COMPARATIVE STUDY ON PROPORTION OF HOLLOW CONCRETE BLOCK TO ITS COMPRESSIVE STRENGTH

[1]SITTATI MUSALAMAH, [2]RECTIFA RIO, [3]RIRIT APRILIN SUMARSONO

[1,3]Department of Civil Engineering, State University of Jakarta, Indonesia
[2]Undergraduate Student of State University of Jakarta, Indonesia
E-mail: [1]smusalamah@unj.ac.id, [2]rectifario@gmail.com, [3]ririt-aprilin@unj.ac.id

Abstract- Wall as one of non-structural parts in a building is usually considered to be light material based. Concrete block and clay block are still chosen to be one of the most selected materials so that the strength can be fulfilled to support the loading even though the self weight of the wall cannot be considered light at last. However, concrete hollow block had been one of the solutions to fulfill both strength and weight in Indonesia since many earthquakes attacked for recent years. The absence of clear requirements on SNI 03-0349-1989 for gaining certain quality of hollow concrete block had created many failures in trial for reaching the target compressive strength. This paper will do comparative study on the proportion of hollow concrete block in order to help the producer, researcher, and public to get the target strength easily (Quality I of required compressive strength) based on the determination of fine aggregate quality and water cement ratio. The proportion of cement and fine aggregate was selected to be 1:1 to 1:6 and 0.5 for water cement ratio. The result refer that the proportion or 1:5 (cement to sand) was the minimum proportion to reach the no. 1 quality compressive strength target of hollow concrete block. Meanwhile, the absorption can be handled accurately below 25 per cent for the whole comparative proportion tested until the proportion of 1:6 (cement to sand).

Keywords- Hollow Concrete Block, Compressive Strength, Water Cement Ratio, Absorption.

I. INTRODUCTION

Characteristics of concrete – as well as hollow concrete block – was usually related to the aggregate, cement, and water. In the case of hollow concrete block, fine aggregate as one of the main components took much role in reaching the target strength. Moreover, the water cement ratio also played the important role of reaching the target strength. In general, the proportion of concrete block mixture based on SNI 03-0349-1989 was not clearly stated. The only way to reach the target strength can be performed by using amount proportion of cement almost equal to sand. The absence of detail standard for reaching the target quality of compressive strength for hollow concrete block had created some difficulties for the standard procedure of making hollow concrete block mixture for each quality. On the other hand, deciding for using more cement was not economical. This paper will focus on the study of getting the best proportion of hollow concrete block mixture in the minimum portion of cement. Some requirements on fine aggregate will also be detailed tested in order to get an acceptable conclusion for public to do as the guidance of making hollow concrete block in the future. Validity of the conclusion can only be applied for certain limitations made in this paper.

II. PRELIMINARY TEST AND EXPERIMENTATION

Preliminary test was performed for fine aggregate as the main focus. While the data of cement, could be originally taken from the manufacturer which was already compatible with the standard. Some tests done for fine aggregate was mud content, organic content, specific gravity, absorption, and sieve analysis. Sand was loaded from the mountainous area, but the raw condition was not suitable for the concrete mixture, so some treatments were applied until the quality matched the standard of hollow concrete block mixture which can be seen below.

Table 1: Preliminary Test Results for Sand

Parameter	Value
Mud content	3.03%
Organic content	-
Specific gravity	2.52
Absorption	0.04%

After doing sieve analysis test, sand can be categorized as fine granular sand of Zone 4 as shown in Figure 1. Overall treatments for sand had resulted the availability of the sand to be used for hollow concrete block.

Comparative study was conducted by making samples of concrete hollow block from different proportion of cement and sand starting from 1:1 to 1:6. The water cement ratio was set to be 0.5 which can be predicted to be best in workability (from 0.4 to 0.6). Each proportion of cement to sand ratio consisted of 30 samples tested for compressive strength value. Besides, there are 5 samples for each proportion to get the absorption value. In total, there were 230 samples to be tested for both compressive strength and absorption. The target compressive strength of this experiment was for Quality I. Requirements of each quality can be seen in Table 2.

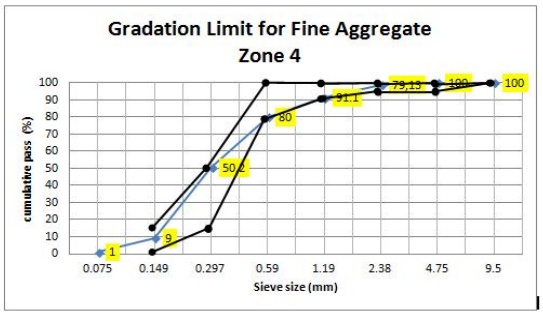

Fig. 1 Sieve analysis of sand

Table 2: Compressive Strength and Absorption Requirements of Hollow Concrete Block

Quality	Compressive Strength (kg/cm^2)	Absorption (%)
I	65	25
II	45	35
III	30	-
IV	17	-

III. RESULTS

Some physical experiment also detail checked to make sure that the samples are flawless to be suitable for compressive strength test. Since the samples were made by machine in the manufacturing company, the physical appearance was 100 per cent passed the investigation for further test.

Total area and/or volume of hollow for the hollow concrete block samples shouldbe minimum 25 per cent of total area and/or volume. These requirements also fulfilled the criteria.

3.1 Compressive Strength

Proportion of cement and sand from 1:1 to 1:5 shown to be fulfilling the criteria of Quality I which were the average compressive strength was 132.74 kg/cm^2, 110.15 kg/cm^2, 105.76 kg/cm^2, 70.84 kg/cm^2, and 68.50 kg/cm^2 respectively. The remaining proportion of 1:6 resulted for 59.13 kg/cm^2. The declining strength from the proportion 1:1 to 1:5 is slightly significant as shown in the figure below.

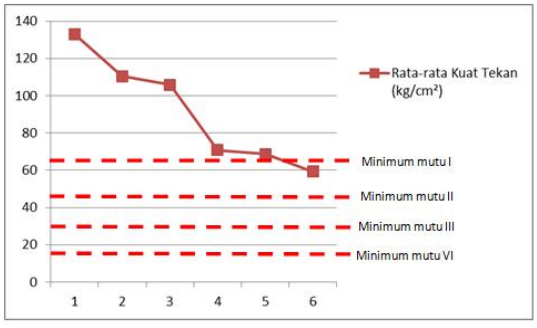

Fig. 2 Compressive strength for each proportion

The declining strength of the compressive strength for different proportion as the number of sand added because cement has more worked to done for bonding numerous volume of cement so the binding between each granular of cement limited. As the result, the ability for handling the load due to compression test to the specimen of concrete hollow block was less.

Furthermore, the presence of 3% of mud in the sand may also be judged as the lowering strength capacity as the number of sand increased. It can be predicted that reducing the mud content to the maximum will create better result even for the larger proportion of sand.

3.2 Absorption

Different result as described in Figure 3 where the absorption satisfied the standard for all the proportion. The proportion of cement to sand equal to 1:6 only reached the absorption of 11.17 per cent which was far below the standard of 25 per cent.

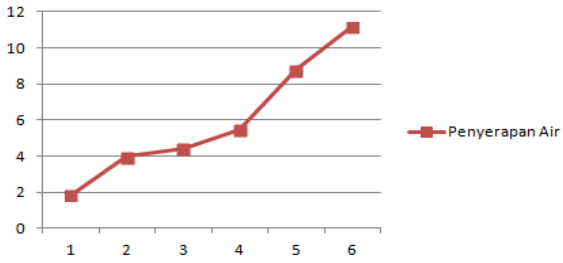

Fig. 3 Absorption of hollow concrete block

Further analysis for the increasing value of absorption can be explained by the presence of pores inside the hollow concrete block. Pores would be increased as the number of cement was being limited to bind higher portion of sand so that the void for the air will be available. During the wet condition, the air can be turn out to be replaced by water.

Take more focus on the 1:6 proportion of specimen where the target compressive strength was not fulfilled as the target of absorption reached. Moreover, the absorption was still far below the standard. It can be analyzed that the mud content of 3% participating in lowering the compressive strength for sure.

CONCLUSIONS

Based on the experiments performed in this research, there were some conclusions as follow:

a. The proportion of 1:5 (cement to sand) was proven to be the minimum proportion for gaining the target compressive strength of Quality I

b. Mud content below 5% will not guarantee the target compressive strength reach precisely. Preliminary treatment of sand should be needed as the mud content more than or equal to 5% in order to avoid the failure of target strength.

c. Water cement ratio of 0.5 was suitably workable for mixing the hollow concrete block as well as the target compressive strength.

d. The possibility of re-treatment of sand for the 1:6 proportion may increase the quality of hollow concrete block significantly to reach the target Quality I

FURTHER RESEARCH

Regarding many limitations made in this research, there will be many possibilities in the near future to increase the validity of proportion as the useful guidance for public to be easier to get the target compressive strength. We suggest some further research such as:

a. Consider more variations in sand. Maximizing the number of mud content may also be an advantage in order to eliminate the process of preliminary treatment for sand which usually takes time and cost.

b. Water cement ratio is also another determination that can be treated as the variable in order to see the best water cement ratio to reach both strength and workability.

c. Function and quality of the product of hollow concrete block will be better to be set first in order to minimize the treatment needed and failure of getting the target compressive strength.

ACKNOWLEDGMENTS

Funding from the Faculty of Engineering State University of Jakarta for this research was completely a big help. A fruitful discussion with our colleagues and good team work of our undergraduate student at the Department of Civil Engineering was worthwhile so that this experiment can be conducted in time with satisfying results.

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