

**PRODUCTIVITY ANALYSIS OF HEAVY EQUIPMENT
WORKING TIME ON THE ROAD PRESERVATION PROJECT OF
RANTAU-KANDANGAN-DS. BAGAMBIR–HAMBAWANG
BEACH–MANTIMIN–PARINGIN**

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ABSTRACT

Use of heavy equipment influences the smooth implementation of a project. if not used efficiently it can result in results that are not in accordance with the plan. In order for its implementation to be in accordance with the planned time target, it is necessary to pay attention to the quality of the use of the heavy equipment.

In this study, observations and direct interviews were carried out in the field to obtain data on equipment working hours and the type of heavy equipment used in the project under review. The method used for the calculation is data analysis which includes the type of work, calculation of heavy equipment productivity based on the 2022 AHSP, calculation of working hours of heavy equipment, and calculating the duration of the implementation of each job from the results of the working hours of the equipment obtained.

The results of the analysis of tool productivity calculations obtained productivity values for the sub-base layer work of class B: *wheel loader* that is 20.1 m³/hour, *dump truck* is 20.0 m³/hour, *motor grader* is m³/hour, *vibrator roller* is 56.25 m³/hour, *tandem roller* is 84.3 m³/hour, *water tank truck* is 64.28 m³/hour. In the work of the top layer of foundation class A: *wheel loader* is 20.1 m³/hour, *dump truck* is 20.0 m³/hour, *motor grader* is m³/hour, *vibrator roller* is 45.0 m³/hour, *tandem roller* is 67.5 m³/hours, *the water tank truck* is 64.28 m³/hour. For liquid asphalt-adhesive coating work: *asphalt distributor* is 4500 liters. In Lapis Aus (AC-WC) work: *asphalt finisher* is 63.2, *wheel loader* is 30.1, *asphalt mixing plant* is 30 tons/hour, *dump truck* is 30.3, *pneumatic tired roller* is 48.0, *tandem roller* is 30.1. With heavy equipment working hours for Layer Aggregate Foundation Class B work as a whole is 303 hours (44 days), for Layer Aggregate Foundation Class A work 388 hours (56 days), and for worn-out Liquid Asphalt Work (AC-WC) it is 441 hours (63 days).

Keywords: heavy equipment, productivity, working time

1. INTRODUCTION

Road repair is a routine thing carried out by the government so that the flow of transportation that connects several regions can run smoothly. To support the smooth flow of land transportation in the upstream area so that there are no obstacles, Road Preservation Works are carried out on the Rantau -Kandangan -Ds road section. Bagambir

- Hambawang Beach - Mantimin - Paringin.

In every road project work, they almost always use heavy equipment in their implementation so that projects can be completed in a faster time. Of course, the use of heavy equipment in the field needs to be considered so that it can be used efficiently so that it does not hinder the smooth running of the process. Therefore, an analysis of the productivity of the heavy equipment used is needed to obtain the right planning for the project.

The purpose of this research is to determine the productivity and working hours of each heavy equipment and to determine whether the working time of heavy equipment in completing work in the field is in accordance with the time of execution of the work that has been planned in the contract data

2. LITERATURE REVIEW

Heavy Equipment

Productivity Heavy equipment productivity can be defined as the level of capability of a working tool to obtain optimal results. (Rostiyanti, 2002). Heavy equipment itself in civil works is very useful to assist humans in making it easier to complete the construction work of a structure, Darmansyah, (1998).

To facilitate the implementation of a construction work, of course, heavy equipment plays a role in helping humans so that they achieve results in accordance with the planning targets and are even expected to get better results. (Susy Fatena Rostiyanti. 1:2002). The following is the formula used to calculate the productivity of the heavy equipment used:

$$Q = q \times \frac{60}{W_s} \times E$$

Where:

Q = Tool productivity (m³/hour)

q = Equipment capacity (m³)

W_s = Cycle time (minutes)

E = Tool work efficiency (Fa)

Heavy equipment

capacity Capacity Tool production is the capacity of a tool which is usually expressed in /hour. If the volume of work and cycle time carried out is obtained, the production can be determined. The calculation of tool production capacity can be calculated by the formula below:

$$Q = q \times N \times E = q \times \frac{60}{cm} \times E$$

Where:

Q = Production per hour (m³ /hour)

q = Production per cycle (m³)

N = Number of cycles per hour, N = 60/Cm

E = Work efficiency

Cm = Cycle time in minutes

Heavy Equipment Work Efficiency

The total work efficiency value is determined based on the experience of the equipment operator in the field. The work efficiency of the tool according to the PUPR Ministerial Decree No. 1 of 2022 can be seen in Table 1

Table 1 Tool Efficiency Factor (Fa)

CONDITION OPERATING OF	MACHINE MAINTENANCE				
	Very Good	Good	Medium	Bad	Very Bad
Good	0.83	0.81	0.76	0.70	0.63
Good	0.78	0.75	0.71	0.65	0.60
Moderate	0.72	0.69	0.65	0.60	0.54
Poor	0.63	0.61	0.57	0.52	0.45
bad	0.53	0.50	0.47	0.42	0.32

Cycle Time

1. To determine the cycle time, the first thing that must be known is the movements of each tool used in the field. Then add up all the variables of the movement time such as unloading and loading time, return time, track leveling time. Not all tools are cycled

timed, only on some tools that do not work all the time and are continuously applied. Calculation of machine cycle time, calculation of different equipment cycle times depending on the type of tool and the work cycle of the tool movements.

3. RESEARCH METHODS

The steps carried out in the research to be able to analyze the data can be seen in Figure 1

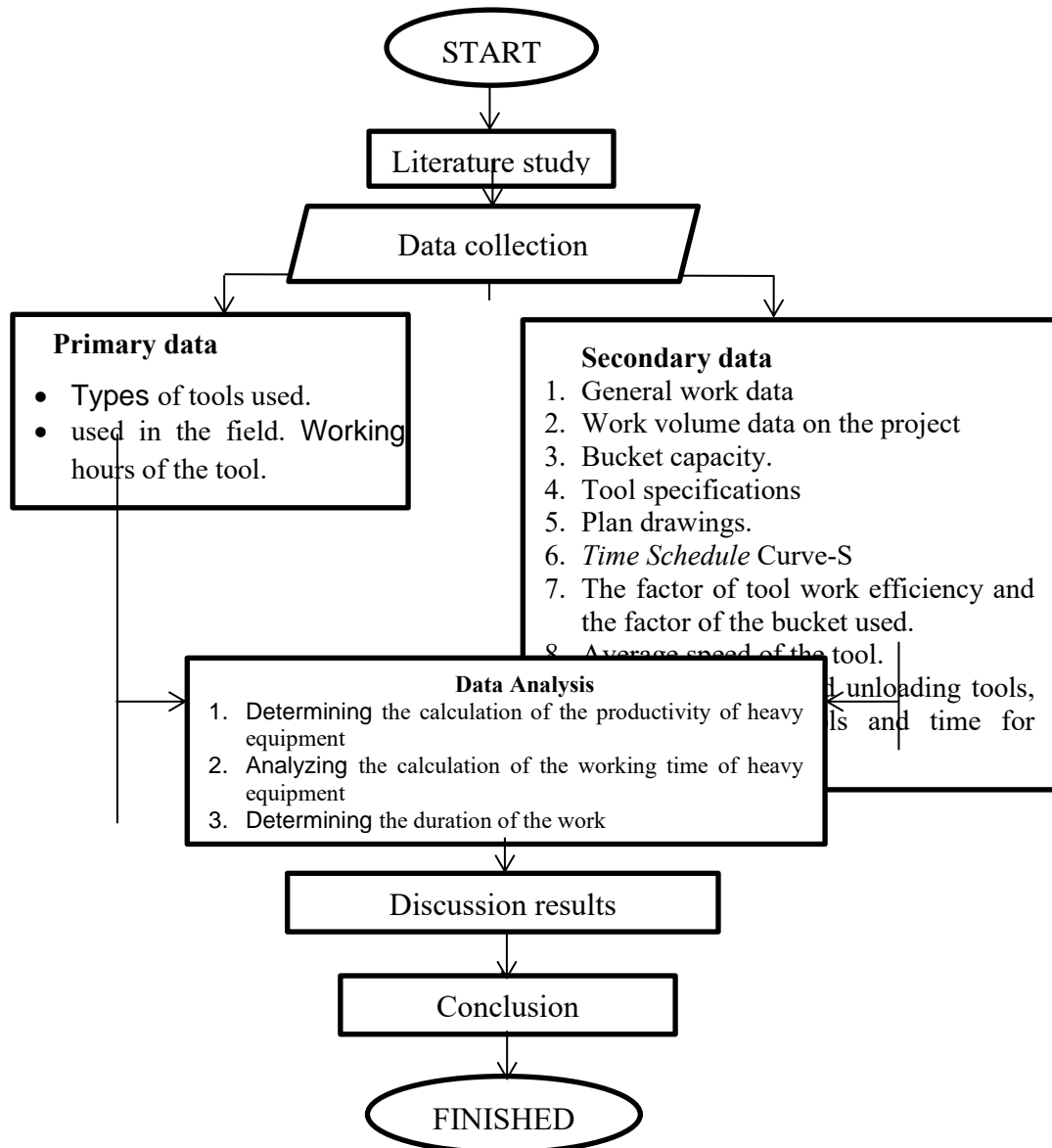


Figure 1 Research Flowchart

4. RESULT AND DISCUSSION

Productivity of heavy equipment

Productivity of heavy equipment on each work item based on the results of calculation analysis from field data can be seen in the following calculation results (see Table 2)

Table 2 results of production analysis of each heavy equipment

No.	Work	Equipment	Productivity
1	Layer Aggregate Foundation Class B	<i>Wheel Loader</i>	20.1
		<i>Dump Truck</i>	20.0
		<i>Motor Grader</i>	68.4
		<i>Vibrator Roller</i>	56.2
		<i>Tandem roller</i>	84.3
		<i>Water Tank Truck</i>	64.2
2	Layer Aggregate Foundation Class A	<i>Wheel Loader</i>	20.1
		<i>Dump Truck</i>	20.0
		<i>Motor Grader</i>	
		<i>Vibrator roller</i>	45.0
		<i>Tandem Roller</i>	67.5
		<i>Water Tank Truck</i>	64.2
3	Layers of Adhesive – Liquid	<i>Asphalt Asphalt Distributor</i>	4500 liters
4	Laston Lapis Aus (AC-WC)	<i>Wheel Loader</i>	30.1 ton/hour
		<i>Asphalt Mixing Plant</i>	30.0 ton/hour
		<i>Dump Truck</i>	30.3 ton/hour
		<i>Asphalt Finisher</i>	63.2 ton/hour
		<i>PTR</i>	48.0 ton/hour
		<i>Tandem Roller</i>	30.1 ton/hour

(source: calculation of tool productivity based on data collected)

Working Time of Heavy Equipment

Following are the results of calculating the duration of working hours of each tool (see Table 3)

Table 3 Recapitulation of calculation of working hours of heavy equipment

No.	Work Item	Type of Tool	Hours /Day	Number of Working Hours Tool
1	Layer Aggregate Foundation Class B	<i>Wheel Loader</i>	7 hours	94 hours
		<i>Dump Truck</i>	7 hours	94 hours
		<i>Motor Grader</i>	7 hours	28 hours
		<i>Vibrator Roller</i>	7 hours	34 hours
		<i>Tandem roller</i>	7 hours	23 hours
		<i>Water Tank Truck</i>	7 hours	30 hours
2	Layer Aggregate Foundation Class A	<i>Wheel Loader</i>	7 hours	114 hours
		<i>Dump Truck</i>	7 hours	11538
		<i>Motor Grader</i>	7 hours	Hours
		<i>Vibrator Roller</i>	7 hours	51 hours
		<i>Tandem roller</i>	7 hours	34 hours
		<i>Water Tank Truck</i>	7 hours	36 hours
3	Layer Adhesive – Liquid	<i>Asphalt Asphalt Distributor</i>	7 hours	2 hours
4	Laston Lapis Aus (AC-WC)	<i>Wheel Loader</i>	7 hours	87 hours
		<i>AMP</i>	7 hours	87 hours
		<i>Dump Truck</i>	7 hours	81 hours
		<i>Asphalt Finisher</i>	7 hours	42 hours
		<i>PTR</i>	7 hours	55 hours
		<i>Tandem Roller</i>	7 hours	87 hours

Analysis of the duration of each job

After the equipment working hours for each type of work are obtained, the duration of the work is calculated as follows:

- The duration of the work on the Layer Aggregate Foundation Class B work

The duration of the Layer Aggregate Foundation Class B work can be seen in the following network diagram (see Figure 2)

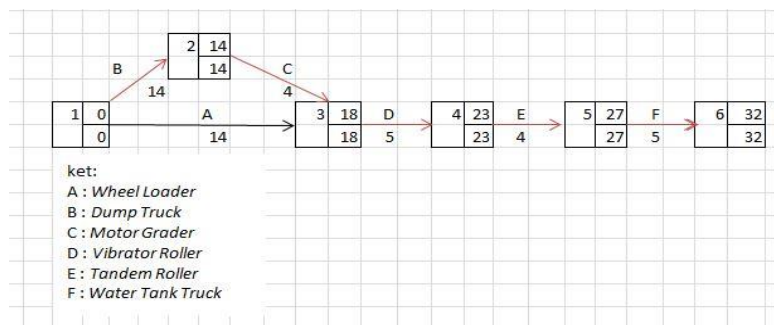


Figure 2 Layer Aggregate Foundation Class B Network Diagram

. Based on the diagram, it can be seen that the duration of work at Layer Aggregate Foundation Class B is 32 days or equal to 6 weeks when compared to the number of days of work on *Time Schedule*, which is 7 weeks, there will be a reduction in tool work time. and its implementation can be 10 (ten) days faster than the planning time provided in the contract.

- The duration of the work on the Layer Aggregate Foundation Class A work

The duration of the Layer Aggregate Foundation Class A work can be seen in the following network diagram (see Figure 3)

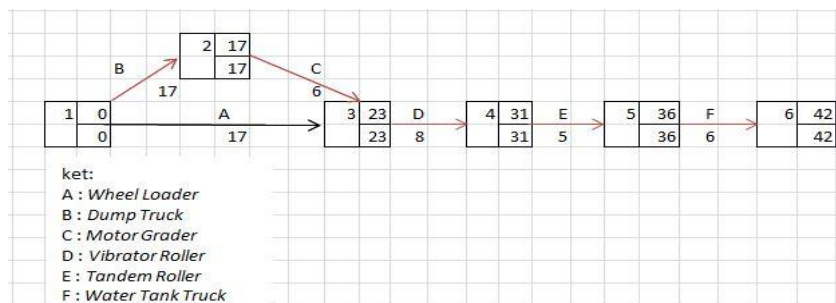


Figure 3 Layer Aggregate Foundation Class A Network Diagram

Layer Aggregate Foundation Class A is 42 days or equal to 7 weeks when compared to the number of days of execution of work on *Time Schedule* which is 9

weeks, there will be a reduction in tool working time and its implementation can be 12 (twelve) days faster than the planning time available in the contract .

- The duration of the work on the adhesive layer work (liquid asphalt) and the worn layer laston (AC-WC) These two jobs are carried out simultaneously with the duration of the work as seen in the following network diagram (see Figure 4)

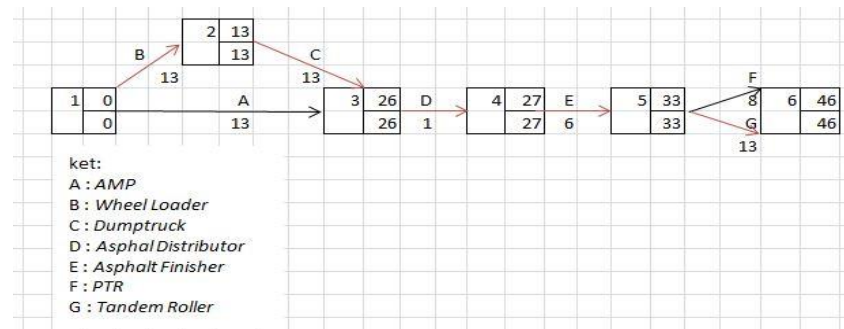


Figure 4 Network diagram for adhesive coating and work laston (AC-WC)

Adhesive layer work (liquid asphalt) and the worn layer laston (AC-WC) is 46 days or equal to 8 weeks when compared to the number of days of execution of work on *Time Schedule* which is 10 weeks, there will be a reduction in tool working time and its implementation can be 14 (fourteen) days earlier than the planning time provided in the contract.

5.CONCLUSIONS

1. From the results of the calculation of tool productivity on the project obtained:
 - a. In Layer Aggregate Foundation Class B work, the productivity value of the *wheel loader* is 20.1 m/hour, the productivity of the *dump truck* is 20.0 m/hour, the productivity of the *motor grader* is m/hour, the productivity of the *vibrator roller* is 56.25 m³/hour, the productivity of the tool is 56.25 m/hour. *tandem roller* is 84.3 m/hour, the productivity of the *water tank truck* is 64.28 m/hour
 - b. In Layer Aggregate Foundation Class A work, the productivity value of the *wheel loader* is 20.1 m/hour, the productivity of the *dump truck* is 20.0 m/hour, the productivity of the *motor grader* is m/hour, the productivity of the *vibrator roller* is 45.0 m³/hour, the productivity of the tool is 45.0 m/hour. *tandem roller* is 67.5 m/hour, productivity of *water tank truck* is 64.28 m/hour
 - c. In liquid asphalt work, the productivity of the *asphalt distributor* is 4500 liters

- d. In the Laston Lapis Aus (AC-WC) work the productivity of the *wheel loader* is 30.1 , the productivity of the *AMP* is 30 tons/hour, the productivity of the *dump truck* is 30.3 , the productivity of the *asphalt finisher* is 63.2 , the productivity of the *pneumatictired roller* is 48.0 , the productivity of the *tandem roller* is 30.1
2. The working time of heavy equipment at Layer Aggregate Foundation Class B as a whole is 303 hours, the working time of heavy equipment on the aggregate foundation layer of class A is 388 hours, while the working time of heavy equipment is generally The overall performance for the Adhesive Coating - Liquid Asphalt Work and the worn lastton work (AC-WC) is 441 hours.
 3. From the results of the analysis of the duration of the work, it is found that the Layer Aggregate Foundation Class B can be done 10 (ten) days faster than the time available in the contract. In Layer Aggregate Foundation Class A work, the implementation of this work can be carried out 12 (twelve) days earlier than the time provided in the contract. Meanwhile, for Liquid Asphalt Works and for Laston Lapis Aus (AC-WC) it can be carried out 14 (fourteen) days earlier than the time provided in the contract.

REFERENCES

1. Aoliya,ika. Wiranto, praise. and Mudianto, wise. 2017. **Analysis of Heavy Equipment Productivity in the Construction of the Marsela Island Ring Road, Southwest Maluku Province**. 1-16. Accessed February 12, 2022 from E – Journal of Civil Engineering FT – Unpak.
2. Asiyanto. (2008). **Heavy Equipment Management For Construction**. Jakarta : Pradnya Paramita
3. Ardiana, P. 2016. **Analysis of Time and Cost of Heavy Equipment Usage in Condotel Building Construction of Sahid Jogja Lifestyle Project in Yogyakarta**. Surabaya : Sepuluh Nopember Institute of Technology.
4. Directorate General of Highways, (2018). **General Specifications for Road and Bridge Construction Works Part III**. Jakarta
5. Indonesia, 2022. **Regulation of the Minister of Public Works and Public Housing Number 1 of 2022 concerning Guidelines for Compiling Estimated Costs of Construction Works in the Public Works and Public Works Sector Public**

- Housing.** Minister of Public Works and Public Housing of the Republic of Indonesia
Jakarta
6. Koetin, Vidia Alda Rizky, 2021. **Analysis of Productivity and Efficiency of Heavy Equipment Combination in the Hauling Road Betterment Construction Project Sebamban**, Banjarbaru: Faculty of Civil Engineering-Unlam
 7. Rochmanhadi. 1982. **Heavy Equipment and Its Use: Ministry of Public Works**, Jakarta
 8. Rostiyanti, Fatena S. 2002. **Heavy Equipment for Construction Projects**, Jakarta: PT Rineka Cipta
 9. Soedrajat, 1982. **Efficiency of Heavy Equipment Use on Highways**. Jakarta: Nova