Compression Earth Block (CEB) with Sawdust Production for the Wall of Simple Housing Workshop

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Abstract: The need of alternative material for red brick has increased in recent days. It is caused by the high amount of firewood needed during the production process. Meanwhile, the availability of firewood is significantly reduced. Compression Earth Block (CEB) is one of the wall material alternative using local soil without combustion process. The weakness of this block is the weight. The density of CEB is 1600 kg/m3 minimum. So that the research used sawdust from wood factory waste as a mixture to reduce the density of the block. The production of CEB and sawdust is not commonly found in the practice. So that it is important to spread the information about how to make the block on rural area (such as villages). The knowledge transfer was done by giving workshop for people who were interested and able to develop the workshop further. During the workshop, the researcher explained the importance of this building material and the relativity for the environment beneficial. The expected result from this workshop is that the participants are able to understand the importance of using factory waste as an alternative material to substitute traditional red brick.

1 INTRODUCTION

There are abundance sawdust created by the wood factory. The factory itself found difficulty to dissolve that abundance sawdust in Probolinggo. The waste itself has the potential to be used as material to make brick for simple houses by giving it a little modification. The waste is mixed with soil to make it more resistant towards water and more solid. Unlike red bricks, the production does not need combustion process. It needs to be compressed and naturally dried. The other material addition for this block is cement.

Compression Earth Block (CEB) is intended to be used as a wall material. The block is made from soil and cement. It does not require combustion process but it needs natural drying. The weakness of this block is the density, which is 1,800 kg/m^3. Adding another material into the mixture is needed to reduce the weight. Using sawdust as the addition for the CEB composition is able to reduce the soil volume. So that the CEB-sawdust block becomes lightweight and does not need combustion process.

The production of CEB is not commonly known in Indonesia. Many architects and building material experts do not know about this material. So that it is important to make a workshop about CEB-sawdust and its production process. At the same time, it helps to reduce the waste of wood factory by making it as a new alternative for building material. The obstacle found of this workshop is the appropriate composition of sawdust, soil and cement to make it meets the minimum standard of red brick compression force.

2 METHOD

The process of making CEB-sawdust consists of several stages. The production uses common and manual technology. Below is the explanation of the stages (Figure 1).

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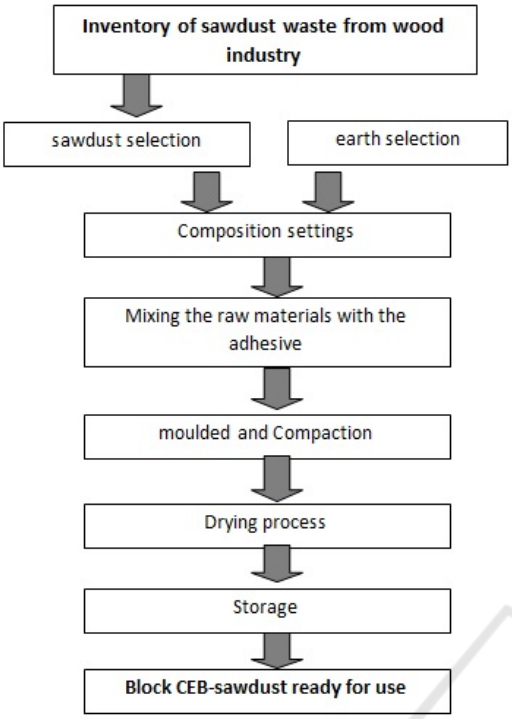

Figure 1. Activity stages

Molding and compressing the mixture increases the strength of the block. Table 1 below shows the composition of soil and sawdust used for the workshop.

Table 1. Material composition

Soil (%)	Sawdust (%)
30	70
50	50
60	40

The aims of the workshop are:

a. Training the wood industry community to make an alternative for building material to substitute red brick by using recycled material, which is sawdust.
b. Reducing the amount of waste produced by the wood factory by using it as a mixture to make bricks.
c. Producing standardized and environmental friendly brick.

The impacts of the workshop are listed below.

a. Stimulating the growth of building material alternative from waste and local material.
b. Reducing other building material production that contributes to the degradation of the environment especially forest due to the elimination of the combustion process.
c. Providing energy conservation and recycled building material.

3 RESULTS AND DISCUSSION

The workshop consists of 3 stages. The first stage is the early experiment on making the CEB with sawdust. Stage 2 and stage 3 are the workshop of making CEB with sawdust for architects.

3.1 Early Experiment

Before the workshop, an experiment was conducted to get the prototype of the CEB-sawdust using commonly found mold with the size of 10 x 20 x 5 cm. The making process of the CEB-sawdust is listed below.

- ✓ Preparing materials such as soil, sawdust, cement and lime (Figure 3)
- ✓ Adjusting material composition based on Table 1.
- ✓ Mixing all the materials evenly so that it had the same color.
- ✓ Molding and compressing.
- ✓ Drying without sunlight but using the surrounding air.
- ✓ The finished block is shown in Figure 2.

Figure 2. Forty percent sawdust block

Figure 3. Fifty percent sawdust block

Figure 4. Seventy percent sawdust block

3.2 Workshop

Young architects in Kabupaten Sidoarjo participated in the workshop program. It consisted of 2 stages. The first stage was a brief explanation about recycle brick which was CEB with sawdust in general. The second stage was the application of how to make the block as explained on the previous stage

3.2.1 The Explanation of CEB-sawdust

The explanation was held before the practice on making CEB-sawdust started. It gave an explanation about why and how to make CEB-sawdust. The talk explained what kind of soil that met the requirement of the block and how the process of making the block from the beginning was.

3.3 Block Making Practice

The practice of making CEB with sawdust is explained below:

3.3.1 Preparation

The material for making the block was prepared at the beginning such as sawdust, soil, cement, compression and supplementary tools. Figure 6 illustrates the material used for the experiment while Figure 7 shows the mould.

Figure 6. Experiment material

Figure 7. Mouldings

3.3.2 Measurement of primary material composition

The composition for the mixture are surrounding soil, cement in 10% heavier than the soil, lime in 10% heavier than the soil and sawdust. The percentage was calculated on the previous research which was the making of paper brick by the writer.

3.3.3 Mixing compositions

The prepared material was mixed in dry and damp condition. The stirring process without cement and lime took place in dry condition. On the other hand the damp condition was created by adding water during the stirring process. (Figure 8)

Figure 8. Mixing soil and sawdust

After the damp mixture became homogen, it went to molding process using commonly found mold. The homogen mixture was molded and compressed in damp condition (Figure 9, 10 and 11).

Figure 9. The mixture inside moulding

Figure 10. The mixture was ready to be pressed

Figure 11. The pressing

The damp brick then were taken of from the mold by pushing the mold in the down part (Figure 12). After that the block was stored in a specific space to get dried and avoid direct sun (Figure 13).

Figure 12. Taking the mould process

Figure 13. Wet soil and sawdust block

3.3.4 Obstacles and Solution

Sawdust brick is not commonly known among people. Many people had doubt regarding the excellency of the making process due to the assumption that the brick used a high technology. So that it is really important to run a workshop on how to make the block as well as providing a prototype. The duration to get the brick dry becomes another consideration since it took time to get the result.

4 CONCLUSIONS

Sawdust brick helped the wood industry to reduce the waste produced during the sawing process. Sawdust brick mixed with soil is an alternative to substitute red brick and never been commercialized before. The sawdust should be 50% of the soil weight to achieve the best composition while the cement should be 10% of the soil weight. The sawdust block is lighter than red brick. The density of sawdust block is 1000 kg/m^3

while the density of red brick is 1700 kg/m^3 so that sawdust brick is a convenient wall material in seismic area. The soil in the block functioned as a compressive strength enhancer. Without the soil the block is lightweight but easy to break.

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