Effect on Durability of Light weight concrete containing LECA in corrosive environment

Devang Gajjar[1], Abbas Jamani[2]
Department of Structural Engineering
[1, 2] L.J. Institute of Engineering and Technology

Abstract- *In this study, an attempt has been made to study the effect On durability of concrete with volumetric replacement of LECA aggregates with natural aggregates. The fresh properties, compressive strength test and durability property are performed on light weight concrete. Test like Compressive strength of concrete containing light weight aggregate and compared with normal concrete at at the age of 28 days. The tests performed foe durability are acid resistance test, sulphate resistance test and density of concrete at the age of 28 days and 56 days.*

Keywords- sulphate, durability, acid, light weight Concrete.

I. INTRODUCTION

The largely use of concrete in this era is increase day by day. Concrete is basically composite material made by different constituents such as binding materials, water, aggregates and admixtures. Among these aggregate are major part of the concrete which are used as filler materials of the concrete, but the problem of the 70 to 85 percent of the weight of concrete. In normal concrete the density is almost 2400kg/m3. It is a necessary component that defines the concrete's density and durability properties. The composition, shape, and size of the aggregate all have significant impact on the workability, durability and density with strength of the concrete.

Because of maximum dosage of the aggregate having corresponding its high weight it is necessity to look at the light weight aggregate. Light weight concrete is nothing typical type concrete with a density between 1350 and 1900 kg/m3 and a minimum compressive strength of 17 MPa.

Lightweight concrete is nothing but type of concrete in which aggregates are light weight expanding agent are replace volumetric in concrete. by this type of light weight aggregates dead load is decreases and dry density of concrete are achieve about 800kg/m3 to 1800kg/m3.the light weight concrete was preliminary used by Romans in the second century where 'The Pantheon' has been constructed using pumice.

In this research work, lightweight aggregate concrete are used. The main requirement for this type of concrete is that it should have adequate strength and a low density and durability. This type of concrete is fully compacted similar to normal concrete. Only the denser varieties of lightweight aggregate are suitable for use in structural concrete. Here main focus on the density and durability aspect which are gives corresponding batter strength.

II. EXPERIMENTAL PROGRAM

A. Materials

1. Cement

Ordinary Portland Cement 53 Grade (Ultratech) was used in production of concrete. The physical properties of cement are given in Table 1

Table 1.

Table 1. Physical Properties of Cement

Sr. No.	Physical Properties	Cement
1	Setting time in Min.	
	(a) Initial setting time (Minute)	43
	(b) Final setting time (Minute)	315
2	Soundness (By Le-chat Expansion in mm)	0.39
3	Compressive Strength in (MPa)	
	3 Days	29.53
	7 Days	40.78
	28 Days	57.34

2. Normal Aggregate

The fine aggregate (specific gravity: 2.67) and course aggregate (specific gravity: 2.87 and 2.73) were used. The maximum size of aggregate was 20 mm.

3. Light weight Aggregate

For the experimental purpose Light-weight Expanded Clay Aggregates (LECA) are used. This type of light weight expanded clay aggregates are prepared by heating clay to around 1,200 °C in a rotary kiln. These types of aggregates are

typically round or potato in shape. They are available in different sizes and densities.

Table-2 Physical Properties of LECA

Sr. No.	Physical Properties	
1	Water Absorption in (%)	16%
2	Sp. Gravity of Agg.	1.30
3	Type of aggregates	Rounded aggregates
4	Size of aggregates	12mm to 20 mm
4	Colour	Brown
5	Unit weight of aggregates	830 kg/m3

B. Design Mix

A normal mix M-25 and M-40 grade was designed as per Indian Standard method (IS 10262-2009). Mix design will be finalized by by trial mixtures.

From the pilot test, we conclude that the optimum replacement of natural aggregate with light weight aggregate lies between 20% to 35%.

C. Testing Procedure

For Compressive strength tests were conducted on 150x150x150 mm cubic specimens, after standard curing. Three specimens were prepared and tested for each mixture.

For durability purpose were conducted on cylinder specimens with a different size were prepared Three specimens were prepared and tested for each mixture.

Total number of cubes for strength purpose = 30
Total number of cubes of 150*150*150 mm= 180
Total number of cylinders of 150*150 mm = 30
Total number of cylinders of 100*50 mm = 30
So, Total number of specimens casted = 270 specimens

D. Concrete Mix Proportions

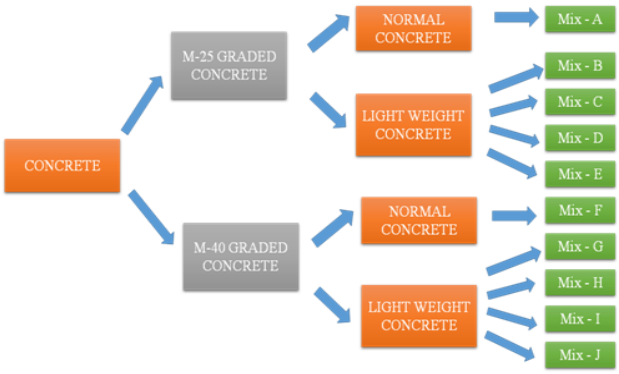

Figure 1.

Concrete mix proportions are given in Table 3

Table 3.

Table 3 Replacement of LECA

Sr. no.	Grade of Concrete	Mixes	Light weight Aggregate replacement (%)
1	M-25	Mix-A	0
2		Mix-B	20
3		Mix-C	25
4		Mix-D	30
5		Mix-E	35
6	M-40	Mix-F	0
7		Mix-G	20
8		Mix-H	25
9		Mix-I	30
10		Mix-j	35

III. TEST RESULTS

A. Fresh Concrete Properties

Table-4 Slump Test Results

Sr No.	Mix ID	LECA replacement (%)	Slump (mm)
1	Mix-A	00	68
2	Mix-B	20	71
3	Mix-C	25	75
4	Mix-D	30	78
5	Mix-E	35	83
6	Mix-F	00	56
7	Mix-G	20	61
8	Mix-H	25	64
9	Mix-I	30	70
10	Mix-j	35	72

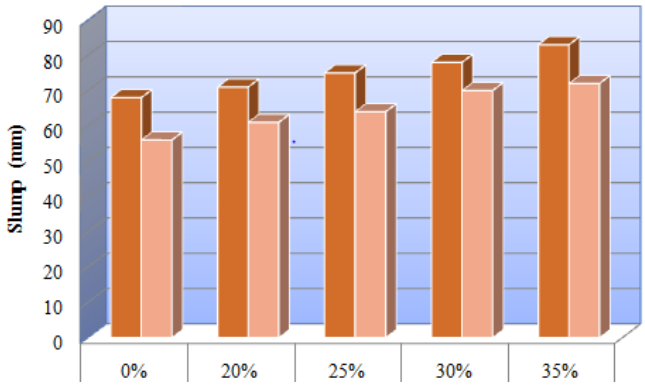

Figure 2.

B. Hardened Concrete Properties

The compressive strengths of LECA concrete at 28-days are given bellow.

Table 5. The compressive strengths

strength		
SR NO.	GRADE	28 DAYS
1	M-25	31.48
2		28.74
3		27.7
4		22.74
5		22
6	M-40	49.7037
7		45.03704
8		38.51852
9		31.24444
10		28.07407

C. DENSITY OF CONCRETE

The density of light weight concrete for different volumetrix replacement is given belloo:

Table 6. density of concrete

Sr. no.	Light weight Aggregate replacement (%)	Density (kg/m3)		
		Weight	Avg. weight	Density (kg/m3)
1	0	8.605	8.58	2543.21
		8.69		
		8.455		
2	20	7.69	7.77	2304.89
		7.84		
		7.807		
3	25	7.504	7.56	2241.78
		7.612		
		7.582		
4	30	7.129	7.26	2151.21
		7.348		
		7.304		
5	35	6.875	6.79	2011.95
		6.743		
		6.753		
6	50	6.26	6.21	1841.48
		6.177		
		6.208		

D. SULPHATE RESISTANCE TEST

In this test the cube are immersed into 5% sodium sulphate and the bulk diffusion is observed.

Table 7. Bulk diffusion in Sulphate at 30 days

Mix. No.	Weight after water curing	Weight of cube after 30 days in sulphate
Mix-A	8.68	8.705
Mix-B	7.78	7.785
Mix-C	7.57	7.601
Mix-D	7.306	7.328
Mix-E	6.79	6.802


Figure 3. Sulphate Attack at 30-Days

From the test result it is observed that effect of sulphate solution gives similar effect on each concrete. By the visually inspection the change in surface color is largely affected also the surface is slightly corroded compared to normal concrete.

E. ACID RESISTANCE TEST

The results of acid resistance of light weight concrete are compared with normal concrete by visually inspection and bulk diffusion. After removing the cubes after 28-days of water curing it is immersed in to 5% concentrated sulfuric acid for 30 days.

Table 8. Bulk Diffusion in sulfuric acid at 30-days

Mix. No.	Weight after water curing	Weight of cube after 30 days in acid	Bulk diffusion (kg)
Mix-A	8.68	8.16	0.52
Mix-B	7.78	7.27	0.51
Mix-C	7.57	7.05	0.52
Mix-D	7.26	6.79	0.47
Mix-E	6.79	5.93	0.86

Figure 4. for acid attack at 30-Days

The effect of acid solution gives similar effect on each concrete. But it is also be observed that the bulk diffusion slightly decrease up to 30% LECA aggregate but higher at 35% replacement.

IV. CONCLUSION

1) Increased LECA content gives higher workability also with compare to normal concrete.
2) From the test results it is observrd that the density of light weight concrete is larglly affected by LECA content.
3) Up to 35% of LECA content the strength is decreases but considerable utilizable in structure, but further increase in LECA content it is not utilizable.
4) LECA aggregates are not affected by sulphate.
5) In the sulphate media bulk expansion will observed and compared to normal concrete light weight concrete is batter for sulphate.
6) The both concrete gives same results in to acidic medium.
7) To increase the strength try for coating for future study for same material.

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