The Efficiency of Steel Material as Buildings Construction

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Abstract. The purpose of this paper is to inform the effectiveness of using steel construction in buildings nowadays with practicality and can minimize costs. This research used a qualitative analysis method by collecting data. The results of this research show that the use of steel construction materials is more effective, shortens the processing time, and can minimize costs in building construction. In conclusion, the transition steel construction is needed to reduce the current wood material and planting wood that is not balanced with the needs.

1. Introduction

Steel structures are metal structures made of steel components, it is structurally interconnected to carry loads and provide full rigidity. Steel has unique properties that are rust-resistant and is now applied to the construction field. The use of steel structures in construction makes new opportunities to arise from the shift towards sustainable development. The steel frame has many characteristics and can be utilized in the field of construction. The nature of the steel, which has corrosion-resistant, durable, and thin properties are widely used by architects to be shaped [1]. The structure is the most vital thing in a building. Along with the development of current technology now began to use structural materials that have practical properties in the process and with minimal costs but do not reduce the load. With the reduced current wood material and planting, the development of changing the use of wood to steel construction is very rapid because mild steel is a structural material that can shorten the processing time in constructing a building. The effectiveness in the use of steel structures greatly affects the construction cost savings resulting in savings of $ 700,000 in the County of San Diego, California [2].

The steel construction is more efficient than other materials. For example, a steel-concrete hybrid frame framework developed in the 380m high tower in Raffles City Chongqing. Both the steel of frame and concrete outrigger walls work together to improve the overall structural performance and deliver the load through hybrid systems. It shortens the overall construction period and reduces overall material costs [3]. The steel structure project is a field of construction projects that many factors have an impact on productivity in this field. This construction industry, especially the construction of steel structure projects, is considered as one of the main industries. This helps in developing and achieving community goals. The study and knowledge of construction productivity are very important because they affect the construction industry's economy; this is because prior knowledge of crew productivity during construction can save money and time [4].

The steel construction system can withstand the load and the floor constructed of mild steel or concrete profiles is such a suitable system for industrial production and can contribute to a more efficient development process [5]. Mild steel has a minimum strength of G550, which means that mild steel has a minimum melting strength of 550 MPa. During laboratory tests, mild steel must not break when pulled at 550 MPa. Besides, the steel has a shear modulus of 80,000 MPa and an elastic modulus of 200,000 MPa [6]. The Light Steel Framed construction (LSF) has the impact of reducing demand during several
stages of the building's cycle and it is crucial to a more sustainable built environment [7]. Through numerical engineering that steel construction can minimize costs and be very effective [8]. The purpose of this study is to determine the effectiveness of the use of steel construction in buildings against practicality and can reduce costs. This study used a descriptive method with qualitative methods to collect the data.

2. Method
This research used a descriptive qualitative method by collecting data, design and application, library research, and internet using previous research related to this research.

3. Results and Discussion
3.1 Wooden Roof Frame
The wooden roof truss is the most widely used roof truss type because this is easy to find and construct [9]. Making a wooden roof frame takes longer because it is a material from nature that requires time to process it first (See Figure 1).

3.2 Lightweight Steel Roof Truss
Making a lightweight steel roof truss requires a shorter time than using the wood material [10]. Light steel fabrication can be done in the factory or the field (See Figure 2).
Based on the results, steel construction is more effective in workmanship and can minimize costs in construction. It can be proven through an analysis of the cost of work using wood and steel materials (See Figure 3).

**Figure 2. Lightweight Steel Roof Truss**

| Type of Woodworking                                      | Total (IDR)  |
|---------------------------------------------------------|---------------|
| Install 1 m$^2$ construction of conventional easel     | 8,033,000,00  |
| wood class II, span 6m                                |               |
| Install 1 m$^2$ gording construction                   | 7,459,800,00  |
| Install 1 m$^2$ roof truss                            | 93,620,00     |
| Install 1 m$^2$ roof cover                             | 56,725,00     |
| Install 1 m$^2$ cam                                    | 77,280,00     |
| Install 1 m$^2$ bamboo scaffolding                     | 39,520,00     |

**Figure 3. Analytics Table**

| Type of Work on mild steel                          | Total (IDR)  |
|-----------------------------------------------------|---------------|
| Install 1 m$^2$ pairs of mild steel easel + batten   | 243,093,60    |
| Install 1 m$^2$ pairs of title roofs                | 48,050,00     |
| Install 1 m$^2$ cam                                 | 40,580,00     |
| Install 1 m$^2$ bamboo scaffolding                  | 39,520,00     |

Figure 3 shows the analytics table about the comparison of woodworking and work on mild steel type. We can see that the type of woodworking need a higher cost than the work on mild steel type. The comparison and results of time analysis of steel and wood construction can be seen in Figure 4.
Table 4. Analytics Table

| Description         | Wood                  | Mild Steel      | Comparison                               |
|---------------------|-----------------------|-----------------|------------------------------------------|
| Structural strength | \( \text{Ratio} = 0.16 \) | \( \text{Ratio} = 0.9 \) | Wood has a better ratio than mild steel |
| Structural weight   | 369,297 kN            | 276,561 kN      | Mild steel has a structural weight of 25.11% lighter |
| Budget Plan         | IDR. 237,521,371,90   | IDR. 194,913,484,22 | 17.93% more efficient than mild steel |
| Work Duration       | 85 days               | 85 days         | Wood requires more work than steel       |

Figure 4 shows the analytics table comparison between the wood and mild steel. We can see that the use of mild steel is more effective and efficient comparing to the wood.

4. Conclusion

With current technology that is growing, the construction sector is now starting to use structural materials that have practical properties and minimal cost. The transition steel construction is needed to reduce the current wood material and planting wood that is not balanced with the needs. Currently, steel material is growing rapidly, especially in Indonesia and is also easy to order through online sales.

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