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Research paper

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ABSTRACT

Purpose: Delays in box girder erection activities remain a significant challenge in elevated toll road construction, particularly when launching gantry systems operate below their expected productivity levels. This study aims to analyze the productivity of a launching gantry used in the North Jakarta Elevated Toll Road project, evaluate project acceleration alternatives through extended overtime and workforce addition, and compare their impacts on project duration and cost to determine the most effective productivity improvement strategy.
Methods/Design: This study employed a quantitative case-study approach using Time–Cost Trade-Off (TCTO) analysis. Primary data were collected through direct field observations to determine launching gantry cycle times, while secondary data were obtained from project documents, including box girder erection methods and project budget plans. Productivity under existing conditions was calculated and compared with two acceleration scenarios—extended overtime hours and additional workforce—to identify the optimal balance between productivity, duration, and cost.
Findings: The existing launching gantry productivity was 0.040 span/day, resulting in a project duration of 322 days for 13 spans and a total cost of IDR 36.57 billion. The overtime scenario increased productivity to 0.053 span/day and reduced project duration to 243.25 days; however, the total cost increased to IDR 36.59 billion. Meanwhile, the workforce addition scenario improved productivity to 0.048 span/day and shortened project duration to 268.26 days with a total cost of IDR 36.57 billion. Although overtime achieved the highest productivity improvement, workforce addition provided a more favourable balance between schedule acceleration and cost efficiency.
Practical Implication: The findings provide practical guidance for project managers in selecting acceleration strategies for launching gantry-based box girder erection works. Workforce augmentation can serve as a more cost-effective alternative to extended overtime, enabling productivity improvement and schedule reduction while maintaining project cost efficiency in elevated toll road construction projects.

INTRODUCTION

The construction of elevated toll roads is widely implemented in large cities such as Jakarta, which face limited space, high vehicle volumes, and the increasing need for fast and efficient mobility. This condition is influenced by significant population growth, where based on data from the Population and Civil Registration Office, the administrative population of Jakarta in 2025 will reach 10,677,975 people, an increase of around 22.1% from the previous year. This large population reflects the high daily mobility needs of the community for work, school, distribution of goods, and other economic activities (Dinas Kependudukan dan Pencatatan Sipil, 2026). This high mobility need is reflected in the high traffic volume on the Jabodetabek toll road network. PT Jasa Marga noted that throughout 2025, total vehicle transactions on toll roads reached 1.3 billion vehicles, with an average of 3.58 million vehicles per day (Putri, 2026). This enormous traffic volume demonstrates that toll roads have become vital infrastructure for supporting daily mobility in the Jakarta metropolitan area.

Concurrently, the increasing population has also been accompanied by a growth in the number of vehicles in circulation, which has even surpassed 25 million units by the end of 2025, representing a 22.1% increase from the previous year (Kompas.Com, 2026). This condition has a direct impact on increasing congestion levels in the Jakarta area. According to the (Tom, 2025), Jakarta recorded an average congestion level of 59.8%, a 1.1 point increase compared to the previous year. This condition causes a 10 km travel time in Jakarta to reach 26 minutes and 19 seconds, even increasing to 38 minutes and 43 seconds during the afternoon rush hour with an average speed of only 15.5 km/h. These data indicate that the increasing vehicle volume has exacerbated congestion levels in the Jakarta area.

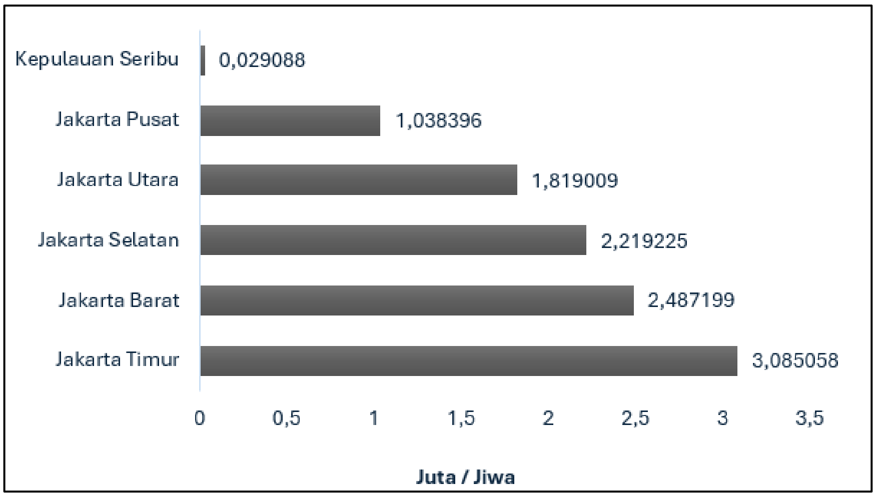

Figure 1. Graph of Jakarta population in 2025

These conditions demand effective and efficient infrastructure solutions to reduce traffic congestion. In this regard, the construction of elevated toll roads is a suitable alternative because it can provide a barrier-free route without requiring large-scale land acquisition. Therefore, the government is developing elevated toll road projects as an alternative route that can improve transportation flow and mobility efficiency in densely populated areas (Kementrian PUPR, 2017). One such elevated toll road currently underway is the Jakarta Elevated Toll Road project. This project stretches 9.69 kilometers and forms part of a strategic toll road network in northern Jakarta. The elevated toll road aims to improve connectivity between ports, industrial areas, and existing toll roads. Furthermore, the project is expected to streamline logistics distribution to and from Tanjung Priok Port, while strengthening Jakarta's role as a key national transportation hub (Asmaaysi, 2025). Given its role as a key logistics distribution route connecting industrial areas and ports, the Jakarta Elevated Toll Road project is highly urgent. Delays in project completion not only impact the contractor internally but also have the potential to hinder the smooth flow of goods and increase logistics costs. Therefore, timely project completion is crucial. In its construction, the Jakarta elevated toll road project utilizes a primary structure in the form of a girder to transfer the load from the vehicle floor slab to the pillars (Sayyida et al., 2024). Various types of girders are available, including precast concrete U-girders, precast concrete I-girders, steel box girders, and box girders. This project used the box girder type due to its efficiency in resisting deflection and its ability to withstand large bending moments over long spans (Sucita, 2025). The box girder installation process was carried out using heavy equipment in the form of a launching gantry, as shown in the figure. The use of the launching gantry in this project was due to limited work space and high traffic density, making it impossible to use other heavy equipment such as a crawler crane.

Figure 2. Erection box girder

Based on a preliminary survey, the span-to-span box girder erection work on this elevated toll road project has experienced delays compared to the planned schedule. The work process, from sealing to moving the Launching Gantry from one span to the next, takes a relatively long time. One of the main causes of the delays is a shortage of labor for several tasks, such as grouting, removing spreaders and pulling sticks, and sealing between segments. The shortage of workers during these activities has resulted in longer cycle times for each span than originally planned. Furthermore, suboptimal coordination between work teams has also resulted in delays in the mobilization of equipment and labor in the field. This situation is a significant concern because the project is targeted for completion in early 2026.

Delays in box girder erection work not only impact the project completion schedule but also have the potential to increase direct (fixed) and indirect (non-fixed) costs, such as heavy equipment rental, field operations, supervision, and project management costs. In projects using a Launching Gantry, equipment productivity is a key factor because each work cycle within a span is interdependent and cannot be performed in parallel. Productivity is influenced by the volume of work produced, the number of workers involved, and the effectiveness of work time utilization (Mulyadi & Hasnawati, 2019). If the cycle time per span is longer than planned, the accumulated delays will increase across the entire span. Therefore, analyzing equipment and labor productivity is a strategic step in controlling project time and costs. Furthermore, studies on optimizing Launching Gantry productivity using a quantitative approach based on actual work cycle data are still relatively limited. Most previous studies have focused on general project acceleration without focusing on the primary equipment that determines the duration of superstructure work. Therefore, research is needed that specifically analyzes Launching Gantry productivity and alternative acceleration options using the Time-Cost Trade-Off approach to obtain the most optimal combination of time and cost. Acceleration efforts are carried out by adding workers and implementing overtime or extended working hours. Although it increases labor and equipment maintenance costs, this approach is expected to increase Launching Gantry productivity, accelerate the completion of box girder erection work, and effectively reduce project delays.

METHODS

The research location is in the North Jakarta *elevated toll road project* which stretches from Ancol to Pluit for 9.69 km.

Figure 3. North Jakarta toll road project research location

The research location is in zone 3 of *pier* P110.S – P.111.S or 13 spans. Each span *has 17 box girder* segments. This research is a case study with a quantitative approach. The case study method is used to analyze the productivity of *the Launching Gantry in box girder erection* work based on real-world conditions (Soeryodarundio & Setiono, 2022). Numerical data such as working time, costs, number of workers, and project duration are analyzed using *the Time Cost Trade Off method* to determine the most efficient project acceleration alternative in terms of time and cost.

Cycle Time Analysis

Cycle time calculations were performed to obtain overall duration data for zone 3. In this study, the author conducted direct observations on one span, as this span covered the entire span. The time data was then processed using *Microsoft Excel*.

Launching Gantry Productivity Analysis

Launching Gantry productivity was analyzed using cycle time data results, then using the following equation (Rochmanhadi, 1992a):

$$\text{Durasi Pekerjaan} = \frac{\text{jumlah span}}{\text{durasi}} \quad (1)$$

$$\text{Total Durasi} = \text{jumlah span x durasi} \quad (2)$$

Job Duration Analysis

The duration of the work is calculated according to the acceleration of each condition (Rochmanhadi, 1992b), with the following equation:

$$\text{Durasi} = \frac{\text{Waktu Siklus}}{\text{Durasi Bekerja / hari}} \quad (3)$$

Cost Budget Draft Analysis

The RAB analysis in each condition is calculated by referencing the Circular Letter of the Director General of Construction Development No. 68/SE/Dk/2024 (KemenPUPR, 2021)

Implementation of Overtime and Worker Additions Using _the Time Cost Trade Off Method_

1. _Time Cost Trade Off_ (Overtime)

Referring to the provisions for implementing overtime work, it refers to the Decree of the Minister of Manpower and Transmigration of the Republic of Indonesia Number 102. (Tenaga et al., 2004) In this study, the addition of working hours is 2 hours per day, from the initial 8 hours to 10 hours.

2. _Time Cost Trade Off_ (Add Workers)

The addition of workers is done by recalculating the labour requirements for each activity based on the acceleration or *crashing duration* to be performed, without adding additional working hours per day. The addition of workers is not done freely but is limited by field efficiency and work coordination.

The following is a table of additional workers:

Table 1. Workforce addition scenario

Scenario	*SE*	*F*	*L*	*S*	*SS*	Amount
Existing	2	1	12	5	1	21
1	2	1	14	5	1	23
2	2	1	16	5	1	25
3	2	1	18	5	1	27

Analysis of the Relationship Between Time and Cost

Both direct and indirect costs in a project will change over time and over the progress of the project. While this relationship cannot always be expressed in a specific formula, generally speaking, the faster a project is completed, the smaller the accumulated indirect costs tend to be. Conversely, total direct costs typically increase due to the accelerated work (Hidayah A H, Setyawan A, 2024).

$$\text{Produktivitas LG} = \frac{jumlah\ span}{durasi} \quad (4)$$

FINDINGS

Cycle Time Results

In recording cycle time, direct observation was carried out in the field using a stopwatch *as* a time recorder, so that the following cycle time data were obtained:

Table 2. Cycle time

No	Description	Code	Period (minutes)
1	Tool Settings	T1	20
2	Box Girder Erection	T2	2380
3	Placement of girders on the pier/pierhead (EJ Setting)	T3	70
4	Movement of the Master Winch to the box girder installation position (travel/ shifting)	T4	595
5	Stressing Temporary PT	T5	120
6	Close-up	T6	1105
7	Install Pipe and Strand (20 pipe and strand points)	T7	600
8	Stressing Stage 1	T8	480
9	Load Transfer	T9	120
10	Stressing Stage 2	T10	450
11	Spreader & Pulling Stick Release	T11	2040
12	Cutting Strand	T12	60
13	Grouting (20 strand points)	T13	1800
14	End Cap	T14	120
15	Preparation for the next cycle (Moving Span/ Launching)	T15	1920
16	Cycle Time	***TS1***	***11880***

Table 1 shows that the cycle time required at point P.110.S – P.111.S is 11,880 minutes. This represents the time required to complete one span of *box girder erection work* until *the Launching Gantry* moves to the next span.

Launching Gantry Productivity Analysis

A Launching Gantry productivity analysis was conducted to determine the equipment's ability to complete *box girder erection work* per *span*. Productivity was calculated based on the actual duration required to complete one span, then converted into days per *span*, taking into account effective daily working hours.

At this stage, the *Launching Gantry productivity analysis* was conducted based on direct field observations. Productivity calculations focused on the P110.S to P123.S span, considering that the span is within the same work zone and has relatively uniform field conditions. Under existing conditions, work is carried out using a single shift system, namely 8:00–17:00, with an effective working time of 8 hours per day.

Durasi Pekerjaan $= \frac{jumlah\ span}{durasi}$ (1)

$= \frac{11880\ menit/60}{8\ jam/hari}$

$= \frac{198\ jam/span}{8\ jam/hari}$

= 25 days / span

= 322 days /zone3

Produktivitas LG $= \frac{jumlah\ span}{durasi}$ (4)

= 13 / 322

= 0.04 *span* /day

Based on the calculations, the productivity *of the Launching Gantry* under *existing conditions* is 322 days. This means that the *Launching Gantry* requires approximately 322 working days to complete *erection* in zone 3 *of the box girder,* with a productivity in zone 3 of 0.04 *spans* per day.

Table 3 Launching gantry productivity.

	Existing	**Overtime**	**Plus Worker**
Launching Gantry Productivity	0.04	0.053	0.048

Job Duration Analysis

After obtaining productivity under *existing conditions* , acceleration simulations were conducted using *the Time Cost Trade-Off method* through two alternatives: increasing overtime hours and increasing the workforce for stressing work. Each alternative was analyzed to determine changes in work duration, productivity increases, and its impact on project completion time. The results of the analysis were used to determine the most effective acceleration method in speeding up *the box girder erection work*.

Table 4. Comparison of acceleration calculation results.

	Existing	**Overtime**	**Plus Worker**
Duration	322 days	244 days	269 days
Acceleration		78 days	53 days

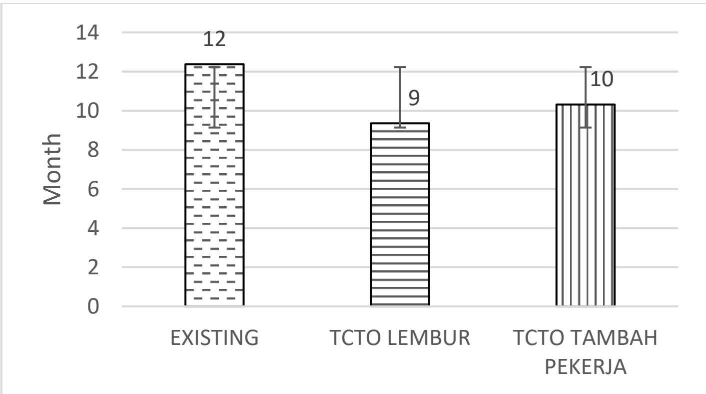

Figure 4. Comparison of the duration of each condition

The comparison shows that the overtime method has the most significant impact on accelerating project implementation duration. This is because additional working hours directly increase operational time, allowing work volume to be completed more quickly. This finding aligns with the opinion (Soeharto I dan Sumiharti Y, 1997)that additional working hours (overtime) can accelerate project implementation duration, but must still consider decreased productivity due to worker fatigue. Furthermore, these results are also supported by research (Susanti & Rimawan, 2021)showing that project acceleration through additional working hours can result in a shorter completion duration than normal conditions, although accompanied by increased implementation costs.

Cost Budget Draft Analysis

The cost calculations in this study were conducted by referencing the Circular Letter of the Director General of Construction Development Number 68/SE/Dk/2024 concerning Procedures for Compiling Cost Estimates for Construction Work in the Public Works and Public Housing Sector as a guideline in the analysis and calculation process. The cost analysis was conducted to calculate the total implementation costs for each condition, including labor, equipment, materials, and indirect costs. The calculation results show that:

1. *Existing* condition has a total cost of Rp36,567,248,875.41.
2. The overtime alternative increases the total cost to Rp36,589,751,714.54.
3. The alternative of adding labor results in a total cost of Rp. 36,567,103,562.32.

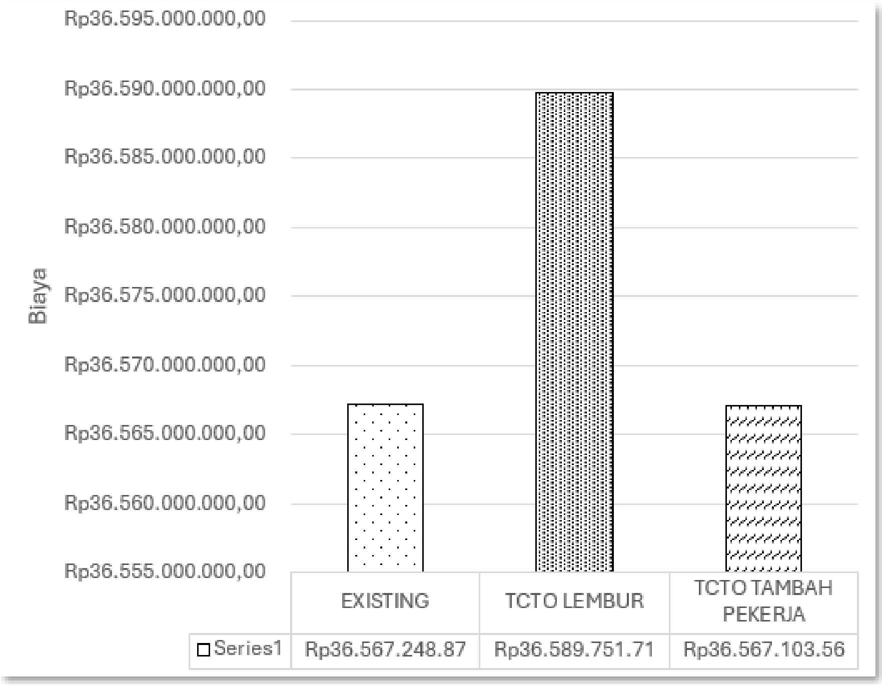

Figure 5. *Bar chart* comparison of costs for each condition

The results show that the overtime TCTO condition results in the highest total costs compared to the other conditions. Meanwhile, the additional labour TCTO condition shows total costs closest to the *existing condition*, even slightly lower. This indicates that the additional labour method provides better cost efficiency than the overtime method.

Analysis of the Relationship Between Time and Cost

A time-cost analysis is performed to evaluate the effect of acceleration on total project costs. Generally, shorter project durations reduce indirect costs, but direct costs can increase due to additional resources.

The analysis of the relationship between time and cost in this study was conducted using the *Time Cost Trade Off (TCTO) method* , which is a method used to determine the most optimal combination of project implementation duration and cost. This method is based on the principle that accelerating project duration generally causes an increase in direct costs, such as overtime and additional labor, but on the other hand can reduce indirect costs due to reduced project implementation time.

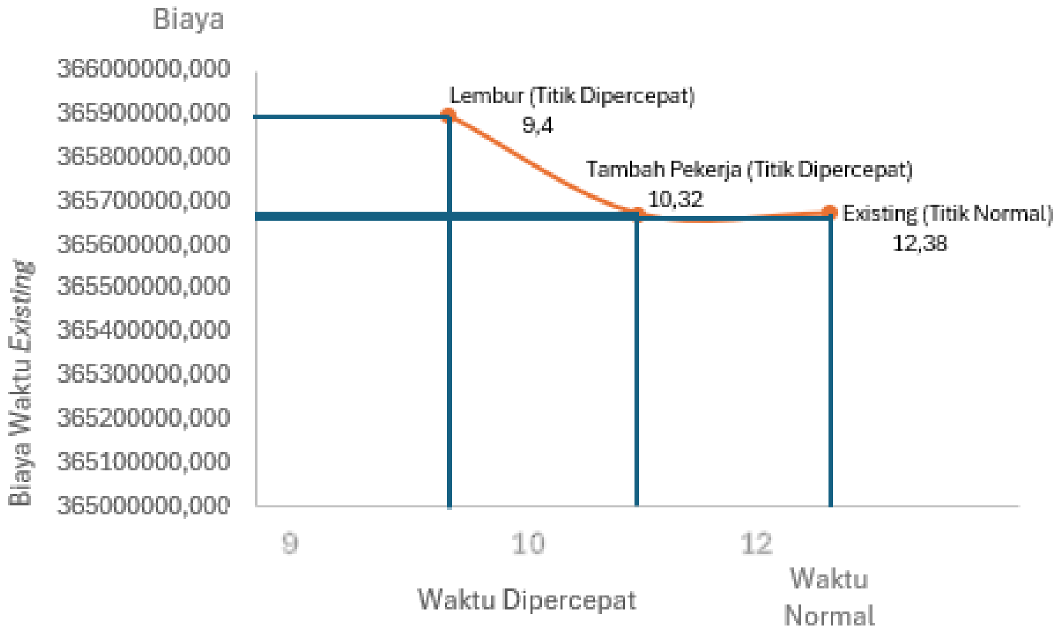

Figure 1. Graph of the relationship between duration and cost

The results of the analysis show that:

1. Existing condition has a duration of 322 days with a total cost of Rp36,567,248,875.41.
2. The overtime alternative resulted in the fastest duration, namely 243.25 days, but the total cost increased to Rp36,589,751,714.54.
3. The alternative of adding labour resulted in a duration of 268.26 days with a total cost of Rp36,567,103,562.32.

Based on the time-cost curve*,* overtime acceleration provides the greatest reduction in duration but requires significant additional costs. Conversely, adding more labour effectively reduces project duration at a lower total cost than *existing conditions. Therefore, based on the Time-Cost Trade-Off* principle, the alternative of adding more labour is the most optimal combination of time and cost because it provides accelerated duration with the best level of cost efficiency.

This difference between the normal and accelerated points is triggered by uneconomical resource use to save time, such as overtime payments or additional equipment. The graph shows that the steeper the line (especially with the overtime method), the greater the cost slope, or additional costs incurred per unit of accelerated time. This analysis serves as the basis for determining acceleration efficiency to ensure the project remains within reasonable budget limits.

PRACTICAL IMPLICATION

Based on the analysis of Launching Gantry productivity and the application of the Time Cost Trade-Off method to the Jakarta elevated toll road project, the following conclusions were obtained:

1. Launching Gantry productivity under existing conditions was 0.04 span/day. This value indicates that under normal conditions, a Launching Gantry requires approximately 25 days to complete one span, with a total implementation duration of 322 days or 12.38 months to complete 13 spans in Zone 3. This productivity reflects the actual project implementation conditions before the acceleration and serves as the basis for evaluating equipment performance improvements under accelerated conditions.
2. The application of the Time Cost Trade-Off (TCTO) method through overtime and additional labor options both increased Launching Gantry productivity and accelerated the project implementation duration compared to existing conditions. The overtime method increased productivity to 0.053 span/day with a duration of 243.25 days, while the additional labor method increased productivity to 0.048 span/day with a duration of 268.26 days. Although overtime acceleration resulted in the shortest duration, the additional workforce method still achieved significant acceleration with a shorter duration compared to the existing method.
3. The additional workforce method was the most optimal acceleration alternative for increasing Launching Gantry productivity because it provided the best balance between cost and time. This method accelerated the implementation duration from 322 days to 268.26 days, increased productivity from 0.04 span/day to 0.048 span/day, and resulted in a total cost of IDR 36,567,103,562.32, which was IDR 145,313.09 lower than the existing method. This indicates that the additional workforce method not only increased productivity and accelerated implementation duration but also provided the best cost efficiency compared to the overtime method. Therefore, the additional workforce method was selected as the most optimal acceleration alternative.

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DISCLOSURE STATEMENT

The author declares that this research topic was carried out without any conflict of interest.

NOTES ON CONTRIBUTOR

Annisa Qurrota Ayun is a bachelor's degree student in Applied Civil Engineering at the Faculty of Vocational Studies, Yogyakarta State University. Her research interests are structural engineering. Wisnu Rachmad Prihadi is a lecturer in the Department of Applied Civil Engineering

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REFERENCES

Asmaaysi, A. (2025). *Tol Harbour Road II Ancol Milik Emiten Jusuf Hamka Dibidik Rampung 2027*. Ekonomibisnis.Com. https://ekonomi.bisnis.com/read/20250928/45/1915379/tol-harbour-road-ii-ancol-milik-emiten-jusuf-hamka-dibidik-rampung-2027#goog_rewarded

Dinas Kependudukan dan Pencatatan Sipil. (2026). *Data Kependudukan Bersih Semester II 2025 Dirilis, Penduduk DKI Jakarta Tercatat 10,88 Juta Jiwa*. JAWARA.

Hidayah A H, Setyawan A, S. (2024). *Optimasi Biaya dan Waktu Menggunakan Metode Time Cost Trade Off (Studi Kasis : Proyek Spam Regional Wosusokas Segemen 4 , Pipa Distribusi Utama Duwet – Mojobalan)*. *17*. https://journals2.ums.ac.id/dts/article/view/5213/1763

KemenPUPR. (2021). Surat Edaran 11/SE/Db/2021 Tentang Penerapan Building Information Modelling pada Perencanaan Teknis, Konstruksi dan Pemeliharaan Jalan dan Jembatan di Direktoran Jenderal Bina Marga. *Kementrian PUPR Direktorat Jenderal Bina Marga*, (20), 3–4. https://binamarga.pu.go.id/index.php/peraturan/detail/surat-edaran-direktur-jenderal-bina-marga-nomor-11sedb2021

Kementrian PUPR. (2017). *Kementerian Pekerjaan Umum dan Perumahan Rakyat :: Galeri*. 1–16. https://www.pu.go.id/foto/detail/22/presiden-jokowi-akan-dorong-terus-pembangunan-perumahan-bagi-pekerja-dan-mbr

Kompas.Com. (2026). *Rekor Kendaraan 25 Juta di Jakarta: Tantangan Lalu Lintas 2025*. https://otomotif.kompas.com/read/2026/01/01/080200315/rekor-kendaraan-25-juta-di-jakarta--tantangan-lalu-lintas-2025

Mulyadi, M., & Hasnawati, H. (2019). Analisa Produktivitas Tenaga Kerja Pada Pekerjaaan Penutup Atap. *Inersia, Jurnal Teknik Sipil*, *11*(2), 17–24. https://doi.org/10.33369/ijts.11.2.17-24

Putri, N. F. (2026). *Jasa Marga Catat Volume Transaksi di Seluruh Jaringan Jalan Tol Tembus 1,3 Miliar Kendaraan Sepanjang 2025*. JawaPos.Com.

Rochmanhadi. (1992a). *Alat-Alat Berat dan Penggunaannya*. Departemen Pekerjaan Umum.

Rochmanhadi. (1992b). *Alat-Alat Berat dan Penggunaannya*. Departemen Pekerjaan Umum.

Sayyida, A. N., Sunarjono, S., & Subagyo, U. (2024). Metode Pelaksanaan Pemasangan Steel Box Girder (SBG) menggunakan Crawler Crane (Studi kasus pada pekerjaan metode erection proyek KPBU pergantian dan/atau duplikasi jembatan Callender Hamilton di pulaiJawa (CH Pemali B) Kabupaten Brebes, Jawa Tengah). *Prosiding Seminar Nasional Teknik Sipil 2024 Teknik Sipil Fakultas Teknik Universitas Muhammadiyah Surakarta*, 307–314.

Soeharto I dan Sumiharti Y. (1997). *Manajemen Proyek : dari Konteks Sampai Operasional*. Erlangga. https://lib.ui.ac.id/detail.jsp?id=12708

Soeryodarundio, K., & Setiono. (2022). Analisa Manajemen Risiko Proyek Dengan Metode Zero-One (Studi Kasus: Proyek Pembangunan Gedung Perpustakaan Universitas Islam Internasional Indonesia Depok). *Matriks Teknik Sipil*, *10*(4), 375.

Sucita, I. K. (2025). *Pelaksanaan Erection Box Girder Menggunakan Launcher Gantry pada jalan Tol Layang*.

Susanti, I. I., & Rimawan, F. (2021). *Cost and Time Analysis of the Acceleration Earthworks with the Method of Adding Heavy Equipment to the Depok-Antasari Toll Road Project*. *2*(6).

Tenaga, M., Dan, K., & Republik, T. (2004). *keputusan Menteri Tenaga Kerja dan Transmigrasi Republik Indonesia Nomor KEP.102/MEN/VI/2004*.

Tom, T. (2025). *Kondisi lalu lintas Jakarta pada tahun 2025*. Tom Tom. https://www.tomtom.com/traffic-index/city/jakarta/