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Delay Analysis of Structural Work of Housing Project in Meruya (Indonesia) Using Critical Path Method

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Abstract
Project scheduling is one of the results of planning that can provide information about the planned schedule and project progress in terms of resource performance in the form of costs, labor, methods, equipment and materials as well as the planned project duration and time progress for project completion. The basis of this research is on the construction project of a single-story house (low-rise apartment) in Meruya, Indonesia, which consists of two buildings, each consisting of 7 main floors and a mezzanine floor. The purpose of this research is to analyze several types of work, especially in the main structure of the building that is in a critical time path and analyze the impact of work costs based on the development of planned and actual progress of the building structure work. The use of the Critical Path Method (CPM) is to develop a project schedule by identifying which tasks are critical. A questionnaire includes work delay factors in the project, for actions that can handle delay factors, and finally actions in handling work delays in the project by causal factors. From data analysis, it is discovered that the CPM network diagram can be used to check the possible ongoing delays by comparing the dates on the CPM to the current date. It can be caused by significant root factors of delays, so that the right corrective action can be done in the right time; the final result should be on time project.

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Keywords: Project Schedule, CPM, Mair Structural Works

Introduction

The need for housing in Karang Mulya, Meruya, Indonesia, is increasing along with the growing population. In 2020, Ciledug District was the most densely populated area, with 18,717.33 people per square kilometer. Therefore, a plan was made to build a vertical single-family house, consisting of two buildings, each consisting of seven stories, to be built within the middle-to-upper class housing area of Bumi Permata Indah, to be built as short duration as possible.

One way to shorten a project's duration is to accelerate the work. Shortening project work duration is generally accompanied by increased funding, as it requires additional funds to increase the workforce, work overtime, and so on. Increasing work hours can lead to lower productivity, as workers not only get fatigue but also safety issues. (Agustiar I., Handrianto R., 2018; Djojowirono, 2005) [1, 2].

One project scheduling method, the Critical Path Method (CPM), recognizes the existence of a critical path. This critical path is crucial for project activities, as delays in implementation can impact the overall project. CPM uses work duration estimates, making it more widely used in industry and construction projects. (Patrasik *et. al.*, 2013) [10].

Methodology

Data analysis is divided into two, namely secondary data analysis and primary data analysis. The secondary data analysis, which is based on the collection of original project schedule files, weekly progress reports, the original S-curve of the project in order

to maintain the originality of the research in order to compare how long the progress of completing the structure work (days/weeks) with a list of work durations developed by the researcher which is used in the CPM analysis and to obtain the duration of the work specifically on the critical path. Then from the sequence of work in the critical path is used in the development of the weekly progress of the project that has been known the date (month, day, year) from the beginning to the end and is examined whether the completion in this weekly progress exceeds the duration limit from the start and end times that have been determined in the "critical path". If it exceeds the specified duration limit then the structural work on that floor is delayed. It practically can be done by comparing the planned dates on the CPM network diagram with the current date of evaluation made.

Primary data comes from filling out a questionnaire with the main discussion of "factors of delays in building project work" and "actions in dealing with these delays" is submitted to 30 respondents who have had direct work experience in the field of building construction projects for more than 1-3 years. The acquisition of the contents of the questionnaire form of these 30 respondents was then tested for validity, reliability and strength of the correlation test based on the standard provisions of Spearmann's Rho and Kendall's Tau, and finally by using frequency analysis.

Literature Review

According to Ervianto (2023) [3], scheduling is the process of preparing a schedule of project activities. The schedule serves as a reference in the realization of project implementation, where it contains various activities that will be carried out, when they will be carried out and when they will end (the project implementation period). The project schedule can function as a controller or project controller so that it is carried out efficiently and economically. Factors that influence the optimal project schedule are resources, time and costs.

The process of compiling a network by some literature is often associated with project management methodology, especially in the aspects of planning and control. This opinion is due to the wide scope of the process of compiling a network, namely from reviewing and identifying project scope activities, breaking them down into components, to re-arranging them into a sequence based on dependency logic so that all of this requires knowledge of the ins and outs of the scope of the project being faced (Soeharto,1999) [8].

The total time required to complete a project will depend on the time required to complete the project's components. Therefore, the accuracy of the estimated completion time for each component has a direct impact on the overall project completion estimate. There is a difference between the CPM and PERT methods in estimating or determining the duration of an activity or project. CPM uses a "deterministic" approach, namely using a single estimate. Therefore, the time to complete the work is assumed to be known, and in the next stage, further assessment is conducted to determine whether this time can be shortened, for example by increasing costs, known as a time-cost trade-off (Nurhasanah *et. al*., 2025; Setiawati *et. al*.,2016) [5, 6].

The CPM method recognizes the critical path, which is the path containing the sequence of activity components with the longest total time and indicates the fastest project completion period. Thus, the critical path consists of a series of critical activities, starting from the first activity to the last activity of the project. The meaning of the critical path is important for project implementers, because on this path are activities whose implementation delays will cause delays to the entire project. Sometimes there is more than one critical path in a network. The "critical path" of each project is the longest path in the network. Any task on the critical path that is off schedule will extend the entire project schedule (Loka et. al., 2025; Siregar and Iffiginia, 2019; Sulistio and Andi, 2016) [, 4, 7, 9]

Analysis and Discussion

1. Analysis of Secondary Data

In CPM (critical path method) analysis, the initial step in processing data using this method is to create a network diagram. A network diagram can present activities, their duration, their sequence, and the relationships between them, making it easy to identify which activities are on the critical path. The network diagram, developed by researcher from the list of structural work activities secondary data collected from the case study project of a single-story house (low-rise apartment) in Meruya, Indonesia can be seen in Figure 1 to Figure 6. The red color denotes the critical path. The work items that are on the critical path that are formed into a straight line with forward and backward forward are jobs = D, H, K, L, P, V, X, U, Y, AF, AK, AS, AR, AZ, BD, BG, BF, BL, BP, BX, CB, CH, CJ, CP, CT, CZ, DB. The total real duration of all work from the beginning to the end of the main structure work on the path is 699 days, and the total duration of only the structural work from the beginning of preparation on the planned schedule is 386 days; there is a difference between the planned and actual duration of 313 days of delays.

It is found that the main structural works on critical path in the planned network diagram that experienced delays from the weekly progress report are: horizontal casting work on the ground floor (X), horizontal formwork work on the 2nd floor (AF), vertical formwork work on the 2nd floor mezzanine (AK), horizontal reinforcement work on the 3rd floor mezzanine (AZ), horizontal reinforcement work on the 4th floor mezzanine (BL), horizontal formwork work on the 5th floor (BP), horizontal reinforcement work on the 5th floor mezzanine (BX), horizontal formwork work on the roof floor/LMR (CZ). In other words, there are 8 main structural work items out of a total of 27 work items that are in the “critical path”. This delay was identified because the work real duration range in the project schedule by equating the initial and final calendar dates of this work has exceeded the limit and the work progress on the planned dates, so that the work items have not been fully 100% completed.

2. Analysis of Primary Data

In this study, the authors collected data using a questionnaire. The questionnaires were distributed to a total of 30 respondents. The questionnaires were divided into three sections. The first section, a respondent analysis, identified factors influencing project delays, specifically those found at the location where the final project's test materials were collected, specifically the Meruya Lowrise Apartment (single-story house) construction project.

It is discovered that five highest work delay factor values based on the mean value are: late delivery of materials, poor quality of labor, planning calculation errors, orders to delay work, and many work results that must be repeated/repaired

due to defects/errors. Furthermore, the five highest ranking of actions to handle project work delay factors are: to increase the number of workers to catch up on time delays, to conduct monitoring evaluations, to prioritize work that is included in the critical path, to increase working hours or overtime, and finally to replace less productive workers with more productive ones.

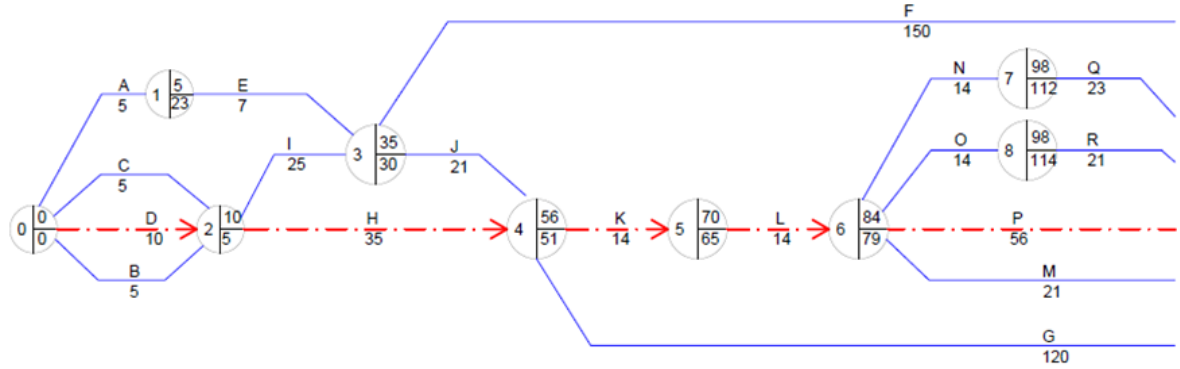

Fig 1: Network Diagram Part 1

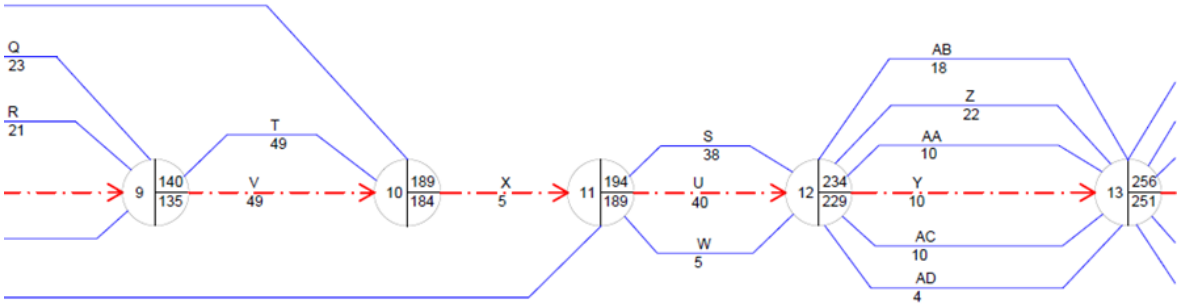

Fig 2: Network Diagram Part 2 (Own Analysis,2023)

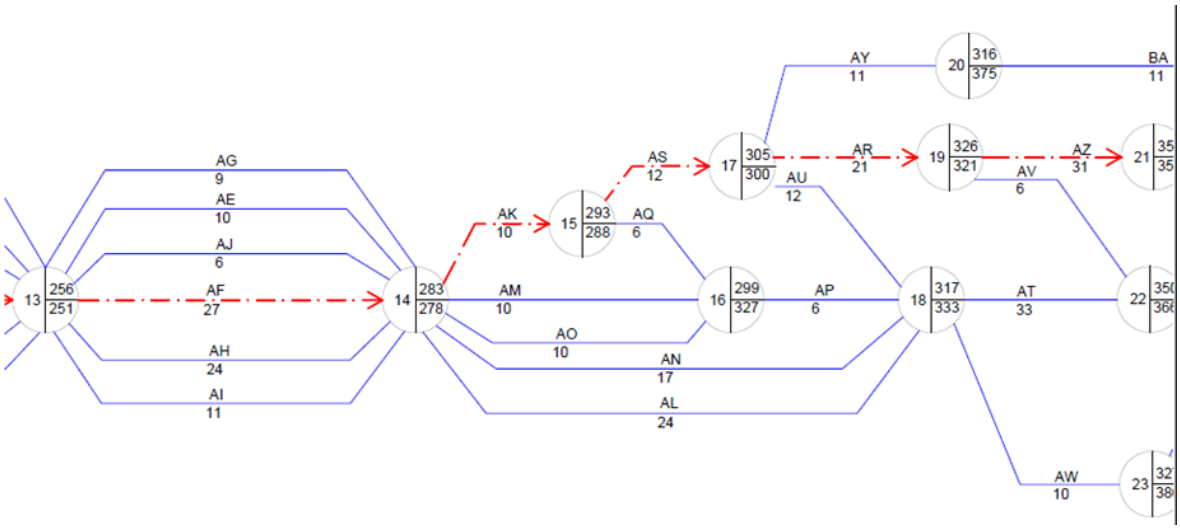

Fig 3: Network Diagram Part 3 (Own Analysis,2023)

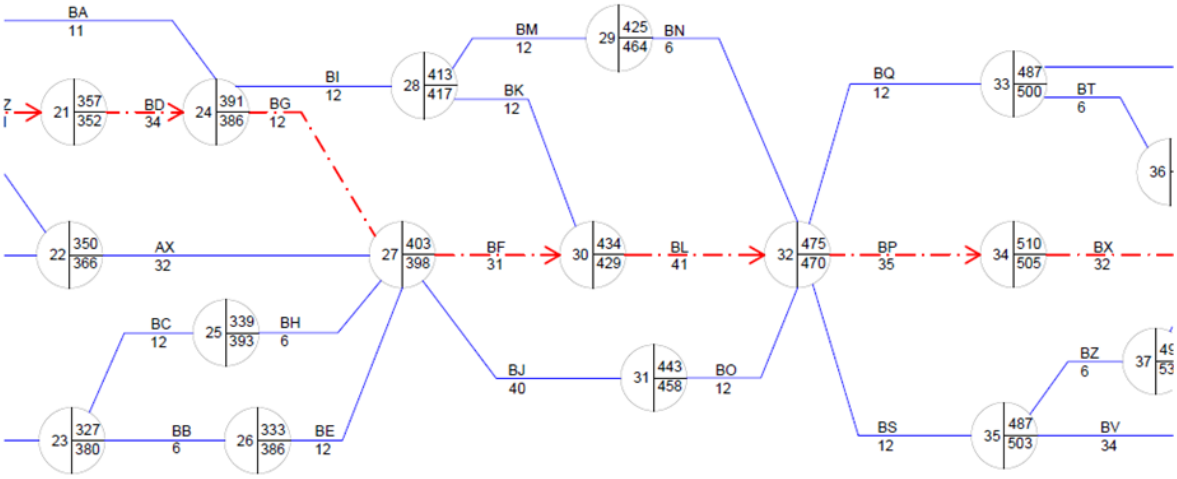

Fig 4: Network Diagram Part 4 (Own Analysis,2023)

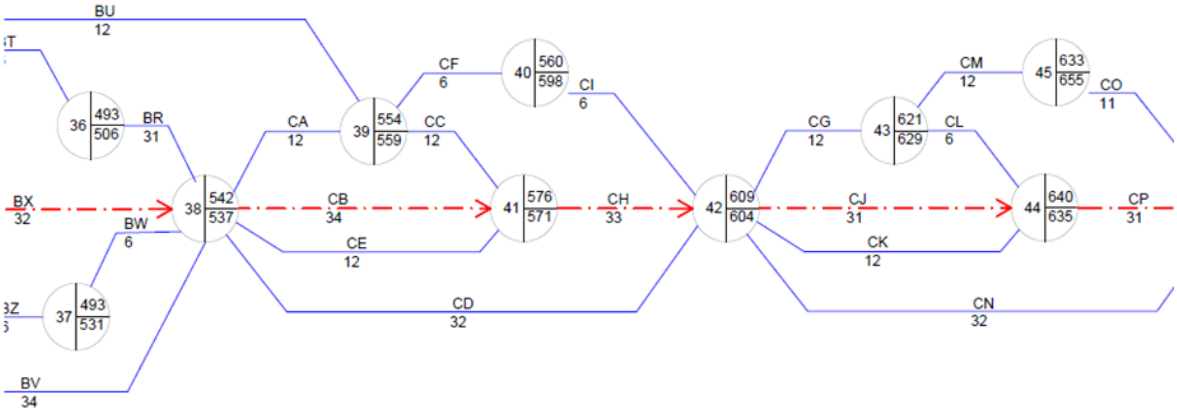

Fig 5: Network Diagram Part 5

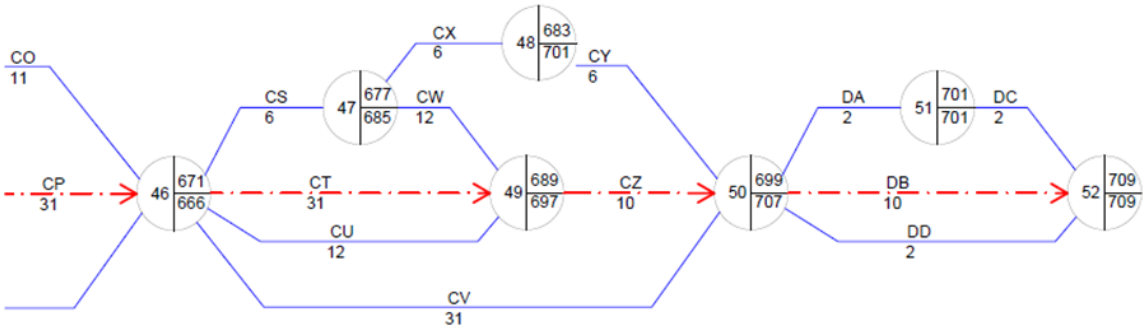

Fig 6: Network Diagram Part 6

Conclusion

The primary calculation of the CPM (critical path method) involves determining the sequence of work items and creating predecessors to identify the activities performed previously. The initial step in processing data using this method is creating a network diagram. A network diagram can represent activities, their duration, their sequence, and the relationships between them, making it easy to identify which activities are on the critical path.

In order for work efficiency and effectiveness to be met properly, then in the implementation of the project, good project management is needed, effectiveness and efficiency in project implementation are influenced by planning and scheduling factors. The CPM network diagram can be used to check the possible on-going delays by comparing the dates on the CPM to the current date. It can be caused by significant root factors of delays, so that the right corrective action can be done in the right time; the final result should be on time project. Similar projects elsewhere may use the findings of this study to solve their problems.

References

1. Agustiar I, Handrianto R. Evaluasi penjadwalan proyek menggunakan metode CPM dan Kurva-S. Wahana Tek J Keilmuan Terapan Tek. 2018;7(2). Universitas Gresik, Indonesia.
2. Djojowirono S. Manajemen konstruksi. Yogyakarta: Biro Teknik Sipil, Universitas Gadjah Mada; 2005.

3. Ervianto WI. Manajemen proyek konstruksi. Yogyakarta: Penerbit Andi; 2023.
4. Loka DP, Rabani F, Weningsih PA, Surahman, Batoteng H, Ningsih A. Analysis of project management control in wooden stilt house construction using the critical path method (CPM). Int J Multidiscip Res Growth Eval. 2025;6(4):147-53.
5. Nurhasanah A, Mahani D, Sinambela IP, Pebriana RP, Prapdopo. Optimization of project time for the construction of 2-door rental houses type 55 using the critical path method (CPM). Int J Multidiscip Res Growth Eval. 2025;6(3):1865-70.
6. Setiawati S, Syahrizal, Dewi RA. Penerapan metode CPM dan PERT pada penjadwalan proyek konstruksi (studi kasus: rehabilitasi/perbaikan dan peningkatan infrastruktur irigasi daerah lintas kabupaten/kota D.I Pekan Dolok) [thesis]. Medan: Universitas Sumatera Utara; 2016.
7. Siregar AC, Iffiginia. Penggunaan Critical Path Method (CPM) untuk evaluasi waktu dan biaya pelaksanaan proyek. Teknika J Sains Teknol. 2019;15(2):102.
8. Soeharto I. Manajemen proyek: dari konseptual sampai operasional. Jakarta: Erlangga; 1999.
9. Sulistio W, Andi. Perbandingan penjadwalan proyek menggunakan Kurva S dan CPM Network pada proyek "X" di Surabaya. J Dimensi Utama Tek Sipil. 2016;3(2). Universitas Petra, Surabaya, Indonesia.
10. Patrasik FP, Malingkas GY, Tisano T, Tarore AH. Menganalisis sensitivitas keterlambatan durasi proyek dengan metode CPM. J Sipil Statik. 2013;1(9). Universitas Sam Ratulangi, Manado, Indonesia.