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The effect of water absorption characteristic of aggregates on compression strength of light-weight concrete

A.Ostovar Zyjrdy; Tamadon_well@yahoo.com,
A.Hossein Eskandani; arman_eskandani@yahoo.com
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Name of the Presenter: A.Hossein Eskandani

Abstract

The compression strength of the light-weight concrete depends on different factors such as the kind and strength of light-weight aggregate used, water/cement ratio, the age of concrete, curing method, and water absorption rate of the aggregates. In this research the effect of water absorption rate of the aggregates on compression strength of concrete is going to be discussed.

To do so, four kinds of concrete using four different types of aggregate were built and studied. In the mentioned research it was seen that the highest strength was obtained by a low-weight aggregate called Lika.

Key words: compression strength, water absorption, curing, water/cement ratio

1. Introduction

Nowadays light-weight concrete is produced through adding special additives to concrete. In fact one of the two following methods is employed to produce low- weight concrete:

1. Using special bubble-making additives which lighten concrete such as (bubble or gas concrete), if this method is employed concrete production phases and mixture plan will differ.

2. Using low- mass materials such as Gorvee instead of sand or gravels or utilizing special artificial materials with similar physical function as the existing concrete materials(like Fiberglass , welded wire fabrics and Polystyrene isolated layer instead of bars or frames existing in the concrete)[1],[2]

2. Data and Material

The specifications of mineral aggregates have brought about many uses for light-weight concrete. The most important characteristics of light-weight concrete is low weight, easy transportation, high efficiency in structures, suitability for surfacing, resistance and load carrying in specific circumstances, thermal isolation, fire resistance, sound isolation, resistance against freezing, protection against dampness, and durability against lime materials.

Depending on the weight and strength required for light-weight concrete as filling materials, light-weight concrete can be filled to into the member in site or can be used as prefabricated construction members or blocks. In each case according to the use and construction method proper aggregation is used. Filling and isolating concrete are mostly used in foundation and bases, sloping floors and roofs, blocks, or the none-carrier parts of separating and surrounding walls. However structural light-weight concrete –which is often isolating too- are used in making resistant members such as load carrying blocks, reinforced wall and ceiling slabs, and reinforced frames of the structures as well. Generally speaking based on a common definition light weight concrete is less than 1840 kg/m3.Usual concrete (heavy) generally is heavier than 2400 kg/m^3.Current light-weight concrete is generally less than 1000 kg/m^3 which means that they are lighter than water.[3],[4].
Light-weight concrete production and utilization has started since early 20th century and is mostly used in construction industry. Other industrial uses such as isolators, fire resistant bricks, and special industrial profiles have been reported. Generally light-weight concrete is produced due to using porous materials or because of producing porosity in concrete texture. Light-weight concrete has been produced in Iran in the past and present which is known as light-weight industrial concrete and light-weight gas concrete each of which is harmful to the environment in a way. Nowadays in developed countries, these kinds of concrete have been replaced with air-entrained concrete. [5]

3. Materials and methods

Experiments have been carried out in Shabestar Azad University and in all experiments 10 cm^3 samples were used. Mixture plan consists of type 2 Portland cement, and Lika, Gorvee, Azerbaijan and Damavand light-weight mineral materials with different aggregation and water rates. It must be considered that in all conducted experiments values of concrete components are presented in *kg/m^3* and compression strength in *Mpa* units.
The curing method of samples was to keep them wet for a day in casts in wet bags and then up to the experiment date submerged curing in laboratory circumstances was applied.

Type of light-weight material	Lika	Gorvee	Azerbaijan	Damavand
Water absorption percentage	42.25	39.45	53.46	55.35

Table (a): Water absorption rate of the aggregates

shomare	Azerbaijan [1.18-2]	Azerbaijan [2-2.36]	Azerbaijan [2.36-4.75]	Azerbaijan [4.75-9]	cement	water	Compression strength 1 days	Compression strength 7days	Compression strength28 days	density kg/m^3
1	200	200	200	200	300	150	2.30	3.22	3.86	910
2	200	200	200	200	250	150	1.99	3.08	3.45	862
3	200	200	200	200	200	150	1.74	2.76	3.15	821

Table (1): Compression strength of concrete made using Azerbaijan light weight material in different ages

shomare	Gorvee [1.18-2]	Gorvee [2-2.36]	Gorvee [2.36-4.75]	Gorvee [4.75-9]	cement	water	Compression strength1 days	Compression strength 7days	Compression strength 28 days	density kg/m^3
1	200	200	200	200	300	150	2.38	3.27	4.09	948
2	200	200	200	200	250	150	2.22	3.18	3.63	896
3	200	200	200	200	200	150	1.89	3.01	3.36	885

Table (2): Compression strength of concrete made using Gorvee light weight material in different ages

shomare	Lika [1.18-2]	Lika [2-2.36]	Lika [2.36-4.75]	Lika [4.75-9]	cement	water	Compression strength1 days	Compression strength7days	Compression strength28 days	density kg/m^3
1	200	200	200	200	300	150	2.31	3.25	4.01	940
2	200	200	200	200	250	150	2.04	3.10	3.55	890
3	200	200	200	200	200	150	1.86	2.85	3.20	875

Table (3): Compression strength of concrete made using Lika light weight material in different ages

shomare	Damavand [1.18-2]	Damavand [2-2.36]	Damavand [2.36-4.75]	Damavand [4.75-9]	cement	water	Compression strength1 days	Compression strength7 days	Compression strength28 days	density kg/m^3
1	200	200	200	200	300	150	2.24	3.09	3.76	905
2	200	200	200	200	250	150	1.94	3.01	3.42	848
3	200	200	200	200	200	150	1.71	2.67	3.12	815

Table(4): Compression strength of concrete made using Damavand light weight material in different ages

Conclusion:

General lightness of the structure reduces the destruction risk caused by earthquake waves because structural bulking vibrations in lateral loads has direct relation with structural weight.

Compression strength of low-weight concrete like conventional concrete increases as time goes on. However this strength increase is less dependent on weak curing or dry environmental circumstances. The water saved in the pores in the light-weight material lengthens internal curing.

In these experiments the highest water absorption rate was for Damavand light-weight material and the least was for Gorvee light-weight material and the highest strength was for the Gorvee light-weight material and the least was for Damavand light-weight material. This shows the higher water absorption rate the less the compression strength is.

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