

ANALYSIS OF HEAVY VEHICLE PRODUCTIVITY ON THE TERBANGGI BESAR-KAYU AGUNG TOLL ROAD PROJECT KM 30+100 TO 30+500

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ABSTRACT

Infrastructure projects, especially in flexible pavement work, are highly dependent on the use of heavy vehicles. This use is a crucial factor in supporting the success of asphalt road construction projects, where the production capacity of heavy vehicles plays a vital role in the progress of project implementation. Therefore, the calculation of production volume capacity analysis is important. The purpose of this study is to identify the production volume capacity of work on the construction of the Semarang-Demak Toll Road section 1C KM 35+400 to KM 36+400, including the capacity of asphalt finishers, dump trucks, pneumatic tire rollers, and tandem rollers. The method used is the volumetric method, which aims to calculate the volume and production capacity of heavy vehicles. The results of the analysis show that the calculation of the volume and productivity of heavy vehicles has been in accordance with the planned schedule.

Keywords: Heavy Vehicles, Civil Engineering, Mechanical Engineering, Productivity.

INTRODUCTION

In large-scale civil engineering projects, heavy equipment is essential and plays a crucial role in determining the success of the project, including in the construction, agriculture, forestry, and mining sectors. The effectiveness of using heavy equipment not only increases productivity but also depends on a deep understanding of maintenance costs, operations, and equipment specifications and functions. The productivity of this heavy equipment is also influenced by the duration of the work, the topography of the location, and the type of equipment specifications, so that the wrong choice of equipment can hinder the smooth running of the project.

METHOD

The research method is described in the flow diagram or research stages in the form of a flow chart below.



Figure 1. Research Flowchart

Literature study, conducting a literature study from various literature books related to heavy equipment on projects, especially those related to road projects. Field data is directly related to the field. The field data is as follows: heavy equipment costs, work implementation plans, scope of work. The heavy equipment used by the contractor company to work on projects in the field is as follows: Asphalt Finisher, Asphalt Mixing Plant, Asphalt Sprayer, Compressor, Dump Truck, Hydraulic Excavator, Motor Grader, Pneumatic Tired Roller, Stone Crusher, Tandem Roller, Tronton Truck, Vibration Roller, Wheel Loader.

The cycle period to be calculated is the cycle period of the dump truck, hydraulic excavator, wheel loader.

1) Dump truck

The equation below can be used to calculate the cycle time of a dump truck:

$C_m = C_{m1} + C_{m2} + C_{m3}$; where C_m = cycle period, C_{m1} = fixed period (minutes), C_{m2} = loading period, C_{m3} = travel period.

2) Hydraulic excavator

Based on Figure 2 below, the excavator cycle time can be determined.

Figure 2. Excavator Cycle Period

3) Wheel loader

Wheel loader has a fixed period or fixed time of around 10.9 seconds. The filling process is determined using the V-loading method: $C_m = 2 \left(\frac{D}{F} + \frac{D}{R} \right) + Z$; where C_m = cycle period (minutes), D = haul route (m), F = forward speed (m/minute), R = reverse speed (m/minute); Z = fixed time (minutes).

The specifications of the heavy equipment used in this project are as follows, namely:

1) Asphalt finisher

Spreading width: 2.5 m – 6 m

Hooper capacity: 10 tons

Type: Mitsubishi MF55H

2) Hydraulic excavator

Type: Komatsu PC500LC-10 R

Bucket capacity: 3.8 m³

Net engine output: 360 HP

DISCUSSION

The work realization schedule is a breakdown of the project implementation into a series of steps or work stages. Based on the work schedule that has been approved when the tender winner was announced, it is known that the construction of the Terbanggi-Kayu Agung Toll Road Project km 30+100 to km 30+500 is scheduled for 160 effective working days. The mobility of heavy equipment will take approximately 45 effective working days, and the finishing work will take approximately 15 effective working days. Thus, the total effective

working time to complete the main work is approximately 100 days. Therefore, based on the agreed duration and the calculated production activity capacity, the production volume that can be seen in Table 1 below can be determined.

Table 1. Operational Activity Production Capacity

No.	Tipe Aktivitas	Waktu Efektif Pekerjaan	Kapasitas Produksi	
			/ hari (m ³)	/ jam (m ³)
1	Galian	41	717,75	86,80
2	Timbunan	21	411,93	49,29
3	Lapis Pondasi Agregat	20	47,71	5,92
4	Perkerasan Aspal	8	77,99	8,75

Production capacity volume analysis is a calculation to determine the working capacity of heavy equipment per hour adjusted to the topographic conditions of the field. It is important to conduct a cycle time analysis first because this is fundamental in analyzing the production capacity of heavy equipment.

Table 2. Cycle Time Analysis of Soil Excavation Work

No	Peralatan yang dipakai	Cycle time (menit)
1	Dump Truck	0,43
2	Hydraulic Excavator	7,55

The analysis of heavy equipment volume capacity is based on the use of the equipment in the work, and the results can be seen in Table 3 below.

Table 3. Analysis of Heavy Vehicle Volume Quantity in Land Filling Activities

No	Kendaraan Berat	Kuantitas Volume Kendaraan Berat
1	Dump Truck	21,54 m ³ /jam
2	Motor Grader	15,37 m ³ /jam
3	Vibration Roller	1977 m ³ /jam
4	Wheel Loader	50,86 m ³ /jam

The productivity of heavy equipment can be seen in Table 4 below, the condition is obtained based on field activities as in the analysis that has been carried out previously.

Table 4. Average Quantity of Heavy Vehicles in Soil Excavation Activities

No.	Peralatan berat yang dipakai	Volume pekerjaan	Kapasitas Volume Peralatan berat	Waktu kerja efektif	Jumlah alat
		(m ³ /jam)	(m ³ /jam)		
1	Dump Truck	77,86	151,51	39	2
2	Hydraulic Excavator		55,77		5

CONCLUSION

From the discussion above we get the following formulas: the most effective and productive time period in working on this project is around 110 days; This project uses the following operational production vehicles:

- 1) Asphalt finisher;
- 2) Dump truck;

- 3) Hydraulic excavator;
- 4) Motor grader;
- 5) Pneumatic tired roller;
- 6) Tandem roller;
- 7) Vibration roller;
- 8) Wheel loader.

REFERENCES

- Abdillah, S. R., Zulfikar, S., & Prima, Y. (2023). PENGARUH LIMBAH CANGKANG KERANG SEBAGAI SUBSTITUSI AGREGAT HALUS TERHADAP KUAT TEKAN BETON. *Jurnal Sipil Krisna*, 9(1), 39-48.
- Achmad, F. A., & Rumbyarso, Y. P. A. (2023). Analisis Struktur Slab On Pile terhadap Kontrol Lendutan pada Proyek Jalan Tol Kataraja. *Jurnal Pendidikan Tambusai*, 7(2), 13457-13467.
- Achmad, F. A., & Rumbyarso, Y. P. A. (2024). Analisis Penjadwalan Proyek Klinik Spesialis Mata & Tht Ayani Dengan Pert & Cpm. *International Journal Of Multi Science*, 4(01), 1-8.
- Abidin, Z., & Rumbyarso, Y. P. A. (2024). PCI-Analyzed Administrative Way Damage. *Larisa Teknik Sipil*, 1(1), 8-14.
- Arga RumbyarsoY., & PribadiG. (2024, September 30). Analisis Kapasitas Daya Dukung Bore Pile Pada Proyek Gedung Fakultas Hukum Unisulla Semarang Jawa Tengah. *Pasak: Jurnal Teknik Sipil Dan Bangunan*, 2(1), 1-5. <https://doi.org/https://doi.org/10.32699/pasak.v2i1.6976>
- Arga Rumbyarso, Y. P. (2024). Buku Ajar Struktur Beton Prestress.
- Arga Rumbyarso, Y. P. (2024). Kinerja Struktur Gedung Office 36 Lantai: Analisis History dan Pushover.
- Arga Rumbyarso, Y. P. (2021). Pengukuran Kinerja Perusahaan PT. Ritra Cargo Indonesia Menggunakan Balanced Scorecard.
- Artiani, G. P., Rodji, A. P., Sihombing, S. M., Arga, Y. P., & Pribadi, G. (2023). PERENCANAAN SUMUR RESAPAN UNTUK PENGENDALIAN BANJIR DI WILAYAH KECAMATAN PASAR REBO, JAKARTA TIMUR. *Abdimas Galuh*, 5(2), 1008-1018.
- Artiani, G. P., Rodji, A. P., Sihombing, S. M., Arga, Y. P., & Pribadi, G. PERENCANAAN SUMUR RESAPAN UNTUK PENGENDALIAN BANJIR (STUDI KASUS: SUB BWP KECAMATAN PASAR REBO, JAKARTA TIMUR) DESIGN OF INFILTRATION WELLS FOR FLOOD CONTROL (CASE STUDY: SUB BWP, PASAR REBO DISTRICT, EAST JAKARTA).
- Ashshiddiq, F. R., Rumbyarso, Y. P. A., & Siagian, B. M. (2024). ANALYSIS OF FLEXURAL STRENGTH OF BEAM USING BAMBOO REINFORCEMENT. *INTERNATIONAL JOURNAL OF MULTI SCIENCE*, 4(02), 97-103.
- Darmiyanti, L., Prima, Y., & Aldianto, M. A. (2023). Analisis Borepile Menggunakan Metode Meyyerhoff dan Reese Wright. *Jurnal Sipil Krisna*, 9(1), 27-38.
- Farhan, M. F. F., Rumbyarso, Y. P. A., & Siagian, B. M. (2024). Analisa Penjadwalan Proyek Menggunakan CPM dan PERT Pada Proyek Pembangunan Gedung KONI Jakarta Pusat. *Jurnal Teknik dan Teknologi Indonesia*, 2(3), 1-11.
- Fransiscus, R., Sihombing, S. M., & Prima, Y. (2022). ANALISIS TEBAL PERKERASAN LENTUR PADA JALAN TOL AKSES MENUJU BANDARA INTERNATIONAL KERTAJATI. *Jurnal Sipil Krisna*, 8(1), 50-61.
- Pribadi, G., & Rumbyarso, Y. P. A. (2024). ANALISIS UJI TEKAN BETON MENGGUNAKAN BAHAN LIMBAH KARET DILATASI KONDISI CURING DENGAN AIR LAUT. *Jurnal Konstruksi Teknik Sipil*, 1(3), 203-213.

- Gamaliel, B., & Rumbyarso, Y. P. A. (2022). PELATIHAN DESIGN GAMBAR DENGAN APLIKASI AUTOCAD 2D UNTUK SISWA/I SMK YAPPA DEPOK. *KRIDA CENDEKIA*, 1(09).
- GIOVANNI, D., RUMBYARSO, Y. P. A., & SIAGIAN, B. (2024). ANALYSIS OF CONCRETE COMPRESSIVE STRENGTH WITH PARTIAL SUBSTITUTION OF IRON POWDER WASTE AS FINE AGGREGATE. *INTERNATIONAL JOURNAL OF MULTI SCIENCE*, 4(02), 122-129.
- Lydia, D., Sahat, S., & Yonas, P. (2023). PENGARUH ELEKTROOSMOSIS TERHADAP KUAT GESER TANAH LEMPUNG. *Konferensi Nasional Teknik Sipil (KoNTekS)*, 1(6).
- Pribadi, G., & Rumbyarso, Y. P. A. (2024). Model Perkuatan Anyaman Bambu pada Subgrade Bunker Tangki Pendam. *Jurnal Ilmiah Universitas Batanghari Jambi*, 24(3), 2530-2535.
- Pribadi, G., & Rumbyarso, Y. P. A. (2023). Analisis Profil Atap Baja WF dengan Metode LRFD Menggunakan SAP 2000 dan Idea StatiCa. *Jurnal Teknik Industri Terintegrasi (JUTIN)*, 6(4), 1543-1559.
- Pribadi, G., & Rumbyarso, Y. P. A. (2023). Analisis Perbandingan Daya Dukung dan Penurunan Pondasi Tiang Bor Dengan Perhitungan Manual dan Software ALLPILE. *Jurnal TESLINK: Teknik Sipil Dan Lingkungan*, 5(2), 16-20.
- Pribadi, G., Rumbyarso, Y. P. A., & Sakti, E. M. S. (2023). Pelatihan Merancang Gambar Dengan Aplikasi Autocad untuk Pembekalan Siswa SMK dalam Memasuki Dunia Kerja. *Media Abdimas*, 2(2), 52-56.
- Prima, Y., & Pribadi, G. (2023). Penggunaan Program Plaxis Dalam Studi Penelitian Perkuatan Geotextile Pada Kestabilan Lereng Buatan. *Jurnal Sipil Krisna*, 9(1), 22-26.
- Prima, Y., & Darmiyanti, L. (2023). Analisis Kinerja Struktur Gedung Rusun TNI AU Halim Perdanakusuma Dengan Menggunakan Metode Pushover Analysis. *Jurnal Sipil Krisna*, 9(2), 26-35.
- Prima, Y. (2022). ANALISIS DAYA DUKUNG KAWASAN PENDIDIKAN STT WASTU KENCANA (STUDI KASUS GEDUNG STT WASTUKENCANA). *Jurnal Ilmiah Plano Krisna*, 18(1).
- Rinjoko, N. F., Rumbyarso, Y. P. A., & Darmiyanti, L. (2024). THE EFFECT OF GRANITE WASTE AS A FINE AGGREGATE SUBSTITUTION IN ASPHALT CONCRETE BINDER COURSE. *INTERNATIONAL JOURNAL OF MULTI SCIENCE*, 4(02), 56-62.
- Rumbyarso, Y. P. A. (2024). Aplikasi Perangkat Lunak Plaxis dan Geostudio dalam Studi Subsiden Tanah di Kecamatan Tarumajaya akibat Pemanfaatan Air Tanah Berlebih. *Jurnal Teknologi dan Sains Modern*, 1(3), 100-108.
- Rumbyarso, Y. P. A., & Pribadi, G. (2024). Analisis Kapasitas Daya Dukung Bore Pile Pada Proyek Gedung Fakultas Hukum Unisulla Semarang Jawa Tengah. *Pasak: Jurnal Teknik Sipil dan Bangunan*, 2(1), 1-5.
- Rumbyarso, Y. P. A. (2023). Re-planning of Concrete Structures in the Ngoro Dormitory Project in Surabaya. *Journal of Applied Science, Engineering, Technology, and Education*, 5(1), 15-24.
- Rumbyarso, Y. P. A., & Pribadi, G. (2023). Analisis Stabilitas Lereng dengan Metode Bishop pada Proyek Geotechnical Investigation Jalur Transportasi Pelabuhan Batubara Marangkayu Kabupaten Kutai Kartanegara. *JURNAL KRIDATAMA SAINS DAN TEKNOLOGI*, 5(02), 562-577.
- Rumbyarso, Y. P. A. (2023). Penyuluhan Komposisi Campuran Beton untuk Jalan Tol. *Journal of Social Work and Empowerment*, 2(3), 137-144.
- Rumbyarso, Y. P. A. (2022). Analisis Perkuatan Rangka Atap Baja pada Bangunan Gedung Heritage 1921 Menggunakan Software SAP 2000. *Jurnal Teknik Indonesia*, 1(1), 1-8.
- Rumbyarso, Y. P. A., & Pribadi, G. (2022). Penyuluhan Tentang Pentingnya Sebuah Kontruksi Bangunan Rumah Yang Baik Serta Tahan Gempa. *Krida Cendekia*, 1(08).

- Rumbyarso, Y. P. A. (2021). PERENCANAAN STRUKTUR BANGUNAN ATAS (UPPER STRUCTURE) GEDUNG STIE BANK BPD JATENG KOTA SEMARANG. *TEKNOKRIS*, 24(1), 1-7.
- Rumbyarso, Y. P. A. (2019). Perencanaan Struktur Bangunan Atas (Upper Structure) Gedung Stie Bank Bpd Jateng Kota Semarang. *Teknokris*, 22(1).
- Rumbyarso, Y. P. A. (2022). Analysis Of Compressive Strength Of Concrete By Using Slag Circum As A Concrete Aggregate Mix. *International Journal Of Multi Science*, 2(12), 35-46.
- Rumbyarso, Y., Chusna, N., & Khumaidi, A. (2022). Dissolved Oxygen Prediction of the Ciliwung River using Artificial Neural Networks, Support Vector Machine, and Streeter-Phelps. *Jurnal Ilmiah Merpati (Menara Penelitian Akademika Teknologi Informasi)*, 10(3), 180-190.
- Rumbyarso, Y. P. A., & Ulum, R. B. (2021). Analisis Pengaruh Penggunaan Cangkang Telur Bebek Ras Petelur Sebagai Filler Pada Campuran Aspal Beton. *Jurnal Teknologika*, 11(2), 115-124.
- Rumbyarso, Y. P. A. (2023). PERHITUNGAN PRODUKTIVITAS PERALATAN BERAT PADA PROYEK JALAN TOL SEMARANG–DEMAK SEKSI 1C KM 35+ 400 SAMPAI DENGAN 36+ 400. *Mechonversio: Mechanical Engineering Journal*, 6(2), 34-39.
- Rumbyarso, Y. P. A., & Pribadi, G. (2024). Analysis of Landslide Handling With Mini Pile Reinforcement Using Plaxis Software on The “X” Toll Road Project. *Jurnal Teknik Industri Terintegrasi (JUTIN)*, 7(2), 801-810.
- Rumbyarso, Y. P. A. (2024). Analisis Perbandingan Kinerja Struktur Tahan Gempa Pada Wilayah Berbeda Dengan Metode Respon Spektrum (Studi Kasus: Apartemen 19 Lantai). *Pasak: Jurnal Teknik Sipil dan Bangunan*, 1(2), 69-72.
- Rumbyarso, Y. P. A., Pribadi, G., & Achmad, F. A. (2023). PENGENALAN DASAR–DASAR PENGOLAHAN DATA PADA SMK PGRI 4 JAKARTA MENGGUNAKAN APLIKASI SPSS. *KRIDA CENDEKIA*, 2(02).
- Rumbyarso, Y. P. A., & Fariqi, A. (2024). Learning Obstacle On Integral (Antiderivative) Material In Didactic Situation Theory. *Larisa Teknik Sipil*, 1(1), 1-7.
- RUMBYARSO, Y. P. A., & Pribadi, G. (2024). ANALYSIS OF CONCRETE COMPRESSIVE STRENGTH WITH COCONUT FIBER WASTE AS A PARTIAL REPLACEMENT OF FINE AGGREGATE. *INTERNATIONAL JOURNAL OF MULTI SCIENCE*, 4(02), 130-135.
- Rumbyarso, Y. P. A., Pribadi, G., & Addin, F. (2024). PENGENALAN DAN PELATIHAN AUTOCAD UNTUK MENINGKATKAN KETERAMPILAN SISWA SMA YAPEMRI DEPOK. *KRIDA CENDEKIA*, 3(02).
- Saifulloh, R., Rumbyarso, Y. P. A., & Sukadi, S. (2024). Analisis Pengaruh Penggunaan Limbah Cangkang Siput Pada Campuran Asphalt Concrete-Wearing Course (AC-WC). *Madani: Jurnal Ilmiah Multidisiplin*, 2(8), 202-216.
- Sihombing, S. M., Darmiyanti, L., & Prima, Y. PENGARUH ELEKTROOSMOSIS TERHADAP KUAT GESER TANAH LEMPUNG. *PROSIDING Konferensi Nasional Teknik Sipil 17*.
- Taqwa, I., Rumbyarso, Y. P. A., & Darmiyanti, L. (2024). ANALYSIS OF LIGHTWEIGHT BRICK WASTE FOR PARTIAL SUBSTITUTION OF FINE AGGREGATE ON CONCRETE COMPRESSIVE STRENGTH. *INTERNATIONAL JOURNAL OF MULTI SCIENCE*, 4(02), 34-41.
- Ulum, R. B., Rumbyarso, Y. P. A., Akbar, M. A., & Utami, D. PERANCANGAN MODEL ANALISIS SISTEM PENDUKUNG KEPUTUSAN UNTUK EVALUASI PENCAPAIAN HASIL PRODUKSI DI PERUSAHAAN OTOMOTIF DI JAWA BARAT.
- Wahyudi, T., Rumbyarso, Y. P. A., & Siagian, B. M. (2024). THE EFFECT OF FISH BONE POWDER WASTE AS A FINE AGGREGATE SUBSTITUTION IN ASPHALT

CONCRETE WEARING COURSE PAVEMENT. *INTERNATIONAL JOURNAL OF MULTI SCIENCE*, 4(02), 63-69.

Yonas, P. Infrastruktur Pembaharu Silica Fume in Asphalt Concrete-Wearing Course.

Yonas Prima, A. R. Kinerja Struktur Gedung 36 Lantai Analisis Time History Dan Pushover.