CERUCUK
Volume 9 No. 1 2025 (10-19)

ANALYSIS OF HEAVY EQUIPMENT PRODUCTIVITY IN THE PAVING WORK OF LASTON LAPIS WEAR (AC-WC) ROAD IN THE BANJARMASIN-MARTAPURA ROAD RECONSTRUCTION PROJECT SECTION II

Ronna Sabilla Putri, Candra Yuliana, Aulia Isramaulana
Civil Engineering Study Program, Lambung Mangkurat University
Jl. Jenderal Achmad Yani Km 35.5 Banjarbaru, South Kalimantan – 70714
E-mail: ronnabilla@gmail.com

ABSTRACT

The reconstruction of the Banjarmasin-Martapura Road Section II is carried out to meet the community's needs for better transportation access. In this project, the role of heavy equipment is very important to support the efficiency and effectiveness of the project. This study aims to analyze the *output* level of heavy equipment based on theory and field conditions and identify factors that affect productivity in Laston Lapis Wear (AC-WC) road paving work.

The method applied in the analysis of heavy equipment production capacity is the *Time Study* Method. This method is used to calculate the standard time of work by collecting data on the amount of time it takes to complete a task.

The results of the study show that the production capacity of heavy equipment based on theory reaches 301.06 tons/day and the duration of work is 5 (five) days with the number of heavy equipment *Asphalt Sprayer* as many as 1 tool, *Dump Truck* as many as 20 tools, *Asphalt Finisher* as many as 1 tool, *Tandem Roller* as many as 1 tool, and *Pneumatic Tire Roller* a total of 1 tool. Meanwhile, based on the analysis carried out in the field, it was found that the productivity of all heavy equipment was 143 tons/day and the duration of work was 11 (eleven) working days with the number of heavy equipment *Asphalt Sprayer* as many as 1 tool, *Dump Truck* as many as 26 tools, *Asphalt Finisher* as many as 1 tool, *Tandem Roller* as many as 1 tool, and *Pneumatic Tire Roller* a total of 1 tool. The aspects that affect the performance of heavy equipment in this study are material factors, field, heavy equipment conditions, weather and time management.

Keywords: Productivity, heavy equipment, duration analysis, road paving, influencing factors, *time study*.

1. INTRODUCTION

In the implementation of road reconstruction work so that it runs on time in addition to using human services, of course, it involves the use of heavy equipment to achieve the expected work specifications, this work begins with digging, moving, compacting.

This research focuses on the Banjarmasin-Martapura Road Reconstruction Project on section II located in Sungai Rangas, West Martapura District, Banjar Regency, South

Kalimantan. The project has a 3.4 km work route with work using project machinery. Heavy equipment used in the Laston Lapis Wear (AC-WC) road paving project includes Asphalt Finisher, Dump Truck, Tandom Roller, Pneumatic Tire Roller, and Asphalt Sprayer.

This analysis is important to identify the aspects that affect the performance of the machine on the project, such as:

1. Performance productivity value of each tool
2. Tool required time
3. Aspects that affect production capacity

By analyzing these factors, it is possible to identify shortcomings or problems that exist in the Banjarmasin-Martapura road reconstruction project section II. Furthermore, the right solution can be proposed, such as paying more attention to the condition of the equipment that will be applied at the project site and rechecking before the heavy equipment is sent to the work site, so that the problem of tool damage when in the process of work does not occur again so that the time used is also more efficient and the work can be completed on time.

2. THEORETICAL STUDY

Heavy Equipment

According to (Susy Fatena Rostiyanti, 2002). In projects, especially large-scale construction projects, heavy equipment is essential. The purpose of this heavy equipment is to make it easier for humans to do their work so that the expected results can be achieved more easily in a shorter time and with better quality.

Work Efficiency and Operators

Work efficiency is a comparison between the amount of time spent working and the amount of time spent working. Meanwhile, the operator efficiency factor is the ability to operate the equipment that the operator must have in order to avoid work delays.

Machine Productivity

The method of production capacity of the heavy equipment to be used is determined through the calculation of the productivity of the heavy equipment. The results of Rochmanhadi's (1982) research show that, when compared to the ideal condition of the

tool, the productivity of heavy equipment in the field is not the same. This is due to factors such as topography, operator capabilities, operation, and maintenance of the equipment.

Several methods for calculating the production capacity of heavy equipment, such as:

1. Dump *truck*

   Soil haulers and dump trucks use the following equation to calculate production capacity:

   A. Production Capacity *of Dump Truck*

   V x E x 60/Fh/CT..... (2.1)

   B. Bucket Capacity

   C = n x q x Fb..... (2.2)

   C. Cycle Time

   CT = LT + HT + OT + RT + ST..... (2.3)

2. Alat Perata (*Asphalt Finisher*)

   The calculation of the production capacity *of the asphalt finisher* uses equations such as:

   $$Q = v \; x \; b \; x \; 60 \; x \; Fa \; x \; t$$..... (2.4)

3. Compaction Tools (*Tandem Roller, Pneumatic Tire Roller*)

   To calculate the productivity of the compactor, the following equation can be used :

   $$Q=\frac{(v \times 10000) \times (N\,(b\text{-}bo)+bo) \times t \times Fa \times D1}{n\text{-}N}$$..... (2.5)

Cycle Time

Moving materials involves repetitive work cycles, such as: digging, loading, moving, unloading, and returning to the initial activity is the main task in cycle time activities. All of these activities can be done with one or more tools.

Factors Affecting Heavy Equipment Productivity

In order to carry out effective machine management, it is important to understand the productivity value of the machine and the variables that affect it. The right method can reduce the cost and duration of construction projects (Methe et al., 2018).

The results of observations in the field and analysis of heavy equipment productivity calculations can be used to determine aspects that affect the production

capacity of heavy equipment. Some of the factors that affect the productivity of heavy equipment include:

1) Engine condition
2) Operator
3) Working method
4) Terrain conditions
5) Work environment

3. METHOD

The basic principle of heavy equipment productivity is to calculate the production of heavy equipment (tons), then find out the number of heavy equipment used in the Banjarmasin-Martapura Road Reconstruction Project on Section II. The first step to analyzing this calculation of heavy equipment needs is to calculate the working production of heavy equipment for each type of work. After knowing the production of work, the number of heavy equipment needed and the work time can be calculated.

The research location of the Banjarmasin-Martapura Road Reconstruction Project on section II located in Sungai Rangas, West Martapura District, Banjar Regency, South Kalimantan. The details of the location of the research are listed in Figure 3.1.

Figure 3. 1 Project Location View

Data Collection

Primary Data

Primary data is information collected directly from researchers in the field through observations or surveys. Primary data forms include machine hours, type of machine used for road paving, distance to construction site, average machine speed, operator, and machine cycle time.

Secondary Data

Secondary data is data collected from agencies involved in observations. Secondary data needed includes: generalproject data, heavy equipment specification data, work volume, bucket capacity and bucket factors, year of acquisition of tools, service life of tools and physical condition of tools, width and length of roads handled, thickness of road paving layers.

Data Analysis Stage

To calculate the production capacity of the tools as well as calculate the work time and working time of the tools used in the project, then compare it with the realization in the field. Then, make tables and graphs compare the productivity of the results of theoretical analysis and realization in the field can be seen. Then describe the factors that affect productivity based on facts in the field.

4. RESULTS AND DISCUSSION

Asphalt Sprayer *Heavy Equipment Productivity Analysis*

The calculation of the productivity *of the AHN 1000* asphalt sprayer is as follows:

Hourly Production Capacity:

$$Q = V \times lt \times Pa \times Fa$$
$$= 3000 \times 0.8 \times 55 \times 0.83$$
$$= 109{,}560\ m^3/hour$$

Conversion from /h to ton/h:m^3

Productivity (tons/hour) = Qasphalt sprayer (m/h) x asphalt weight (tons/m)

= 109,560 m/jam x 2,32 ton/m

= 252,988 from/jam

Production Capacity Per Day:

$$Q = \text{Productivity per hour} \times \text{Effective working hours}$$
$$= 252.988 \text{ tons/hour} \times 7 \text{ hours/day}$$
$$= 1770.91 \text{ liters/day}$$

Dump Truck *Heavy Equipment Productivity Analysis*

The hourly production analysis *of dump truck* (Q) is calculated below. Settlement:

Hourly Production Capacity:

$$Q = \frac{\text{v x Fa x 60}}{\text{D x Ts}} = \frac{8 \text{ x } 0{,}83 \text{ x } 60}{2{,}32 \text{ x } 107{,}3} = 1{,}600 \text{ to/jam}$$

Productivity per day:

Q = 7 jam/hari x Q*dump truck*

= 7 hours/day x 1,600 tons/hour

= 11,200 tons/day

Asphalt Finisher *Heavy Equipment Productivity Analysis*

The productivity analysis of *asphalt finisher* heavy equipment can be calculated using the following formula:

Hourly Production Capacity:

Q = v x b x 60 x Fa x t x D1

= 5 m/min x 4 m x 60 x 0.80 x 0.05 m x 2.32 tons/m3

= 111,36 from/jam

Production Capacity Per Day:

Q = Productivity per hour × Effective working hours

= 111.36 tons/hour x 7 hours/day

= 779.52 tons/day

Productivity Analysis of *Tandem Roller Heavy Equipment*

The analysis of the production capacity *of tandem roller* heavy equipment is calculated using the following calculations:

Hourly Production Capacity:

$$Q = \frac{(\text{v x } 10000) \text{ x } (\text{N } (\text{b} - \text{bo}) + \text{bo}) \text{ x t x Fa}}{\text{n x N}}$$

$$Q = \frac{(6 \text{ x } 1000)\text{km/jam x } (3 \text{ } (1{,}45 \text{ m} - 0{,}15 \text{ m}) + 0{,}15 \text{ m}) \text{ x } 0{,}05 \text{ m x } 0{,}75}{6 \text{ x } 3}$$

= 54,375 from/jam

Production Capacity Per Day:

Q = Productivity per hour × Effective working hours

= 54.375 tons/hour x 7 hours/day

= 380,625 tons/day

Productivity Analysis of *Pneumatic Tire Roller Heavy Equipment*

For the analysis of the productivity of *pneumatic tire roller* heavy equipment, it can be calculated using the following calculations:

Hourly Production Capacity:

$$Q = \frac{(v \times 1000) \times (N(b-bo)+bo) \times t \times Fa}{n \times N}$$

$$= \frac{(4 \times 1000) \times (2\ (2{,}4-0{,}15)+0{,}15) \times 0{,}05 \times 0{,}83}{8 \times 2} = 49{,}08 \text{ ton/jam}$$

Production Capacity Per Day:

Q = Productivity per hour × Effective working hours

= 49.08 tons/hour x 7 hours/day

= 348.6 tons/day

The results of the analysis of heavy equipment productivity can be seen in Table 4. 1.

Table 4. 1 Heavy Equipment Productivity Based on Theoretical Calculation Analysis

No.	Heavy Equipment	Productivity (tons/hour)	Productivity (tons/day)
1	*Asphalt Sprayer*	252,988	1770,91
2	*Dump Truck*	1,600	11,200
3	*Asphalt Finisher*	111,36	779,52
4	*Tandom Roller*	54,375	380,625
5	*Pneumatic Tyre Roller*	49,08	348,06

Results of Analysis of Heavy Equipment Needs and Work Duration

After the machine productivity analysis is completed, the needs and duration of the work are calculated using the production value of each machine. In the asphalt laying work, the planned volume is 1600 tons while the work that has been done is 1577.5 tons, so the volume of work in this study is the amount of work that has been done. The analysis of the heavy equipment requirements formula is as follows:

$$t = \frac{\text{Volume pekerjaan terhampar}}{\text{Produktivitas per hari asphalt sprayer}}$$

After all the analysis is complete, determine the number of tools needed and the time required, then refer to Table 4. 2. for the recapitulation. Furthermore, comparisons are made based on the situation in the field.

Table 4. 2 Comparison of Results of Theoretical and Reality Analysis in the Field

No.	Heavy Equipment	Theoretical Analysis			Field Analysis		
		Productivity per day (tons/day)	Number of tools (Units)	Job Duration (days)	Productivity per day (tons/day)	Number of tools (Units)	Job Duration (days)
1	*Asphalt Sprayer*	**301,06**	1	**5**	**143**	1	**11**
2	*Dump Truck*		20			26	
3	*Asphalt Finisher*		1			1	
4	*Tandom Roller*		1			1	
5	*Pneumatic Tyre Roller*		1			1	

Factors affecting machine productivity

Based on the results of discussions and questions and answers in the field that can be seen in the appendix, there are material factors, environment, equipment conditions, weather, and time management which are some of the factors that can affect productivity.

5. CONCLUSION

Based on the results of a large study on the production capacity of heavy equipment and about aspects that have an impact on road paving work, especially on Laston Wear Layer (AC-WC), it can be concluded that:

1. The productivity value of road paving work based on theoretical analysis is 1577.5 tons/day with a work duration of 5 (five) days with the number of heavy equipment *Asphalt Sprayer* as many as 1 unit, *Dump Truck* as many as 26 units, *Asphalt Finisher* as many as 1 unit, Tandem Roller as many as 1 unit and *Pneumatic Tire Roller* as many as 1 unit. Meanwhile, based on the analysis carried out in the field, it was found that the duration of work was 11 (eleven) working days and the productivity of all heavy equipment was 143 tons/day with the number of heavy equipment *Asphalt Sprayer* as many as 1 unit, *Dump Truck* as many as 20 units, *Asphalt Finisher* as many as 1 unit, *Tandem Roller* as many as 1 unit and *Pneumatic Tire Roller* as many as 1 unit.
2. Based on the results of interviews conducted with the parties concerned in the field, the factors that affect the productivity of heavy equipment in this analysis are material

factors, environment, heavy equipment conditions, weather and time management.

REFERENCES

Akbar, F., Yamali, F. R., & Dwiretnani, A. (2021). Analysis of the Use and Productivity of Heavy Equipment in the Improvement of the Simpang Pauh-Air Hitam Road Section of Jambi Province. *Journal of Civil Talent, 4*(2), 114-119.

Aris, M., Pramanda, H., Kurniasari, F. D., & Ariansyah, D. (2023). Analysis of Productivity and Effectiveness of Heavy Equipment in the Work of Improving Irrigation Roads in Kr. Jreu Kec. *Journal of Planning and Research in Civil Engineering*, *2*(1), 127-134.

Arsyad, R. (2021). Analysis of Heavy Equipment Productivity in the Pekanbaru-Padang Section VI Pekanbaru-Bangkinang Toll Road Construction Project (Doctoral dissertation, Riau Islamic University).

Bina Marga. (2010). General Specification 2010 (fix 2)", National Road Implementation Center V, Yogyakarta ; Directorate General of Highways, Department of Public Works.

Handayani, E., & Akbar, F. (2020). Study on the Efficiency of Heavy Equipment Productivity in Road Projects (Case Study: Mendalo Darat Road Section (Sp. Tiga)-Bts. Jambi City). *Journal of Civronlit Unbari*, *5*(1), 16-22.

Indriani, F. (2023). Analysis of Heavy Equipment Productivity in Grained Pavement Work on the Handil Maluka Road Handling Project – Harapan Beach, Bumi Makmur District. Lambung Mangkurat University

Regulation of the Minister of Public Works and Public Housing Number 8 of 2023 concerning Guidelines for the Preparation of Construction Work Cost Estimates in the Field of Public Works and Public Housing

Prasetya, R. T., Yulianto, T., Nugroho, M. W., & Sundari, T. (2023). Time and Cost Analysis Based on Field Productivity Reference Using the Actual Cost Estimation Method. *Journal of Engineering Research Cluster*, *2*(2), 11-20.

Prima, G. R., & Hafudiansyah, E. (2022). Heavy Equipment Productivity in Toll Road Project Work (Case Study: Pematang Panggang Kayu Agung Toll Road Section 2, Ogan Komering Ilir, South Sumatra). *Acceleration: Scientific Journal of Civil Engineering*, *3*(2).

Purwanto, T., Wiranto, P., & Lukman, H. (2016). Heavy Equipment Productivity in the Construction of the Laratlamdesar Road Section, Maluku Province. *Pakuan University Student Online Journal, 1*(1).

Sihasale, H., Leuhery, L., & Titaley, H. D. (2023). Analysis of heavy equipment productivity in the construction of the Pattimura University Marina Center phase II in Hila Village. *Journal Agregate*, *2*(2), 186-195.

Wardani, P. I. K., Ratih, S. Y., & Primantari, L. (2022). Productivity Analysis of Excavator and Dump Truck Heavy Equipment (Case Study of the Manahan Indoor Building Construction Project in Surakarta City). *World Communication Media of Civil Sciences*, *4*(2), 46-51.

Zaoqi, A., Hasyim, H., & Warka, I. G. P. (2022). Evaluation of Heavy Equipment Productivity and Efficiency in Earthworks of Runway Extension Project at Lombok International Airport. *Ganec Swara*, *16*(2), 1627-1636.