Comparison of Uniaxial Compressive Strength of Light Weight Concrete Prepared with Bagassese between Cubic and Cylindrical Specimens

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Abstract: Sugar cane had been one of the most important agricultural products in the province of Khuzestan in Iran Country. Because of that since a long time ago this region has been called "The sugar Cane Region" or "Khoozestan ". In the process of sugar cane refinery, yellow fibers called Bagasse are generated which are known as the wastes of this product. About one million tons of Bagasse is produced in the province of Khuzestan each year, which could be a source of bioenvironmental problems and environmental pollutants. In this study, this tributary product which had been used before by the author and his co-workers (**labibzadeh, et. al., 2011**) to generate a kind of Light Weight Concrete (LWC) was more examined in order to investigate its effect on the relationship between the compressive bearing of the proposed LWC with different shape samples (cubic and cylindrical) including Bagasse. To perform this work, at the first a constant mixing plan was considered according to ACI-211.2 standard code, then some samples were prepared according to this strategy, without adding Bagasse and after curing, they were tested. Then, samples with the mentioned mixing plan and 10,20,30,40 &50 percents of including Bagasse were designed to substitute the aggregates in the mixture and after curing these samples according to standard code manual ACI-211.2, the corresponding tests conducted and the results have been deduced and interpreted. The results showed that the ratio of compressive strength of cylindrical samples to cubic ones of the normal concrete for mass concrete is 0.89 which can be increased to 1 for 20% including Bagasse light weight concrete. Here, the point which should be considered is the noticeable reduction of this ratio for 30% Bagasse concrete which is equal to 0.988 to 0.404 for 40% Bagasse concrete.
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1. Introduction

In concrete buildings, concrete has a very important role in the whole structural load bearing capacity and the reduction of its weight leads to significantly considerable advantages. The advantage of obtained Light Weight Concrete (LWC) has been very sensible from very ancient times. Many authors stated in their investigations that the light weight concrete has many advantages, including the high ratio of strength to weight, good tensile strength and low temperature expansion coefficient. In addition, when the concrete becomes lighter, workers will tolerate less pressure for shipping and casting it in comparison with mass normal weight concrete, and also the gross weight of materials which must be carried out will be reduced. The reduction of the dead weight of a building will result in the reduction in the cross-section of columns, beams and foundations which will be resulted in the reduction of construction cost and earthquake loadings (Liu, et al., 1995). In the recent years, considering the bioenvironmental pollutants issues and the tendency to garbage and waste materials recovery for further usage in the developing and industrial countries has allocated a huge capital to itself. Nowadays, the common method in consuming the agricultural wastes is burning them in the open air which turns them into ash and that ash returns to the earth i.e. "from ashes to ashes". In some countries, burning these wastes in the open air has been forbidden, since it leads to polluting the environment and causes various illnesses in human beings (Tommy, et. al., 2006). Bagasse is one of these agricultural wastes. In the refining process of sugar, yellow-colored fibers called Bagasse are generated as tributary product. About 1 million tons of Bagasse are produced each year in the province of Khuzestan which brings about some bioenvironmental problems.

There exist few researches on using Bagasse in concrete making and they are limited to its usage as a substitute for cement. Gansan, et.al, (2007) have studied the effect of Bagasse ashes as a substitute for cement on the physical and mechanical characteristics of hardened concrete. They found out that the Bagasse ash is a useful mineral and the optimal substitution amount for cement is 20%. Chaslip, et. al, (2009) have studied the use of ash as a substitute for cement and have evaluated the characteristics of pressure drag, permeability and the temperature of Bagasse ash concrete and found out that the optimal amount of using Bagasse ash in the mixture as part of the cement is 20% of cement weight. When this ratio increases to 30%, the permeability and the pressure drag will be reduced.

Most of the researches on Bagasse in concrete were associated with using it as a replacement for cement in order to improve concrete mortar. In this study, based on the previous study of the authors (**Labibzadeh, et. al., 2011**) fibers of Bagasse are used, in a new vision, as a replacement for aggregates and we will investigate the pressure drag of cylindrical and cubic samples and their relationship with each other.

2. Material and Methods

The cement consumed in this research is the 2th brigade of Dorood-Lorestan with with density of 3.15 and specific area of about 3350 cm^2 /gr. Bagasse fibers used in this study has obtained from Dezful – Hafttappeh sugarcane agro- industry factory and has 64 kg per cubic meter specific for loose specific weight kind and 129 kg per cubic meter for dense type and the moisture absorption of it about 50%. The consumed water is the drinking water of Ahvaz. The aggregates used in this research are from the fluvial Ballast of province of Dezful. The gravels have two dimensions with 50% gravel 3/8 in and 50% gravel 3/4 in with 1.16% moisture percentage and 1526 kg/cubic meter specific weight, 43% vacuum and 2.68 density. Furthermore, the sand with 5.8% moisture, 1724 kg/cubic meter specific weight, 35%vaccum and 2.64 densities has been used in the mixture of LWC.

The mix design of consumed concretes with having different percentage of Bagaase has been shown in table1.The numbers mentioned are for 1 cubic meter volume concrete.

Table 1. Mix design (kg in $1m^3$ concrete)

Bagassese	Water	Cement	Sand	Coarse	
0	160	340	840	1130	CC
32	176	340	672	904	CB20
48	184	340	588	791	CB30
63	192	340	504	678	CB40
79	200	340	420	565	CB50

It should be mentioned that Bagasse has been substituted by the aggregates in such a way so that its volume remains constant. The values in the table1 are measured in kilograms. Also, since the Bagasse absorption is 50%, surplus water consumed in the mixed design in order to avoid the moisture reduction of concrete and has been added to the aforementioned content of water in table 1. The mixtures were made manually in order to control the moisture, pour out in three layers into the cast and each layer has been compacted by 25strokes by the standard rod and its surface was level. After 24 hours, the samples are brought out of the cast and were located in the curing water basin. Totally, in this research 60 cubic and cylindrical samples have been made.

Figure 1. Dorood-Lorestan cement used

Figure 2. Bagasse used from Dezful – Hafttappeh sugarcane agro- industry factory

Figure 3. The cubic and cylindrical samples

Figure 4. Fracture of the cubic sample of LWC

Figure 5. Different mode of the fracture of the cylindrical and cubic samples of LWC including Bagasse

After curing the samples, the uniaxial compressive strength of the cubic and cylindrical units made of the proposed light weight concrete including Bagasse has been investigated through performing the standard test. In the next section the results of the tests have been illustrated using tables and figures.

3. Results

The results of the compressive strength tests over 60 cylindrical and cubic samples and their specific weight have been shown in table 2. Left hand column shows the value of the specific weight of the proposed LWC. Right hand column shows the percentage of the Bagasse used in the LWC. The middle columns illustrate the compressive strength of the cubic and cylindrical samples.

Table 2. The rate of resistance loss and the specific weight

Specific weight kg/m^3	Cubical compressive strength kg/cm^2	cylindrical compressive strength kg/cm^2	Curing time days	Baggase %
2470	240	205	7	o
	300	270	14	
	410	359	28	
2125	137	128	7	20
	180	172	14	
	238	230	28	
1950	103	77	7	30
	130	103	14	
	177	150	28	
1780	68	26	7	40
	87	36	14	
	119	47	28	
1610	51	20	7	50
	81	29	14	
	110	41	28	

It should be mentioned that the 60% Bagasse concrete couldn't resist any force instead of the aggregates and it relaxes after stripping. It could be seen from the aforementioned table that all 20% and more Bagasse concretes could be considered as light weight ones. Table 3 shows the ratio of the pressure resistance changes of the samples in comparison with the natural concrete (0% Bagasse).
As it is clear from the aforementioned table, the compressive strength of the Bagasse cubic and cylindrical samples in all the curing periods have a considerable reduction.

In order to compare the compressive strength of cylindrical and cubic samples and their relationship, figures 1, 2, 3, 4 and 5 have been derived and illustrated. As we see, in order to obtain the relationship between the compressive strength of cubic and cylindrical samples, linear regression has been used. The high regression coefficient of these diagrams indicates the high preciseness of this approximation. The gradient of regression lines shows the ratio of compressive strength of cylindrical samples to the compressive strength of cubic samples with a high approximation. As it could be understood from the samples, the ratio of compressive strength of cylindrical samples to cubical ones for mass concrete is 89% which increases to 1 for 20% Bagasse concrete and then this ratio will be reduced for the other percentages. But the point which should be considered in these diagrams is the noticeable reduction of this ratio for 30% Bagasse concrete from (0.988) to 0.404 for 40% Bagasse concrete. This could be the result of the change in the concrete structure from 30% to 40% and the rigid core of cubic samples which are more conspicuous than before.

Table 3. Change in strength and specific weight due to change in Bagasse values

Specifc weight kg / m^3	Cubical compre-ssive strength kg / cm^2	cylincal compre-ssive strength kg / cm^2	Curig time days	Baggase percentae
-14%	-43 %	-38%	7	20
	-40 %	-36%	14	
	-42 %	-36%	28	
-21%	-57 %	-62%	7	30
	-57 %	-62%	14	
	-57 %	-58%	28	
-28%	-72 %	-87%	7	40
	-71 %	-87%	14	
	-71 %	-87%	28	
-35%	-79 %	-90%	7	50
	-73 %	-89%	14	
	-73 %	-89%	2	

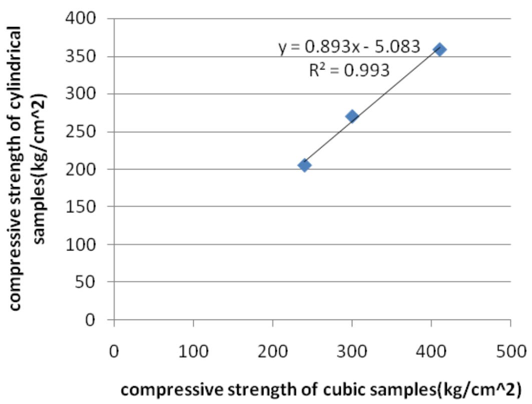

Figure 6. The relation between cylindrical and cubic compressive strength of normal concrete (0% Bagasse)

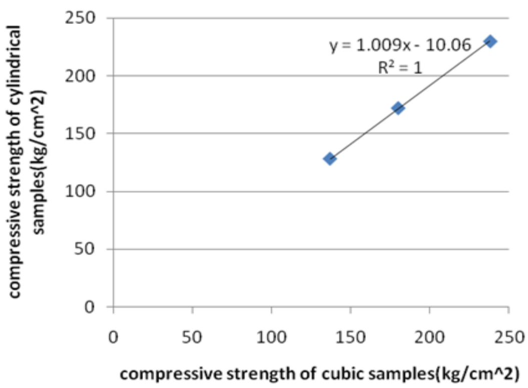

Figure 7. The relation between cylindrical and cubic compressive strength of LWC (20% Bagasse)

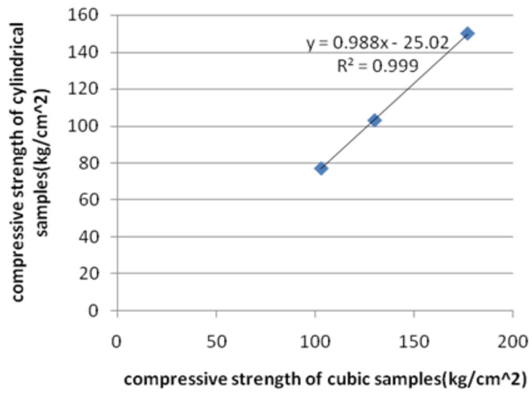

Figure 8. The relation between cylindrical and cubic compressive strength of LWC (30% Bagasse)

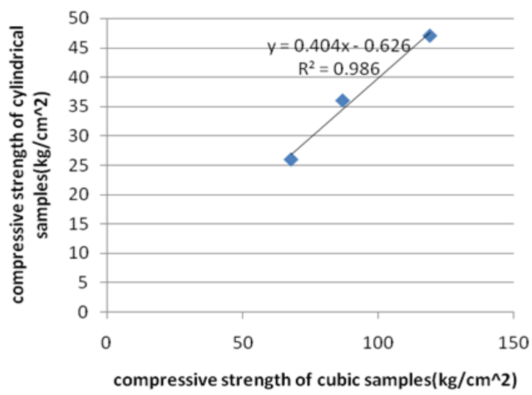

Figure 9. The relation between cylindrical and cubic compressive strength of LWC (40% Bagasse)

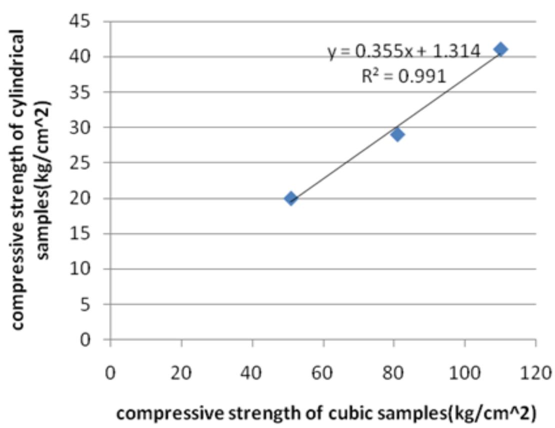

Figure 10. The relation between cylindrical and cubic compressive strength of LWC (50% Bagasse)

4. Discussions

The 60% Bagasse concrete which is used instead of the aggregates could not tolerate any force and it will be relaxed after stripping.

All 20% and more Bagasse concretes could be considered as light weight concrete.

The compressive strength of concrete is reduced by the substitution of Bagasse for the aggregates which could be resulted in weakening and deleting of the main skeleton of the aggregates.

The compressive strength of the cubic samples is greater and more unified than the cylindrical samples.

The ratio of the compressive strength of cylindrical samples to cubic ones is 89% for the mass normal concrete (0% Bagasse), which increases to 1 for the Bagasse concrete (LWC) and then reduces for the other percentages of the Bagasse. The remarkable point is the conspicuous reduction of this ratio from 30% Bagasse concrete (0.988) to (0.404) for 40% including Bagasse LWC which could be due to the change in the concrete construction and the rigid core of the cubic samples which shows itself more conspicuous than before.

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