An Experimental Study on Light Weight Concrete Behaviour

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Abstract— Lightweight concrete (LWC) is lighter than conventional concrete. The use of LWC has been widely spreaded across the world. This type of concrete contains an aggregate which increase the volume of the mixture or specimen. This paper conveys the information of the compressive strength test, water absorption and density of lightweight concrete behaviour. Moreover, it portrays the grading, material properties, aggregates and testing of LWC. It has been beneficial for the construction purpose and behaviour of the specimen.

I. INTRODUCTION

Light weight concrete has a maximum density of 1900 kg/m3 and is achieved by using low density aggregates. LWC maintains its large voids and not forming laitance layer when placed on the wall. This was based on the performance of aerated LWC. Sufficient water cement ratio is vital to produce cohesion between cement and water. Lack of water can cause lack of cohesion between particles, that loss in strength of concrete. Therefore, too much of water can cause cement to runoff aggregates to form laitance layers, subsequently weakens its strength. This research project is to show the performance of aerated LWC such as compressive strength tests, water absorption and density and comparison made with other types of LWC.

TYPES OF LIGHT WEIGHTWEIGHT CONCRETE
Lightweight concrete can be prepared by injecting air in its composition or even replacing them by a hollow, cellular or porous aggregate. Particularly, LWC can be categorized into three types:

1. No-fines concrete
2. Lightweight aggregate concrete
3. Aerated/Foamed concrete

1. NO-FINES CONCRETE

It is a very lightweight type of concrete it doesn't contain fine aggregate in the concrete mixture. And this mixture contains ordinary Portland cement (OPC), water, and coarse aggregate. And it has low dry shrinkage value due to absence of fine aggregate.

TYPE OF AGGREGATE: Natural aggregate Blast furance slag clinker.

GRADING OF AGGREGATE: Crushed rock or gravel of 20mm size coated in a cement slurry with no fine aggregate.

2. LIGHTWEIGHT AGGREGATE CONCRETE

LWC of low specific gravity is used in the LWC in place of ordinary concrete. It can be natural aggregate such as pumice, scoria and all of those of volcanic origin and artificial aggregate such as blast furance slag, vermiculite and clinker aggregate. The main character of this is its high porosity which results in a low specific gravity.

The lightweight aggregate concrete is divided inti two types:

- Partially compacted
- Structural

TYPE OF AGGREGATE: Clinker foamed slag & Foamed slag.

GRADING OF AGGREGATE: Light coarse & fine aggregate, cement and water.

3. AERATED CONCRETE

It does not contain coarse aggregate, and be regarded as aerated mortar. And it is made by cement and fine aggregate.

TYPE OF AGGREGATE: Natural fine aggregate, Fine lightweight aggregate, Raw pulverized fuel ash, Ground slag and burnt shales.

GRADING OF AGGREGATE: Coarse and fine aggregate. Coarse aggregate is > 4.75mm and Fine aggregate is < 4.75mm (passing sieve).

II. MATERIAL PROPERTIES

1. CEMENT

- Specific gravity is 2.74
- Standard consistency is 35%
- Initial setting time is 40 minutes.

2. SILICA FUME

It is a fine pozzolanic material composed of amorphous silica.

- Specific gravity is 2.2
- SiO2 is 85% - 90%

EXPANDED AGGREGATES

1. COARSE AGGREGATES

- Size ranging from 16mm - 20mm
- Specific gravity is 2.86
- Water absorption is 0.20%

2. POLY VINYL ALCOHOL

- Specific gravity is 1.19 – 1.26
- PH is Neutral

3. WATER

Mixing of water in concrete and curing of the prepared specimens.

III. TESTING PROGRAM OF LIGHTWEIGHT CONCRETE

- COMPRESSIVE STRENGTH (N/MM2)

S.NO	7 DAYS	28 DAYS
1	27.13	29.21
2	27.35	39.45
3	27.08	38.98

- WATER ABSORPTION

S.NO	WATER-CEMENT RATIO	7 DAYS	28 DAYS
1	0.65	6.86	10.32
2	0.4	6.59	4.17
3	0.45	3.35	2.16
4	0.5	2.16	1.79

- DENSITY

Lightweight concrete – 1750 kg/m3.

IV. SUPPLEMENTARY TEST

Moisture test and comparison between hardened and wet concrete is another supplementary test in this research. It can be seen that moisture content is increased when percentage of foam is increased too. 100% of foam gives the highest moisture content followed by 75%, 50% and 25% of foam. The explanation for this differential will be the same with the water absorption case where the increasing of voids that caused by the increment of percentage of foam will cause the moisture content to increase accordingly. Moisture content for 100% of foam mixture is 15.3%, while 75% is 10.36%, 50% is 9.82% and 25% is 8.93% respectively.

TABLE 1: Density of Hardened Concrete and Compressive Strength at 28 days.

DENSITY (KG/M^3)	COMPRESSIVE STRENGTH (KG/M^2)
1470	2.52
1720	5.5
2050	9.35
2060	22.99

TABLE 2: Compressive Strength for Different Percentage of Foam.

DAYS	25% FOAM	50% FOAM	75% FOAM	100% FOAM
7	13.2	9.45	8.12	1.43
14	14.68	8.88	11.02	2.44
21	16.41	14.42	11.96	2.23

28	17.27	11.87	13.12	2.52

TABLE 3: Compressive Strength at Different Foam Agent and Water Ratio

DAYS	1:25	1:30	1:40
7	4.09	8.12	11.15
14	4.86	11.02	11.95
21	5.45	11.96	13.72
28	5.5	13.12	13.21
DENSITY(KG/M^3)	1720	1810	1840

TABLE 4: Compressive Strength at Different Cement and Sand Ratio.

DAYS	1:2	1:3	1:4
7	19.44	8.12	7.57
14	17.58	11.02	7.16
21	21.28	11.96	7.44
28	22.99	13.12	10.34
DENSITY(KG/M^3)	2060	1810	1770

TABLE 5: Water Absorption at Different Percentage of Foam.

% OF FOAM	WATER ABSORPTION
25	1.4
50	2.46
75	3.31
100	7.21

TABLE 6: Water Absorption at Different Foam Agent and Water Ratio.

FOAM AGENT: WATER	WATER ABSORPTION (%)
1:25	2.60
1:30	3.31
1:40	4.46

TABLE 7: Moisture Content at Different Percentage of Foam.

% OF FOAM	MOISTURE CONTENT (%)
25	8.93
50	9.82
75	10.36
100	15.3

TABLE 8: Density of Hardened and Wet Concrete at Different Percentage of Foam.

% OF FOAM	HARDENED CONCRETE	WET CONCRETE
25	2040	2000
50	1820	1770
75	1810	1790
100	1470	1400

CONCLUSION

- The initial readings have shown that the LWC has a desirable strength.
- Compressive strength values is compared to normal concrete and replaced of coarse aggregate by pumice from different percentages. (50%, 60% and 70%)
- Maximum value of strength is obtained in 60%.
- This type of concrete can be used in construction of partition walls and panel walls in frame structures.

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