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Overview of Mini Pile Erection Using Drop Hammer Technique (A Case Study of STA 10+161, IKN Segment 3B Toll Road Project, KKT Kariangau-Simpang Tempadung)

Danang Tali Asmoro[1], Dheka Shara Pratiwi[2*]
[1,2] Teknik Sipil, Fakultas Sains dan Teknologi, Universitas Muhammadiyah Kalimantan Timur
[*]Corresponding E-mail : dsp746@umkt.ac.id

Abstract– Planning of mini pile foundation in the construction project of IKN Segment 3B KKT Kariangau-Simpang Tempadung Toll Road is one type of deep foundation that is usually used in tall buildings, serves to pass the load caused by the upper structure to the bottom without causing excessive foundation decline. This toll road project is planned to be built along 7.32 km connecting the Balikpapan city area with North Penajam Paser Regency. The participatory observation method was employed in this study, involving direct participation and engagement in various project activities. Aims to collect data including primary data such as direct observation methods, interviews, documentation, and secondary data including work drawings, project organization data, and other data needed in writing this report. Erection on STA 10+161 box culvert area is carried out using the drop hammer method which is considered more economical. This type of foundation uses precast concrete piles of K-450 quality square pile measuring 20 x 20 cm with a length of 4-6 meters, and obtained a total of 166 points.

Keywords: implementation review, drop hammer, pile, mini pile

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1. Introduction

Soil conditions in Indonesia have various types of soil for each region, that diversity makes each region have different soil properties and different soil carrying capacity [1]. In the process of Construction of the IKN Segment 3B KKT Kariangau-Simpang Tempadung Toll Road, several problems were found in certain areas such as the STA 10+161 box culvert has a relatively low soil carrying capacity condition, to overcome these problems, good soil handling is needed by using deep foundations such as piles as building foundations, especially the soil under the base of the building does not have a bearing capacity enough to carry the weight of the building acting on it [2]. Mini pile foundations are poles used to support building foundations such as buildings, bridges, piers, and so on that stand on soft soil [3]. The mini pile pile foundation used in this project serves to pass the load caused by the structure from the top to the bottom without causing soil shear collapse and excessive foundation subsidence [4],[5]. The erection method uses the drop hammer method because it is considered easier to operate the tool. In every construction project there needs to be a structure or organizational structure, there are limitations in working on a project, a project organization is needed to manage the resources owned to achieve a project goal [6],[7].

2. Purpose

The objectives to be achieved in the Field Work Practice at the IKN Segment 3B Kariangau-Simpang Tempadung Toll Road Construction Project are:

a. Understand the method of installing mini pile poles in the construction project of the IKN Segment 3B Toll Road KKT Kariangau-Simpang Tempadung.
b. Understand the problems that occur in the field in the construction project of the IKN Segment 3B Toll Road, KKT Kariangau-Simpang Tempadung.

3. Research Methodology

In conducting analyses related to scientific problems, various methods are employed to obtain the necessary data. The methods used to collect data in this study are of two types: primary data and secondary data. Primary data for this study encompassed on-site observation methods conducted directly on field activities, entailing direct participation and observation of project activities. Interviews were also conducted with project supervisors,

contractors, foremen, and handymen regarding aspects unknown to the researcher or to inquire about various field-related issues, with the aim of obtaining valuable insights for this practical work. And finally documentation is used as an attachment to the Practical Work report, documentation in the form of photographs in the field. In addition to primary data, there is secondary data collection, in the form of direct data collection about the project needed in this fieldwork practice report. Such as work plan drawings, project organization data, and other data if needed in preparing this practical work report [8],[9].

4. Results and Discussion

A detailed report of all field activities pertaining to the implementation of fieldwork practices in the construction project of the IKN Segment 3B Toll Road KKT Kariangau-Simpang Tempadung cannot be provided in this study. This limitation arises from the fact that the authors involved in this project have achieved only 13% progress due to a short working time, approximately 60 working days. The discussion that will be discussed in this chapter is the erection method as the foundation of the STA 10+161 box culvert, which does not cover all project implementation activities from beginning to end [10].

4.1 Scratching Using Drop Hammer

In the construction of a building or highway that requires special treatment, the foundation is one very important part to support the building on the ground. Foundation installation on skyscrapers is usually done using pile foundations. It is important to determine the construction method in advance before work begins so that the execution process becomes easier [11]. In the installation of mini pile poles this time using a Drop hammer, which is a pile machine where a heavy hammer is placed at a certain height on top of the pole [12].

a. The advantages of a drop hammer are:
   1) Low investment,
   2) Easy to regulate the energy to be released,
   3) It is easy to adjust the height of the fall on the pole.

b. The disadvantages of the drop hammer are:
   1) The possibility that the pole could be damaged because the hammer is dropped is quite high.
   2) It is possible that nearby buildings could be damaged due to the vibrations emitted by this tool
   3) Its use cannot be applied to foundation work that is underwater.

4.2 Preparatory Stage

a. Preparing shop drawings and job proposals
   Work proposals and drawings must be prepared with the aim of serving as a guide for the implementation of the work to be carried out in accordance with the planned classification [13]. It can be seen in figure 4.1.

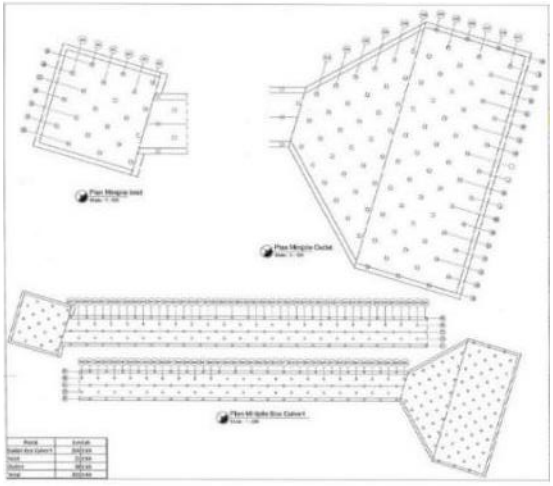

Figure 4. 1 Plan Drawing **Kerja**
(Source: Secondary Data, 2023)

b. Land clearing
   Land clearing activities are carried out by each project to ensure that all project conditions can be seen, such as cutting down trees, removing tree roots, carrying out excavations and filling in accordance with working drawings for the landfill area. After land clearing is complete, the excavated soil is thrown into the dump [14,[15]. It can be seen in figure 4.2.

Figure 4. 2 Work Area Cleaning
(Source: Personal Documents, 2023)

c. Equipment mobilization
   Some of the tools needed to carry out piling work to help and make the job easier include:
   1) Drop Hammer is a tool used to anchor piles into the ground. This type consists of a drop

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hammer as the main fall hitter powered by a steam diesel engine.
2) Theodolite, used to measure and determine the point of piles and know the perpendicularity of piles.
3) Waterpass, used to find out the perpendicularity of piles.
4) Meter, used to measure the distance between the spike poles.
5) Las machine, used to connect the spike poles.

d. Material mobilization
There are several materials needed in beheading, including:
1) Piles
a) Bottom with a length of 4 - 6 meters.
b) Middle with a length of 4 - 6 meters.
2) Las wire, used for welding in the connection of spike poles.
3) Wet paint, or spray paint, is used to mark every 0.5-1 meter on piles and to paint the piling joints.

e. Mobilization of workers
Worker mobilization is carried out by anyone carrying out project work. The required workforce preparation depends on the size of the scope of work and influences how fast or slow the work process is. The jobs are foremen, handymen, installation workers, electrical parts, heavy equipment operators and so on.

4.3 The process of implementation of the simmering

a. Inspection of Heating Locations
Preparing the Erection Site where the erecting equipment will be placed, the soil must be able to support the weight of the tool. If the final elevation of the pile head is below the original soil surface,excavation must be carried out prior to erection [16]. It can be seen in figure 4.3.

Figure 4. 3 Preparing the Work Area
(Source: Personal Documents, 2023)

b. Marking on piles
Marking on piles with wet paint or spray paint (pilok) at every interval of 0.5 m and numbering piles 1 m is useful to determine the depth limit of piles at the time of erection [17]. It can be seen in figure 4.4.

Figure 4. 4 Marking on poles
(Source: Personal Documents, 2023)

c. Measuring and Determining Piling Points
Measurement and Positioning of the point to be staked is determined and marked in advance. Determination of the pile points is carried out using a rope that has been determined on the ground and measured using a theodolite, in accordance with the planning drawing. In the process of determining these points, the surveyor is always responsible for controlling them, can be seen in figure 4.5.

Figure 4. 5 Determining the Breaking Point

(Source: Personal Documents, 2023)

d. Piling Lifting
In the process of lifting piles, there are several things that need to be paid attention to, such as the lifting position, lifting sling, and when pulling. The pile will be lifted from a position that meets the safety criteria, with a lifting sling that has a safety point SF $\geq$ 3. When pulling, the distance between the pile and the piling equipment must not be too far, and the area must be free from objects that could interfere. It can be seen in figure 4.6

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Figure 4. 6 Pole lifting

(Source: Personal Documents, 2023)

e. Upright Control of Piles

Before the hammer is dropped, the straightness of the pile must be checked first to avoid damage in the form of rupture or cracks in the pile.

At this stage the straightness of the piles can be measured using a theodolite and waterpass, as can be seen in figure 4.7.

Figure 4. 7 Upright Control of Piles

(Source: Personal Documents, 2023)

f. Spike Pole Breaking

Piling installation is carried out using a drop hammer tool. The operator is in charge of controlling the fall of the hammer, at the last stroke the maximum set is 2 cm with a fall height of 1 meter. One person is in charge of tying the rope to the pile and arranging the vertical perpendicular position on the pile and one person counts the number of strokes. The total number of erections carried out in the STA 10+161 box culvert area was 166 points. The erection process can be seen in figure 4.8.

Figure 4. 8 Tightening Process

(Source: Personal Documents, 2023)

g. Spike Pole Connection

Splicing piles is carried out because the soil condition has not reached the maximum limit. So it is necessary to connect the pile by lifting the middle pile with the position of the pole must be straight in line, the surface of the bottom and middle piles must be attached perfectly then connected by welding, it takes about 10-20 minutes. It can be seen in figure 4.9.

Figure 4. 9 Spike Pole Connection

(Source: Personal Documents, 2023)

h. Calendaring on piles

Calendaring is used in pile laying work to determine the carrying capacity of the soil through calculations generated by the process of beating piling tools. The stake tool here is in the form of a drop hammer. Usually calendaring in the process of piling piles is a mandatory item that must be carried out and make a report for the project [18]. It can be seen in figure 4.10 and figure 4.11.

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Figure 4. 10 Calendaring Process
(Source: Personal Documents, 2023)

Stages of Calendaring Implementation:

1) When determining the calendaring, it is temporarily stopped beating by a hammer.
2) Installing millimeter block paper on piles using tape.
3) Prepare a marker resting on wood, then attach the tip of the marker to millimeter paper.
4) Running a beating.
5) One person does the calendaring and one person watches and counts the number of strokes.
6) After 10 strokes, millimeter paper is taken.
7) This stage can be done 2-3 times in order to get a good chart.

Figure 4. 11 Calendaring Results Data
(Source: Secondary Data, 2023)

From the results of the calendaring that has been done above, namely in figure 4.11, the results of field data are obtained as follows:

Date : 14-07-2023
Location : Box culvert STA 10+161
Type : Square pile
Length : 6 m
Dimension : 20 x 20 cm
Hammer Model : Drop Hammer
Pilling No : B81 E
Penetration Depth : 4,7 m
Final Set : 1,6 cm
Total No. of Blows : 118

Based on the field data, the mini pile installation was conducted on July 14, 2023, at the Box Culvert STA 10+161 area. The installation utilized square mini piles measuring 20x20 cm and 6 meters in length. During the driving process, 118 hammer strikes were recorded. The final set was determined after the last 10 strikes when the pile encountered hard soil, yielding a final set measurement of 1.6 cm. This indicates that the soil is sufficiently supportive, as the final set did not exceed the maximum limit of 2 cm. The penetration depth of the mini piles was recorded at 4.7 meters.

i. Pole Cutting

The piles are cut manually using a hammer according to the specified elevation. This cutting was carried out because the length of the existing piles exceeded the planned maximum limit, so to achieve uniformity of height on the piles, cuts were needed on the piles. It can be seen in figure 4.12.

Figure 4. 12 Pole Cutting
(Source: Personal Documents, 2023)

4.4 Problems that Occur in the Field

In the implementation of construction work, sometimes various kinds of problems are also found that can interfere with the course of work [19],[20]. Problems arise due to many causative factors, such as natural, technical, mobilization, and human origin as follows :

a. Natural factors

The problem that occurs during piling work and other work is rain. Rain can occur both during the day and at night so it can disrupt the casting process

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and reduce the quality of the concrete if rainwater mixes with the concrete

The settlement that can be taken is to stop work temporarily to avoid work accidents. It can be seen in figure 4.13.

Figure 4. 13 Work Areas Unusable
(Source: Personal Documents, 2023)

b. Technical Factor

The problems that occur include damage to heavy equipment. Work such as taking piles, digging, and others is greatly assisted by heavy equipment. However, over time, damage can occur to the machine, which can affect the performance of a job and cause work delays.

The solution that can be taken is to perform periodic service of the heavy equipment used. It can be seen in figure 4.14.

Figure 4. 14 Machine Damage
(Source: Personal Documents, 2023)

c. Mobilization Factors

The problem that occurs is in the form of delays in material delivery because making mini pile concrete takes a long time. This can interfere with the course of work because the erection process will continue.

The solution that can be taken is to prepare a backup supplier if the main supplier cannot provide the materials needed. It can be seen in figure 4.15.

Figure 4. 15 Material Mobilization
(Source: Personal Documents, 2023)

d. Human Factor

The problem that occurs is in the form of lack of coordination between workers in the field and the office of directors in the project, as a result of which problems arise such as differences in the location of marking coordinate points and differences in the size of the planned building. This can result in loss of time and also costs that have been incurred.

The solution that can be taken is by checking regularly and establishing good communication between the field and the office in the project. It can be seen in figure 4.16.

Figure 4. 16 Field Coordination Meeting
(Source: Personal Documents, 2023)

5. Conclusion And Advice

5.1 Conclusion

Based on the results of practical work in the field on the construction project of the IKN Segment 3B Toll Road KKT Kariangau-Simpang Tempadung, several conclusions can be drawn as follows:

a. The method of implementing pile erection in the construction project of the IKN Segment 3B Toll Road KKT Kariangau-Simpang Tempadung uses the drop hammer method. The stages of the pile

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erection implementation process, including: Inspection of the erection site, marking on piles, Measurement and determination of pile points, Lifting piles, Upright control of piles, Piling erection, Splicing piles, Collecting calendaring data.

b. In the erection process carried out on STA 10 + 161, the box culvert area uses a type of precast concrete pile foundation K-450 quality square pile measuring 20 x 20 cm with a length of 4-6 meters, and obtained a total of 166 points.
c. The implementation of work at the project site is quite smooth, but in its implementation, there are often problems such as natural factors (rain), technical factors (equipment damage), mobilization factors (delays in material delivery), and human factors (lack of coordination).

5.2 Advice

In the construction project of the IKN Segment 3B Toll Road KKT Kariangau-Simpang Tempadung there are several problems, based on the results of field observations regarding pile erection and other work at PT WIKA-PP-JAKON, KSO the following suggestions are provided for improvement:

a. Improve coordination or establish good communication between the field and the office of directors in the project, in order to reduce errors that occur during the process of carrying out work.
b. The need for periodic maintenance and ensuring the condition of field equipment can work properly before the start of work, because it has a major effect on the results of implementation if the condition of the equipment is not good.
c. Prioritizing occupational health and safety (K3) in carrying out construction work, especially for workers in the field to avoid unwanted events.

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