WORK ANALYSIS OF HYDRAULIC STATIC PILE DRIVER EQUIPMENT ON PILE FOUNDATION WORK IN TERMS OF TIME AND COST

(Case Study of the Physical Works Project and the Expansion of the Marabahan District Court Building)

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ABSTRACT

To make a building requires a strong foundation to withstand the load on it. the Physical Work Project, Renovation and Expansion of the District Court Building requires heavy equipment management in the form of piles, the piling method used is the Hydraulic Static Pile Driver. The pile management is needed to find out the estimated working time on the entire building so that the implementation goes according to or does not exceed the planned project time. Therefore, it is necessary to analyze the efficiency of the piling tool. The results of the descriptive analysis in this study obtained the production value of the Hydraulic Static Pile Driver tool. The highest production value was 0.23 meters/minute, and the lowest value was 0.21 meters/minute. The time required to complete the project erection work based on the planning is nine weeks, while the realization in the field to complete it in seven weeks. The planned implementation cost to complete the erection work for this project is Rp. 2,073,360,000. Meanwhile, the cost of field realization is Rp. 2,481,150,000. this means that the implementation costs in the field are greater than the planning costs of Rp. 407,790,000 this was due to the addition of 828.00 m³ of pile procurement volume and 828 m³ of piling and handling work, and 138 nos of pile connections.

Keywords: Productivity, Hydraulic Static Pile Driver, Efficient

1 INTRODUCTION

A building is a physical form resulting from construction work integrated with a place of residence either above, below the ground, and in the water. Buildings are usually connoted with houses, buildings or all facilities, infrastructure or infrastructure in culture or human life in building civilization, such as bridges and their construction and design, roads, telecommunications facilities, and others. The Physical Work Project for the Renovation and Expansion of the Marabahan District Court Building is a renovation project for the Marabahan District Court building with a contract value of Rp. 6,682,311,660.20, which is located on Jl. Puteri Junjung Buih No. 77 - Barito Kuala(Kab.). This project uses piles as the foundation with the condition of the soil on the island of Kalimantan, which will has quite a lot of texture properties, will affect the type of construction of the building. In the process of using the piling method on the building's foundation., the piling method requires heavy equipment management in the form of piles as the main tool in the implementing of pile foundation work. The pile management is needed to find out the estimated working time on the entire building so that the implementation goes according to or does not exceed the planned project time. Therefore, it is necessary to analyze the efficiency of the piling tool. The pile management is needed to find out the estimated working time on the entire building so that the implementation goes according to or does not exceed the planned project time. Therefore, it is necessary to analyze the efficiency of the piling tool. The
pile management is needed to find out the estimated working time on the entire building so that the implementation goes according to or does not exceed the planned project time. Therefore, it is necessary to analyze the efficiency of the piling tool.

2 RESEARCH METHODS

Methodology This research was conducted by collecting data obtained from direct observation to the project/field. This research was conducted by explaining the stages of driving through the Hydraulic Static Pile Driver tool and processing the data at the stage to determine the productivity of the Hydraulic Static Pile Driver tool in the Physical Work Project for the Renovation and Expansion of the Marabahan District Court Building. The framework of the research method can be seen in Figure 3.1.

3 RESULTS AND DISCUSSION

3.1 Hydraulic Static Pile Driver Working Method

This tool consists of several sub-machines that each has different work functions. So that each sub-machine has its working method which, is then combined into a unified driving work method. The types of work are:
1. Move To The Point
2. Lifting Pile
3. Clamping & Piling
4. Joint Pile (Welding)
5. Cutting Pile.
These types of work have different durations of work, so it is necessary to analyze the method to obtain a duration of 1 cycle of 1 pile driving on a project.

3.1.1 Employment data

Name of Work Package: Physical Works Project and Expansion of Marabahan District Court Building, Physical Works Project and Expansion of the Marabahan District Court Building.
Area: 4,968 m²
Type of work: Construction Works
Work unit: The state court is angry
Activity Manager: PT. Suramadu Nusantara Engineering and PT. Indonesian Energy Defani (KSO)
Contract No.: W15.9/1614/PL01.
Contract Price: Rp. 6,685,000,000.00
Sources of funding: APBN 2020
Implementation time: 87 Calendar Days
Contract Date: 04 OCTOBER 2020
Supervision Consultant: CV. Dayakarsa Madya ConsultantTraffic Volume

3.1.2 Tool Profile

Tool's name: Hydraulic Static Pile Driver
Producer: Tianwei Engineering Machinery Manufacturing Co.Ltd. China
In this project, the lifting pile process takes 480 seconds per pile until the tip of the pile is inserted into the clamping tool, the pile that is lifted is a pile with a length of 10 meters. This data was obtained from interviews with the project contractor supervisor.

Known:
Lifting duration: 8 minutes = 480 seconds
Pole Length : 10 m = 1000 cm

\[
\text{Durasi Pekerjaan} = \frac{\text{Volume Aktivitas (sat.vol)}}{\text{Produktivitas kerja (sat. vol/waktu)}}
\]
\[
= \frac{1000 \text{cm}}{480 \text{ detik}}
\]
\[
= 2.08 \text{ cm/second}
\]
\[
= 125 \text{ cm/minute}
\]

LT = 8 minutes

3.1.6 Welding Work Productivity Calculation.

This work is carried out by one person with the time needed for 23.5 minutes the piles used are dimensions of 25x25 cm.

Known:

<table>
<thead>
<tr>
<th>Table 3.1. Welding Job Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>The number of workers</td>
</tr>
<tr>
<td>one person</td>
</tr>
</tbody>
</table>

Find welding length = 
Pile circumference x number of welding layers 
= (0.25m x 4) x 2 layers
= 2 + 20% safe number (assumption)
= 2 + 0.4
= 2.4m

From this calculation, the welding length is 240cm, so the welding productivity is calculated as follows.

Known:
Welding Duration : 23.5 minutes = 1410 seconds
Number of Builders :1 person
Welding Length :240 cm

\[
\text{Durasi Pekerjaan} = \frac{\text{Volume Aktivitas (sat.vol)}}{\text{Produktivitas kerja (sat. vol/waktu)}}
\]
Work productivity \( = \frac{240}{10.2} \) = 0.17 cm/detik

\( = \frac{10.2 \text{ cm/minute}}{1410} \)

After getting the productivity of welding work, then the productivity value is entered in the formula:

\[
WT = \frac{WL \times 240}{menitQL} = \frac{24}{10.2}
\]

3.1.7 Calculation of Productivity of Cutting Pile Jobs

The duration required for cutting / slapping concrete piles with dimensions of 25x25 cm with a hammer and carried out by two people is 15 minutes. This data was obtained from interviews with field supervisors.

Known:
Dimension Length : 25cm x 4 = 100cm
Number of Builders : 1 person
Duration : 10 minutes

Durasi Pekerjaan : jumlah orang = Volume Aktivitas (sat.vol) / Produktivitas kerja (sat.waktu)

Produktivitas kerja (sat.vol) = \( \frac{100 \text{ cm}}{10 \text{ menit} \times 1 \text{ orang}} \)

Produktivitas kerja = 10 cm/min
After getting the productivity of the cutting pile work, the productivity value is entered in the formula:

\[
CPT = 10 \text{ (minutes)} \times \frac{100}{10} = 10 \text{ minutes}
\]

3.1.8 Pailing Duration Calculation

Pailing machine speed itself is 9.40 m/min

with a pile length of 6m and 10m with the condition of the pile being in the Good category 0.75

Known:
Machine Speed = 9.40 m/min
Pile length = 10 meters
Tool condition = 0.75

(Good)

\[
PT = \frac{2s}{Vo.} = \frac{2.10}{9.40} = 2.836 \text{ min}
\]

3.1.9 Calculation of Per-Cycle Driving Duration

connection and it is cut if there is any remaining pile that does not go into the ground.

The time for moving to the point is added when the total construction time of the pile has been calculated.

### Table 3.2. Per-cycle Sampling Duration Data

<table>
<thead>
<tr>
<th>Pile length (m)</th>
<th>lifting pile (LT) (minutes)</th>
<th>pailing (PT) (minutes)</th>
<th>Welding (WT) (minutes)</th>
<th>cutting Pile (Cpt) (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>8</td>
<td>2.836</td>
<td>24</td>
<td>10</td>
</tr>
</tbody>
</table>

The driving duration formula using a hydraulic static pile driver is

\[
CTP = LT + PT + WT + CPT = 8 + 2.836 + 24 + 10 = 47.84 \text{ min}
\]

3.1.10 Calculation of Production Capacity of Hydraulic Static Pile Driver Tool Pile

In accordance with what is known that the general productivity formula is Work productivity = \( \frac{volume}{jam \times \text{jam kerja}} \)

Known:
Pile Length: 10 meters
Sampling Cycle Results: 47.84 minutes

\[
Q = \frac{8}{\frac{CTP}{10.47}} = 0.21 \text{ m/min} \text{ m/min, so the productivity value is } 0.21 \text{ meter/minute}
\]

### Table 3.3. Production Capacity of Hydraulic Static Pile Driver Tool Piling

<table>
<thead>
<tr>
<th>no</th>
<th>pile type(m)</th>
<th>pile length (m)</th>
<th>driving cycle yield (CPT) (minutes)</th>
<th>productivity (Q) (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10m x 25m x 25m</td>
<td>10</td>
<td>47.84</td>
<td>0.21</td>
</tr>
<tr>
<td>2</td>
<td>6m x 25mm x 25mm</td>
<td>6</td>
<td>26.96</td>
<td>0.23</td>
</tr>
</tbody>
</table>

As we have seen, 1 driving cycle on the hydraulic static pile driver tool is when the tool lifts the pile and then
puts it on the pile, after that time is added if there is a pile.
From the recapitulation, the lowest production value is 0.21 meters per minute and the highest production value is 0.23 meters per minute. Due to considering the factors that affect work delays, the production value used is the longest production, which is 0.23 meters per minute. The production value is used to calculate the overall driving duration for both the 6-meter and 10-meter pile profiles.

3.2 . Time difference analysis

3.2.1. Time Schedule

The work network in which each component of the activity has been given a period is then analyzed and calculated as a whole and the project completion period is calculated so that the master schedule and schedule for the implementation of work in the field can be known.

3.2.2. Weekly report

s curve is shown in red and the plan s curve is shown in blue. For the time difference, it can be seen that the realization is faster because the realization is completed in the 7th week while the plan is completed in the 9th week. So the difference in realization time is 2 weeks faster than the plan.

3.3 Analysis of the Budget Plan (RAB)

3.3.1. Budget plan

Calculation of the amount of costs required for materials, tools and wages, as well as other costs related to the implementation of the work or project. For work volume data obtained from the initial RAB Planning. As in the table below, Weekly report is a report that contains reports on progress or work weights (realization of work) on a weekly basis.

### Table 3.4. Realization Weekly Report

<table>
<thead>
<tr>
<th>No</th>
<th>Name of Activity</th>
<th>Mile</th>
<th>Mile</th>
<th>Mile</th>
<th>Mile</th>
<th>Mile</th>
<th>Mile</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sambungan Tiang</td>
<td>12</td>
<td>22</td>
<td>36</td>
<td>62</td>
<td>102</td>
<td>170</td>
</tr>
<tr>
<td>2</td>
<td>Handling Tiang</td>
<td>12</td>
<td>22</td>
<td>36</td>
<td>62</td>
<td>102</td>
<td>170</td>
</tr>
<tr>
<td>3</td>
<td>Pemancangan</td>
<td>12</td>
<td>22</td>
<td>36</td>
<td>62</td>
<td>102</td>
<td>170</td>
</tr>
<tr>
<td>4</td>
<td>Pengujian Tiang PDA Test</td>
<td>12</td>
<td>22</td>
<td>36</td>
<td>62</td>
<td>102</td>
<td>170</td>
</tr>
<tr>
<td>5</td>
<td>Transpotasi</td>
<td>12</td>
<td>22</td>
<td>36</td>
<td>62</td>
<td>102</td>
<td>170</td>
</tr>
</tbody>
</table>

In the table above table 3.4, the volume and weight obtained where the weight results are entered into the time schedule which can be seen in Figure 3.1.

Figure 3.1. Time Schedule

In the time schedule picture, you can see the difference in work progress between the realization and the plan, where the realization

### Table 3.5. Plan Budget Plan

<table>
<thead>
<tr>
<th>No</th>
<th>Name of Activity</th>
<th>Mile</th>
<th>Mile</th>
<th>Mile</th>
<th>Mile</th>
<th>Mile</th>
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<tr>
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<td>62</td>
<td>102</td>
<td>170</td>
<td>20</td>
</tr>
</tbody>
</table>

Example of calculation to get the total plan price
Job name : Procurement of 25/25 Pile and its Transportation
Volume : 4,140 m
Unit price : Rp. 345,000
Total price per job
= Volume x Unit price
= 4,140 x 345,000.00
= 1,428,300,000.00
Total Price = total price of pile procurement + total cost of Piling and Hamlng + total pile connection + total price of breaking and cutting the pile head + testing of piles
= 1,428,300,000 + 558,900,000 + 20,700,000.00 + 23,460,000.00 = 2,073,360,000.00

### Table 3.6. Field Realization Budget Plan

<table>
<thead>
<tr>
<th>No</th>
<th>Name of Activity</th>
<th>Mile</th>
<th>Mile</th>
<th>Mile</th>
<th>Mile</th>
<th>Mile</th>
<th>Mile</th>
<th>Mile</th>
</tr>
</thead>
<tbody>
<tr>
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<td>102</td>
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<td>170</td>
<td>20</td>
</tr>
</tbody>
</table>
Example of Calculation of Total Realized Price
Job name : Procurement of 25/25 Pile and its Transportation
Volume : 4,968 m
Unit price : Rp. 345,000
Total price per job = Volume x Unit price
= 4,968 x 345,000.00
= 1,713,960,000.00
Total Price = total price of pile procurement + total cost of Piling and Handling + total pile connection + total price of breaking and cutting the pile head + testing of piles
1,713,960,000 + 670,680,000 + 31,050,000 + 23,460,000 + 42,000,000 = 2,481,150,000

3.3.2. Difference between Planned Budget Plan and Field Realization

The difference in the budget plan can be seen in the table below.

<table>
<thead>
<tr>
<th>No.</th>
<th>Plan</th>
<th>Budget</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

From the table above we can see the total difference in the cost of work is Rp. 407,790,000 due to the additional volume in the piling work as much as 828.00 m³ and in the piling and handling work at 828 m³ and the pile connection as much as 138 nos.

The addition of the pile volume is due to the piling work being planned at a depth of 30 meters, while the results of field inspections carried out with PPK and the Implementing Contractor are at a depth of 30 meters of soil bearing capacity. has not been able to bear and withstand the design load, so a "test pile" was held and was found at a depth of 36 meters which was considered capable of carrying the existing design load.

4 Conclusion

Conclusion based on the results and the previous discussion, the following conclusions can be drawn:

4.1 Based on the results of the analysis, the productivity of the erection work on the physical work project and the expansion of the Marabahan state court building, the highest production value of the Hydraulic Static Pile Driver was 0.23 meters/minute or the equivalent of 14 meters/hour and the lowest value was 0.21 meters/minute. minutes or the equivalent of 12 meters/hour.

4.2 The time required to complete the erection work of the physical work project and the expansion of the Marabahan court building based on the planning is 9 weeks, while based on the realization in the field to complete it is 7 weeks. Which means the implementation time in the field is 2 weeks faster than planned.

4.3 The planned implementation cost to complete the erection work of the physical work project and the expansion of the Marabahan state court building, the budgeted cost is Rp. 2,073,360,000. Meanwhile, the cost of work in accordance with the realization in the field is Rp. 2,481,150,000. Which means that the implementation costs in the field are greater than the planning costs of Rp. 407,790,000 this was due to the addition of 828.00 m³ of pile procurement volume and 828 m³ of piling and handling work and 138 nos of pile connections.

REFERENCES


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