# Experimental Study on Light-Weight Concrete by using Cinder and ECA

**Dr Deepa A.Sinha[1], Parmar Hitesh[2], Shah Sagar[3], Kachiya Akhil[4], Jagani Bhavesh[5], Dafda Ravi[6]**

*[2,3,4,5,6]Final year student, Civil Engineering Department,BVM Engineering College, Vallabh Vidyanagar – Gujarat- India*

*[1]Associate Professor, Civil Engineering Department, BVM Engineering College, Vallabh Vidyanagar – Gujarat- India*

---***---

**Abstract -** Foundation is a significant part that drives generally advancement of the Indian economy looking to the populace boomt, ascend in street vehicles, genuine State area and different structures which has brought about the decrease of good quality accessible land. Far reaching soil is a hazardous soil for structural specialists as a result of its low quality and cyclic swell therapist conduct. Plan and development of asphalts on and with sweeping soils is a difficult errand for specialists. Subsequently adjustment of soil ends up essential as it improves soil properties to withstand the heaps from foundation to satisfy the predefined prerequisites. This is a survey paper on soil adjustment concentrating on marble waste powder as an added substance featuring the exhibition of subgrade streets and affordable to the arrangement creators and contractual workers; likewise the issues of quick development of businesses of marble squanders making a major issue to the people encompassing them just as contamination which influence the biological arrangement of the earth can be limited.

**Key words -** Marble dust, Expansive soil, stabilization, Engineering properties, Utilization.

## 1. INTRODUCTION

Lightweight concrete mixture is made with a lightweight coarse aggregate and some times a portion or entire fine aggregates may be lightweight instead of normal aggregates. Normal weight concretes a density in the range of (2240 to 2400 kg/m$^3$). density of lightweight concrete between 300 kg/m3 and1850 kg/m3. Structural lightweight concrete has an in-place density (unit weight) on the order of 1440 to 1840 kg/m$^3$. The strength of the light-weight concrete varies from about 0.3 N/mm2 to 40 N/mm2. A cement content of 200 kg/m3 to about 500 kg/m3 may be used. Strength of light-weight concrete depends on the density of concrete. Less porous aggregate which is heavier in weight produces stronger concrete particularly with higher cement content. The grading of aggregate, the water/cement ratio, the degree of compaction also effects the strength of concrete.

Lightweight concrete is a very versatile and advantageous material in modern construction industry. It is lighter than normal weight concrete. In this project we are going to study on the significant applications and advantages of using lightweight concrete in the field of Civil Engineering. Also, it focuses on the methods of production and the basic properties of each type. Therefore, the use of lightweight concrete has great impact on developing countries as it permits design flexibility and substantial saving in cost of construction.

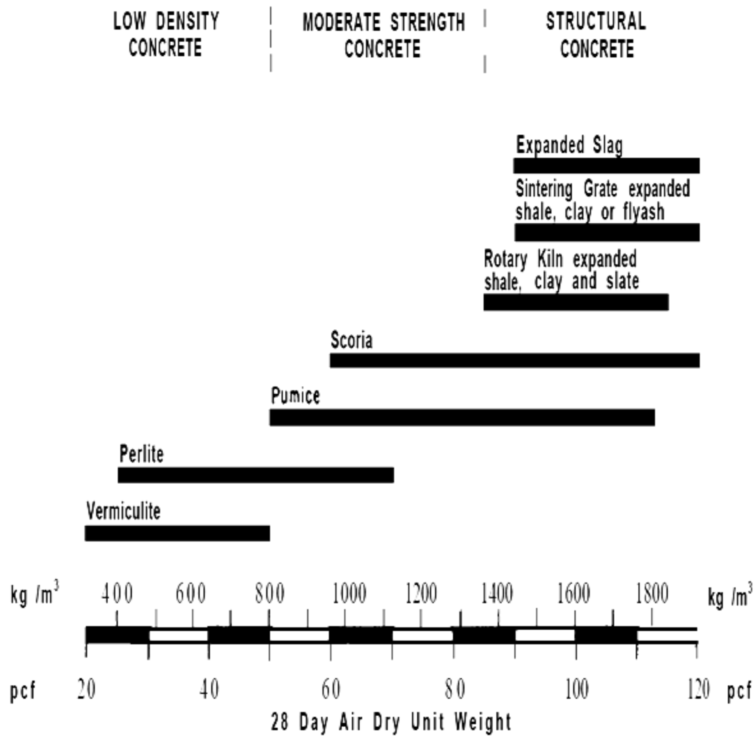


**Fig-1**:different light weight aggregate

## 2. LITERATURE REVIEW

**Dr.Bashkar Desai et al.,** describes experimental investigation an attempt is to be made to study the strength properties of light weight cinder aggregate cement concrete in different percentage proportions of 0, 25, 50, 75 and 100 by volume of light weight aggregate concrete can be prepared. By using this properties such as compressive strength, split tensile strength, modulus of elasticity, density and shear stress.

**P.S. Raghuprasad et al.,** as studied the coarse aggregates in the conventional solid concrete blocks were replaced partially with Cinder (12mm) and tested for compressive strength at the age of 3days, 7days and 21days. From the results of the investigation, it can be concluded that solid concrete block with 15% replacement of coarse aggregate by cinder records more strength than the conventional one.

**M. A. Caldarone and R. G. Burg et al.,** Structural lightweight concrete is defined as concrete made with low- density aggregate having an air-dry density of not more than (1850 kg/m$^3$) and a 28-day compressive strength of more than (17.2 MPa). This paper presented the test results of very low- density structural lightweight concrete mixtures developed in the laboratory for the purpose of finding a suitable mixture for use on a historic building rehabilitation project. Mixture parameters included a specified compressive strength of 3000 psi at 28 days and an air-dry density approaching 70 lb/ft3. Various constituent materials, mixture proportions and curing methods were examined. The result of this research exemplifies the feasibility of achieving very low densities with structural concretes.

## 3. MATERIAL PROPERTIES

Ordinary Portland cement of 53 - grade conforming to IS: 12269 -2013 with a specific gravity of 3.15 with initial setting time of 50 minutes has been used in present investigations. Well graded locally available river sand passing through IS 4.75 mm sieve with specific gravity 2. 66 and fineness modulus 2.68 is used. Natural granite aggregate passing through I.S 20-mm sieve with specific gravity 2.75 and cinder aggregate passing through I.S 20 - mm sieve with specific gravity 2.67 is also used. Tests on physical properties like bulk density, specific gravity, water absorption, and fineness modulus were conducted for fine and coarse aggregates respectively in the laboratory and the results are tabulated. These results are used in concrete mix design. The mix proportions are also tabulated below.

### 3.1 PHYSICAL PROPERTIES OF MATERIALS :

The physical properties of cement are indicated in table 1.

| ❑ Cement | ❑ Requirement of IS 12269: 2013 | ❑ Test result |
|---|---|---|
| ▪ Specific gravity | 3.15 | 3.15 |
| ▪ Standard Consistency | 25-35% | 32% |
| ▪ Initial setting time | 30 min | 50 min |
| ▪ Final setting time | 600 min | 320 min |

**Table No.1**

The physical properties of fine aggregate (river sand) are indicated in table 2.

| | | |
|---|---|---|
| ▪ Specific gravity | 2.66 | 2.57 |
| ▪ Water absorption | 1% | 0.60% |
| ▪ Bulking | 4% | 3.33% |

**Table No. 2**

The physical properties of Coarse aggregate (Crushed granite) are indicated in table 3.

| Test results on aggregate | Size | | |
|---|---|---|---|
| ❑ Coarse aggregate | ❑ 20 mm | ❑ Requirement Of IS :383 (2016) | ❑ Test result |
| ▪ Specific gravity | 20 mm | 2.6-2.8 | 2.67 |
| ▪ Elongation & Flakiness | 20 mm | 40-45% | 9.6%<br>33.3% |
| ▪ Water absorption | 20 mm | Not more then 3% | 1.30% |
| ▪ Crushing strength | 20 mm | Less then 30% | 22.29% |
| ▪ Impact strength | 20 mm | Not more then 45% | 22.6% |

**Table No.3**

The physical properties cinder and ECA are indicated in table 4.

| MATERIAL | Specific gravity | Water absorption | Density(kg/m3) |
|---|---|---|---|
| ECA | 0.97 | 14.78% | 400 |
| Cinder | 1.77 | 1.3% | 1050 |

**Table No. 4**

## 4. EXPERIMENTAL PROGRAMME

The basic materials of concrete mixes are cement, fine aggregates, coarse aggregates (granite and cinders – 20 mm nominal size), and water. Concrete Mix has been designed for M20 grade concrete mix has been designed according using IS code. A water cement ratio of 0.47 has been adopted for concrete mixes. Concrete has been placed in standard moulds in three layers and the each layer is compacted by tamping rod and vibrated on table vibrator for 10 to 15 seconds for full compaction. The top surfaces of concrete specimens were finally finished for smooth surface. Cubes (150 x 150 x 150) mm of standard sizes were casted and tested for 28 days curing period and results for compressive strength, of concrete are tabulated in tables. Results for Density for concrete mixes are tabulated in table no.10 respectively. we prepare total nine mix design, and replace coarse aggregate by cinder and ECA.

(1) The mix design for normal concrete ( M20 )

| **Sr No.** | **Cement** | **FA(Sand)** | **CA** |
|---|---|---|---|
| Quantity ($m^3$) | 0.133 | 0.422 | 0.578 |
| Quantity (kg) | 419 | 720 | 1024 |

(2) The mix design for LWC concrete using 100% E.C.A ( M20 )

| **Sr No.** | **Cement** | **FA(Sand)** | **ECA** |
|---|---|---|---|
| Quantity ($m^3$) | 0.133 | 0.422 | 0.578 |
| Quantity (kg) | 419 | 720 | 372 |

(3) The mix design for LWC concrete using 100% cinder ( M20 )

| **Sr No.** | **Cement** | **F.A.(Sand)** | **Cinder** |
|---|---|---|---|
| Quantity ($m^3$) | 0.133 | 0.422 | 0.578 |
| Quantity (kg) | 419 | 720 | 678 |

(4) The mix design for LWC concrete using 25% normal C.A and 75% E.C.A ( M20)

| **Sr No.** | **Cement** | F.A. | C.A. | ECA |
|---|---|---|---|---|
| Quantity ($m^3$) | 0.133 | 0.422 | 0.1445 | 0.4335 |
| Quantity (kg) | 419 | 720 | 256 | 279 |

(5)The mix design for LWC concrete using 50% normal C.A and 50% E.C.A ( M20)

| **Sr No.** | **Cement** | F.A. | **C.A** | **E.C.A** |
|---|---|---|---|---|
| Quantity ($m^3$) | 0.133 | 0.422 | 0.289 | 0.289 |
| Quantity (kg) | 419 | 720 | 512 | 186 |

(6) The mix design for LWC concrete using 50% normal C.A and 50% Cinder ( M20)

| **Sr No.** | **Cement** | F.A. | **C.A** | **ECA** |
|---|---|---|---|---|
| Quantity ($m^3$) | 0.133 | 0.422 | 0.289 | 0.289 |
| Quantity (kg) | 419 | 720 | 170 | 269 |

(7) The mix design for LWC concrete using 25% normal C.A and 75% cinder ( M20)

| Sr No. | Cement | F.A. | C.A | Cinder |
|---|---|---|---|---|
| Quantity ($m^3$) | 0.133 | 0.422 | 0.1445 | 0.4335 |
| Quantity (kg) | 419 | 720 | 256 | 509 |

(8) The mix design for LWC concrete using 50% E.C.A and 50% cinder ( M20)

| Sr No. | Cement | F.A. | E.C.A. | Cinder |
|---|---|---|---|---|
| Quantity ($m^3$) | 0.133 | 0.422 | 0.289 | 0.289 |
| Quantity (kg) | 419 | 720 | 512 | 339 |

(9) The mix design for LWC concrete using 25% cinder and 75% E.C.A ( M20)

| Sr No. | Cement | F.A. | ECA | Cinder |
|---|---|---|---|---|
| Quantity ($m^3$) | 0.133 | 0.422 | 0.1445 | 0.4335 |
| Quantity (kg) | 419 | 720 | 186 | 339 |

## 5. RESULTS AND DISCUSSIONS

### 5.1. Compressive Strength

The compressive strength test is carried out as per IS 516:1959 test on hardened concrete. The load is applied without shock and increased continuously at a rate of approximately 140 kg/sqcm/min until the resistance of the specimen to the increasing load breaks down and no greater load can be sustained. The maximum load applied to the specimen shall then be recorded and the appearance of the concrete and any unusual features in the type of failure shall be noted.

- **Compressive Strength Test Results ( 3 days )**

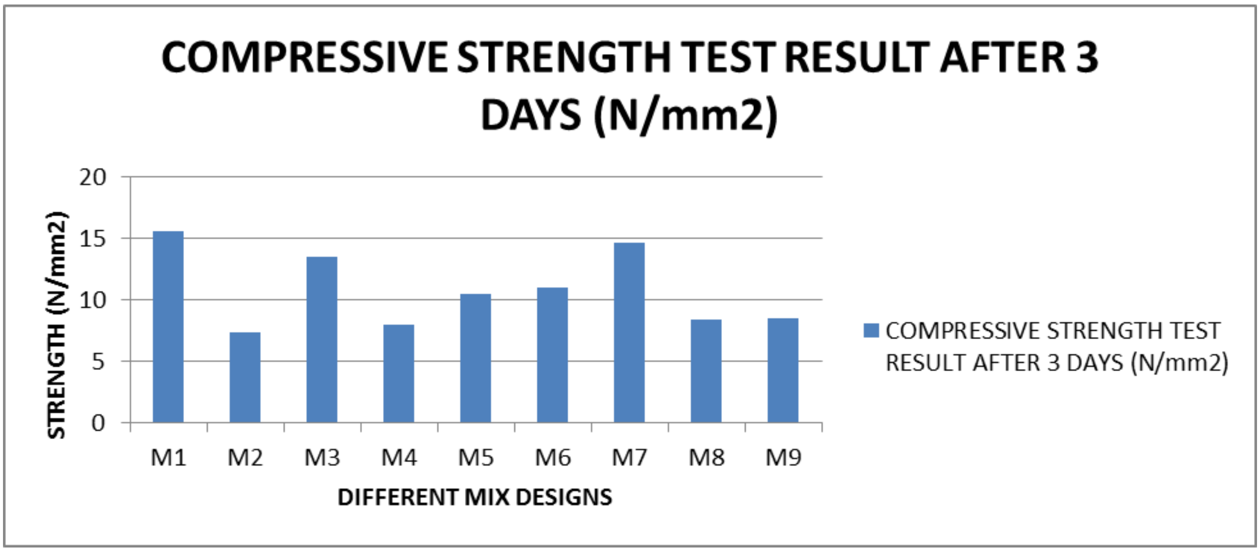


**Chart-1:**Compressive Strength Test Results ( 3 days )

- **Compressive Strength Test Results ( 7 days )**

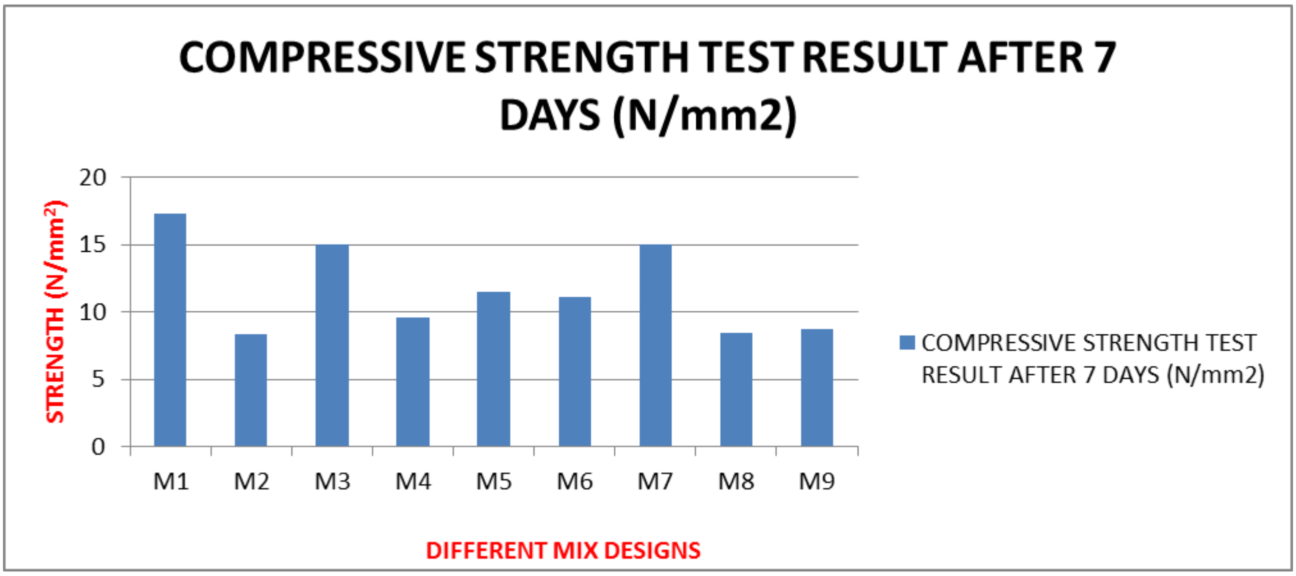


**Chart-2:** Compressive Strength Test Results 7 days )

- **Compressive Strength Test Results ( 28 days )**

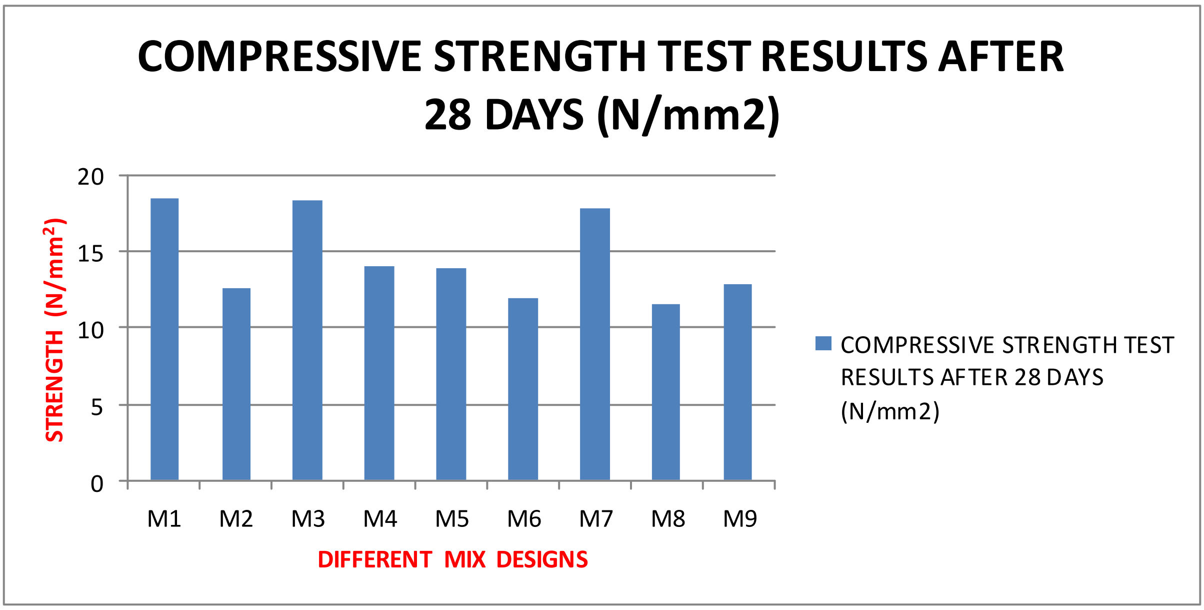


**Chart-3:** Compressive Strength Test Results (28 days )

- **Strength Comparison**

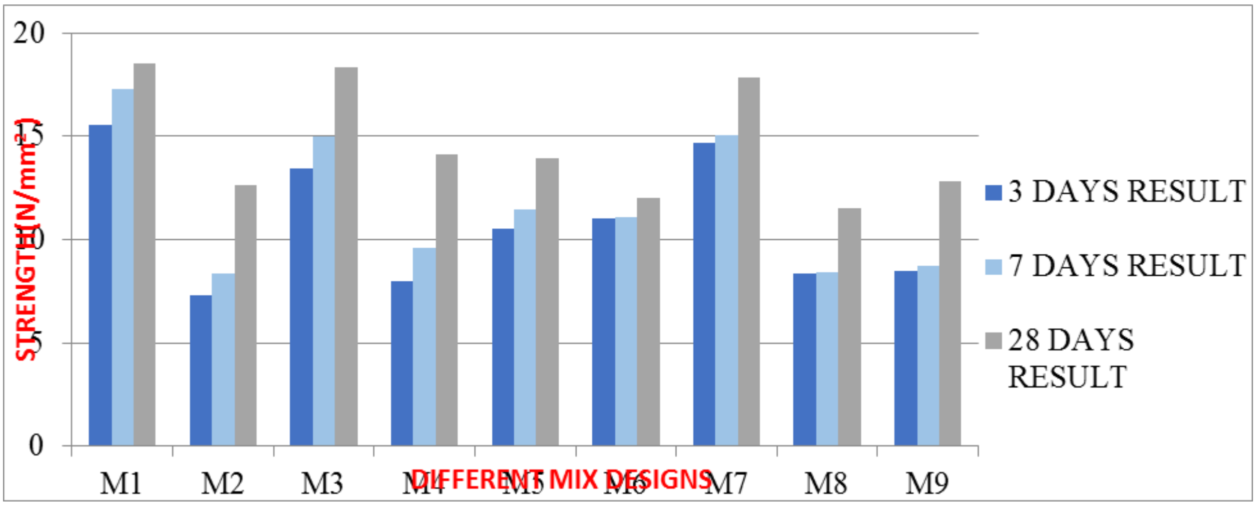


**Chart-4**:Compressive Strength Test comparison

### 5.2. Density

The density of both fresh and hardened concrete is of interest to the parties involved for numerous reasons including its effect on durability, strength and resistance to permeability. Hardened concrete density is determined either by simple dimensional checks, followed by weighing and calculation or by weight in air/water buoyancy methods.

| Sr No | Concrete Mix | Density (kg/m3) |
|---|---|---|
| 1 | M1 | 2450 |
| 2 | M2 | 1495 |
| 3 | M3 | 2198.5 |
| 4 | M4 | 1546 |
| 5 | M5 | 1806 |
| 6 | M6 | 2044 |
| 7 | M7 | 1989 |
| 8 | M8 | 1702 |
| 9 | M9 | 1555 |

Table-5 : Density 28 days for various mix proportions

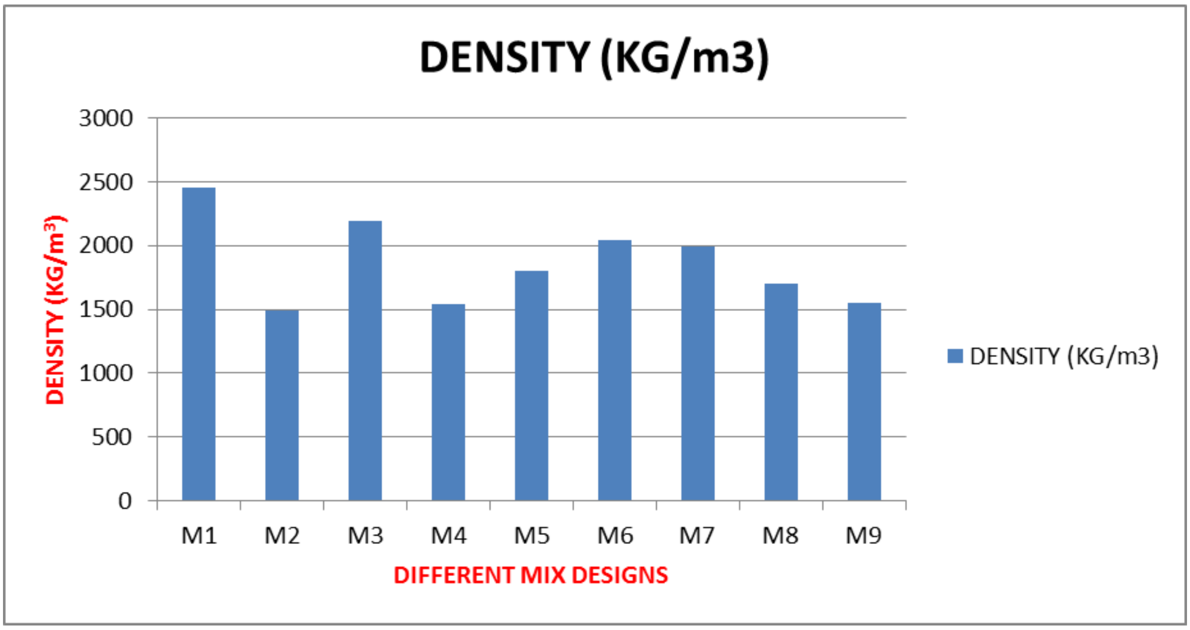


**Chart-5:** Density Result

## 6. CONCLUSIONS

- The compressive strength of large ECA concrete has lesser strength than the small ECA concrete.
- The compressive strength of light weight concrete is lower than the ordinary conventional concrete.
- Concrete using cinder gives more strength than Concrete using ECA.
- The density of Concrete using ECA falls in the range of 1200 –1500 kg/$m^3$.
- Surface finishing of ECA concrete is not good.
- From the above compressive strength results, it is observed that as the percentage of ECA is increasing the compressive strength is decreasing since, the density of concrete is reduced by addition of ECA
- This light weight concrete has low thermal conductivity and has an ability to absorb sound. So, it can be used for acoustic structures.

## REFERENCES

(1) Rapolu Kishore Kumar, S. Nikhil and P. Sairamchander, (April 2017), '' STUDY OF LIGHT WEIGHT CONCRETE'', International Journal of Civil Engineering and Technology (IJCIET), Volume 8, Issue 4, PP.1223–
(2) Hanamanth shebannavar1, maneeth p. d2 ,brijbhushan s3. "comparative study of leca as a complete replacement of coarse aggregate by aci method with equivalent likeness of strength of is method"(irjet), volume: 02 issue: 08 |
(3) Dr. S. Vijaya and Nagashree B , '' Experimental Study on Light Weight Concrete using Leca and Cinder as Coarse Aggregates'', July-2015, (IJERT), Vol. 4 Issue 07,
(4) Dasthagir and Dadapeer A.B.S, Strengths Analysis of Concrete by using Cinder Aggregate, December 2016, Vol. 5, Issue 12
(5) E.Hanuman Sai Gupta and V.Giridhar Kumar, (july 2015), ''Investigations on Properties of Light Weight Cinder Aggregate Concrete'', International Journal of Engineering Research and Development, Volume 11, Issue 07, PP.50-59.
(6) r.S. muralitharan and V. ramasamy, (october - november 2017),Development of lightweight concrete for structural applications ,'' Journal of Structural Engineering'', Vol. 44, no. 4, pp. 1-5 Associate Professor, Department of Civil Engineering, R.V. College of Engineering, Bangalore, Karnataka, Ind
(7) Dr.V.Bhaskar Desai ,A.Satyam,'Some studies on strength properties of Light weight cinder aggregate concrete', "volume 4 issue 2, feb 2014
(8) P.S.Raghuprasad, R.satish "Experimental investigations on solid concrete blocks with partial replacement of coarse aggregate with cinder aggregate".
(9) M.A.Caldrone and R.G.Burg "Development of low density structural light concrete" ACI journal vol.218 feb.2004
(10) www.wikipedia.com
(11) Concrete technology by M.S. SHETTY.

(12) Building material by S.K.DUGGAL.
(13) IS 10262-2019
(14) IS 383-2016
(15) IS 12269-2013
(16) IS 516-1959
(17) IS 3085:1965