Analysis on the Strength of 5" CUB with Oyster Shell as Component of the Aggregates

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Abstract

This study explored the possibility of using oyster shells as component of aggregates in the production of 5" CHB by determining its compressive strength and comparing this to the strength of 5" CHB taken from the construction site.

Twelve (12) samples using different proportions were produced by researchers and another three (3) samples were taken from the construction.

All the samples brought to the testing laboratory are below the required compressive strength for non-load bearing concrete hollow blocks. However, it is noteworthy that the samples with oyster shells have higher compressive strength compared with the samples taken from the construction site.

It was also found out that the lesser the number of pieces of CHB produced the higher is the compressive strength.

There are also significant differences among and between the 5" CHB produced using different proportions including the samples taken from the construction site.

Introduction

Background of the Study

In the Philippines, concrete hollow blocks (CHB) are commonly used for exterior and interior walls of buildings especially residential projects. It is also used for perimeter fence, tank, septic vault, drainage canal and many more.

The growing demands of housing projects have led to the increase of construction materials, particularly the cement and aggregates. Since concrete hollow blocks is made of cement and aggregates, it follows that an increase of one material will affect the cost of CHB. Considering the present economic crisis, the low income household especially those from the coastal areas will be deprived from having houses made of concrete hollow blocks. The researchers were, then, prompted to develop a new component in the production of concrete hollow blocks which are available from the available area and can be taken for free to reduce the cost of concrete hollow blocks.

Significant researches were already conducted on many different materials for aggregate substitute such as granulated coal ash, blast furnace slag or various solid wastes including fiberglass waste materials, granulated plastics, paper and wood products/wastes sintered sludge, pellets, burnt bagasse ash and others. However, the researchers' concern is to look for materials in the coastal area which can be used as component of the aggregates for CHB production which is not expensive but with equal or greater compressive strength as the commercial CHB or CHB with 100% aggregates.

Oyster shells *(Crassostrea gigas)* are abundant in the coastal areas of the Ilocos Region. Some shells are being brought back to the hatchery to produce larvae, but the excess of the oyster shells are filed along the coastal areas which if not recycled become garbage. The researchers were challenged to conduct a study on other way to recycle the oyster shells which could benefit the oyster growers and the community and in same manner will reduce the cost of CHB needed for low-cost housing.

A proportion of oyster shells and aggregates were mixed with cement to produce a 5" CHB to determine the compressive stress and compare this with 5" CHB using 100% aggregates and the 5" CHB which are available in the market.

The result of the laboratory test can be used as basis for other proportions which could meet the desired compressive stress for non-load bearing S" CHB. Thus, mixtures which Will be developed can be recommended for the production of 5 CHB for the constnJCtion of low cost housing. In effect, the problem of waste disposal along the coastal areas will be minimized.

Objectives of the Study

The main objective of this study is to determine ways to recycle oyster shells that would Peneft the oyster shell growers and the environment. The following are the specific objectives:

1. Determine the compressive strength of 5" CHB using different proportions
2. Determine the number of 5 CHB produced per bag of cement using different proportions
3. Determine the unit cost of 5" CHB using different proportions
4. Compare the compressive strength of 5" CHB using different proportions

Significance of the Study

Concrete hollow blocks, being one of the most commonly used construction materials for buildings, has resulted to the increase of its cost. The use of additional material which are abundant and can be acquired for free can reduce the cost of concrete hollow blocks.

The researchers were prompted to conduct a study on the analysis on the strength of 5" CHB wall with oyster shell as component of the aggregates because oyster shells are abundant in the coastal area and it is believed that the cost of production is cheaper. Likewise, problem on waste disposal will be minimized. It can also be a great help to oyster growers because the excess oyster shells can now be used to build their houses, fences tanks and canals at a cheaper cost.

Review of Related Literature

Concrete hollow blocks are classified as bearing and non-bearing blocks. Load bearing blocks are those which thickness ranges from 15 cm. to 20 cm. and are used to carry load aside from its own weight. Non-bearing blocks on the other hand, are blocks which are intended for walls, partitions fences or dividers carrying its own weight which thickness ranges from 7.5 cm. to 10 cm. (Fajardo, 2000)

The compressive strength of hollow blocks for non load bearing is 350 psi for individual and 300 psi for an average of 5 CHBs. (PTS 661-09:1968)

Concrete hollow blocks has three whole cells and two one-half cells at both ends having a total of four. These cells vary in sizes as there are different manufacturers using different moulds.

All concrete masonry units are modular in size. The largest units, called blocks, have nominal face dimension of 8 inches in height by 16 inches in length and nominal thickness of 4, 6, 8,10 or 12 inches. The actual dimension is in all cases 3/8" to allow for the thickness of the joint. Permissible dimension tolerance is 1/8" but the practical deviation rarely exceeds 1/32" (Amistad, et.al., 1996).

In the study of Amistad, et.al. (1996) on the Compressive Strength Test of Concrete Hollow Blocks Manufactured in Ilocos Sur, it revealed that out of 137 samples, only two (2) surpassed the allowed crushing strength of 300 psi for an average of 5" CHBs. Likewise, the crushing strength has no significant difference among and between the commercial sizes taken from each manufacturer.

The result on the study of Sabalburo, et. al. (2009) showed that the compressive strength is higher for proportions with lesser CHB produced. Furthermore, the lesser the number of pieces of CHB produced the higher is the unit cost per CHB.

Scope and Delimitation of the Study

The scope of the study covered the testing of strength of 5" CHB produced using the proportions I:8:I (I bag cement, 8 cuft aggregates and 1 cuft oyster shells grind into aggregate size); I:9 (I bag cement, 9 cuft aggregates); I:8:2 (I bag cement, 8 cuft aggregates and 2 cuft oyster shells grind into aggregate size); I:IO (I bag cement, 10 cuft aggregates) and 5" CHB produced commercially.

Hypothesis

The researchers hypothesized at .05 level of significance that:

There are no significant differences among and between the compressive strength of samples produced using different proportions and taken from the construction site.

Methodology

This section presents the research design, sample, data gathering procedure.

Research Design. This study utilized the descriptive method of research. Out of the data gathered, findings were summarized, analyzed, and interpreted.

Sample. The samples used in this study are (15) fifteen pieces. 5" CHB with different proportions. The researchers hired laborers to produce 5" CHB using various proportions identified by the researchers. Samples of 5" CHB were taken from the construction site for testing as basis for comparison. Oyster shells were taken from the coastal area of Caoayan, llocos Sur.

Procedure

I. Oyster shells taken from Caoayan were rinsed with clean water and broken in sizes same as the aggregates.

2. Aggregates and oyster shells were mixed with cement as to desired proportions using the following proportions:

Samples	Proportions		
	Cement (bag)	Aggregates (cuft)	Oyster Shells (cuft)
A	I	8	1
B	1	9	
C	I	8	2
D	1	10	
E		commercial	

3. The mixed cement, aggregates and oyster shells were placed in a 5" CHB molder tamped and properly compacted.
4. Molded CHB is then placed on a flat surface and cured for 28 days. Samples were sprinkled with water twice a day.
5. After 28 days the three samples for each mixture were brought to BIP Geotechnical and Materials Testing Engineers, an accredited testing laboratory by the Department of Public Works and Highways and tested for compressive strength using the Universal Testing Machine.
6. The researchers also took 5"CHB from **a** construction site and brought to the same laboratory for testing.
7. The average compressive strength were computed and used as basis for analysis.

Discussion of Results

Table I presents the compressive strength of 5CHB using different proportions. It can be seen that Sample B proportioned at I bag of cement and 9 cuft gravel has the highest compressive strength, followed by sample D proportioned at I bag cement and 10 cuft aggregates.

It is to be noted that sample A proportioned at I bag cement 8 cuft aggregates and 1 cuft oyster shells has a higher compressive strength (204.12 psi) than Sample E which is **a** commercial 5" CHB (178.52 psi).

Table 1. Compressive Strength of 5" CHB Using Different Proportions

Samples	Average Compressive Strength (si)
A	204.12
B	332.77
C	177.28
D	242.80
E	178.52

However, all samples have compressive strength which is below the required compressive strength for non-load bearing hollow *blocks* which is equal to *350* psi.

It is noteworthy that on the study of Amistad, et.al. (*1996),* only two samples out of 137 samples taken from the manufacturer passed the allowed compressive strength.

This finding implies that concrete hollow blocks being used for building construction have compressive strength below the required strength for non-load bearing concrete hollow blocks which is 350 psi.

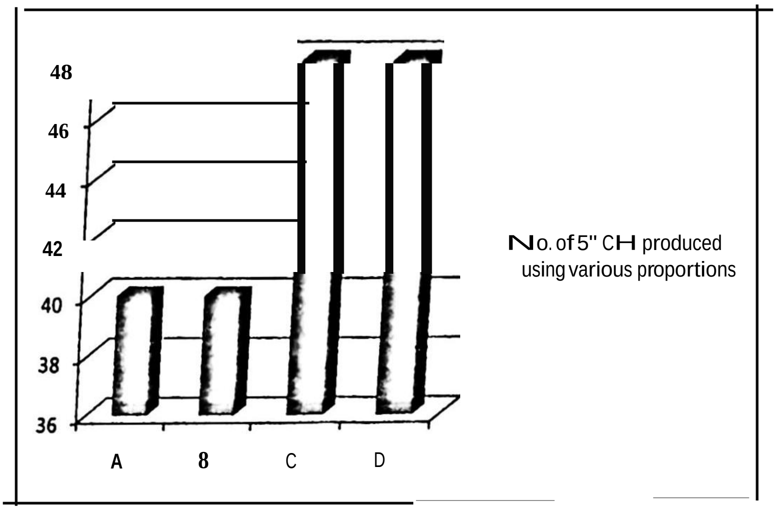

Figure 1. Number of 5" CHB Produced Using Different Proportions

ht is reflected in Figure I that Samples C and D has 48 pcs. *5"* CHB cach produced per b? of cement while Samples A and B has 40 pcs *5"* CHB each.

Sample E which **is a** commercial 5" CHB has no data on the number of pieces produced per bag, since this is produced in bulk taken from the construction site and the supplier was not identified.

The researchers have also noted the unit cost of 5 CHB produced using different proportions. Among the first four samples produced and proportioned by the researchers, sample B has the highest unit cost and sample D has the lowest unit cost.

Based on the result of the compressive strength it is to be noted that sample B has the highest compressive strength and sample D has the lowest compressive strength.

Table 2. Unit Cost of 5" CHB Produced Using Various Proportions

Samples	No. of Pieces	Cost				Unit Cost
		Cement	Aggregates	Labor	Total	
A	40	205	297.44	100	602.44	15.06/pc
B	40	205	334.62	100	639.62	15.99/pc
C	48	205	371.80	100	676.80	14.10/pc
D	48	205	297.44	100	602.44	12.55/pc
E						9.50/pc.

This confirms the study of Sabalburo et al (2009) that the compressive strength is higher for CHB samples with higher unit cost.

Table 3. ANOVA Table on the Compressive Strength of 5" CHB Produced using Different proportions

Source of Variation	Sum of Squares	Df	MSS	F
Between Groups	50,347.16	4	12,586.79	
Within Groups	25,858.53	10	2,585.85	4.88
Total	76,205.29	14		
	F@.0S= 3.48	Ho is rejected		

Table 3 shows the analysis of variance on the compressive strength of 5° CHB produced using different proportions.

It can be seen that the computed value of F which is 4.88 is higher than the tabular F-value at .05 level of significance which is equal to 3.48. This implies that there are significant differences among the compressive strength of 5" CHB produced using different proportions.

In order to determine which pair of group means were significantly different or not, the Scheffe' Method of Least Significant Difference or LSD was employed. The computed F value was compared with the critical F-value at the .05 level of significance.

Table 4. Multiple Comparison of the Compressive Strength of 5" CHB Produced using Different proportions

Comparison	F-test	Comparison	F-test
A versus B	2.4001	B versus D	109.8494
A versus C	0.1045	B versus E	267.2701
A versus D	16.0406	C versus D	42.5273
A versus E	6.0356	C versus E	0.0132
B versus C	270.3454°	D versus E	41.1016

The Scheffe's Test yielded that there are significant differences on the compressive strengths between the five groups as revealed in Table 4. It can be seen on the result that almost all the ratio are high which implies that there is a highly significant difference on means of each samples specifically between sample E (commercial) and the other samples prepared by the researchers.

Sample B with the highest average compressive strength and sample C with the lowest average compressive strength showed a highly significant difference.

Conclusions

Based on the findings of the study, the following conclusions were drawn:

I. The compressive strengths of the samples produced using different proportions and the samples taken from the construction site is below the required strength for non-load bearing concrete hollow blocks.

2. Sample with oyster shells proportioned at 1:8:1 has **a** higher compressive strength than the sample taken from the construction site.

3. The higher the compressive strength of 5" CHB the lower is the number of 5" CHB produced.

4. There were significant differences on the compressive strengths of the samples using different proportions.

Recommendations

In view of the aforementioned findings and conclusions derived from the study, the following are hereby recommended by the researchers.

1. Another set of proportions for 5" CHB with oyster shells shall be prepared in order to reach the required strength for non-load bearing concrete hollow blocks.
2. In as much as the samples taken from the construction site did not pass the allowed strength and these were being used for building construction, the 5" CHB produced with oyster shell can be used for low cost housing.
3. However, in order not to sacrifice the strength of buildings with more than one storey, the constructors should subject the concrete hollow blocks for laboratory testing before it is used for construction purposes.
4. The Department of Trade and Industry should monitor the concrete hollow blocks sold in the market so as to ensure the quality of products being bought by the consumers.

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