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ANALYSIS AND RISKS FAST TRACK AND CRASH PROGRAM METHOD ON BUILDING PROJECT

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Abstract

Project delay is a major issue in execution, often causing cost overruns if not addressed. Acceleration helps meet targets and increase profits. Research on fast track and crash programme methods is extensive, but mainly focuses on case studies rather than risks or work quality. Building X's construction project faced a 3rd-week delay, extending from 23 weeks (December 2022) to 25 weeks (January 2023). This study aims to determine the most time- and cost-efficient acceleration method using primary (questionnaire) and secondary data (S-curve, unit price analysis, budget plan, and project reports). Applying fast track and crash programme methods along with risk frequency analysis, the study identifies the fast-track method as optimal, reducing project time to 22 weeks with 12% efficiency and Rp. 759,698,484.61 in cost savings. However, a potential risk is concrete cracks due to acceleration. This research complements previous studies by integrating risk analysis and quality assessment in fast-track acceleration.

Keywords: Critical Path, Fast Track, Crash Program, Time, Cost, Risk

Introduction

Many construction projects have become increasingly complicated due to delays in project completion, resulting in increased construction costs (Murbayani, 2015), (Laia & Susetyo, 2024). Recent data shows that one-third of contractors successfully complete their projects within the specified time and budget (Soliman et al., 2024). Most others, ranging from 40% to 70%, experience sub-optimal performance in terms of meeting budget targets or deadlines, resulting in dissatisfaction among customers and costs such as fines and disputes for stakeholders (Bhosekar & Vyas, 2012). A considerable amount of research has been conducted on project delays in the past, yet the persistence of this issue calls for an ongoing pursuit of solutions (Rejeki, 2022).

Based on these problems, the contractor will be increasingly required to be able to control project scheduling so as to reduce the risk of project delays (Stefanus, Wijatmiko, & Suryo, 2017). In general, contractors use scheduling methods that can reduce the project completion time to be faster and also the cost of completing the project at a lower cost (Mokalu, et al., 2022). At the time of the research, the results of the work progress report until week 3 of the X Building Project were 10% of the original plan which should have been at week 3 of 10,24%. With the delay in the X Building Project, this research will be conducted to determine the optimal acceleration method between the fast track method and the crash program.

This approach carries out development activities in parallel or overlapping, which helps to explore the future faster and gain a time advantage as well cost-effectiveness. This method reviews the critical path in construction scheduling by modifying (accelerating) the time on the critical path (Hemalia, 2023). A crash program is an approach to shortening a project schedule by reducing the time it takes to complete activities on the critical path, which can decrease total project completion time (Caesaron & Thio, 2015). Research related to fast track and crash program acceleration methods has been conducted by (Sutciana et al., 2020), (Rambe & Mariani, 2021), (Prawirawati et al., 2022), (Salakory et al., 2023), (N. Putu & Mega, 2023), (Sanjaya et al., 2023), (Pertiwi et al., 2023), (Masero et al., 2023), (Rivaldy et al., 2023), (Aulia & Widiasanti, 2023), (Harpriyanto et al., 2023), (Pangemanan et al., 2023), (Wala et al., 2023), (Sultan et al., 2023), (Verocha et al., 2024), (Ariyanto et al., 2024), (Rifai & Noviani, 2024) and (Adinanda et al., 2024). Most of the previous studies have focused on either one or two of the time and cost variables, but very few studies have explored the two variables and identified the risks of the optimal acceleration method to the final quality of the project, especially in terms of quality, design and labour accuracy. Although there is a lot of literature on the comparison between fast track and crash program methods, there seems to be limited research that specifically compares and analyses the optimal acceleration method in terms of risk. Therefore, the novelty of this research is to compare the two variables of time and cost for fast track and crash programme acceleration methods and identify the risk of the optimal method. This paper is expected to contribute to science and become literature because there are still few studies that combines time and cost variables in project acceleration and risks

Research Methods

Data Collection

This research utilizes both primary and secondary data. Primary data is a questionnaire that will be used to analyze the risk of applying the Fast Track method. While the secondary data in this research are S-curves, unit price analysis, cost budget plans, and weekly project reports on structural work. This secondary data is used to analyze the optimal acceleration method between Fast Track and Crash Program.

Fast Track Method

Steps in fast track analysis are (Athallasyah & Efrida, 2024), (Anwar et al., 2023), (Rahman, 2023), (Rijal et al., 2022), (Ikhsan, 2021), (Lucmana, 2021), (Rahayu et al., 2018), (Wirawan et al., 2015):

1. Translating the idea of critical path activities to a parallel system, this means that you can begin an activity while other similar ones are being performed using start-to-start logic.
2. Activity relationship logic must be logical, based on what actually happens in reality and not just from being physically connected in the real world.
3. Reviewing the amount, availability of resources flux and yields for critical path activities.
4. Focus on reducing the duration of activities with the longest timelines, ensuring that any reduction is at least one day.
5. Implement fast tracking only on critical paths, particularly for activities with the longest durations.
6. The minimum duration for fast tracking should be two days
7. Consider the relationships between critical activities to be fast tracked. If the duration of activity i is less than that of activity j, then activity j can only be accelerated once activity i has been completed or is at least one day in progress. Conversely, if the duration of activity i is greater than that of activity j, then activity j can commence as soon as the remaining duration of activity i is less than or equal to that of activity j, with both activities needing to be completed together.

After the initial fast track phase, if the critical path shifts, repeat the same steps for the activities on the new critical path. Continue this process iteratively until there are no further activities that can be fast tracked. Finally, calculate the total time achieved after implementing fast tracking through the various stages until the time reaches a saturation point.

Crash Program Method

The Crashing method involves reducing the overall project duration by analyzing existing alternatives within the work network. To better understand the relationship between the cost and time of an activity, several terms are defined, including normal duration, crash duration, normal cost, and crash cost. The relationship between normal and reduced costs over time is illustrated in Figure 1 (Pertiwi, 2023).

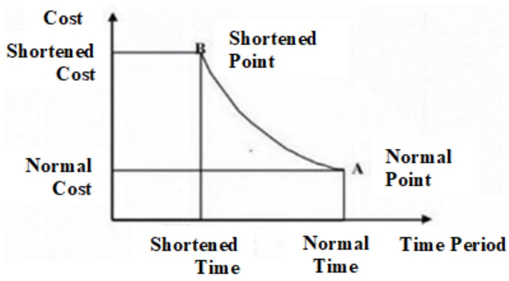


Figure 1. The time-cost relationship is shortened
Source: (Pertiwi et al., 2023)

The steps in calculating acceleration with the crash program method are as follows (Azmy & Herzanita, 2023), (Putra et al., 2022), (Malifa, 2019), (Oetomo, 2017), (Adi et al., 2016), (Khodijah et al., 2013):

1. Collecting project data.
2. Determining the critical trajectory with the help of the Microsoft Project program.
3. Analyze the acceleration of time on activities on the critical path.
4. Calculating the slope value of each activity.
5. Calculating normal total cost and total cost after crash program.

Risk Analysis of Optimal Acceleration Method

The stages in the risk analysis of optimal acceleration method include (Satria, 2016), (Cahyono, et al., 2022):

1. Risk identification through literature study, shown in table 1.

Table 1. Risk of Applying of optimal Acceleration Method in Projects

No.	Category	Code	Risk Factors
1	Cost	1.1	Addition of labour cost
		1.2	Addition of tool costs
		1.3	Addition of working hours
2	Quality of work	2.1	Water rope is not symmetrical
		2.2	Plastering and plastering of the wall is wavy
		2.3	Cracked concrete
		2.4	Hollow concrete joints
		2.5	There are voids in the masonry mortar
		2.6	Concrete deck and roof leaking
		2.7	Column is not symmetrical
		2.8	The amount of reinforcement is not as planned
		2.9	Ringbalk beams and hanging beams are porous
		2.10	Roof tiles and listplank not fitting properly
		2.11	Non-conformity of structure size with plan

Source: (Satria, 2016)

2. Risk measurement by distributing questionnaires containing risk variables with the Risk Measurement scale in tables 2 and 3.

Table 2. Risk Factor Occurrence Intensity Rating Scale

Grading Scale	Description
1	Very Low (never happened)
2	Low (rarely happen)
3	Moderate (sometimes happen)
4	High (often happen)
5	Very High (very often happen)

Source: (Satria, 2016)

Table 3. Rating Scale of the Magnitude of the Impact of the Risk Occurring

Grading Scale	Description
1	Very Low
2	Low
3	Medium
4	High
5	Very High

Source: (Satria, 2016)

3. Validity and reliability tests to obtain valid and reliable questionnaire results.
4. Analysing and evaluating risks, namely by mean analysis averaging the value of the respondent's answer questionnaire and assessing the risk level by multiplying the intensity of the risk occurrence with the risk impact.
5. Compile the results of risk analysis into boundaries to justify the assessment results as follows:
   a. $1,00 \leq IR \leq 6,00$, Risk category → Low (risk that must be accepted)

b. 6,00 < IR ≤ 12,00, Risk category → Medium (risk that must be reduced)
c. 12,00 < IR ≤ 25,00, Risk category → High (risk to be avoided)

Research Flowchart

Measurement of time and cost performance is carried out using earned value analysis so that it can be seen if the project is experiencing delays and cost overruns. Then an acceleration analysis is carried out using the fast track and crash programme methods. From the two methods, the optimal method in terms of cost and time is selected and then risk analysis is carried out.

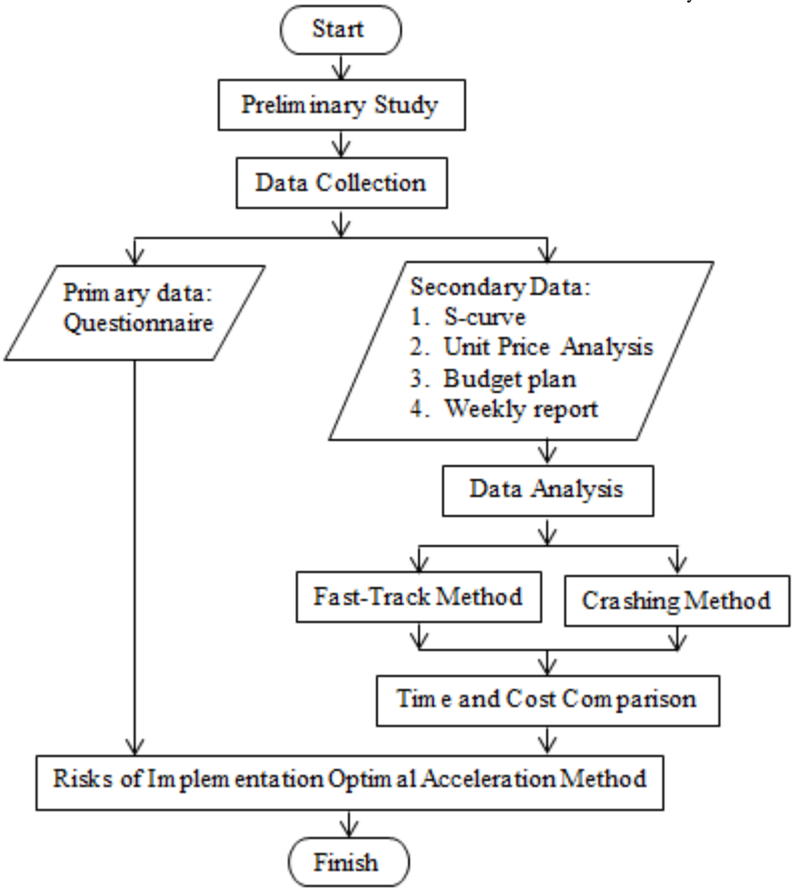


Figure 2. Flow chart)

Research Results and Discussion

Project Data

The project reviewed in this study is X building project, with a contract value of Rp. 62.584.684.684,68 and an implementation time of 23 weeks, starting in February 2022 and ending in December 2022. The physical progress report data shows that the implementation of activities until the 3rd week has only reached 10% while the percentage of the plan is 10.24%, so that the deviation between the plan and the realisation is 0.24% as a result of which the work that was originally planned to be completed in 23 weeks has become 25 weeks or 2 weeks late (figure 3).

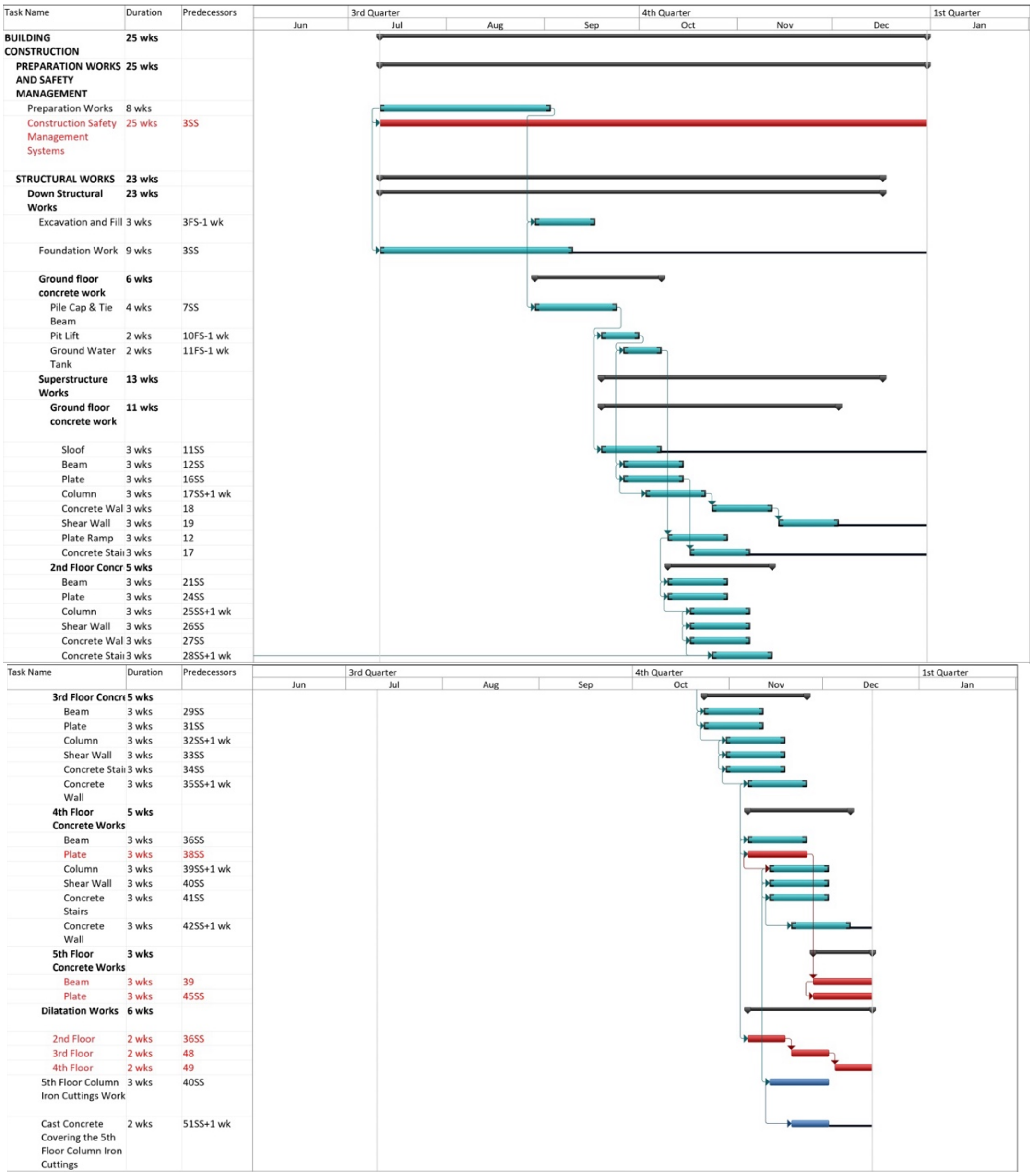


Figure 3. Scheduling before fast track

Based on Figure 3, the work that is on the critical path are construction safety management system, floor plate 4, floor beam 5, floor plate 5, floor dilatation 2, floor dilatation 3 and floor dilatation 4.

Fast Track Method Analysis

The analysis of the calculation of the fast track method does not increase the amount of labour and costs for each job, as well as the use of materials that are in accordance with normal use. The jobs that will be fast-tracked are those on the critical path such as construction safety management system, floor plate 4, floor beam 5, floor plate 5, floor dilatation 2, floor dilatation 3 and floor dilatation 4 (Figure 4).

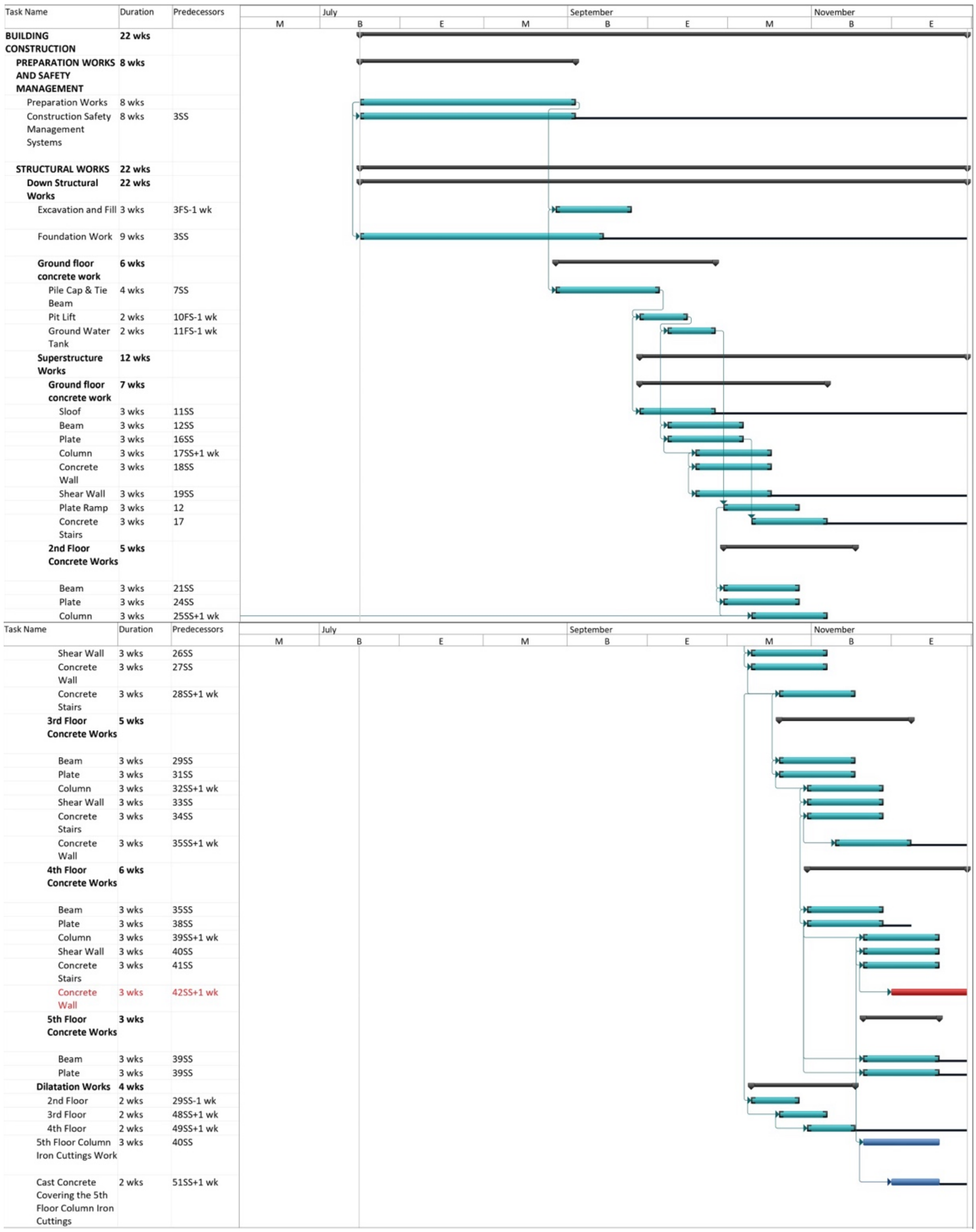


Figure 4. Scheduling after fast track

From Figure 4, it can be concluded that before Fast Track, the duration of work was 25 weeks, after Fast Track, the duration of work was reduced to 22 weeks. The use of the Fast Track method can reduce indirect costs. The initial cost in completing the project according to the RAB is Rp. 62.584.684.684,68. The cost consists of direct costs and indirect costs.

Direct Cost

From the analysis of the unit price of work, the direct cost is 90% of the total cost, so the direct cost of the X Building project is:

Direct cost = 90% x Rp. 62.584.684.684,68
= Rp. 56.326.216.216,22

Indirect Cost

From the unit price analysis, the value of indirect costs is 10% of the total cost.

Indirect cost = 10% x Rp. 62.584.684.684,68

= Rp. 6.258.468.468,47

Indirect costs affect the accelerated implementation time using the Fast Track method. If divided by the planned time duration of 175 days, the average indirect cost per day is Rp. 36.176.118,31. After Fast Track, the acceleration duration is 154 days, so the time difference with the planned duration is 21 days. Thus the cost efficiency obtained by using this acceleration method is as follows.

Cost efficiency = 21 x Rp. 36.176.118,31

= Rp. 759.698.484,61

So it can be concluded that the results of the acceleration analysis of the fast track method produce a comparison of the acceleration duration with the normal duration of 25 weeks to 22 weeks with an efficiency of 12%. This is in line with research conducted by (Salakory et al., 2023), (Sutciana et al., 2020), and (Athallasyah & Efrida, 2024), on building projects where the acceleration efficiency is 13%, 14%, and 17,34% respectively.

Crash Program Method Analysis

The work plan to accelerate the completion time of activities with overtime hours are:

1. Normal activities operate for 8 working hours with a 1-hour break (08:00-17:00 WIB).
2. Overtime work occurs after regular hours for an additional 3 hours each day (18:00-21:00 WIB), with overtime labor rates equivalent to regular labor rates.
3. The wage rate for overtime work is set at twice the normal hourly wage.
4. Productivity during overtime is estimated at 60% of normal productivity, reflecting declines due to fatigue, reduced visibility at night, and colder weather conditions.

Table 4. Acceleration Crash Program

No.	Job List	Duration (weeks)	Weight	Daily productivity	Productivity/ hour	Productivity After Crash	Completion Time (weeks)
1	Construction Safety Management System	25	1,76	0,0109	0,0014	0,0134	20,4082
2	Floor Plate 4	3	1,64	0,0781	0,0098	0,0957	2,4490
3	Floor Beam 5	3	1,91	0,0910	0,0114	0,1114	2,4490
4	Floor Plate 5	3	1,54	0,0733	0,0092	0,0898	2,4490
5	Floor Dilatation 2	2	0,14	0,0100	0,0013	0,0123	1,6327
6	Floor Dilatation 3	2	0,12	0,0086	0,0011	0,0105	1,6327
7	Floor Dilatation 4	2	0,01	0,0007	0,0001	0,0009	1,6327

The acceleration with the addition of working hours resulted in an increase in costs for payment of workers' wages (crash cost of workers). Based on the analysis of the unit price of work, the construction safety management system does not plan for labour costs (costs budgeted for the preparation of construction safety plan documents). While the 2-4 floor dilatation work only budgets for material costs, therefore the calculation of worker crash costs will only be carried out on 3 jobs, which are outlined in Table 5.

Table 5. Total Crash Cost Workers

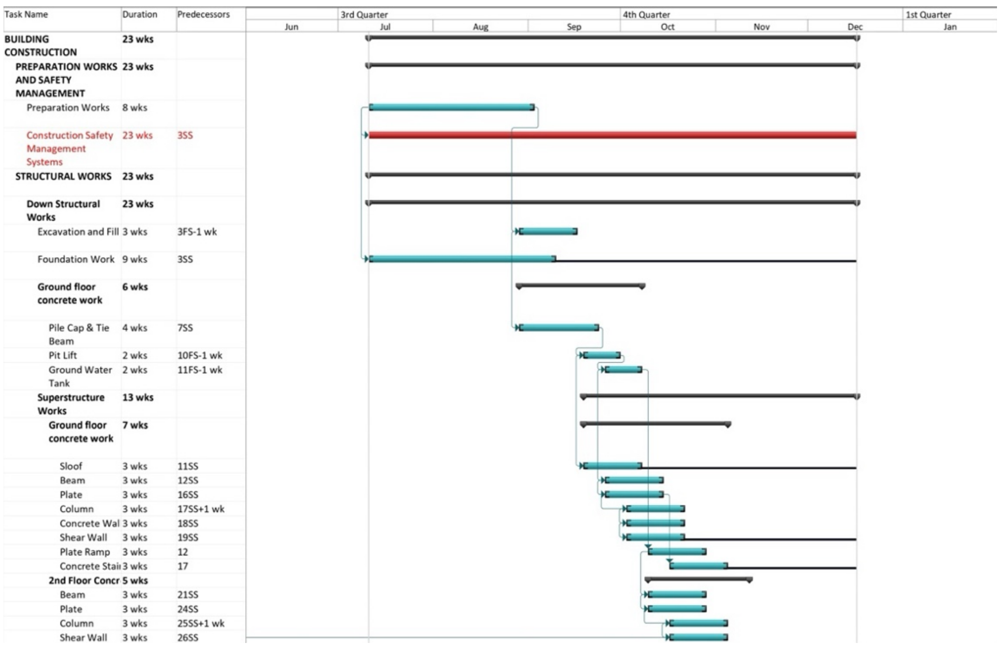
No.	Job List	Labour wage/day (normal)	Working wage/hour (normal)	1 day overtime wage	Crash cost of workers per day	Crash cost total
1	Floor Plate 4	Rp 17.292.161	Rp 2.161.520	Rp 12.969.121	Rp 30.261.283	Rp 518.764.844,143
2	Floor Beam 5	Rp 9.136.912	Rp 1.142.114	Rp 6.852.684	Rp 15.989.596	Rp 274.107.365,914
3	Floor Plate 5	Rp 9.776.632	Rp 1.222.079	Rp 7.332.474	Rp 17.109.106	Rp 293.298.954,657

After knowing the crash cost value of workers, the next step is to calculate the cost slope of each job.

Table 6. Cost Slope

No.	Job List	Cost Slope
1	Floor Plate 4	Rp 22.232.779
2	Floor Beam 5	Rp 11.747.459
3	Floor Plate 5	Rp 12.569.955

Based on the cost slope calculations presented in Table 6, it can be concluded that the beam work on the 5th floor, which has the lowest cost slope value, will be selected for crashing. Consequently, the updated schedule after the crash can be viewed in Figure 5 below.



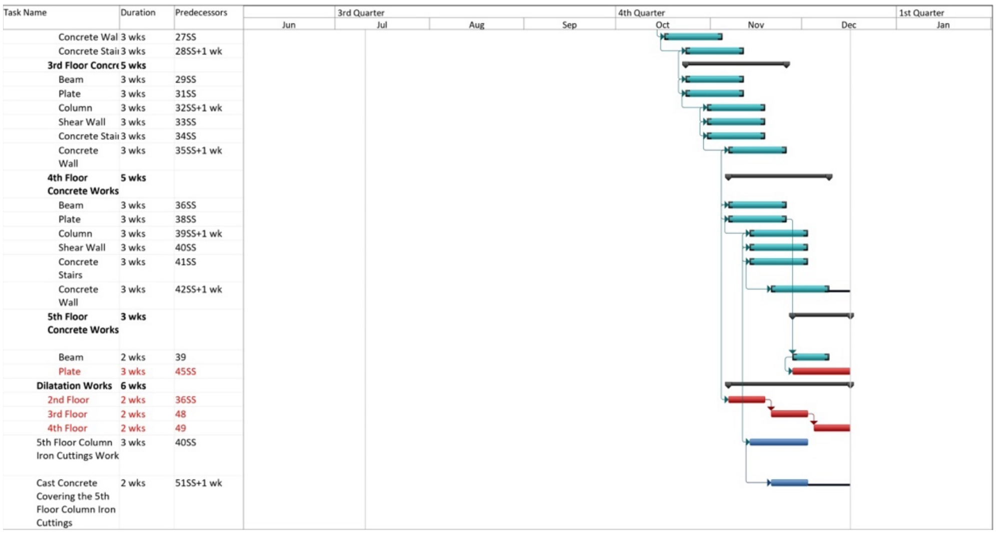


Figure 5. Scheduling after crash

From the analysis of the crash program method that has been carried out on the 5th floor beam work, it results in an accelerated duration of 23 weeks from the normal duration of 25 weeks or equivalent to 8%. This result is supported by previous research conducted by (Ariyanto et al., 2024), (Oetomo, 2017), (Pertiwi et al., 2023), (Pangemanan et al., 2023), (Putra et al., 2022), (Wala et al., 2023) and (Adinanda et al., 2024) with efficiency are 3%, 4%, 5%, 6%, 8,4%, 9,3%, and 10,41% respectively.

Comparison of Fast Track and Crash Program Methods

Comparison of project completion time with the Fast Track method takes 22 weeks, while the Crash Programme method takes 23 weeks. The cost comparison of the fast track and crash programme methods can be seen in Table 7.

Table 7. Cost Comparison of Fast Track and Crash Programme Methods

Before acceleration	Fast Track Method	Crash Program Method
Rp 62.616.737.120	Rp 61.857.038.635	Rp 62.698.969.330

From Table 7, it can be concluded that the Fast Track method is more profitable in time and cost than the Crash Program method, this result is also in line with research conducted by (Prawirawati et al., 2022) and (Ruff et al., 2024). Other studies mentioning if the time or cost of fast track is more optimal than crash programme were also conducted by (Zuhriyah et al., 2022), (Atikaningrum et al., 2023) and (Oli'i et al., 2024). Fast track is more optimal because there is no additional labour and overtime hours.

Risk of Fast Track Method Implementation

The first step in risk analysis is to conduct validity and reliability tests. The validity test shows if the r_{count} value is greater than r_{table} so that this questionnaire is declared valid. While the reliability test of 14 indicators produces a value of 0,841 so that it can be declared very reliable. Furthermore, to determine the probability of risk and impact appears in Table 8.

Table 8. Risk Analysis of Fast Track Method Implementation

No.	Mean Value Frequency/Intensity	Mean Value Impact	Risk Index	Description	Rank
1.1	3,15	2,81	8,86	Medium	12

1.2	3,56	3,33	11,85	Medium	6
1.3	3,30	3,15	10,38	Medium	11
2.1	2,59	2,56	6,63	Medium	14
2.2	2,67	2,63	7,01	Medium	13
2.3	3,74	3,59	13,44	High	1
2.4	3,70	3,56	13,17	High	3
2.5	3,41	3,33	11,36	Medium	8
2.6	3,67	3,56	13,04	High	4
2.7	3,74	3,56	13,30	High	2
2.8	3,44	3,37	11,61	Medium	7
2.9	3,37	3,33	11,23	Medium	9
2.10	3,33	3,22	10,74	Medium	10
2.11	3,70	3,52	13,03	High	5

Based on the risk analysis in Table 8, it can be concluded that the risk category in this study can be justified to high risk (risk index value between 13,03 – 13,44) and medium risk (risk index value between 6,63 – 11,85). The risk that must be avoided in the first rank application of Fast Track method is the occurrence of cracked concrete. This may happen if the formwork is removed too quickly due to the accelerated schedule. In addition to cracking, improper timing in structural work can lead to structural failure. The next category of risks to avoid are column is not symmetrical, hollow concrete joints, concrete deck and roof leaking, and the last is non conformity of structure size with plan.

This is in line with research conducted by (Satria, 2016) where quality reduction is one of the risks that has the most impact on the application of the fast track method. Other studies were conducted by (Azmy & Herzanita, 2023), (Rahayu et al., 2018), (Verocha et al., 2024), and (Stefanus, Wijatmiko, & Suryo, 2017) with the most impactful risks being the addition of labour, working hours and poor management where these risks fall into the medium risk category in this study.

Conclusion

Project acceleration methods can be used to accelerate implementation time and reduce project costs. Fast track and crash programme are two acceleration methods that are often used in project implementation. This research concludes:

1. Fast Track method is the most optimal approach in terms of both time and cost when compared to the Crash Program method. In terms of time the deviation is 1 week, while in terms of cost the deviation is Rp. 841.930.694. This is in accordance with research conducted by (Prawirawati et al., 2022) and (Ruff et al., 2024).
2. Fast track method is able to accelerate 3 weeks (12% acceleration efficiency) with a total budget of Rp. 61.857.038.635 according to (Salakory et al., 2023), (Sutciana et al., 2020), and (Athallasyah & Efrida, 2024) with an efficiency range of 13% - 17,34%.
3. Crash programme method is able to accelerate the project for 2 weeks (8% acceleration efficiency) with a total budget of Rp. 62.698.969.330, in line with (Ariyanto et al., 2024), (Oetomo, 2017), (Pertiwi et al., 2023), (Pangemanan et al., 2023), (Putra et al., 2022), (Wala et al., 2023) and (Adinanda et al., 2024) with an efficiency range of 3% - 10,41%.
4. Application of the fast track also poses a risk of cracking in the concrete. this may occur due to reduced setting time due to accelerated concrete work, in line with (Satria, 2016).

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