Innovation of Iron Reinforcing Column of Partical From Frame of Light Steel

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Abstract. Almost half of houses in Indonesia are using lightweight steel roof truss today. The phenomenon in the field is that lightweight steel roof truss can blend with mortar mixture. Thus this phenomenon is captured for later applied dynamically, creatively, and innovatively with new idioms such as reinforcement for columns. This research aims to investigate the comparison of the way of making and the price of the materials between the column material made of the light steel and the column material made of the iron reinforcement which is the most efficient. Type of research is qualitative with a comparative causal approach. This research is divided into several stages, namely; Literature study, column creation, and validation. This study concludes that the manufacture of column material from reinforcement is more efficient, than the lightweight steel column material. The reinforcement column material is more efficient because of the more effective way of making and the price of the working materials more economical than the lightweight steel column material. Lightweight steel columns can be used for public housing on condition made by experienced craftsmen to make the process faster, and the dimensions of lightweight steel can be scaled down to make it more economical.

1. Introduction
Today, the world of residential construction has grown rapidly. The rapid development of housing construction also occurs in the world of construction in Indonesia, innovation is very important role in this regard. With the innovation, it is expected to create an end product of a fairly efficient construction. However, in reality today innovations in construction in Indonesia are considered immovable, this leads to inefficient construction work [1]. For small spans, the cost of lightweight steel roof truss is more efficient than wood [2]. Lightweight steel roof truss is a frame made of cold rolled steel silicon [3]. The use of mild steel as a roof truss more popular today. Almost half of the housing in Indonesia is already using lightweight steel roof truss, because the installation process is efficient [4].

Lightweight steel on buildings tends to be used only as a roof frame. The phenomenon in the field that lightweight steel roof truss can blend with mortar mix on the construction wall of horses made of red stone. This phenomenon is thus captured for dynamic, creative, and innovative application with new idioms such as reinforcement for practical columns. Practical columns serve to bind masonry pairs and funnel structural loads to buildings [5]. The purpose of this research is to investigate the comparison of the way of making and the price of the material between the column material made of the light steel and the column material made of the iron reinforcement which is consired the most efficient.
2. Literature Review

2.1. Practical Column Creation

The column practically serves as a binder and auxiliary wall of the main column. Maximum distance of practical column is 3 m. Practical columns are located on the wall, at meeting walls, and next to the door and window holes [6]. The practical columns occupy an important position in the building structure system. Practical column failures can have direct consequences on other structural components. In terms of the requirements for making practical columns, it should pay attention to cross-sectional strength [8]. The requirement of making practical columns has also been studied, it should also pay attention to the quality of concrete, and iron reinforcement. The column reinforcement consists of bending reinforcement and shear reinforcement. The bending hose is horizontally mounted and the shear reinforcement is mounted transversely [9].

At the practical manual column preparation stage, the compressive strength of concrete is made by means of low average manual (12.78 Mpa), so it does not meet the minimum requirement limits of compressive strength (20 MPa). The low compressive strength of the concrete column can not bear the combination of dead load, live load, and earthquake load. At the practical column preparation stage concluded that the practical column work stages are as follows: formwork stage, column reinforcement stage, and column casting stages. Thus it can be concluded that in the manufacture of practical columns should be considered cross section, concrete quality, reinforcement, compressive strength, and manufacturing procedures [8].

2.2. Dual Channel of C Profile

The current usage of channel profile C is not limited only for gording but also used as home structural elements such as columns [10]. The channel of C profile when used as a column and given a casting concrete cast, proved to prevent local buckling. To increase profile stability, reinforcement is used with reinforcing steel and add cast filler concrete within its profile [11,12]. The C profile of concrete filled with cracked patterns can prevent shear failure in concrete [13].

C canal profile beam with lightweight concrete filler can improve bending strength compared to beam C profile without lightweight concrete filler [14]. The channel profile C has a weakness in terms of stability. Therefore, in the application the profile needs to be given a stiffener and must be double installed. Thus it can be concluded that concrete C filled double channel C can prevent local buckling, increase load capacity, and add strength to the column, increase profile stability, and increase bending strength [15].

2.3. Efficient Principles on Building

Revenue is a description of the economic position of the household. If the income increases then the physical condition of the house will increase as well. The structure of the building must meet the requirements of stability, balance, strength, aesthetics, and economical. Terms of building construction in general should meet economic requirements, in the sense that there is no waste so that the financing becomes relatively efficient. The best structural system is attractive and cost saving. The results showed that the beams and columns of the house had smaller reinforcement dimensions than the installed reinforcement. This means that the reinforcement installed in the field is safe to use but can still be scaled to make it more economical [16].

To facilitate the implementation in the field should avoid the use of highly variable reinforcement with the aim of improving the efficiency of materials used. Commonly used wall-making materials are red bricks and concrete blocks. Red bricks and concrete bricks are the most economical wall materials. To save the cost, it is better that the brick installation should be flat so that the plaster has the same surface [17]. Thus it can be concluded that the principles for building structures require principles that are fast, economical, and effective in order to be efficient.
3. Research Methods

This research is a qualitative design with a comparative causal approach. This research is divided into several stages, namely; literature study, column creation, and validation. The literature study stage is presented in descriptive form.

The design stage consists of: making a column of lightweight steel material and a column of reinforcing steel material. The Validation stage is done by comparing the way of making and calculating the price of materials work in the form of data tabulation.

4. Results and Discussion

4.1. Comparison of How to Create

| No. | Category                                      | How to Make                          | Effectiveness How to Make |
|-----|----------------------------------------------|--------------------------------------|---------------------------|
| 1.  | Column material of Lightweight steel (3.00 m x 0.15 m x 0.15 m) | Stage of column framing               | Effective                 |
|     |                                              | Stage of making column molding        | Effective                 |
|     |                                              | Stage insert the column frame in to the mold | Ineffective            |
|     |                                              | Stages of making a mixture of columns | Effective                 |
|     |                                              | Stage of column casting               | Ineffective               |
| 2.  | Column material of reinforcing steel (3.00 m x 0.15 m x 0.15 m) | Stage of column framing               | Effective                 |
|     |                                              | Stage of making column molding        | Effective                 |
|     |                                              | Stage insert the column frame in to the mold | Effective            |
|     |                                              | Stages of making a mixture of columns | Effective                 |
|     |                                              | Stage of column casting               | Effective                 |
| 3.  | Equation                                     | All ways to make it effective except the stage of inserting mild steel in the mold and the pool casting stage |

Table 1. above explains that the steps of preparing the column material of light steel and the column material of the reinforcement have an equation. The first stage is the preparation of column frames. The second stage is making column molds. The third stage is to insert the column into the mold. Columns of reinforcement material are easily and rapidly performed at this stage. Meanwhile, lightweight steel of column material is difficult because an anchor is mounted on the column mold by drilling from side edges to sideways. At the stage of installing the anchor need carefulness because the anchor hole on the molding board must be translucent straight on mild steel to penetrate the side.

The fourth stage is the creation of a mixture of columns. The fifth stage is the column casting. The column material of iron reinforcement is easy and fast at this stage. Whereas, lightweight steel column material is difficult because the mixture is inserted from the top with a ladder. The cast
mixture is not only filled on the outside of the mild steel, but on the hole between the lightweight steel, so to insert the cast mixture need to be pierced with reinforcement. When inserting the mixture into a mild steel cavity should be done with great care because of the shape of a small hole, in the hole there is an anchorage iron, and the shape of large pebbles. Thus, the inner light steel is feared to be unfilled with the cast mixture, although it is pierced with reinforcing steel to mix the filling up to the bottom of the column mold (shown in Figure 1).

![Stage 1](image1)
![Stage 2](image2)
![Stage 3](image3)
![Stage 4](image4)
![Stage 5](image5)

**Figure 1.** The steps of making column materials of mild steel  
Source: Result of documentation 2017

### 4.2. Material Price Comparison

| No. | Work Materials | Column Material from Light Steel (3.00 m x 0.15 m x 0.15 m) | Column Material from Iron Reinforcement (3.00 m x 0.15 m x 0.15 m) |
|-----|----------------|-------------------------------------------------------------|---------------------------------------------------------------|
|     |                |                                                             |                                                               |
1. Iron reinforce with dia 6 mm 1 bars 26.000 2 bars 52.000
2. Iron reinforce with dia 8 mm - - 1 bars 36.000
3. Cement ½ sack 35.000 ½ sack 35.000
4. Sand 2 bars 10.500 2 bars 10.500
5. Gravel 3 bars 11.000 3 bars 11.000
6. Light steel 1 bars 75.000 - -

Total Price Rp. 157.500,- Rp. 144.500,-
Difference Rp. 13.000,-

Table 2 above explains that the price of working materials to reinforce column material is more economical (Rp 144,500,-) than the lightweight steel column material (Rp 157,500, -) and price difference is Rp. 13,000, - (thirteen thousand rupiah) per column.

5. Conclusion

This study concludes that the manufacture of column material of reinforcing steel is more efficient than lightweight steel column material. Column material of reinforcing steel is more efficient because the way of making is more effective and the price of working materials is more economical than lightweight steel column materials. Material of lightweight steel columns can be used for public housing on condition made by experienced craftsmen to make the process faster, and the dimensions of lightweight steel can be scaled down to make it more economical.

6. References

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