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CHANGES IN THE INSTALLATION METHOD FOR SEGMENTAL ON-SITE STEEL STRUCTURES (ERECTION) TO LIFTING CENTER SPANS ON YOUTEFA BRIDGE (HOLTEKAMP)

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***Abstract*— This study aimed to determine the appropriate method for the implementation of structural steelwork at the Youtefa Bridge Construction in terms of execution time, work risk, and quality of work. This type of research was field research with a qualitative descriptive method, located on the Youtefa Bridge over Youtefa Bay which connects Jayapura City, Hamadi Village, and Muara Tami District, Papua Island. Data collection conducted by collecting supported data related to the implementation of the Youtefa Bridge, then analyzed on the implementation time, work risks, and the right quality of work to be applied in the Youtefa Bridge Construction. This study showed that the on-site method had not been fully implemented in the field. This is due to the high risk of construction, the assembly duration which takes at least two years, and the threat to the mangrove ecosystem around Youtefa Bay. Based on the method analysis, known that the right method for the Youtefa Bridge work is using the Lifting method. The Lifting method will ensure the safety of the work because the welding process is not carried out at a height. The quality of the steel frame installation is higher because all welding operations are performed in a factory whose quality is more tested when compared to the results of welding in the field, and the work execution time is shortened by 6 months and is faster than when performed on site.**

***Keywords*— Holtekamp, Bridge, Arch Bridge, Lifting Bridge**

I. INTRODUCTION

The President's instructions for equitable distribution of infrastructure development throughout Indonesia manifested in the announcement of the Holtekamp Bridge construction in Papua Province 2015. President Joko Widodo immediately laid the groundwork for bridge construction that will become the pioneer of the first arch bridge on the Papua Island. The Youtefa Bridge has a length of 732 meters, consisting of 400 meters of the main span and 332 meters of the approach span. This bridge has a connecting road of 2,750 meters on the Hamadi Beachside and 7,800 meters on the Holtekamp Beachside. The Arch Bridge with steel material and Box type was chosen in the construction of the Youtefa bridge.

The Holtekamp Bridge construction was located in Jayapura City, precisely above Youtefa Bay, connecting the South Jayapura District with Muara Tami. The Holtekamp Bridge construction aimed to solve the problem of population density in Jayapura City. With the Holtekamp Bridge, expected that the development of residential areas can occur evenly in Jayapura City. In addition, the Holtekamp Bridge can cut the travel time to the Skouw border from 2.5 hours to 60 minutes.

In the implementation of Youtefa Bridge Construction, the implementation method in the field initially used the Segmental On-Site structural steel assembling method was changed to the Lifting method with structural steel assembling conducted in Surabaya and delivered with barge. So, it is necessary to evaluate the Segmental On-Site Method and the Lifting Method on the Youtefa Bridge..

1. Problem Formulation

From the background above, the problem can be formulated as follows:

a. What is the most effective method to speed up time on structural steelwork on Youtefa Bridge?
b. How is the quality and safety of work using the lifting method on structural steelwork on the Youtefa bridge?

2. Research Purposes

The purpose of this research is as follows:

a. Determined the effective method to speed up the time of steel structure work on the Youtefa Bridge.

b.Determined the quality and safety of work with the lifting method on structural steelwork on the Youtefa bridge.

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II. THEORY

The Youtefa Bridge construction used an arch bridge-type because in substance the arch bridge has a local content of more than 95 percent, which is higher than the cable-stayed bridge. In addition to local content, the Arch Bridge will bring up regional landmarks as a new icon of Jayapura. For the government, Youtefa Bridge is the main capital to develop residential areas and the economy to the east, so the problem of population density and inequality in the city center is solved (Mawangi, 2020).

The bridge construction has challenges in its construction, one of which is an earthquake. Papua has a high earthquake intensity so there was hight risk of danger during the construction period. The next challenge is the implementation time, if there is no innovation in its construction, it is estimated that this work will be behind the deadline for implementing the work according to the work contract. So, it is necessary to conduct a study related to the appropriate implementation method for the steel structure of the Youtefa bridge.

Selecting the installation method of a bridge frame is the first and most important step in ensuring that the installation proceeds smoothly, based on the system chosen according to the natural conditions on the project site.

In general, the steel frame bridge installation consists of several methods namely, Full Scaffolding installation method, Cantilever installation method, Semi cantilever installation method, and Launch installation method.

In choosing installation methods such as full scaffolding, cantilevering, semi-cantilevering, and launching, it is necessary to look at several alternatives to the river conditions where the bridge frame built. It is important to consider several things when installing a bridge frame, namely:

1. The condition of the river where the bridge will build, the data collected is the width of the river, whether the river flows fast, river depth, whether the river contains rocks, sand, muddy, and so on.
2. Access roads or areas around the bridge, straight, flat, winding, sloping, high, low, under excavation, on top of a pile, and so on.
3. Availability of labor, equipment, and local resources in the area concerned.
4. Access to the location where the bridge will build for the transportation of materials, materials, and equipment, whether by land, river, or air.

The criteria for consideration in choosing the method of installing steel frame bridges include:

1. Full Scaffolding Installation Method, Full Scaffolding System according to river conditions as follows:

a. Having a sandy bottom or consisting of clay, facilitate the installation of supports.
b. Shallow, this situation will limit the size of the height of the support material itself.
c. The lower structure of the bridge is not too high above the high water, limit the height of the support material to a minimum.
d. Having a strong current, will reduce the horizontal forces on the support.
e. Free from drifting objects, keep the scaffold from breaking and collapsing.

2. Cantilever Installation Method, Full Scaffolding System according to river conditions as follows:

a. Has a deep mud bottom, requires long (high) materials (possibility of disappears).
b. The riverbed has large boulders.
c. Having a strong current, the supporting materials must be able to withstand the large forces that can cause the support to collapse.
d. The bridge located on narrow but deep rivers, so high support is needed.

3. Semi Cantilever Installation Method, this method requires combined river conditions of methods 1 and 2.
4. The Launching System method is a method with a full launch that does not require river conditions that have conditions such as the Scaffold and Cantilever method, but in practice, this method requires an area or location of a straight and long road because the frame bridge must be assembled on land, either a permanent frame or a frame as a counterweight (Counter Weight) which is then pulled or pushed across the river on a predetermined road.

Steel Frame Bridge is a bridge structure consisting of a series of steel bars connected. The load or load borne by this structure will be described and transmitted to the steel bars structure, as compressive and tensile forces, through the meeting points of the rods (gusset points). We always try to avoid eccentricity forces that can cause secondary moments. Therefore, the neutral lines of each bar that meet at the gusset point must intersect at one point only, to avoid secondary moments. Steel framed construction has several important considerations, namely:

1. The quality and dimensions of each rod must be strong enough to withstand the forces that arise. Frame rods are not in the damaged condition. Therefore, the bridge frame rods must be maintained during the transportation, storage, and installation period.
2. The strength of the connecting plate must be greater than that of the connecting rod (the joint structure must be stronger than the whole rod).
3. To maintain the occurrence of the eccentricity of forces that can cause secondary moments, the neutral lines of each bar that meet must intersect through one point (must plan the shape of the gusset plate correctly). The gusset plate at the end, both lower and upper gusset plates, 11 are usually exceeded in length, for connection with linking steel when required.

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III. RESULT AND DISCUSSION

Generally, Indonesian bridges are fully assembled on the construction site (on-site). Bridge frames are usually arranged segment by segment with the help of cranes and temporary towers, to form a complete bridge structure. This method is widely chosen because of the lower cost of the work, considering that almost all stages of development are carried out centrally in one place. However, the evaluation results from the consortium universities and their partners Wagner Biro Indonesia Ltd. showed that the method of assembling in stages takes a long time and even threatens to exceed the deadline given by the government as the owner of the bridge.

1. Analysis of Effective Methods for Youtefa Bridge Steel Structure Works

The on-site bridge frame assembling method on the Youtefa bridge feared that it will cause difficulties implementation in the field. The main difficulty in working on the Youtefa bridge is the location of the stretch which has high seismic activity in Youtefa Bay, Jayapura City. Large and medium magnitude earthquakes have a high potential to occur in these waters because the located close to the faults of the two Indo-Australian and Eurasian plates. So the on-site assembling method cannot be fully applied in the Youtefa Bridge Construction project. Moreover, considering the high risk of connecting the middle span on the field, which requires the welder to work above a height of more than 40 meters above sea level.

Thus, in addition to the relatively long time, the on-site assembling method must be re-evaluated to be applied to the implementation of the Youtefa Bridge Construction work. If you want to carry out work using the on-site method, then several things must be considered, namely:

a. High risk of work.
b. The duration of the assembly takes a minimum of two years.
c. The threat of the mangrove ecosystem around Youtefa Bay.

Based on these three main reasons, the on-site assembling method cannot be fully implemented in the Youtefa Bridge Construction. So, we need a new method to reduce the risk of work, speed up installation time and maintain the mangrove ecosystem around Youtefa Bay.

Another method that can be used is by using other method innovations. The innovation needed is changing the existing work method into something new and full of challenges, so the lifting method is used. At first the change in this method was answered pessimistically by various parties, because this method also has risks and is not common, where the construction of the bridge frame carried out in two places, namely in Surabaya and Jayapura. The finished frame in Surabaya will be sent to Jayapura by sea for 3200 km. After the skeleton arrives in Jayapura, it will be lifted in order to connect it to the frame, which has already been built in Jayapura. The process of lifting the 2000 Ton frame is the next challenge. Especially when the lifting activity D-1 came out of the moratorium on stopping the process of heavy and elevated construction work.

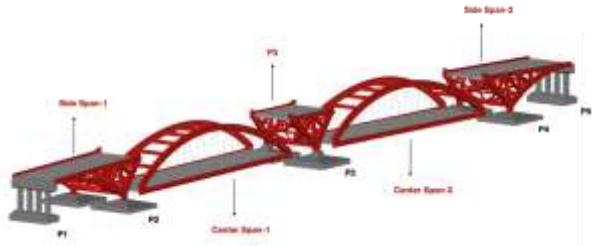

Fig. 1. Changes in Side Span and Center Span Segment Assembling Methods in Different Locations

All innovations that have been planned continue to be finalized and realized with careful planning and calculations, until this innovation is approved by all parties, especially by The Bridge and Tunnel Road Safety Commission (KKJTJ) which oversees the design to the implementation of the Holtekamp bridge. Based on the innovation of delivering a complete frame of 3200 km and lifting a complete frame, this project received 2 Indonesian MURI records (Delivery and Lifting). With the implementation of these innovations, the installation of structural steel is carried out 6 months faster than using the on-site method. So that the Youtefa bridge can be completed earlier than the target set by the government from 2019 to September 2018.

Fig. 2. Center Span Appointment in Jayapura

2.Quality Analysis and Work Safety with the Lifting Method

The Lifting Method will ensure work safety since the welding process will not carry out at a height that will cause work accidents, so there will be no work accidents on the work site (Zero Accident). The quality of the steel frame installation is higher because all welding operations are performed in a factory whose quality is more tested when compared to the results of welding in the field because in the factory there are complete human resources and tools without the need to be mobilized to the job site. And lastly, because of the middle span construction at PAL Ltd., there is no need for a large construction area in Jayapura to preserve the surrounding environment. The decision to use the lifting method by

moving the assembly location at PAL Ltd., is not only minimal risk and the high quality of the resulting bridge.

IV.CONCLUSION

Based on the analysis and discussion of the descriptive research on the Youtefa Bridge Construction, we can conclude the following conclusion:

1. According to the on-site method and lifting method, the lifting method is more effective at speeding up the steel structure work on the Youtefa bridge by six months faster than the on-site method.
2. The Lifting method will ensure the safety of the work because the welding process is not carried out at a height. The quality of the steel frame installation is higher because all welding operations are performed in a factory with complete human resources and tools

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