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Project scheduling for swallow nest construction using the critical path method

Muhamad Rizki Asrul[1] , Merry Christina Angelita Tindaon[2] , Dita Nabila Azzahra[3], Rani Wulandari[4], Rika Ismayanti[5]

[1]Business Administration, Politeknik Negeri Samarinda, Samarinda, Indonesia

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ABSTRACT

Indonesia is a major producer of swallow nests with high export value, but constructing swallow houses remains challenging due to biological and technical complexities. This study aimed to develop a more efficient construction schedule using the Critical Path Method (CPM). CPM was chosen to identify activity paths that directly influenced project duration, thereby minimizing delay risks. A quantitative approach was used through a case study of a four-storey swallow house project in Batua Village, Kutai Kartanegara. Data were collected via observation, interviews, and technical documentation, and analyzed using Microsoft Project to determine critical paths and estimated durations. The analysis revealed that out of 42 activities, several were on the critical path with zero slack. By focusing on these critical activities, the project duration was reduced from the original 220 calendar days to 184 days. This demonstrated that CPM effectively increased scheduling efficiency by aligning with both the biological and technical requirements of swallow nest construction. The findings provided valuable insights for swallow house developers to implement more structured and efficient planning, while also encouraging integration between civil and ecological engineering in specialized construction practices.

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Corresponding Author:

Merry Christina Angelita Tindaon,
Business Administration,
Politeknik Negeri Samarinda,
Jl. Cipto Mangun Kusumo, Sungai Keledang, Kec. Samarinda Seberang, Kota Samarinda,
Kalimantan Timur 75242
Email: christinaangelita23@gmail.com

INTRODUCTION

Indonesia is one of the world's leading producers of swallow nests, with significant potential to meet global demand. According to the Indonesian Central Statistics Agency (2023), Indonesia consistently exports swallow nests, reaching 1,105 tons with a value of USD 541.51 million—primarily to Hong Kong, China, and Singapore. Despite this promising economic potential, the swallow nest industry faces complex development challenges that require a specialized construction approach (Susilowati, 2018).

Unlike conventional building construction, swallow house development involves the creation of artificial ecosystems that must fulfill specific biological needs of swallows (Setiawan, 2013). Critical factors such as proper site selection, humidity control, air circulation, lighting, and acoustics play a key role in attracting swallow colonies (Usman et al., 2019). Failure to meet these conditions can lead to project failure and substantial financial loss.

To address these challenges, the Critical Path Method (CPM) offers a systematic approach to evaluate construction project duration and resource optimization by identifying activities that directly affect completion time (Siregar, 2019). Although CPM has been widely used in infrastructure projects, its application to swallow house construction remains rare and often overlooks ecological variables (Qordhowi and Fendrawan 2025).

Previous studies (Sigit et al., 2024; Aprillia & A'yun 2023) have proven the effectiveness of CPM in residential construction projects, but have not integrated ecological or biological considerations. This research aims to adapt the Critical Path Method to the unique requirements of swallow house construction by combining civil engineering principles with swallow ecology. The study proposes a scheduling model that identifies critical activities, optimizes resource use, and minimizes delays—ultimately improving the structure's functionality and production efficiency.

Swallow nest buildings require specific environmental conditions—shape, temperature, humidity, and lighting—that replicate natural habitats (Idrus and Umar, 2024). In this context, building functionality is prioritized over aesthetics or structural strength (Kuang et al., 2024). According to Vitruvius, comfort is a key element in building design, especially in artificial habitats (Yulistya and Roosandriantini, 2022). Therefore, climate-adaptive design is crucial to ensure nesting success and economic viability (Kirana et al. 2023).

Project management practices—planning, implementation, and control—are essential for timely and efficient swallow house construction (Rahmanto and Janizar, 2022). Neni Utami et al., (2023) emphasized the importance of the POAC (Planning, Organizing, Actuating, Controlling) model, which includes stages from land preparation to final finishing. Proper scheduling is essential to prevent delays and cost overruns (Hakim et al. 2023). Project delays are often caused by labor shortages, adverse weather, or late material deliveries (Saudi, Nurdin, & Yusman, 2021). Therefore, the use of project management methods such as the Critical Path Method is essential to maintain efficiency and effectiveness. Structured management will support long-term success, especially in productive projects such as swallow's nests (Bambang Heriyanto et al., 2024).

CPM is a project scheduling method that focuses on the longest-running path that travels across a network (Aulady & Orleans, 2016). CPM is deterministic and suitable for projects with a clear sequence of activities, such as the construction of a swallow's nest and the implementation of CPM has been proven to be able to save project implementation time (Wijaya et al., 2022). Critical paths in the construction of swallow's nests include activities such as land preparation, structural construction, roof installation, ceiling, ceramics, and finishing. Because these activities are interdependent, a delay in one activity can delay the entire project (Hakim, Yulianto, & Nugroho 2023). These activities have a dependency relationship, and a delay in one activity on a critical path will cause the entire project to be delayed (Ervianto, 2023).

CPM uses formulas such as Early Start (ES), Early Finish (EF), Late Start (LS), and Late Finish (LF) to calculate the minimum and maximum time an activity starts and completes (Laksmana et al., 2022). The slack value indicates the delay tolerance before the project is affected. Activities with zero slack are classified as critical paths and should be a top priority (Akbar, 2019). The study applied CPM to optimize the swallow's nest construction schedule, shortening the time from 220 days to 184 days. In addition, CPM helps calculate time and cost efficiency as a basis for decision-making in project implementation.

This study aims to adapt the Critical Path Method (CPM) to the unique requirements of swallow house construction by integrating civil engineering scheduling with ecological considerations. The integration ensures that each construction activity not only follows technical logic but also supports the environmental parameters critical to swallow habitation.

RESEARCH METHOD

This study uses a quantitative approach with a case study method focused on planning and scheduling the construction project of a swallow's nest building. The purpose of this study is to prepare an optimal project implementation schedule with the CPM method to determine critical activity paths and determine the estimated minimum project completion time (Soeparyanto et al. 2024). The object of the research is the construction project of a four-storey swallow's nest measuring 16×8 meters, which is carried out independently by the owner without involving professional personnel. The materials used include brick, cement, iron, wood, and swallow sound systems from local suppliers. The project is located in a semi-rural area with modest resource conditions. Data collection was done through direct observation, interviews with project implementers, and documentation studies in the form of diaries, activity lists, and work sketches. Project activities are then arranged in a logical order and their dependent relationships (Romdona et al. 2025).

To address the potential bias due to limited resources in the semi-rural location, productivity estimates were cross-validated through triangulation—comparing worker productivity logs, builder interviews, and site-specific observations. This ensured that the calculated durations reflect realistic field conditions rather than generalized assumptions.

The structure of the time planning stage using the CPM method consists of the following steps: (1) conducting a review and identification of linkages in the project, breaking it down into a number of activities that are an important part of the project. Supporting data, such as project work information, is identified and broken down into smaller sections to get more complete details; (2) After that, the analysis is continued using the CPM (Critical Path Method) method to analyze the work network thoroughly; (3) Rearrange the components in the first order, forming a logical order based on the dependencies found through literature studies on the method of implementing the construction work of the Swallow's Nest, as well as through direct observation and interviews with builders in the field; (4) Establish an estimated time for each activity resulting from the calculation of worker productivity, involving observations and interviews in the field related to the number of workers, worker rates, and daily productivity of workers; and (5) Calculate Late Event Time (LET) and Early Event Time (EET) using a direct approach with algorithmic methods, with the aim of determining the duration of project implementation and identifying critical paths in the project (Saputra, Erina, and Rodhi 2024).

RESULTS AND DISCUSSIONS

Job Item Data Input

This study processed primary and secondary data from the construction project of a two-storey Swallow's Nest Building in Batuah Village, Loa Janan District, Kutai Kartanegara Regency, where every detail of the activity was coded to facilitate the data processing process.

Table. 1 Activity Details

No	Types of Activities	SymbolsActivities
I	PREPARATORY WORK	1
1	Land Clearing	1.1
2	Measurement and Grading	1.2
3	Construction Board Installation	1.3
4	Foundation Excavation	1.4
5	Restoration.	1.5
6	Underground Confinement	1.6
II	STRUCTURAL WORK	2
7	Foundation Soil Confinement	2.1
8	Foundation Installation (stone kali / reinforced concrete)	2.2

9	12 mm Concrete Iron Fitting for Structure	2.3
10	10 mm Concrete Iron Fitting for Structure	2.4
11	8 mm Concrete Iron Fitting for Structure	2.5
12	Concrete Column and Beam Casting	2.6
13	Wall mounting (light brick/red brick)	2.7
14	Installation of Sand Install for stucco	2.8
15	Lightweight Brick Installation for Wall	2.9
16	Wiremesh or Rebar Iron Installation for Dak	2.10
17	Installation of Wood Formwork for casting	2.11
18	Formwork Installation and Ironing	2.12
19	Concrete dak casting	2.13
20	Casting with Cement	2.14
III	ROOF AND VENTILATION WORK	3
21	Lightweight Steel Frame Installation	3.1
22	4m Wave Zinc Installation	3.2
23	Air Vent Installation	3.3
24	Installation of Aluminum Foil or Heat Absorber	3.4
25	Installation of tiles/zinc/canopy (if not used)	3.5
26	Installation of Roof Cover (concrete/tile/zinc)	3.6
27	PVC Pipe Installation for Ventilation	3.7
28	Installation Air vents (vents, exhaust fans, etc.)	3.8
IV	INTERIOR WORK	4
29	Wood Fin Board Installation	4.1
30	Installation of Swallow Summoner Speaker	4.2
31	Amplifier Installation	4.3
32	Electrical Wiring and Electrical Installation	4.5
33	LED Light Installation	4.6
34	Perfume/Fragrance Installation	4.7
35	Timer Mounting for Amplifier	4.8
36	Installation of Thermometer & Hygrometer	4.9
V	FINISHING & ADDITIONAL WORK	5
37	Anti-Fungal Painting on Walls	5.1
38	Ladder Construction	5.2
39	Door Installation	5.3
40	Installation of Ventilation Window	5.4
41	Manufacture of Water Tubs for Humidity	5.5
42	Creation of Pools/water tubs for moisture in the building	5.6

Source: Data processed (2025)

The data input process follows the order of the field work schedule in the Swallow's Nest construction project, starting from the preparation stage (land clearing, measurement, grading, and installation of bouwplank), followed by foundation and structural work (excavation, confinement, iron installation, casting, and wall installation), then roof and ventilation work (mild steel, tiles, ventilation, and insulation), interior work (wood fins, speakers, lights, cables, etc.). and other biological aids), and finished finishing (painting, installation of doors, windows, and humidity).

Performing Plan Time Input

The input of the plan time begins with a review of the timeline and the calculation of **the free slack** value, where all activities according to the Work Breakdown Structure are input into the Microsoft Project according to the field schedule and then the dependency relationship is determined. This process results in a free slack value for non-critical work, while most main jobs have a slack value of 0. Microsoft Project is used to automatically identify critical project paths based on duration and dependencies.

Table 2. Planning Using Microsoft Project

No	Types of Activities	Duration	Start	finish	Free Slack	Status
1	PREPARATORY WORK	45				
2	Land Clearing	5	04/11/24	08/11/24	0	Critical
3	Measurement and Grading	21	11/11/24	09/12/24	0	Critical
4	Construction Board Installation	5	10/12/24	16/12/24	0	Critical
5	Foundation Excavation	5	17/12/24	23/12/24	0	Critical
6	Restoration.	9	24/12/24	03/01/25	87	Non-Critical
7	Underground Confinement	8	18/12/24	27/12/25	92	Non-Critical
8	STRUCTURAL WORK	75				
9	Foundation Soil Confinement	5	18/12/24	24/12/24	0	Critical
10	Foundation Installation (stone kali / reinforced concrete)	15	24/12/24	14/01/25	0	Critical
11	12 mm Concrete Iron Fitting for Structure	5	15/01/25	21/01/25	75	Non-Critical
12	10 mm Concrete Iron Fitting for Structure	5	15/0125	21/01/25	75	Non-Critical
13	8 mm Concrete Iron Fitting for Structure	5	15/01/25	21/01/25	75	Non-Critical
14	Concrete Column and Beam Casting	10	15/01/25	28/01/25	0	Critical
15	Wall mounting (light brick/red brick)	20	29/01/25	25/02/25	0	Critical
16	Installation of Sand Install for stucco	5	30/01/25	05/02/25	0	Critical
17	Lightweight Brick Installation for Wall	10	30/01/25	12/02/25	59	Non-Critical
18	Wiremesh or Rebar Iron Installation for Dak	5	26/02/25	04/03/25	0	Critical
19	Installation of Wood Formwork for casting	5	05/03/25	11/03/25	40	Non-Critical
20	Formwork Installation and Ironing	10	05/03/25	18/03/25	0	Critical
21	Concrete dak casting	10	19/03/25	01/04/25	0	Critical
22	Casting with Cement	5	19/03/25	25/03/25	30	Non-Critical
23	ROOF AND VENTILATION WORK	25				
24	Lightweight Steel Frame Installation	15	02/04/25	22/04/25	0	Critical
25	4m Wave Zinc Installation	10	23/04/25	06/05/25	0	Critical
26	Air Vent Installation	5	23/04/25	29/04/25	0	Critical
27	Installation of Aluminum Foil or Heat Absorber	5	03/04/25	09/04/25	19	Non-Critical
28	Installation of tiles/zinc/canopy (if not used)	10	23/04/25	06/05/25	0	Critical
29	Installation of Roof Cover (concrete/tile/zinc)	5	23/04/25	29/04/25	5	Non-Critical
30	PVC Pipe Installation for Ventilation	3	30/04/25	02/05/25	2	Non-Critical
31	Installation Air vents (vents, exhaust fans, etc.)	4	03/04/25	08/04/25	20	Non-Critical
32	Heat Absorbing or insulation Installation	5	03/04/25	09/04/25	19	Non-Critical
33	INTERIOR WORK	13				
34	Wood Fin Board Installation	10	26/02/25	11/03/25	0	Critical
35	Installation of Swallow Summoner Speaker	3	03/03/25	05/03/25	0	Critical
36	Amplifier Installation	3	06/03/25	10/03/25	0	Critical
37	Electrical Wiring and Electrical Installation	3	26/02/25	28/02/25	0	Critical
38	LED Light Installation	3	03/03/25	05/03/25	44	Non-Critical
39	Perfume/Fragrance Installation	3	12/03/25	14/03/25	37	Non-Critical
40	Timer Mounting for Amplifier	3	11/03/25	13/03/25	38	Non-Critical
41	Installation of Thermometer & Hygrometer	3	12/03/25	14/03/25	37	Non-Critical
42	FINISHING & ADDITIONAL WORK	48				
43	Anti-Fungal Painting on Walls	10	06/02/25	19/02/25	54	Non-Critical
44	Ladder Construction	8	03/04/25	14/04/25	16	Non-Critical
45	Door Installation	5	26/02/25	04/03/25	45	Non-Critical
46	Installation of Ventilation Window	5	26/02/25	04/03/25	45	Non-Critical
47	Manufacture of Water Tubs for Humidity	5	26/02/25	04/03/25	45	Non-Critical
48	Creation of Pools/water tubs for moisture in the building	5	26/02/25	04/03/25	45	Non-Critical

Source: Data processed (2025)

Determining the Critical Path of the Job

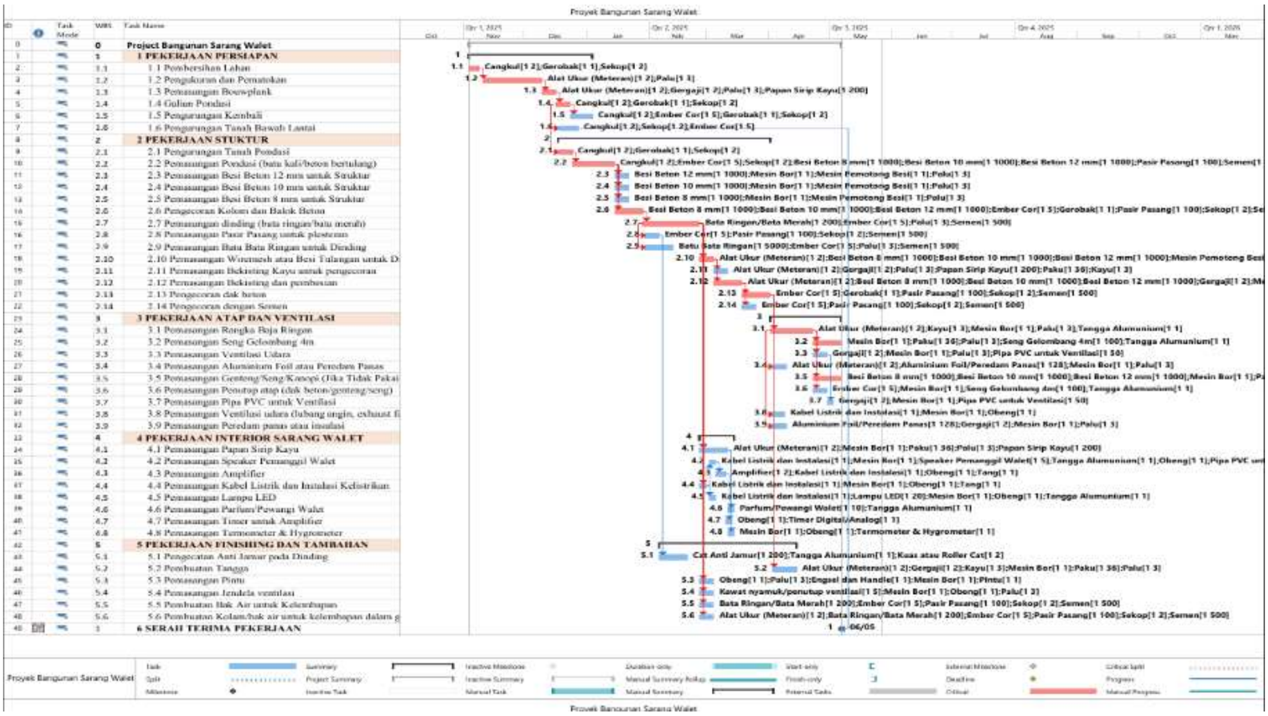

Figure 1. Critical Trajectory with Microsoft Project

Relationships between jobs are made in three types, namely start to start, start to finish, and finish to finish and adjusted to the time of work progress.

The input of the plan time is carried out according to the order of the field schedule, starting from the preparatory work stage, followed by structural work, roof and venting, interior, and finishing.

Critical Path Analysis

The results of scheduling using Microsoft Project show that some activities fall into the critical path category, marked with a slack value of 0. These activities include: land clearing, measurement and grading, foundation installation, casting of main structures, roof installation, and installation of fin boards and swallow sound systems.

All of these activities have logical and sequential dependencies, so delays in one of the activities will have a direct impact on the overall duration of the project. This critical path is a major point of concern in project implementation because it requires strict supervision and time control. Through the identification of critical pathways, project implementers can focus resources and control on the activities that most determine the successful completion of projects on time.

Total Duration and Schedule Efficiency Analysis

Based on initial planning, the four-story bird's nest construction project is scheduled to last for 220 calendar days. However, after a scheduling analysis using the Critical Path Method (CPM) method through Microsoft Project, the optimal duration of the project was obtained for 184 calendar days, starting from November 4, 2024 to May 6, 2025. Thus, there is a time efficiency of 36 days or around 16.4% of the original total time. This shows the success of CPM implementation in identifying critical activities and maximizing the use of slack on non-critical activities.

CONCLUSION

This study proves that the application of the Critical Path Method (CPM) method in scheduling a four-storey bird's nest construction project is able to significantly increase the efficiency of the project duration. Based on field data processed through Microsoft Project, the project duration was successfully shortened from the initial plan of 220 calendar days to 184 calendar days. The critical paths identified indicate the main activities that greatly affect the overall duration of the project. With the use of slack on non-critical activities and a focus on critical paths, CPM has proven to be effective in crafting efficient and realistic scheduling. The research also opens up opportunities for further integration between project management approaches and the biological aspects of swallows, as the basis for building optimal artificial ecosystems

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References

Akbar, E. A. (2019). Analisa Mobilisasi pada Diving Support Vessel Proyek Underwater Inspection (Studi Kasus: Proyek Inspection, Maintenance & Repair Campaign).

Aprillia, S. C., & A'yun, Q. Q. (2023). Optimalisasi Biaya dan Waktu Pelaksanaan Pembangunan rumah tinggal di Kecamatan Rantau Pulung Kutai Timur menggunakan Critical Path Method (CPM) dan Program Evaluation and Review Technique (PERT).

Aulady, M. F. N., & Orleans, C. (2016). Perbandingan Durasi Waktu Proyek Konstruksi AntaraMetode CriticalPathMethod (CPM) dengan Metode Critical Chain Project Management (Studi Kasus: Proyek Pembangunan Apartamen Menara Rungkut). Jurnal IPTEK, 20(1), 13. https://doi.org/10.31284/j.iptek.2016.v20i1.29

Badan Pusat Statistik Indonesia. (2023). Ekspor Sarang Burung menurut Negara Tujuan Utama, 2012-2023—Tabel Statistik. https://www.bps.go.id/id/statistics-table/1/MjAyMiMx/ekspor-sarang-burung-menurut-negara-tujuan-utama--2012-2023.html

Bambang Heriyanto, Hansen Rusliani, & Hareastoma Hareastoma. (2024). Analisis Pengelolaan Usaha Dalam Meningkatkan Pendapatan Sarang Burung Walet Di Desa Sungai Aur Kecamatan Kumpeh Ilir Kabupaten Muaro Jambi Provinsi Jambi. Jurnal Penelitian Ekonomi Manajemen dan Bisnis, 3(2), 227–242. https://doi.org/10.55606/jekombis.v3i2.3518

Ervianto, W. I. (2023). MANAJEMEN PROYEK KONSTRUKSI. Penerbit Andi.

Hakim, A. L., Yulianto, T., & Nugroho, M. W. (2023). Optimalisasi Waktu dan Biaya Menggunakan Metode Crashing Program pada Proyek Gedung BPJS Tulungagung. Briliant: Jurnal Riset dan Konseptual, 8(1), 241. https://doi.org/10.28926/briliant.v8i1.1083

Idrus, I., & Umar, B. (2024). Rancang Bangun Desain Sarang Burung Walet Bagi Warga Masyarakat Kelurahan Talaka Kecamatan Ma'rang Kabupaten Pangkep. Jurnal Pengabdian Masyarakat Konstruksi, 2(1), Article 1.

Kirana, S. N., Baidhowi, M. F., Maharani, R. T., & Ratri, Y. (2023). KONSEP ARSITEKTUR BERKELANJUTAN DALAM PERANCANGAN RUMAH BURUNG WALET.

Kuang, S., Sahputra, R., & Tawil, H. (2024). Analisis Faktor-Faktor Yang Mempengaruhi Perencanaan Optimal Rumah Sarang Burung Walet di Kalimantan Barat. Jurnal Ilmu Pendidikan, 1.

Laksmana, S. P., Wijoyo, A., Rauf, D. I., Burhanudin, M., & Wicaksono, D. (2022). Perencanaan Manajemen Proyek Pembangunan Usaha Rumah Kost Millenial di Pamulang. OKTAL : Jurnal Ilmu Komputer dan Sains, 1(11), Article 11.

Neni Utami, Muhammad Yoga Aditia, & Binti Nur Asiyah. (2023). Penerapan Manajemen POAC (Planning, Organizing, Actuating Dan Controlling) Pada Usaha Dawet Semar Di Kabupaten Blitar. Jurnal Penelitian Ekonomi Manajemen dan Bisnis, 2(2), 36–48. https://doi.org/10.55606/jekombis.v2i2.1522

Qordhowi, A. F. Y. A., & Fendrawan, R. (2025). Analisis efektifitas penerapan Critical Path Method (CPM) pada proyek pembangunan tanggul Kali Lamong Kabupaten Gresik. Jurnal Teknik Industri Terintegrasi (JUTIN), 8(1), Article 1. https://doi.org/10.31004/jutin.v8i1.36105

Rahmanto, T., & Janizar, S. (2022). PENGENDALIAN BIAYA DAN WAKTU DENGAN METODE EARNED VALUE PROYEK FAMILIA URBAN BEKASI. JURNAL TEKNIK SIPIL CENDEKIA (JTSC), 3(2), Article 2. https://doi.org/10.51988/jtsc.v3i2.48

Romdona, S., Junista, S. S., & Gunawan, A. (2025). TEKNIK PENGUMPULAN DATA: OBSERVASI, WAWANCARA DAN KUESIONER. JISOSEPOL: Jurnal Ilmu Sosial Ekonomi dan Politik, 3(1), 39–47. https://doi.org/10.61787/taceee75

Saputra, I. H., Erina, Y., & Rodhi, N. N. (2024). Analisis Pengendalian Waktu dan Biaya Proyek Konstruksi Dengan Metode CPM (Critical Path Method). Innovative: Journal Of Social Science Research, 4(6), 7797–7807.

Saudi, A. I., Nurdin, A., & Yusman. (2021). Pendekatan Pendekatan Metode Jalur Kritis Pada Pekerjaan Peningkatan Ruas Jalan Transmigrasi Piriang Tapiko: BANDAR: JOURNAL OF CIVIL ENGINEERING, 3(1), 1–9. https://doi.org/10.31605/bjce.v3i1.928

Setiawan, T. H. (2013). STUDI PENELITIAN PEMBANGUNAN RUMAH WALET STUDI KASUS RUMAH WALET RAWALUKU PROPINSI BANDAR LAMPUNG. Jurnal Teknik Sipil, 12(2). https://doi.org/10.24002/jts.v12i2.608

Sigit, R. A. P., Al-Muqaffa, F. W., & Sutrisno, S. (2024). Evaluasi Penjadwalan Waktu Pada Proyek Pembangunan Rumah dengan Metode CPM (Studi Kasus: Pembangunan Rumah Tinggal di Perumnas Kabupaten Karawang). Go-Integratif : Jurnal Teknik Sistem dan Industri, 4(02), 148–157. https://doi.org/10.35261/gijtsi.v4i02.10876

Siregar, A. C. (2019). Penggunaan critical path method (CPM) untuk evaluasi waktu dan biaya pelaksanaan proyek | Siregar | Teknika: Jurnal Sains dan Teknologi. https://jurnal.untirta.ac.id/index.php/ju-tek/article/view/6816/4722

Soeparyanto, T. S., Nuhun, R., Ariatno, H., & Zulfitrah, L. O. M. (2024). Analysis Of Project Scheduling Using The CPM Method (Case Study Of Prayer Room Construction In PT. X Empalecement Complex). Journal of Civil Engineering and Planning (JCEP), 5(1), 16–24.

Susilowati, E. (2018). PENGATURAN TERHADAP PEMBANGUNAN GEDUNG SARANG BURUNG WALET DI KOTA PALANGKA RAYA PROVINSI KALIMANTAN TENGAH. 4.

Usman, Harlina, S., & Rizaldy, A. (2019). Rancangan Bangunan Sistem Pengendali Suhu Kelembaban Dan Cahaya Pada Rumah Walet Berbasis Microkontroler. e-Jurnal JUSITI (Jurnal Sistem Informasi dan Teknologi Informasi), 82, 131–140. https://doi.org/10.36774/jusiti.v8i2.614

Wijaya, M. S., Ismiyah, E., & Rizqi, A. W. (2022). Penjadwalan Proyek Instalasi Castable In Rotary Kiln Dengan Metode Critical Path Method (CPM). 19(2).

Yulistya, Y. H., & Roosandriantini, J. (2022). Kajian Elemen Arsitektur Modern berdasarkan teori Vitruvius. Jurnal Lingkungan Karya Arsitektur, 1(2), Article 2. https://doi.org/10.37477/lkr.v1i2.253