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Implementation Method of Steel Construction in the City Furniture Center Building Construction Project in Surakarta

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***Abstract* - The development of building structures in the era of globalization and modernization has progressed rapidly. Building materials commonly used in the construction of buildings, towers, bridges, offices, hotels, and other buildings are a combination of steel and concrete. This development process is used in the construction stage. This research aims to obtain an effective work method in steel construction. The implementation method in a steel construction project requires a monitoring and analysis system that can provide results and input at an early stage regarding the development of project costs, so that it can determine whether the project is profitable for the implementer or vice versa. The application of steel construction implementation methods is used as a control tool in the implementation of construction projects. The implementation method becomes a benchmark in conducting the analysis, and a case study is conducted on the IKM Furniture Building Construction Project in Surakarta City.**

Keywords: Project, Building, Implementation Method, Construction, Steel.

I. INTRODUCTION

A project is a series of activities carried out within a specific time frame, utilizing available resources and aiming to accomplish predetermined tasks [1]. One type of project is a construction project. A construction project is a temporary activity that takes place within a limited time period, where specific resources are utilized to achieve specific goals and produce a product with clearly defined quality standards.

Project management is the collaboration of science and art aimed at achieving successful and beneficial project performance. Through the application of management functions, such as planning, execution, control, and other related activities, project management can have a positive impact on the smoothness and success of a project. Project management plays a crucial role in ensuring that the project progresses according to the established objectives and achieves the expected value for all stakeholders. These stakeholders include both central and local governments, private entities, and the general public. By involving and understanding the needs and expectations of each stakeholder, project management can direct and optimize the project's course, providing benefits for all parties involved [2].

Construction management is the systematic application of management functions, including planning, execution, and control, in a construction project. The main objective of construction management is to utilize available resources effectively and efficiently to achieve the project's goals optimally [3]. Construction methods refer to a series of activities carried out in construction execution, following procedures and designed according to tested knowledge and standards. The use of technology is an integral part of these methods, helping to accelerate the building construction process to meet expectations and improve efficiency in material usage.

Steel structure is a building material primarily composed of iron. Steel is formed through forging and heating, combining iron with carbon in a combustion process, resulting in a material with higher strength than iron [4]. This steel material is superior in terms of strength and rigidity. It is not surprising that steel is always present in construction projects such as bridges, buildings, and towers [5], although its volume may not always be dominant. However, despite its advantages, steel also has its drawbacks, particularly in maintenance and cost. Steel construction requires periodic painting as it interacts directly with air and water. Protection against fire risks is crucial because steel experiences a drastic loss of strength when exposed to high temperatures, and as a good heat conductor, it can accelerate the spread of fire within a building [6]. Another weakness of steel structures is the issue of buckling, which depends on the slenderness of its cross-section.

The planning regulations for steel structures in Indonesia are governed by the National Standardization Agency of Indonesia (Badan Standardisasi Nasional or BSN) through the Indonesian National Standard (Standar Nasional Indonesia or

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SNI). Previously, the "Tata Cara Perencanaan Struktur Baja untuk Bangunan Gedung" or SNI 03-1729-2002 was used as a guideline for planning steel structures in buildings, adopted on March 28, 2002. However, with the advancement of knowledge in the field of steel structures, especially after the issuance of new regulations by the American Institute of Steel Construction (AISC) in 2010, which introduced significant changes compared to the previous regulations, the Indonesian National Standardization Agency felt the need to revise SNI 03-1729-2002.

As a result, on March 12, 2015, the Indonesian National Standardization Agency issued a new regulation called "Spesifikasi untuk Bangunan Gedung Baja" or Specification for Steel Building, which serves as the reference for planning steel structures in building construction.

1.1 Problem Statement

Based on the description above, in this study, the authors took the following problem formulation: How is the way or work method of implementing the installation of Steel construction.

1.2 Problem Limitation

To clarify the research focus and limit its scope, the following problem constraints can be applied to this study based on suggestions from [7] and [8]:

1) This research will be limited to the review of steel construction installation work in the Furniture IKM Building Construction Project in Surakarta city.
2) The research will not include calculations or analyses of the steel frame structure within the building.
3) The focus of the study will be on the methods and procedures used in steel construction installation for this specific project.
4) The research will not include other aspects such as structural design, types of steel used, or other factors related to steel frame construction.
5) These constraints will narrow down the research scope and allow the researcher to study the steel construction installation methods in more detail for this project.

With these problem constraints, the research will be more focused on analyzing the methods or procedures used in steel construction installation for the Furniture IKM Building Construction Project in Surakarta, without involving calculations or analyses of the steel frame structure.

1.3 Research Objectives

The aim of this research is to comprehensively understand the steps or methods of implementing steel construction installation in detail for the Furniture IKM Building Construction Project in Surakarta city [9].

1.4 Research Benefits

The benefits of this writing are to gain an understanding of the methods or procedures for steel construction installation, which serve as a reference in the planning and execution of steel structure construction [10].

II. METHODOLOGY

The steps in this research are shown in the research flow chart.

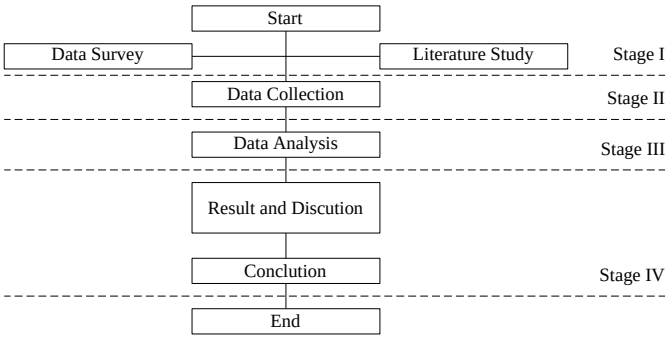

Figure 1: Research Flow Chart

III. ANALYSIS AND DISCUSSION

3.1 Steel Implementation Work Data

In the implementation of steel construction for the Furniture IKM Building Construction Project in Surakarta city, several important aspects need to be considered:

1) Type of Steel Construction: IWF (H-Beam) steel profiles with specifications WF 500, WF 450, and WF 400 produced by PT. KRAKATAU STEEL are used.
2) Number of Drill File Points: There are 148 points that require drill files as part of the steel construction installation process.
3) Shop Drawing and Work Equipment Preparation: Preparation of shop drawings detailing the steel construction plan and the arrangement of necessary work equipment during the implementation.
4) Labor and Work Safety Preparation: Preparation of skilled and qualified labor for steel construction work and the implementation of work safety measures in accordance with health and safety standards.
5) Equipment Used: In the steel construction work, heavy equipment such as mobile cranes and other necessary tools are utilized to facilitate the steel installation process.

These above-mentioned factors are essential considerations in the execution of steel construction for the

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Furniture IKM Building Construction Project in Surakarta city.

3.2 Steel Construction Installation Work Process Analysis

Here is Table 1 that shows the process of steel construction installation in the Furniture IKM Building Construction Project in Surakarta city:

Table 1: The workflow of steel installation work

No	Work
1	Bolt anchor installation and bolt anchor point determination of the anchor lavel height
2	Mobolization of steel material
3	Unloading, dismantling, or lowering of steel materials from the trailer truck and excavator
4	Installation of steel columns at designated anchor points according to the shop drawing and provide the necessary work equipment
5	Installation of Tie Beams
6	Installation of rafters on columns
7	Installation of steel rafter erection
8	Reinforcement of rafters using purlins
9	Setting the joint of the rafters and installing the rafters
10	Installation of purlins as wall bracing
11	Installation of rafters
12	Installation of trusses
13	Installation of the roof and installation of gutters

3.3 Measurement Process (Anchor Installation)

The anchor installation process must be completed before the mobilization of materials from the factory takes place. Below are the steps for the placement and installation of anchors:

1) Determining the location of column axes.

The way to determine is:

1) Making a local building plank.
2) Using a multiplex measuring template with a thickness of t = 9 mm and adding an axis.
3) Installing anchors inside the template and attaching 2 bolts above and below the template.
4) Pulling strings or using a pulled axis in 2 directions according to the right-angle direction.
5) Welding the anchors with the reinforcing steel of the column with the elevation adjusted with a water level.
6) Installing column formwork.
7) Casting the column. h. Removing the anchor template after the casting process is completed.

For base plates that have a thickness greater than 16 mm, it is recommended to adjust the thickness of the template to match the plate thickness or to individually check the vertical height of the anchor.

2) The determination of the building elevation must be in accordance with the construction drawings specified by the planner. Once the fixed points for the installation of anchor bolts have been identified, the implementation of steel construction work can proceed accordingly.

3) The determination of the points where steel construction will be installed or the points that will be anchored must be in accordance with the construction drawings specified by the planner. Once the fixed points are determined, the implementation of steel construction work can proceed, and the construction work can begin at that time.

3.4 The equipment used is a Mobile Crane Type

The KATO SR-250 is a type of mobile crane that has the ability to rotate 360 degrees at its upper part. Equipped with crawler tracks, this type of crane can move within the project site while performing its tasks. When the crane is needed for another project, it is transported using a low bed trailer. The transportation process involves disassembling the boom into several parts to facilitate the transportation process.

Here are the specifications of the Kato SR-250 Mobile Crane:

1) Average vehicle length during travel: 12 meters
2) Average vehicle width during travel: 2.5 meters
3) Average vehicle height during travel: 3.3 meters
4) Maximum speed during travel: 70 km per hour
5) Fully extended boom length: 32 meters
6) Maximum reach of the crane: 29 meters
7) Maximum lifting capacity: 25 tons

With these specifications, the Kato SR-250 has the capability to meet the lifting and load movement requirements in construction projects.

The assembly process of steel construction underneath is usually done for transverse direction portal structures before being lifted as a whole assembly. Once the transverse sections are installed, the upper part of the portal is connected to the longitudinal direction using lacing or slings to the nearest concrete or foundation to maintain balance.

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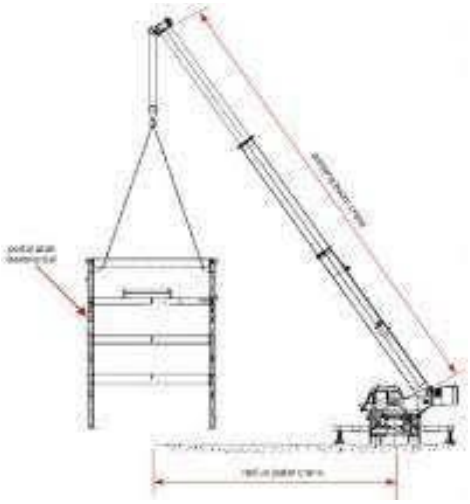

Figure 2: Illustration of crane use in the steel erection process

Here are some factors that need to be considered in the process of lifting steel construction:

a) Weight of the lifted object: It is necessary to calculate the overall weight of the object to be lifted, especially for structures that are assembled underneath first. In some cases, the position of the center of gravity of the lifted object needs to be known to maintain balance during the lifting process.
b) Type of crane used: The selection of the crane type is based on the weight of the lifted object, the lifting location, and the ground conditions in that area.
c) Required crane swing radius: The crane swing radius is determined based on the crane's lifting position, the initial location of the material to be lifted, and the foundation location.
d) Required crane boom length: The crane boom length is influenced by the height of the lifted object, the crane swing radius, and the foundation elevation.
e) Outrigger crane opening length: The outrigger crane opening length is determined based on the weight of the lifted object and the environmental conditions around the lifting area. The larger the outrigger opening, the greater the crane's lifting capacity.
f) Crane lifting capacity: The crane's lifting capacity can be obtained from the load capacity provided by the crane manufacturer. The determination of the lifting capacity is influenced by several factors, including the crane swing radius, the crane boom length, and the outrigger crane opening length.

These factors are some of the things that need to be considered in the implementation of steel construction work. By paying attention to these factors, it is expected that the process of steel construction execution can run smoothly and produce strong and safe structures.

IV. CONCLUSION

The factors that influence the implementation process of steel construction work are as follows:

a) Determination of Anchor Bolt L points for steel construction foundation: This process involves determining the precise points for installing Anchor Bolt L on the steel construction foundation. The selection and determination of these points are crucial to ensure the overall stability and strength of the steel construction.
b) Mobilization of steel construction materials using trailer trucks: The process of mobilizing steel construction materials involves using trailer trucks to transport steel components or materials from the factory to the project site. This requires proper planning to ensure timely and efficient delivery of materials.
c) Steel construction installation and execution process: This process includes the installation and execution of steel construction according to the established plans and specifications. It involves the use of appropriate tools and equipment, skilled labor, and good monitoring to ensure that the steel construction is installed correctly and meets the required standards.

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