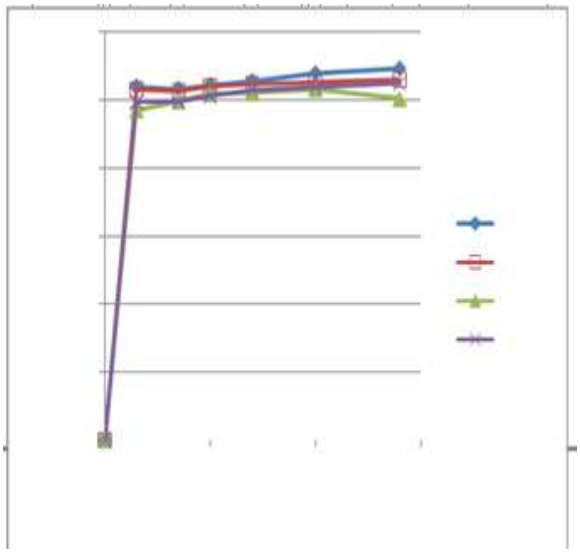

Fig:4.4.3 Avg Weight Loss for Mix B2 (PRISMS) For the Different Dosages of PEG 6000

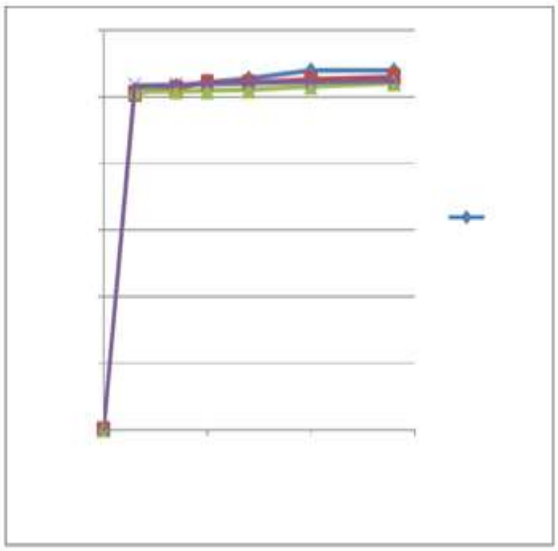

Fig:4.5.1 Avg Weight Loss for Mix B1 (CUBES) For the Different Dosages of PEG 6000

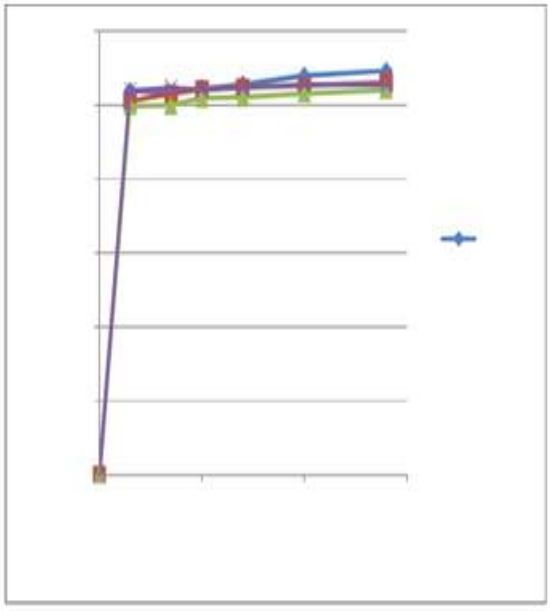

Fig: 4.5.2 Avg Weight Loss for Mix B1(CYLINDERS) For the Different Dosages of PEG 6000

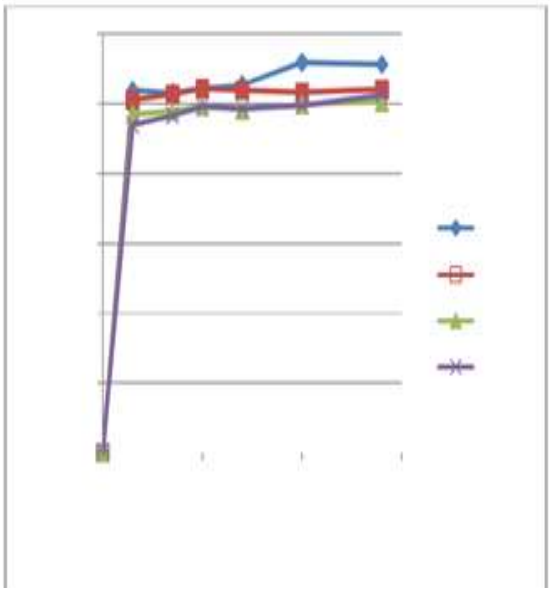

Fig: 4.5.3 Avg Weight Loss for Mix B1 (PRISMS) For the Different Dosages of PEG 6000

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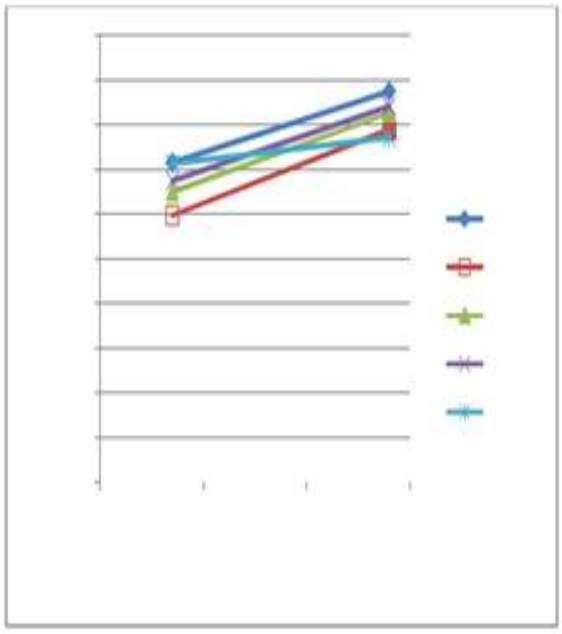

Fig:4.6.1. Avg Compressive Strength of Mix A1 Concrete at Different Dosages of PEG 6000

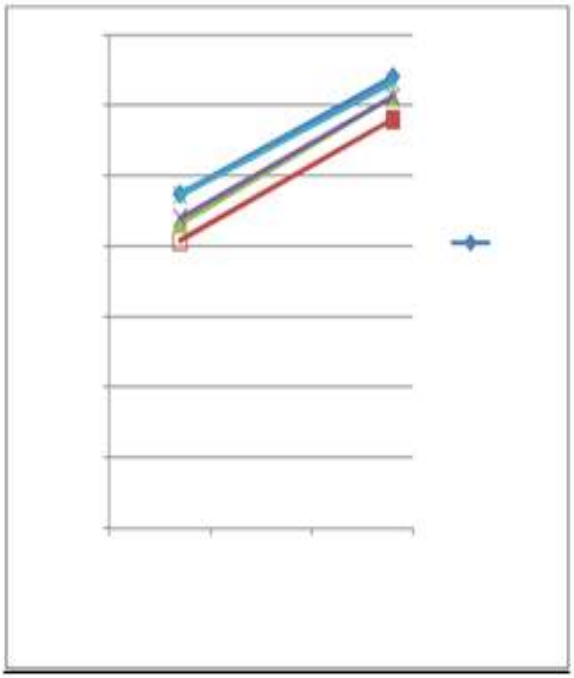

Fig.4.6.2. Avg split tensile Strength of Mix A1 Concrete at Different Dosages of PEG 6000

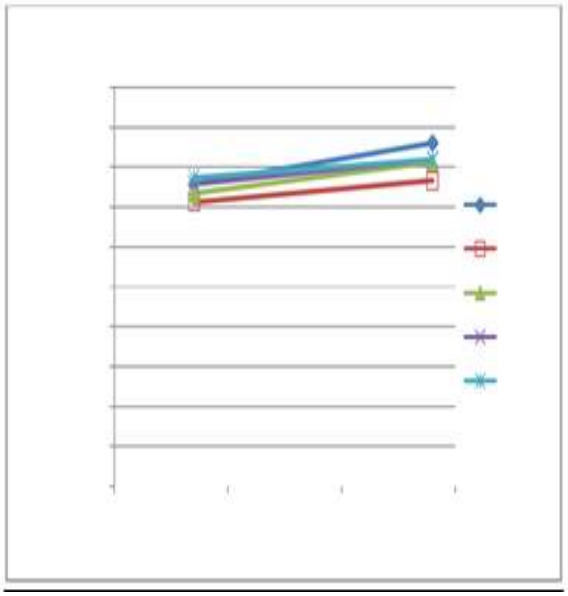

Fig.4.6.3. Avg flexural Strength of Mix A1 Concrete at Different Dosages of PEG 6000

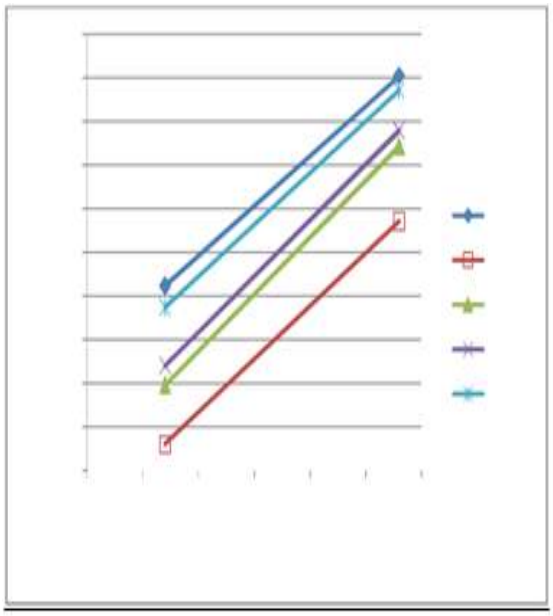

Fig.4.7.1. Avg Compressive Strength of Mix A2 Concrete at Different Dosages of PEG 6000

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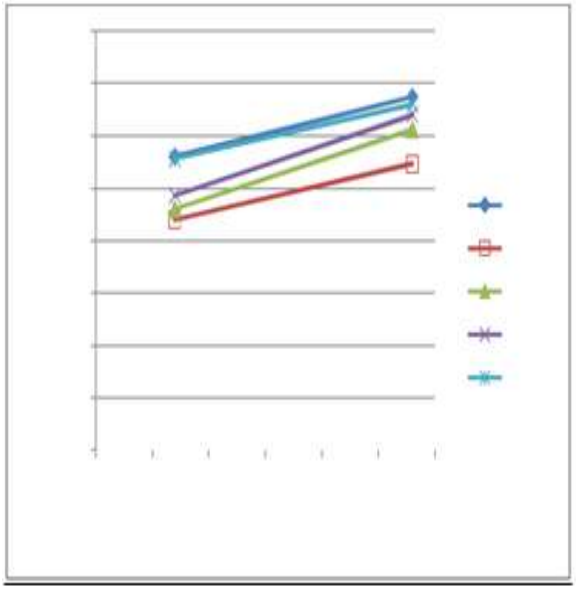

Fig.4.7.2.Avg Split Tensile Strength of Mix A2 Concrete at Different Dosages of PEG 6000

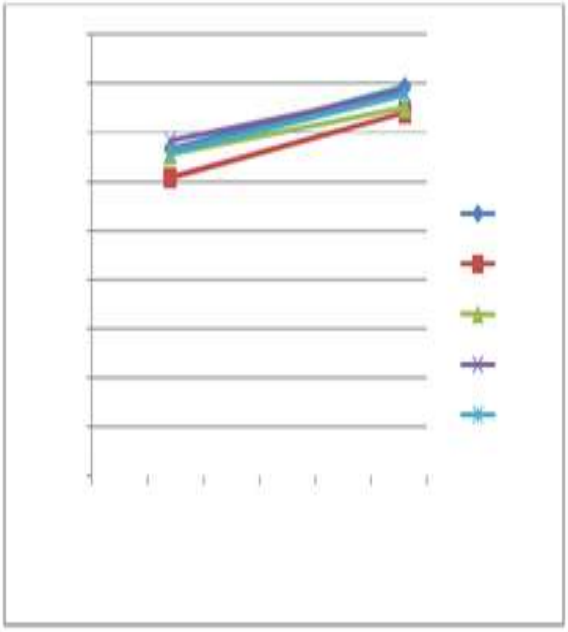

Fig: 4.8.1.Avg Compressive Strength of Mix B1 Concrete at Different Dosages of PEG 6000

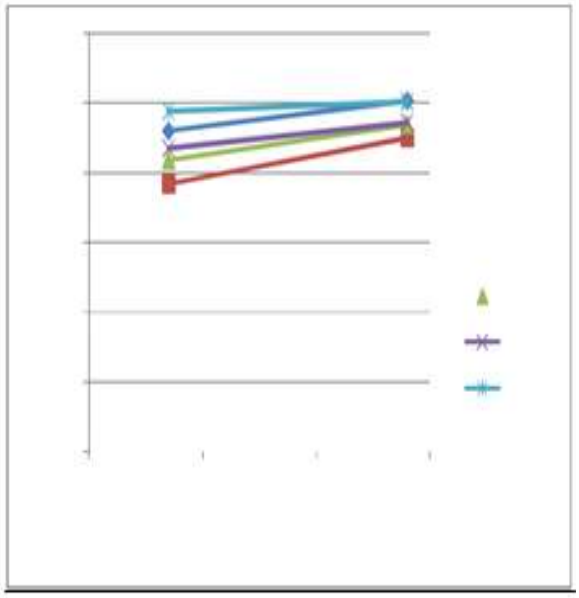

Fig.4.7.3.Avg Flexural Strength of Mix A2 Concrete at Different Dosages of PEG 6000

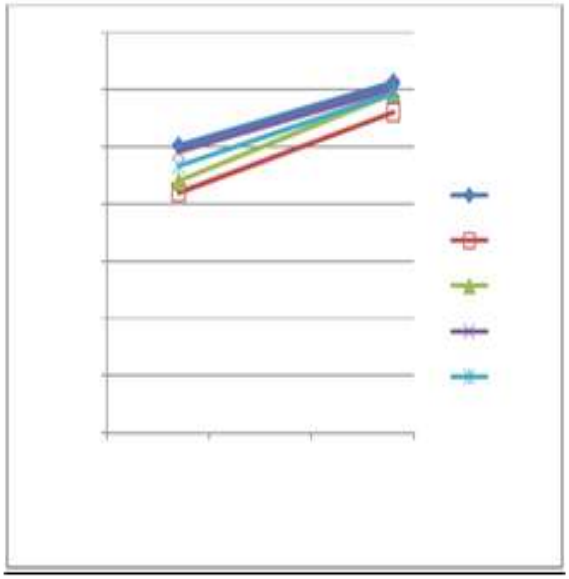

Fig.4.8.2.Avg Split Tensile Strength of Mix B1 Concrete at Different Dosages of PEG 6000

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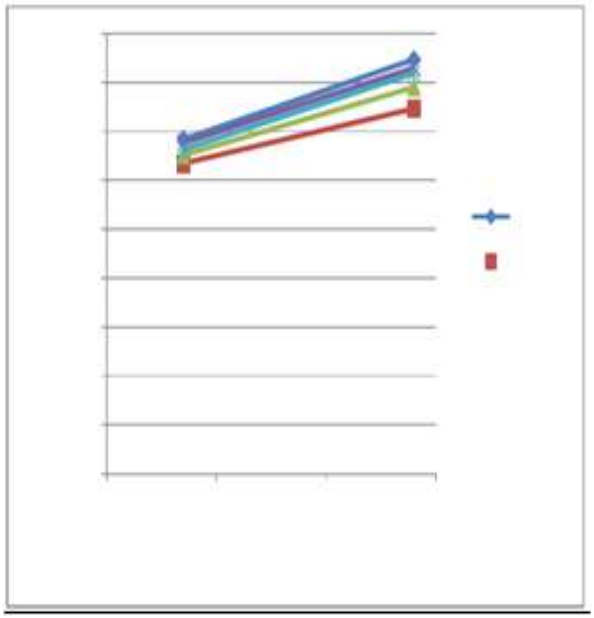

Fig.4.8.3.Avg Flexural Strength of Mix B1 Concrete at Different Dosages of PEG 6000

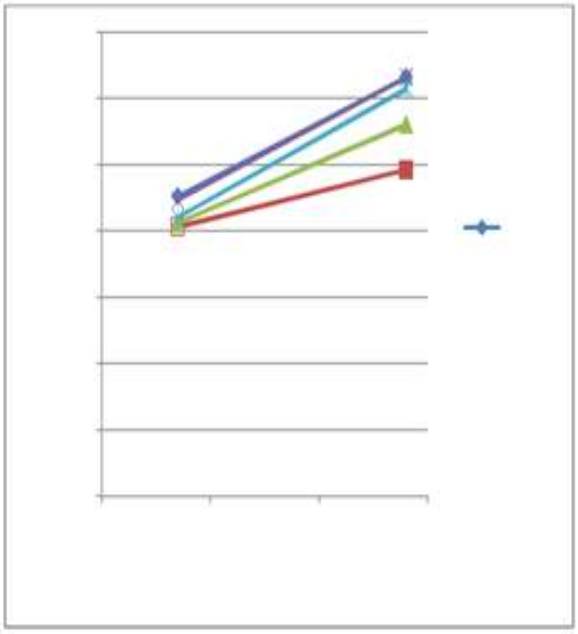

Fig.4.9.2 Avg Split Tensile Strength of Mix B2 Concrete at Different Dosages of PEG 6000

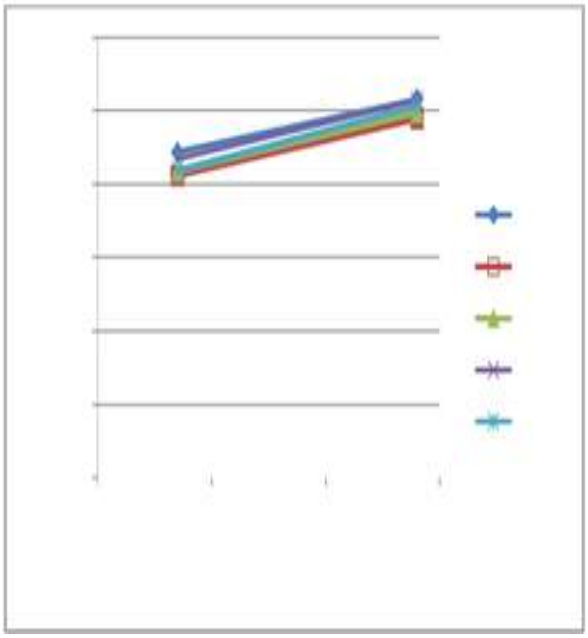

Fig.4.9.1.Avg Compressive Strength of Mix B2 Concrete at Different Dosages of PEG 6000

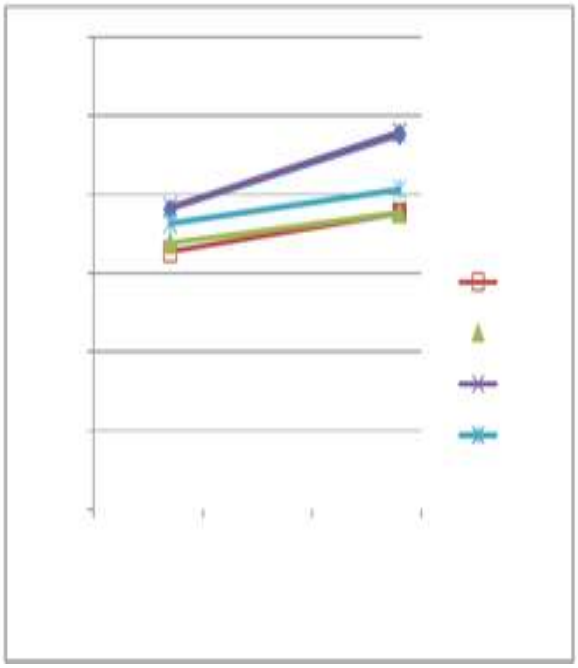

Fig.4.9.3.Avg Flexural Strength of Mix B2 Concrete at Different Dosages of PEG 6000

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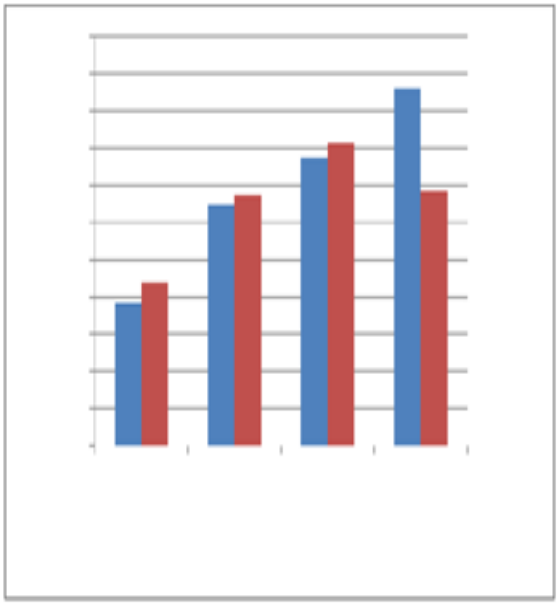

Fig: 4.10.1 Variation of 7 days compressive strength with different dosages of PEG6000

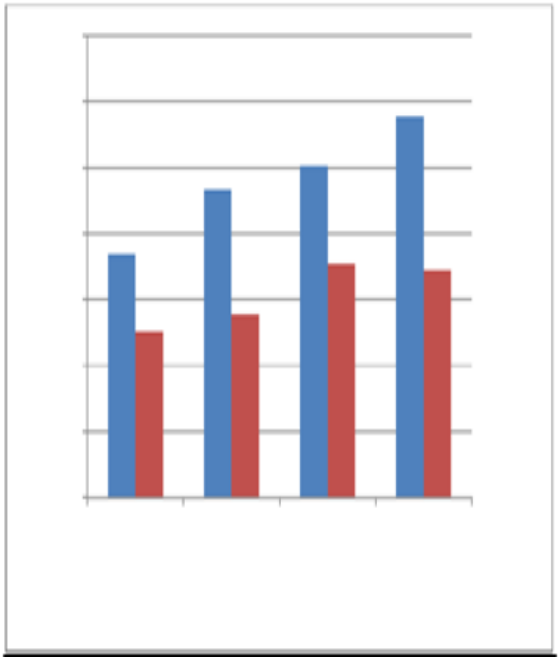

Fig: 4.10.2 Variation of 28 days compressive strength with different dosages of PEG6000

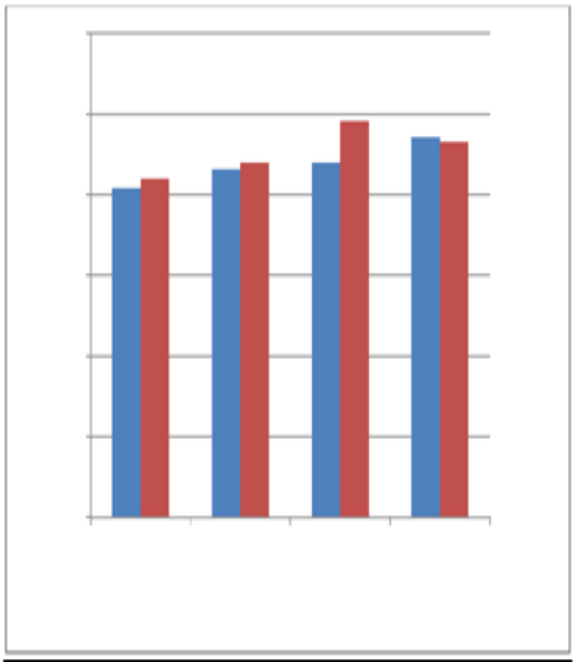

Fig:4.10.3 Variation of 7 days split tensile strength with different dosages of PEG 6000

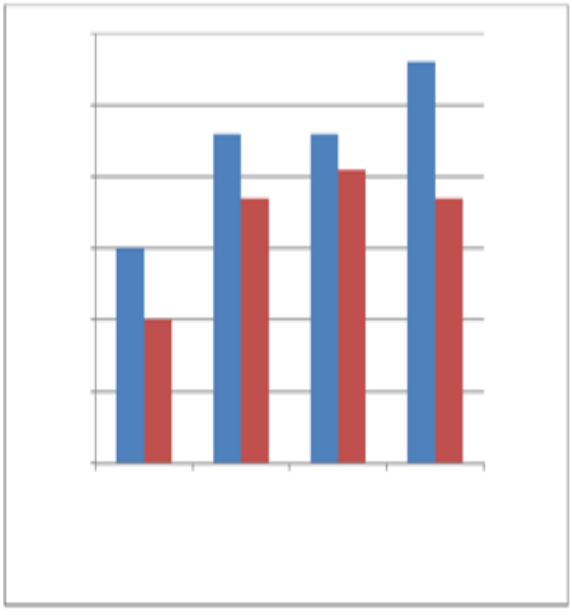

Fig: 4.10.4 Variation of 28 days split tensile strength with different dosages of PEG 6000

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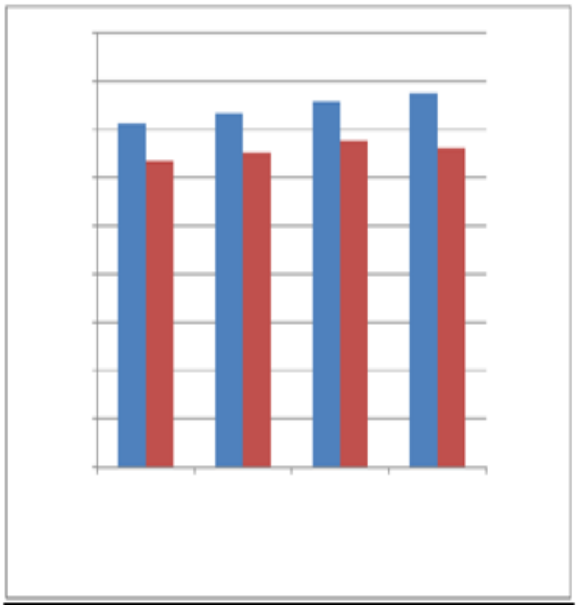

Fig: 4.10.5 Variation of 7 days flexural strength with different dosages of PEG 6000

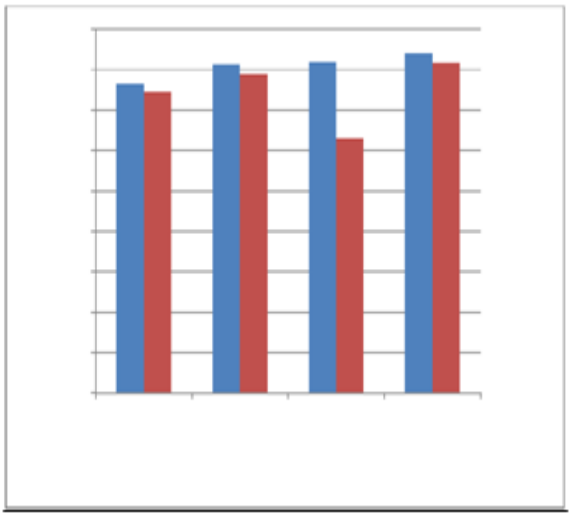

Fig:4.10.6 Variation of 28 days flexural strength with different dosages of PEG6000

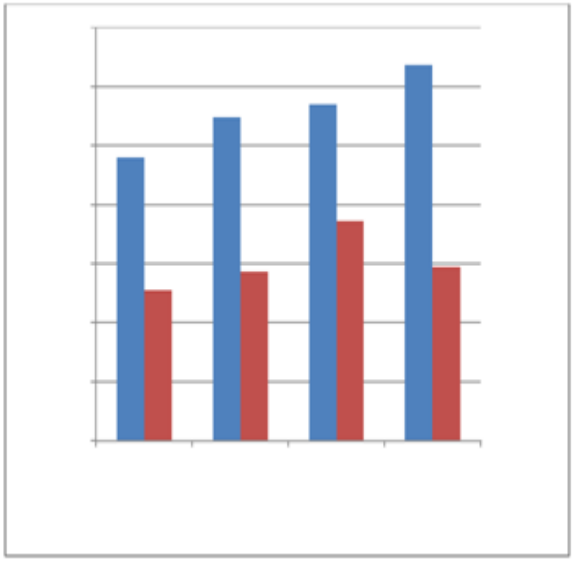

Fig:4.11.1 Variation of 7 days compressive strength with different dosages of PEG 6000

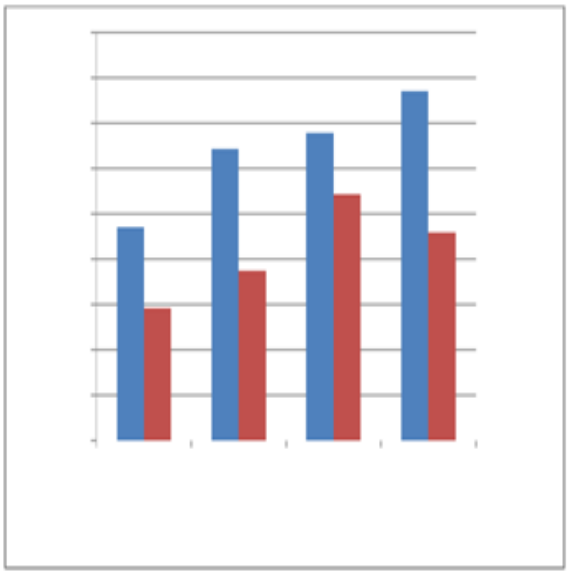

Fig: 4.11.2 Variation of 28 days compressive strength with different dosages of PEG 6000

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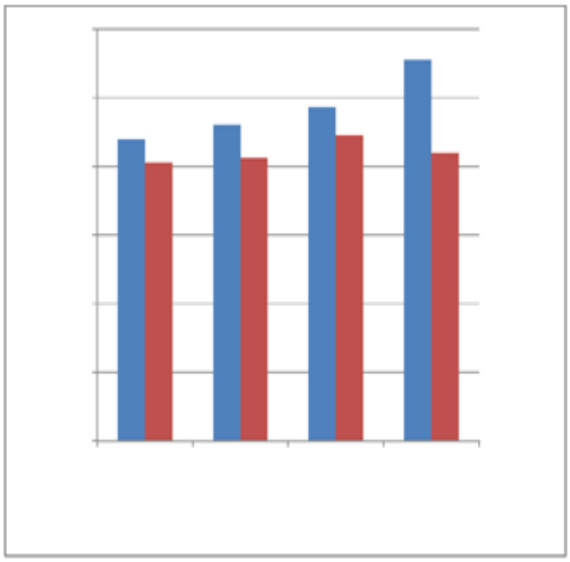

Fig: 4.11.3 Variation of 7 days split tensile strength with different dosages of PEG 6000

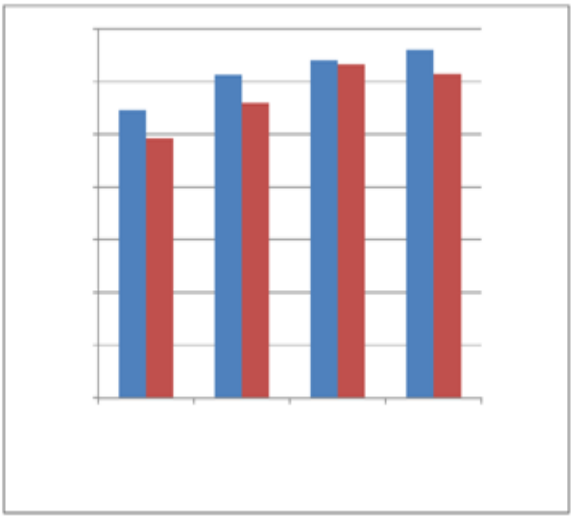

Fig: 4.11.4 Variation of 28 days split tensile strength with different dosages of PEG 6000

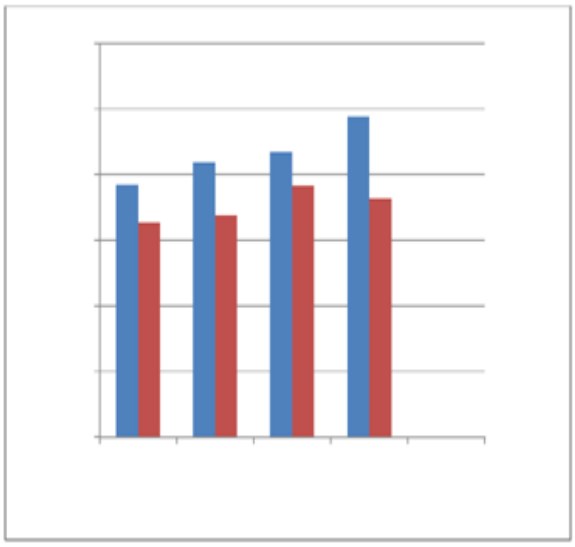

Fig: 4.11.5 Variation of 7 days flexural strength with different dosages of PEG 6000

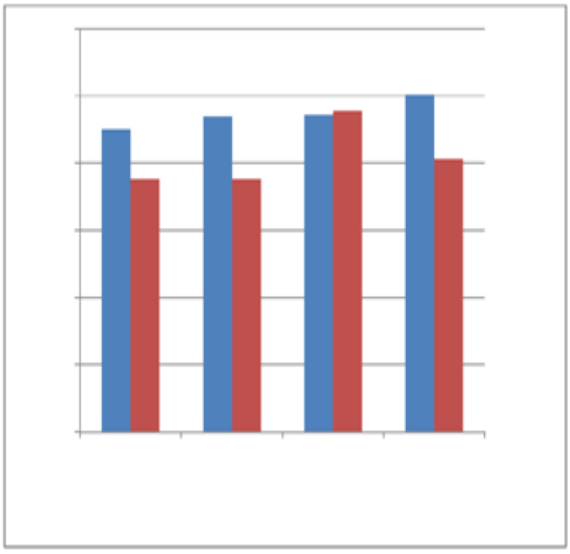

Fig: 4.11.6 Variation of 28 days Flexural strength with different dosages of PEG 6000

5. CONCLUSIONS AND FUTURE SCOPE

After the analysis of the result of the experimental programme the following conclusions were arrived for self curing agent polyethylene glycol (PEG6000) and comparison of different aggregates are obtained.

5.1 Conclusions

Due to the use of PEG6000

- The workability of concrete with low w/c ratio has significant effect due to higher molecular weight polyethylene glycol (PEG6000).
- Water retention of the concrete with low w/c ratio in conjunction has significant effect due to addition of higher molecular weight polyethylene glycol(PEG6000).
- The compressive strength of concrete with lower w/c ratio and with lower dosage of polyethylene glycol (PEG6000) is beneficial.
- The use of higher molecular weight polyethylene glycol (PEG6000) with higher w/c ratio is not beneficial.

Conclusions from comparative studies of different course aggregate

- Effectiveness of self-curing concrete is affected by w/c ratio and percentage dosages of self-curing agent.
- Water retention of concrete mixes incorporating self-curing agent is higher compared to conventional concrete mixes.
- The compressive strength of concrete with low w/c ratio has significant effect due to change in curing regime.
- The mix which shows lower weight loss need not give higher compressive strength.
- Water retention of concrete with lower w/c ratio incorporating higher molecular weight polyethylene glycol (PEG 6000) with lower dosage is more beneficial.

b) Due to the use of Normal coarse aggregate

- Workability of concrete has increased due to PEG 6000 when compared to conventional concrete.
- Water retention of the concrete with low w/c ratio in conjunction has significant effect due to addition of higher molecular weight polyethylene glycol (PEG6000).
- Compressive strength increases from 0.5% to 2% the increases in strength at 2% is maximum then of conventional concrete in both the grades (M35, M45).
- Split tensile strength increased from 0.5% to 2% at 2% is greater then of conventional concrete in both the grades.
- Flexural strength increased from 0.5% to 2%. The increases in strength at 2% is maximum of conventional concrete in both the grades.

c) Due to the use of Recycled coarse aggregate

- Workability of concrete has increased due to PEG 6000 when compared to conventional concrete.
- Compressive strength increases from 0.5% to 1% and then decreases at 2% the increases in strength at 1% is maximum then of conventional concrete in both the grades (M35, M45).
- split tensile strength increased from 0.5% to 1% and then decrease at 2% the increase in strength at 1% is maximum greater then of conventional concrete in both the grades.
- Flexural strength increased from 0.5% to 1%. The increases in strength at 1% is maximum of conventional concrete in both the grades.
- The strength is more for normal coarse aggregate compared to recycled coarse aggregate.

5.2 FUTURE SCOPE

- The effect of self curing agent on the microstructure and pore size distribution of the self-curing concrete requires additional study.
- Structural properties, shrinkage characteristics, creep characteristics of self-curing concrete need to be investigate.
- Sorptivity and durability studies for sulphate salts and chloride induced corrosion on self-curing concrete need to investigate.
- Performance of the self-curing agent is affected by the mix proportions, mainly the cement content and the w/c ratio.
- Mix design procedures for development of self-curing concrete and fibre reinforced self-curing concrete are to established.
- The effect of using higher w/c ratios, different cement types, and supplementary cementing materials (SCM), such as silica fume fly ash and ground granulated blast slag on water retention, hydration and moisture transport of the self-curing concrete needs further investigation.
- Effect of super-plasticizers and viscosity modifying agent on self-curing properties for high strength concrete (above M70) needs further investigation.
- Further in depth investigation is to done for choosing optimum dosage of self curing agent in strength and durability point of view.
- Further investigation is to be done on different hydrophilic polymers for selecting S.C.A w.r.t strength and durability of concrete.
- Further investigation on effect of relative humidity on water absorption and strength

characteristics or different S.C.A has to be carried.

- Study on rate of gain of strength and rate of hydration in concrete is to be carried.
- Study on use of light weight aggregate and recycled aggregate is to be carried which possess more absorption capacities.
- Research on self-curing-consolidating (compacting) concrete is to be done which can rule the future concrete industry.

CERTIFICATE

This is to certify that the project report entitled as "**COMPARATIVE AND EXPERIMENTAL STUDY ON SELF CURING CONCRETE"**being submitted by **J SRAVANI**(Regd.No:18GK1D8726) in partial fulfillment of the requirements for the award of the degree of "Master of Technology in CIVIL ENGINEERING with specialization in SE''during 2018-2020. The results of investigation enclosed in this report have been verified and found satisfactory. The results embodied in the project have not been submitted to any university or institute for the award of any other degree or diploma.

DELCARATION

I,**J SRAVANI**(Regd.No:18GK1D8726) hereby declare that the project report titled "**COMPARATIVE AND EXPERIMENTAL STUDY ON SELF CURING CONCRETE**"is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which has been accepted for the award of any other degree or diploma of the university or other institute of higher learning, except where due acknowledgment has been made in the text. I hereby declare that this thesis has not been submitted to any other university/institute for the award of any other degree/diploma.

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I am also thankful to the authors whose work has been consulted, utilized and cited in my dissertation.

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