A

PROJECT REPORT

ON

FLOATING CONCRETE USING FOAMING AGENTS

SUBMITTED IN PARTIAL FULFILMENT FOR THE AWARD OF

BACHELORS OF ENGINEERING

IN

CIVIL ENGINEERING

MUMBAI UNIVERSITY, MUMBAI

SUBMITTED BY

PATHAN SALMAN ABDUL RAZZAK (17CE40)

KHAN SHAHNAWAZ NAFEES (17CE27)

SAIF ALI TAYYAB ALI KAREL (17CE47)

MIRKAR ATEEKULREHMAN MUBARAK (18DCE08)

UNDER THE GUIDANCE OF

PROF. PROF SAYYEDAZARA JAHAGIRDAR

DEPARTMENT OF CIVIL ENGINEERING

School of Engineering and Technology

Anjuman I Islam's Kalsekar Technical Campus, New-Panvel.

(AFILIATED TO MUMBAI UNIVERSITY)

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CERTIFICATE

*This is to certify that the thesis entitled, **"FLOATING CONCRETE USING FOAMING AGENTS"** submitted partial fulfilment of the requirements for the award of **Bachelors of Engineering** degree in **Civil Engineering** during 2019-2020 session atthe Anjuman I Islam's Kalsekar Technical Campus, New-Panvel is an authentic work carried outby her under my supervision and guidance.*

NAME OF STUDENT: ***PATHAN SALMAN ABDUL RAZZAK (17CE40)***
KHAN SHAHNAWAZ NAFEES (17CE27)
SAIF ALI TAYYAB ALI KAREL (17CE47)
MIRKAR ATEEKULREHMAN MUBARAK (18DCE08)

PROF. Z. S. JAHAGIRDAR
GUIDE

Anjuman -I- Islam's
Kalsekar Technical Campus

PROF. Dr. R. B. MAGAR
HOD
CIVIL ENGG DEPT

Anjuman- I- Islam's
Kalsekar Technical Campus

DR. ABDUL RAZAK HONNUTAGI
DIRECTOR

Anjuman- I- Islam's
Kalsekar Technical Campus

DEPARTMENT OF CIVIL ENGINEERING

School of Engineering and Technology

Anjuman I Islam's Kalsekar Technical Campus, New-Panvel.

(AFILIATED TO MUMBAI UNIVERSITY)

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PROJECT APPROVAL SHEET

The report entitled **FLOATING CONCRETE USING FOAMING AGENTS** submitted by ***PATHAN SALMAN ABDUL RAZZAK (17CE40), KHAN SHAHNAWAZ NAFEES (17CE27),SAIF ALI TAYYAB ALI KAREL (17CE47), MIRKAR ATEEKULREHMAN MUBARAK (18DCE08),*** after presenting histhesis work in form of PowerPoint presentation is hereby approved in partial fulfillment for the award of Degree of Bachelors in Civil Engineering of Mumbai University, Mumbai.

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2) NAME ________________________ SIGN

SUPERVISOR 1) NAME ________________________

2) NAME ________________________

Date:

Place: New-Panvel.

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PATHAN SALMAN ABDUL RAZZAK (17CE40)

KHAN SHAHNAWAZ NAFEES (17CE27)

SAIF ALI TAYYAB ALI KAREL (17CE47)

MIRKAR ATEEKULREHMAN MUBARAK (18DCE08)

DECLARATION

We declare that this written submission represents ideas in our own words and where others ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that; we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinaryaction by the Institute and can also evoke penal action from the sources which have thus notbeen properly cited or from whom proper permission has not been taken when needed.

PATHAN SALMAN ABDUL RAZZAK (17CE40)

KHAN SHAHNAWAZ NAFEES (17CE27)

SAIF ALI TAYYAB ALI KAREL (17CE47)

MIRKAR ATEEKULREHMAN MUBARAK (18DCE08)

Date:

Place: New-Panvel.

CHAPTER ONE

INTRODUCTION

1.1 INTRODUCTION OF FLOATING CONCRETE

The present day world is witnessing construction of very challenging and difficult civil engineering structures. Researchers all over the world are attempting to develop low density or lightweight concrete by using different admixtures in concrete up to certain proportions. The floating concrete is one of the concrete in which floats on water. Hence we know that the density of water is 1000 kg/cum. we supposed to be create a floating concrete it should have density of concrete lesser than density of water.

This study deals with the development of Floating concrete by using lightweight aggregate (Pumice stone) and Aluminum powder as an air entraining agent. Floating concrete is made by introducing air or gas into concrete slurry, so that when the mix sets and hardens, uniform cellular structure is formed. We mix fine powder of Aluminum to the slurry and it reacts with the calcium hydroxide present in it thus producing hydrogen gas. This hydrogen gas when contained in the slurry mix gives the cellular structure and thus makes the concrete lighter than the conventional concrete. Pumice stone is a lightweight aggregate of low specific gravity. It is a highly porous material with a high water absorption percentage. In this we do not use the conventional aggregate and replace it by the pumice stone. Pumice is the specimen of highly Porous rocks having density approximately 500-600 Kg/m3. Pumice is produced when super-heated, highly pressurized rock is violently ejected from volcano. The unusual foamy configuration of pumice happens because of simultaneous rapid cooling & rapid depressurization. Pumice has an average porosity of 60-80% and initially floats on water.

1.2 CONCRETE INGREDIENTS

Basically Floating concrete is having ingredients as follows

1) Cement
2) Pumice stones as a coarse aggregate
3) Fine powder of pumice stones
4) Aluminum powder as an air entraining agent
5) Foam agent
6) Hardener
7) Water

1.2.1 Cement

Cement is an important building material used in the construction industry. It is a fine powder, which when mixed with water, and allowed to set and hardness is capable of uniting fragments or masses of solid matter together to produce a mechanically strong material. Generally, cement is used as a binding material with water for bounding, bricks, stone and aggregate to form a monolith mass.
Some of the reasons for its popularity and universal acceptance are listed below

1) Cement is several times stronger binding material than lime and slag.
2) It can be mixed and used with locally available material at site.
3) When water is mixed, it starts setting very early and acquires sufficient strength in a day or two; where as other binding material such as lime requires much longer to set.
4) When water is added to quick lime, lot of heat is generated, but in case of cement heat generated is unnoticeable and much lesser.
5) It can with stand compressive stress well. Where tension and shear stresses occur, it gives good bond to steel reinforcement and excess stresses are transferred to steel.

Various chemical compounds present in cement and their effect on the properties of cement are represented in Table 1.1 and 1.2 respectively

Table 1.1 The Extent of chemical Compound in Cement

Sr. No.	Compounds	Composition as present
1	C_3S	50±5%
2	C_2S	30±5%
3	C_3A	8±4%
4	C_4AF	12±3%

For better results of mix design, we should have to check the cement according to IS:4031 and IS:4032

Table1.2 Role of Various Compounds on Properties of Cement

Characteristics	C3S	C2S	C3A	C4AF
Setting	Quick	Slow	Rapid	-
Hydration	Rapid	Slow	Rapid	-
Heat liberation [Cal/gm] 7 days	Higher	Lower	Higher	Very High
Early Strength	High up to 7-14 days	Low up to 14 days	Not much Beyond 1 day	Insignificant
Later Strength	Less at later stage	Higher at Later Stage After 14days	----	----

1.2.1.1 Type of Cement used

There are many types of cement in the market to suit every need. But we are used ordinary Portland Cement (PPC). The reasons of using ordinary porland cement is as follows

1) It has higher strength than PPC in the initial stage.
2) It has high heat of hydration making it unfavorable for mass concreting.
3) The presence of sulphates, alkalis, chlorides, etc. is higher and less resistant than PPC.

1.2.2 Pumice stones as a coarse aggregate

Pumice is the one of the most common and the oldest of naturally occurring aggregates utilized lightweight coarse aggregates used for the production of concrete for construction industry. The term pumice is a generic term used to describe porous solids produced during the cooling of magma as a result of volcanic activation the voids are as result of the outflow of gases from the magma produces. Because of the gases small hollow voids renders the resulting solids to have a very porous structure, and this is why pumice has high porosity and absorption. Various studies have been conducted on pumice lightweight aggregate concretes all over the World with most researchers concentrating on the locally available materials in their areas or countries.

In concrete production aggregate is the cheaper material as compared to cement and maximum economy is obtained by using as much aggregate as possible. Aggregates also improve the volume stability and the durability of the resulting concrete. A good aggregate should produce the desired properties in both the fresh and hardened concrete.

1.2.3 Fine pumice particles

We know that the artificial crushed sand is made up of crushing the coursed aggregate in required size. Hence in this project by following this method, we crushed the pumice coarse aggregate of size passing through 10mm sieve and retained on 75micron sieve. Then directly we used these type of crushed pumice fine particles to cast the concrete in all methodology which we are experimented.

1.2.4 Aluminum powder as an air entraining agent

Aluminum powder is produced by presenting pure molten aluminum metal to a compressed gas jet and converting it to fine droplets, which are then solidified and collected. Powders so collected are subsequently graded, depending on size, specification and application.

Fine, uniform, smooth metallic powder free from aggregates available from market is used in this research and it has an atomic weight of 26.98. The aluminum powder of grade was used in this project. It had a density of 0.55 g/cm3. Aluminum powder is commonly used as an air entraining agent to obtain light weight concrete by a chemical reaction producing hydrogen gas in fresh mortar, so that it contains large number of air voids in the mortar.

Table no. 1.3 Properties of Aluminum Powder

Sr. no.	Property	Results
1.	Specific gravity	2.7
2.	Color	Silver
3.	Form	Powder

1.2.5 Foam agent

The foam agent is the most essential influence on the foamed concrete. The foam agents when added into the mix water it will produce discrete bubbles cavities which become incorporated in the cement paste. The properties of foamed concrete are critically dependent upon the quality of the foam. Foam agent can be classified according to types of foaming agent: Synthetic-suitable for densities of 1000kg/m3 and above. Protein-suitable for densities from 400kg/m3 to 1600 kg/m3. Foams from protein-based have a weight of around 80g/litter. Protein-based foaming agents come from animal proteins out of horn, blood, bones of cows, pigs and other remainders of animal carcasses. This leads not only to occasional variations in quality, due to the differing raw materials used in different batches, but also to a very intense stench of such foaming agents. Synthetic foams have a density of about 40g/litter. They are very stable at concrete densities above 1000kg/m3 and give good strength. Their shelf life is about 1 year under sealed conditions. Synthetic foam has finer bubble sizes compared to protein but they generally give lower strength foamed concrete especially at densities below 1000kg/m3.

1.2.6 Hardener (water repelling agent)

We know that when we are adding foam in a concrete then the fresh concrete will be not going to be hard easily and the concrete is going to be absorb more water. Hence we are using water repelling agent to avoid the more absorption of water and also it sets as early as possible. We used 200 ml for 1 nominal size of concrete cube.

1.2.7 Water

Water used for casting and curing of concrete test specimens is free from impurities when present can adversely influence the various properties of concrete.

CHAPTER TWO

MATERIAL USED AND ITS PROPERTIES

2.1 PRELIMINARY REMARKS

Concrete consists of cement, fine aggregates, coarse aggregates and water. Testing of these ingredients is essential to know the their physical, chemical properties and quality. Because the strength of concrete depends on the qualities of these ingredients. Test on ingredients generally performed in following two ways.

1. Laboratory testing

2. Field tests.

The results of different ingredients used in this experimental project have been presented in the following sections.

2.2 TESTING OF CEMENT

2.2.1 Fineness of Cement [I.S.4031 (part-II) 1999]

Rate of hydration depends on the fineness of cement particles, and for rapid development of strength high fineness is necessary. Coarse is the cement lesser will be the strength. The fineness of cement is obtained by dry sieving in table 2.1.

Table 2.1 Fineness Of Cement By Dry Sieving

Weight of sample taken W_1 gm	Weight of residue received on I.S. sieve of 90 micron W_2 gm	Fineness (W_2/W_1)	Average Fineness
100	60	6%	6%

Result

Fineness of cement is 6%.

Requirements

Average percentage retention shall not be more than 10% for Portland cement.

2.2.2 Standard Consistency of cement [I.S.4031 (part-IV) 1988]

Consistency of cement gives the water required to form a paste of appropriate water content. Increased consistency results into more cement paste, which causes reduction in strength. Lesser consistency results into poor cement paste.Purpose of this test is to determine the quantity of water required for producing a cement paste of standard consistency it is performed by using Vicats apparatus.

Table 2.2 Standard Consistency Of Cement

Sr. No.	Percentage of water added	Quantity of water added in ml	Penetration in mm
1	24	120	0
2	27.5	137.5	12
3	30.5	152.5	25
4	31	155	29
5	34	170	34

Results

Consistency of cement is 34%.

Requirements

The water of standard paste is expressed as a percentage by weight of the dry cement, the usual range of values being between 26%-35%.

2.2.3 Soundness of cement [I.S.4031 (part-III) 1988]

It is very important that cement after setting shall not undergo any appreciable change of volume. Certain cements have been found to undergo a large expansion after setting causing disruption of the set and hardened mass. This will cause serious difficulties for the durability of structures when such cement is used. Testing of soundness of cement is of prime importance to ensure that the cement does not show any appreciable subsequent expansion. Purpose of this test is to detect the presence of over burnt lime. It is performed by using Lechatiler apparatus.

Table 2.3 Soundness Of Cement

Sr. No.	Initial reading. Mm	After boiling. mm	Soundness. mm
1	13	18	5

Result

Soundness of cement is 5 mm.

Requirements

Soundness of Ordinary Portland Cement is limited to 10 mm.

2.2.4 Specific gravity of Cement [I.S.4031(part-III) 1988]

Specific gravity of cement is used in design of concrete mixes. Knowing specific gravity of each constituent, its weight can be converted into solid volume and hence a theoretical yield of concrete per unit volume can be calculated. Purpose of this test is to work out the quantities of ingredients and absolute volume of cement in concrete.

Result

Specific gravity of Ordinary Portland cement is 3.15.

Requirements

Specific gravity of Ordinary Portland cement range is 3.09 to 3.20.

2.2.5 Compressive Strength of Cement [I.S.4031 (part-VI) 1988]

The compressive strength of hardened cement is the most important of all the properties. Strength of cement is indirectly found on cement sand mortar in specific proportions. The standard sand (confirming to I.S.650-1991) is used for the finding the strength of cement. The purpose of this test is to study the quality of cement with regard to its compressive strength.

Result

Table 2.4 Compressive Strength Of Various Types Of Cements Used

Sr. No.	Age, days	OPC(43 grade)	OPC (53 grade)
1	3	23Mpa	27
2	7	33Mpa	37
3	28	43Mpa	53

Note-Values in the bracket indicate minimum required strength as per [I.S.1489-2015]

2.2.6 Initial and Final Setting time of cement [I.S.4031 (Part-V) 1988]

Initial setting time is regarded as the time elapsed between the moments when the water is added to the cement, to the time that the paste starts losing its plasticity. The final setting time is the time elapsed between the moment when water is added to cement, and the time when the paste has completely lost its plasticity and has attended sufficient firmness to resist certain definite pressure. Purpose of this test is to know the initial & final setting time of cement, which is useful to calculate mixing, transporting& placement time.

Results

For OPC (53 grade).

Initial setting time = 68minutes.

Final setting time = 185minutes.

Requirements

For OPC (53 grade)

Initial setting time shall not be less than 30 minutes.

Final setting time shall not be more than 600 minutes.

2.3 Testing of Coarse Pumice Aggregate

2.3.1 Sieve Analysis of Coarse Aggregate [I.S.2386 (Part-I) 1963]

Sieve analysis is required for determination of over size and under size aggregates and especially for research work on aggregate grading. Fineness modulus is computed from sieve analysis and is defined as the sum of cumulative percentage retained on the sieves of the standard size 40, 31.5, 20, 16, 12.5, 10, 4.75, 2.36, 1.18 mm and 600, 300, 150 microns and up to the largest sieve size present. Fineness modulus gives an indication of probable behavior of a concrete mix made with aggregate having certain grading. Sieve analysis is carried out to determine the particle size distribution in an aggregate, called gradation.

Table 2.5 Sieve Analysis results for 20 mm coarse aggregate

I.S. sieve size	Lower limit %age passing	Upper limit %age passing	Sample %age passing
37.5mm	100	100	100
20mm	90	100	89.2
10mm	30	60	30.3
5.0mm	0.0	10	6.3

Results

Fineness Modulus of Pumice Aggregate is 6.3

Requirements

Coarse aggregate is said to be well graded if their grading curve matches with curve-II of standard grading curve given in I.S. 2386 (Part-I)

2.3.2. Specific Gravity and Water Absorption of Coarse Aggregate

[I.S. 2386(Part-III) 1963]

The absolute specific gravity refers to the volume of solid material excluding all pores, and can, therefore, be defined as the ratio of weight of solid, referred to vacuum, to the weight of an equal of gas-free distilled water, both taken at stated temperature. The apparent specific gravity is the ratio of weight of aggregate dried in an oven at 100 to 110 ºC for 24 hours or to the water occupying a volume equal to that of solid including the impermeable pores.

Absorption of aggregate will affect the water/cement ratio and hence workability of concrete. Water absorption also affects the final volume of concrete and quality of concrete. Specific gravity and water absorption are used to calculate content of fine aggregate. Knowing specific gravity of each ingredient, its weight can be converted to solid volume.

Results

Specific gravity of coarse aggregate is 0.87Requiremand water absorption of coarse aggregate is 42.41%

2.3.3 Bulk Density of Coarse Aggregate [I.S.2386 (Part-III) 1963]

Bulk density clearly depends on how densely the aggregate is packed. Shape of the particles greatly affects the closeness of packing that can be achieved. Actual bulk density of aggregate depends not only on the various characteristics of the material which determine the potential degree of packing, but also on the actual compaction achieved in a given case. Higher the bulk density lesser is the voids. Bulk density of aggregates gives information regarding the shape and the grading of aggregate.

Results

Table 2.6 Bulk density of compacted 20 mm size coarse aggregate

Types of coarse aggregate	Bulk density of compacted coarse aggregates kg/lit.
20 mm	1.558

2.3.4 Flakiness Index of Coarse Aggregates [I.S.2386 (Part-I) 1963

Flaky particles adversely affect durability of concrete as they tend to be oriented in one plane, with water and air voids forming underneath. Weight of flaky particles expressed as a percentage of the weight of the sample is called the flakiness index. If flakiness index is more than permissible limits, then aggregates shall be replaced and not to be used in concrete. Purpose of this test is to determine the flakiness index of coarse aggregates.

Results '

Flakiness index of 20 mm coarse aggregate is 12.15%

Requirements

Maximum flakiness index allowed is 15%. This test is not applicable to particle sizes smaller than 6.3 mm.

2.3.5 Elongation Index of Coarse aggregates [1.8.2386 (Part-I) 1963]

Elongated particles affect adversely the durability of concrete as they tend to be oriented in one plane, with water and air voids forming underneath. Weight of elongated particles expressed as a percentage of the weight of the sample is called the elongation index. Due to elongated particles segregation of concrete occurs which result in honey combing. Elongation index in an aggregate is the percentage by weight of the particles whose greater dimension is greater than length 1.8 times their mean dimension. Purpose of this test is to determine the elongation index of coarse aggregates.

Results

Elongation index of 20 mm coarse aggregate is 14.76%.

Requirements

Maximum elongation index allowed is 18%. This test is not applicable to particle sizes smaller than 6.3 mm.

2.4 WATER

Purpose of water in concrete is three fold. Water distributes the cement evenly so that every particle of the aggregate is coated with cement and brought into intimate contact with other ingredients. Water reacts chemically with the ingredients of the cement the reaction called hydration of cement, and brings about setting and hardening of cement. Water also lubricates the mix and gives it workability required to place and compact the concrete properly. Cement requires about 25 to 30 percent of water for hydration. Additional water is required for the workability of concrete. This should be restricted since excess water makes the concrete weak. Finally, curing of concrete with water ponding is a widely prevalent practice.

Water used to mix concrete should be clean, free form oil, alkalis, acid, organic material and other substances that may be deleterious to concrete and steel. In general, water that is fit to drink is good for concrete. From durability point of view, chlorides and sulphates should be within the permissible limits. The pH value for water shall not be less than 6.

CHAPTER THREE
METHODOLOGY

We used to comparative study on methodology of concrete which are which are as follows

1. Normal concrete by using aluminum powder
2. Normal foamed concrete
3. Fly ash mixed foamed concrete

The methodology of above concrete is made to study the comparative on the basis of density, compressive strength, specific gravity and water absorption.

3.1 NORMAL CONCRETE BY USING ALUMINUM POWDER

Normal concrete is made up of by using cement, pumice aggregates, fine pumice aggregates, water and aluminum powder as an air entraining agent, in which when aluminum powder reacts with cement and water it produces hydrogen bubbles in a concrete mix and it forms a voids in it and it tends to decrease the density of concrete. The ingredients of Normal concrete by using aluminum powder is as follows,

1. Cement (P.P.C 53 grade)
2. Pumice aggregates
3. Fine pumice aggregate
4. Water
5. Aluminum powder (Air entraining agent)

From the normal concrete by using aluminum powder we conclude that the density of concrete increases with respect to time and 7 days' density and compressive strength of concrete is as shown in following figure number 3.1 and table number 3.2 respectively. The proportions of materials used to cast the normal aluminum Concrete from Design Mix of Section No.4.2.1 Is Shown in Table No. 3.1

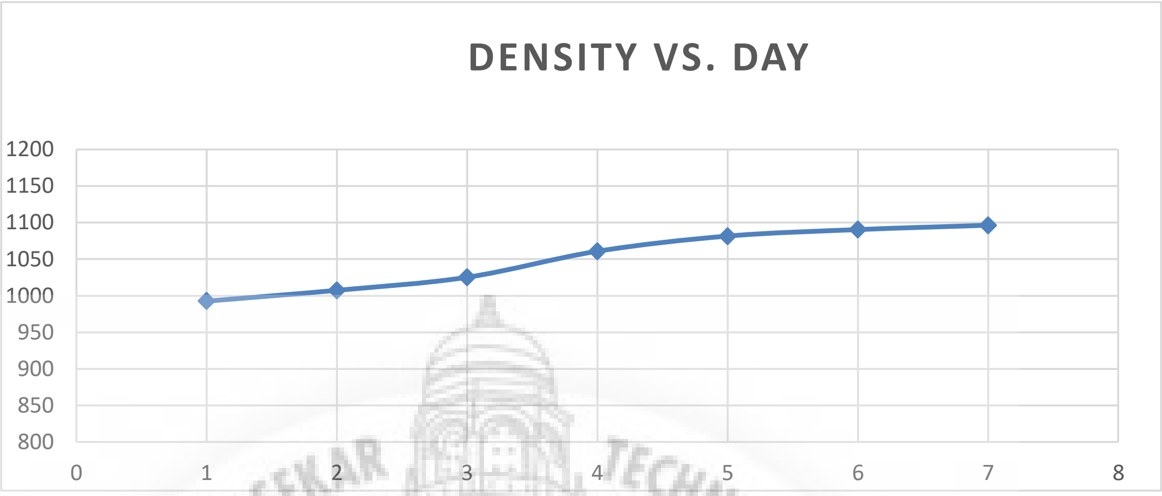

Fig No. 3.1 The Graph Of Density Vs. Day

Table No. 3.1 Proportions of Ingredients Of Normal Aluminum Concrete

Ingredients	Proportions per m3
Cement	297.6 kg
Pumice fine aggregate	217.94 kg
Pumice course aggregate	205.75 kg
Aluminum powder	12.4 kg

Table No. 3.2 Result Of Normal Aluminum Concrete

Parameters	Result
First day Density	992.59 kg/m3
Compressive strength	4.22 N/mm2

3.2 NORMAL FOAMED CONCRETE

Normal foamed concrete is made up of by using cement, pumice aggregate, fine pumice particles, water and foam agent. In which foam agent creates foam which makes concrete light weight and it makes capable to float on the surface of water.

The proportions of materials used to cast the Normal foamed concrete from design mix of section no.4.2.2 is shown in table no. 3.3

From the normal foamed concrete, we conclude that the density of concrete increases with respect to time and 7 days' density and compressive strength of concrete is as shown in following figure number 3.2 and table number 3.4 respectively.

Table No. 3.3 Mix Design Of Normal Foamed Concrete

Ingredients	Proportions
Cement	357 Kg
pumice fine aggregate	204.28 Kg
pumice coarse aggregate	192.86 Kg
Water	326.5kg/m3
Foam agent	1.5lit of liquid for 1 cube of nominal size
Hardener	200ml for 1 cube of nominal size

Table No. 3.4 Results Of Normal Foamed Concrete

Parameters	Results
First day Density	989.63 kg/m3
Compressive strength	2.44N/mm2

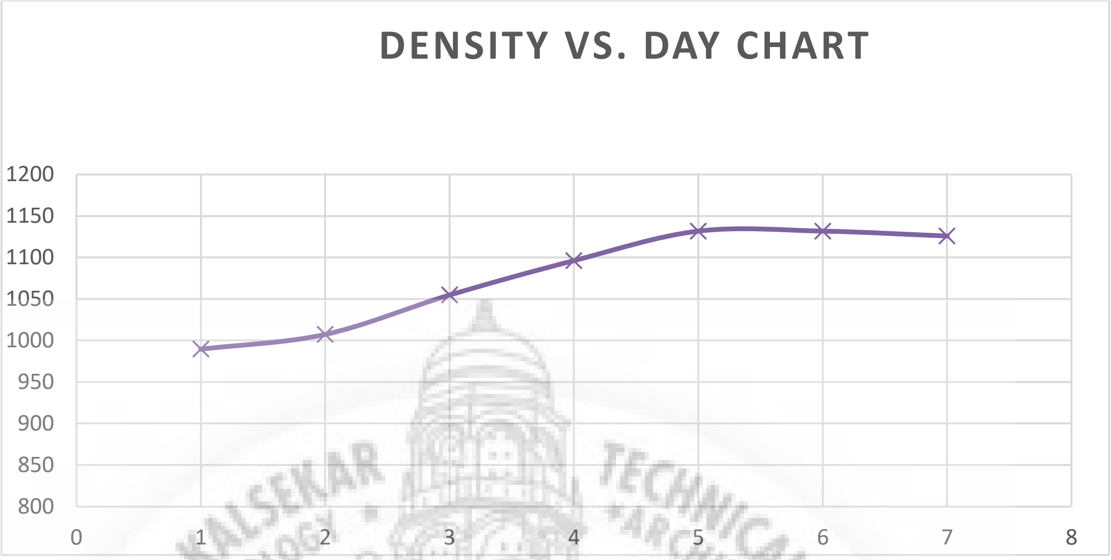

Figure No. 3.2 The Graph of Density Vs. Day Chart of Normal Foam Concrete

3.3 FLY ASH MIXED FOAMED CONCRETE

Fly ash mixed concrete is made up of by using cement, fly ash, pumice aggregate, pumice fine particles, foam agent, water and hardener. In this methodology 8% of mass of cement is replaced by fly ash and hence the ingredient fly ash makes light weight concrete and also the concrete is of economical. The proportions of materials used to cast the fly ash mixed foamed concrete from design mix of section no.4.2.3 is shown in table no. 3.5

From the fly ash mixed foamed concrete, we conclude that the density of concrete increases with respect to time and 7 days' density and compressive strength of concrete is as shown in following figure number 3.3 and table number 3.6 respectively.

Table No. 3.5 Mix Design Of Fly Ash Mixed Foamed Concrete

Ingredients	Proportions
Cement	357 kg/m3
Pumice fine aggregate	204.28 kg/m3
Pumice course aggregate	192.86 kg/m3
Fly ash	28.56 kg/m3
Water	328.41Kg/m3
Foam agent	1.5 lit of liquid for 1 cube of nominal size
Hardener	200ml for 1 cube of nominal size

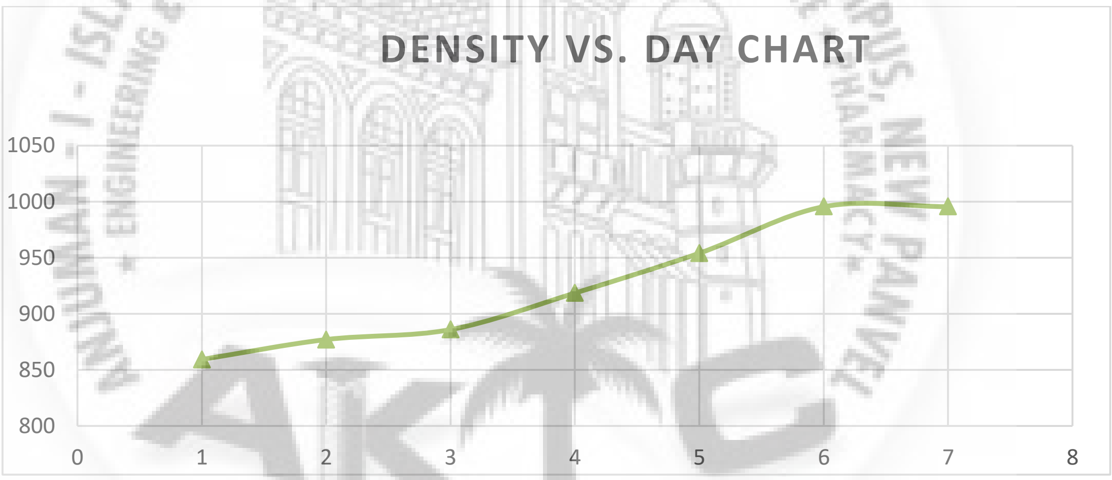

Fig No. 3.3 The graph of Density Vs. Day Chart of Normal Foam Concrete

Table No. 3.6 Results Of Fly Ash Foamed Concrete

Parameters	Results
First day Density	859.26 kg/m3
Compressive strength	2.22 N/mm2

CHAPTER FOUR

CONCRETE MIX DESIGN

4.1 DESCRIPTION OF MATERIALS USED AND ITS PROPERTIES

1. Cement: -

The cement used in this experimental work is **53 grades Portland Pozzolona Cement**. All properties of cement are tested by referring IS 4031 (All parts) Specification for 53 Grade Portland Pozzolona cement. The specific gravity of the cement **3.15**.

2. Water: -

Potable water used for the experimentation. Cement requires about 25 to 30 percent of water for hydration. Additional water is required for the workability of concrete. This should be restricted since excess water makes the concrete weak. Finally, curing of concrete with water ponding is a widely prevalent practice. The pH value for water shall not be less than 6.

3. Fine aggregate: -

In this methodology we used pumice fine particles, which are crushed of pumice aggregates of size passing through 10mm sieve and retained on 75micron sieve. And these fine pumice aggregate are having a specific gravity of 0.79.

4. Coarse Aggregate: -

Pumice aggregate has been used. The coarse aggregates with a maximum size of 20mm having the specific gravity value of **0.79** and fineness modulus of **3.22** are used as coarse aggregate. The loose and compacted bulk density values of coarse aggregates (20mm) are **500 kg/m³ -600 kg/m³** respectively.

5. Mixing and casting operations: -

we were carefully done. The Concrete mixture was prepared by hand mixing on a watertight platform. The coarse. Aggregates and fine aggregates were weighed. On the watertight platform, the coarse, fine aggregates, cement were mixed thoroughly. Then, water was added carefully so that no water was lost during mixing. The moulds were filled with mix. The top surface of the specimen was levelled and finished. After 24 hours the specimens were demolded. And also at the time of casting of foamed concrete we taken care of adding foam in a fresh concrete mix hence the concrete should not segregate and mixing of foam concrete is done carefully.

6) Curing: -

The demolded cube specimen is allowed to cure in curing tank for 3 days, 7 days and 28 days. We used the common type of currying water currying.

4.2 MIX DESIGN BY IS 10262:2009 METHOD

4.2.1Normal aluminum concrete

Step 1: -Target Strength

f'ck = fck+1.65(S)

Where,

f'ck = Target average compressive strength at 28 Days

fck = Compressive strength at 28 days, and

S = standard deviation

For grade of concrete M20, standard deviation is 4 N/mm² (IS 456-2000 Table no. 1 Clauses 3.2.1.2, A-3 and B-3)

Target strength = 20+1.65x4 = 26.6 N/mm^2

Step 2: - Selection of water cement ratio: -

(From table 5 of IS 456-2000 Clauses 6.1.2, 8.2.4.1 and 9.1.2)

Water cement ratio = 0.60

Step 3: -Selection of water content: -

(From table no.2 IS 10262-2009 clauses 4.2, A-5and B-5)

Max. Water content = 186 kg/m3 (for 20 mm aggregate)

Step4: -Calculation of cement content: -

Water cement ratio=0.6

Cement content=186/0.60 =310 kg /m³

For use of 4 % aluminum powder we have to deduct percentage of aluminum powder from cement content.

Actual cement content used = 297.6 kg/m3

Step 5: -Proportion of volume of coarse aggregate and fine aggregate: -

(From table no. 3 are IS 10262-2009 Clauses 4.4, A-7 and B-7)

Volume of coarse aggregate and fine aggregate (Zone 1) for water

Cement ratio 0.60

After applying corrections,

Volume of coarse aggregate =0.62

Volume of fine aggregate =0.38

We are using 4% aluminum powder to introduce air bubbles in concrete

4% of cement content is 12.4 kg/m3

Step 6: - Mix calculations

a) Volume of concrete = 1 m³

for M- 20 mm aggregate 2% air

Total volume of concrete = 1 – 0.02 = 0.98 m3

b) Volume of cement = mass of cement / (sp. gr of cement x1000)

= 197.6/ (3.15x1000)

= 0.0627 m³

c) Volume of water = mass of water/ (sp. gr. of water x1000)

= 186 / (1x1000)

= 0.186m³

d) volume of admixture = 12.4/ (2.702 x 1000)

= 0.00458

e) Volume of all in aggregate = a- (b + c + d)

= 0.98 - (0.0627+0.186 +0.00458)

= 0.726m³

f) Mass of Coarse Aggregate = e) x vol. of 20 mm aggregate x sp. gr. of coarse aggregate x 1000

= 0.726 x 0.62 x0.79 x1000

= 355.59 Kg

Water absorption of coarse aggregate is 42.14%

Water absorbed by coarse aggregate = 355.59 (42.14/100)

= 149.84 kg

Actual weight of water = 186 + 149.84 = 335.84 kg

Actual weight of coarse aggregate = 355.59 – 149.84 =205.75 kg

g) Mass of fine aggregate = e) x volume of fine aggregate x sp. gr. Of fine aggregate x 1000

= 0.726 x 0.38 x 0.79 x 1000

= 217.94 Kg

Mass &Proportion of Concrete for 1m3: -

SR. NO.	INGRADIENTS	MASS OF INGRADIENTS
1.	Cement	297.6 kg
2.	Pumice fine aggregate	217.94 kg
3.	Pumice course aggregate	205.75 kg
4.	Aluminum powder	12.4 kg

4.2.2 Mix design of normal foamed concrete

Step 1: - Target Strength

f'ck = fck+1.65s

Where,

f'ck = Target average compressive strength at 28 Days

fck = Compressive strength at 28 days, and

s = standard deviation

For grade of concrete M20, standard deviation is 4 N/mm² (IS 456-2000 Table no. 1 Clauses 3.2.1.2, A-3 and B-3)

Target strength = 20+1.65x4 = 26.6 N/mm^2

Step 2: - Selection of water cement ratio: -

(From table 5 of IS 456-2000 Clauses 6.1.2, 8.2.4.1 and 9.1.2)

Water cement ratio = 0.52

Step 3: -Selection of water content: -

(From table no.2 IS 10262-2009 clauses 4.2, A-5and B-5)

Max. Water content = 186 kg/m3 (for 20 mm aggregate)

Step4: -Calculation of cement content: -

Water cement ratio=0.52

Cement content=186/0.52 =357 kg /m³

Step 5: -proportion of volume of coarse aggregate and fine aggregate: -

(From table no. 3 are IS 10262-2009 Clauses 4.4, A-7 and B-7)

Volume of coarse aggregate and fine aggregate (Zone 1) for water Cement ratio 0.52

After applying corrections,

Volume of coarse aggregate =0.64

Volume of fine aggregate =0.36

Step 6: - Mix calculations

a) Volume of concrete = 1 m³

for M- 20 mm aggregate 2% air

Total volume of concrete = 1 – 0.02 = 0.98 m3

b) Volume of cement = mass of cement / (sp. gr of cement x1000)

= 357/ (3.15x1000)

= 0.1135 m^3

c) Volume of water = mass of water / (sp. gr. of water x1000)

= 186 / (1x1000)

= 0.186 m^3

e) Volume of all in aggregate = a- (b+c)

= 0.98 - (0.1135+0.186)

= 0.6805m^3

f) Mass of Coarse Aggregate = e) x vol. of 20 mm aggregate x sp. gr. of coarse aggregate x 1000

= 0.6805 x 0.62 x0.79 x1000

= 333.31 Kg

g) Mass of fine aggregate = e) x volume of fine aggregate x sp. gr. Of fine aggregate x 1000

= 0.6805 x 0.38 x 0.79 x 1000

= 204.28 Kg

Water absorption of coarse aggregate is 42.14%

Water absorbed by coarse aggregate = 333.31 (42.14/100)

= 140.45 kg

Actual weight of water = 186 + 140.45 = 326.45 kg

Actual weight of coarse aggregate = 333.31 – 140.45 =192.86 k

Mass &Proportion of Concrete for 1m3: -

SR. NO	INGRADIENTS	MASS OF INGRADIENTS
1.	Cement	357 Kg
2.	pumice fine aggregate	204.28 Kg
3.	pumice coarse aggregate	192.86 Kg

4.2.3 mix design of fly ash foamed concrete

Step 1: -Target Strength

f'ck = fck+1.65 (S)

Where,

f'ck = Target average compressive strength at 28 Days

fck = Compressive strength at 28 days, and

S = standard deviation

For grade of concrete M20, standard deviation is 4 N/mm^2 (IS 456-2000 Table no. 1 Clauses 3.2.1.2, A-3 and B-3)

Target strength = 20+1.65x4 = 26.6 N/mm^2

Step 2: - Selection of water cement ratio: -

(From table 5 of IS 456-2000 Clauses 6.1.2, 8.2.4.1 and 9.1.2)

Water cement ratio = 0.52

Step 3: -Selection of water content: -

(From table no.2 IS 10262-2009 clauses 4.2, A-5and B-5)

Max. Water content = 186 kg/m3 (for 20 mm aggregate)

Step4: -Calculation of cement content: -

Water cement ratio=0.52

Cement content=186/0.52 =357 kg $/m^3$

In this method we used 8 % of fly ash by mass of cement

Fly ash content = 28.56 kg/m3

Actual cement content = 357-357(8/100)

= 328.44 kg / m3

Step 5: -proportion of volume of coarse aggregate and fine aggregate: -

(From table no. 3 are IS 10262-2009 Clauses 4.4, A-7 and B-7)

Volume of coarse aggregate and fine aggregate (Zone 1) for water

Cement ratio 0.52

After applying corrections,

Volume of coarse aggregate =0.64

Volume of fine aggregate = 0.36

Step 6: - Mix calculations

a) Volume of concrete = 1 m^3

for M- 20 mm aggregate 2% air

Total volume of concrete = 1 – 0.02 = 0.98 m3

b) Volume of cement = mass of cement / (sp. gr of cement x1000)

= 328.44 / (3.15x1000)

= 0.104 m^3

c) Volume of water = mass of water / (sp. gr. of water x1000)

= 186 / (1x1000)

= 0.186 m^3

e) Volume of all in aggregate = a- (b + c)

= 0.98 - (0.104+0.186)

= 0.69m^3

f) Mass of Coarse Aggregate = e) x vol. of 20 mm aggregate x sp. gr. of coarse aggregate x 1000

= 0.69 x 0.62 x0.79 x1000

= 337.96 Kg

g) Mass of fine aggregate = e) x volume of fine aggregate x sp. gr. Of fine aggregate x 1000

= 0.69 x 0.38 x 0.79 x 1000

= 207.138 Kg

Water absorption of coarse aggregate is 42.14%

Water absorbed by coarse aggregate = 337.96 (42.14/100)

= 142.41 kg

Actual weight of water = 186 + 142.41 = 328.41 kg

Actual weight of coarse aggregate = 337.96 – 142.41 =195.55 kg

Mass &Proportion of Concrete for 1m3: -

SR. NO	INGRADIENTS	MASS INGRADIENTS
1.	Cement	357 kg
2.	Pumice fine aggregate	204.28 kg
3.	Pumice course aggregate	192.86 kg
4.	Fly ash	28.56 kg

CHAPTER FIVE

COMPARATIVE STUDY OF ALL THOSE METHODOLOGIES

5.1 WEIGHT

As we know that the weight of the concrete is mainly effect on the floating of the concrete if the weight of concrete is lesser then easily floats on the surface of the water. Our main aim is that reduce the weight of concrete in such a way that it floats on the water. The following figure no. 5.1 shows that the comparison of first day weight of experimented three methodologies and table no. 5.1 shows that the first day weight of concrete.

Table No. 5.1 First Day Weight Of Various Methodology Of Concrete

Methodology	First day weight in kg
Normal Aluminum Concrete	3.35
Fly Ash Foamed Concrete	2.9
Normal Foamed Concrete	3.34

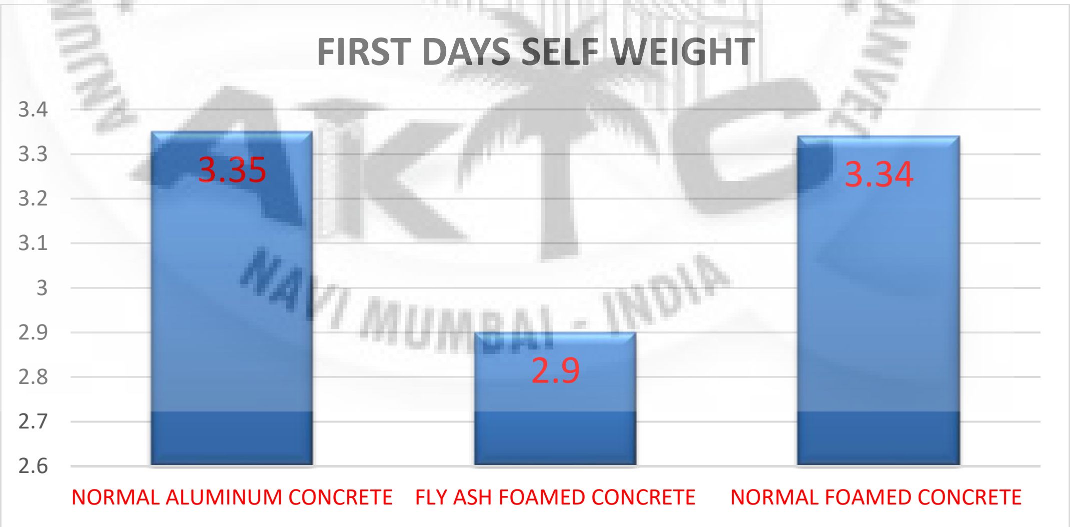

Figure No.5.1 Comparison Graph Of First Day Weight Of Concrete

5.2 DENSITY

The density of the concrete should be less than 1000kg/m3 to float on the surface of the water. The variation of 7 days of different concrete is shown in following figure 5.2 it shows that the fly ash foamed concrete is lighter as compare with these two methodologies, hence the fly ash foamed concrete is floats on water up to its duration of the concrete. And the table no. 5.2 shows the exact values of density of concrete.

Table Number 5.2. 7 Days Density Of Different Concrete

Methodology	**Days**	**Weight In Kg**	**Density in kg/m3**
Normal aluminum concrete	1	3.35	992.59
	2.	3.4	1007.41
	3.	3.5	1025.19
	4.	3.6	1060.74
	5.	3.65	1081.48
	6.	3.68	1090.37
	7.	3.7	1096.29
Normal Foamed Concrete	1.	3.34	989.63
	2.	3.4	1007.41
	3.	3.6	1054.81
	4.	3.7	1096.3
	5.	3.82	1131.85
	6.	3.82	1131.85

	7.	3.82	1131.85
Fly Ash Foamed Concrete	1.	2.9	859.26
	2.	2.96	877.03
	3.	3.0	885.926
	4.	3.1	918.519
	5.	3.22	954.074
	6.	3.36	995.55
	7.	3.36	995.55

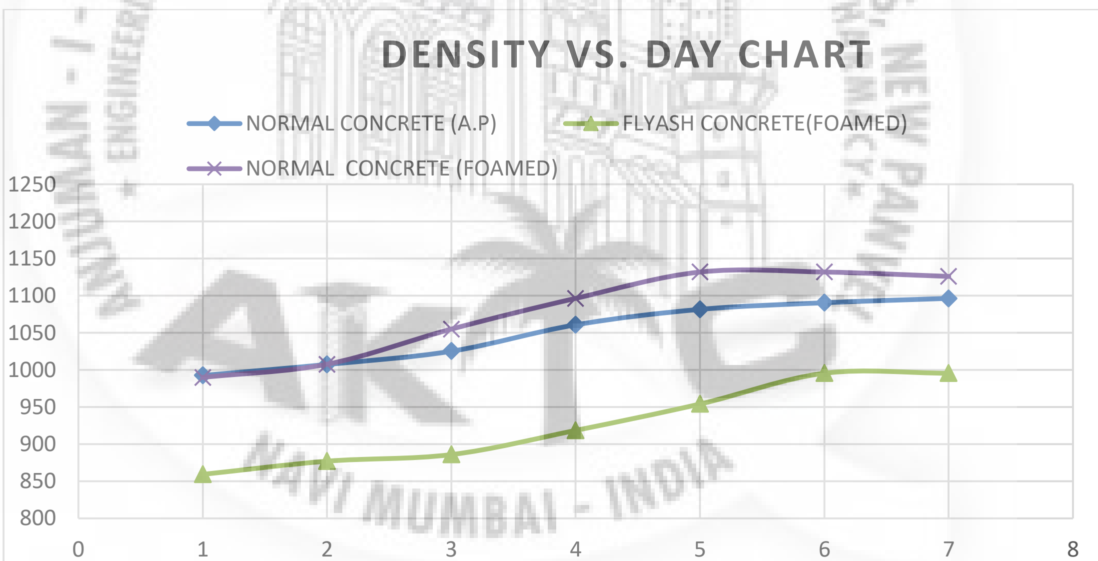

Figure No. 5.2 The Graph Of Density Vs. Day of Various Methods

5.3 COMPRESSIVE STRENGTH OF CONCRETE

As we know that the concrete is tends to compressive strength. The compressive strength of normal aluminum concrete is more as compare to these two methodologies but this concrete is not float on water.

As our experiment the fly ash foamed concrete is much better in compressive strength as well as floating property of the concrete and also as per IS-2185 part (4)-2008 clause no. 5,9.3,9.4,9.5 and 9.8 table number 1 for density of concrete lesser than 1000 kg/m3 is have a minimum 28 days' compressive strength of foamed concrete should be minimum 2.5 N/mm2. Hence our experimentation on foamed concrete is satisfied by IS 2185 part (4) 2008.

The 3 days, 7 days and 28 days' compressive strength is shown in table no. 5.3, 5.4 and 5.5 respectively

Table No. 5.3 3 Days Compressive Strength

Methodology	Load In KN	Compressive Strength N/mm2
Normal aluminum concrete	35	1.55
Normal Foamed Concrete	20	0.89
Fly Ash Foamed Concrete	20	0.89

Table No. 5.4 7 Days Compressive Strength

Methodology	Load In KN	Compressive Strength
Normal aluminum concrete	60	2.67
Normal Foamed Concrete	30	1.33
Fly Ash Foamed Concrete	35	1.55

Table No. 5.5 28 Days Compressive Strength

Methodology	Load In KN	Compressive Strength	Minimum limit of compressive strength as per IS 2185 part(4) 2008
Normal aluminum concrete	95	4.22	-
Normal Foamed Concrete	60	2.67	2.5
Fly Ash Foamed Concrete	65	2.89	2.5

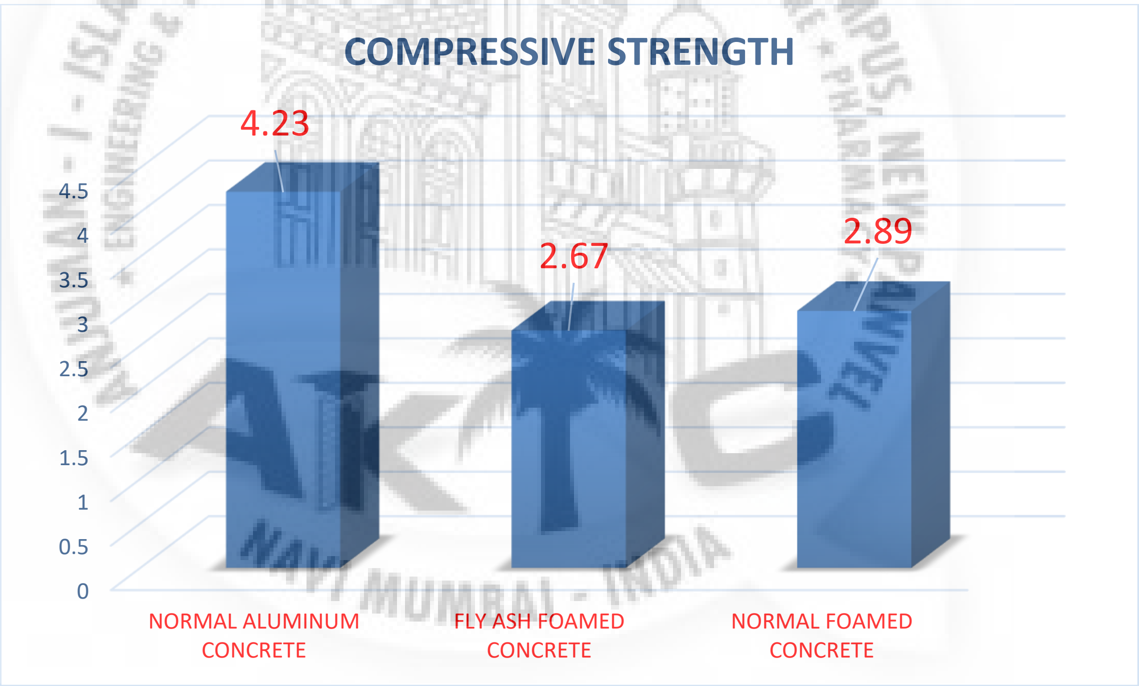

Figure No. 5.3 Comparative Of Compressive Strength Of Various Methods

CHAPTER SIX
APPLICATIONS

6.1 APPLICATIONS

i. Light weight concrete is an ideal material for producing light weight masonry blocks, hence the self-weight of concrete is reducing about 30 to 40% with respect to nominal concrete.

ii. It can be used as a partition wall blocks and compound wall blocks.

iii. It floats on water and hence we can be used as an architectural view in swimming pool.

iv. It helps to reduce the dead load, increase the progress of building and lowers the hauling and handling cost.

v. Foamed light weight concrete in the form of bricks or blocks is used for thermal insulation over flat roofs or for cold storage walls or non-load bearing walls in RCC buildings or for load bearing walls for low rise buildings.

vi. Fire rate of foamed concrete is foamed concrete is far superior to that of brick work or dense concrete, and hence it helps to reduce fire hazard in residential and commercial building.

vii. Light weight concrete have low thermal conductivity. In extreme climatic condition where air condition is to install the use of light weight concrete with high thermal conductivity is advantageous from the point of thermal comfort and low consumption.

CHAPTER SEVEN

CONCLUSION

7.1 CONCLUSION

i. The density of fly ash foamed concrete is less than as compare to normal aluminum concrete and normal foamed concrete.

ii. The floating concrete is made up of light weight pumice aggregate.

iii. The self-weight of the concrete is reducing up to 40 to 45 % of nominal concrete.

iv. When we used the 8% fly ash by mass of cement the concrete has less density as compare to normal aluminum concrete and normal foamed concrete.

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8) 1.8: 1199-1959 Methods of sampling and analysis of concrete.