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PROJECT PLANNING AND CONTROLLING THE CONSTRUCTION PROJECT OF A HOSPITAL HEMODIALYSIS UNIT LOCATED IN TANGERANG USING THE CRASHING METHOD

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ABSTRACT:

The research was carried out by project planning and controlling to analyze the time duration and cost of adding labor and overtime hours at work on amendments to the construction of a hospital Hemodialysis unit located in Tangerang with the accelerated crashing method. Research analysis to see project planning and project control of amendments to the work of building a Hemodialysis unit for Crashing analysis work carried out by the accelerated method of adding working hours, adding labor and the combination of time duration to find the most optimal value.

Keywords: Project, Planning, Controlling, Crashing, Duration

INTRODUCTION

Research Background

In the implementation of the Hemodialysis Development project at the Tanggerang Regional Hospital, it experienced several obstacles which led to amendments that affected the implementation of the planned duration of work (Balderrama & Rodríguez, 2006). Increasing the number of workers and working hours, working with local communities and submitting additional time or contract amendments. The duration and labor equalization method is implemented in the project in order to obtain the optimum value in terms of work duration and labor.This research is to determine the optimum efficiency capacity for the amendments to the work to be implemented (Assefa Tsehayae & Robinson Fayek, 2016). A decrease in labor productivity is something that is always avoided. Lack of attention to worker productivity in a construction project can hinder construction work.

In the Hemodialysis development phase at the Tanggerang Regional Hospital which is planned to be completed in a duration of 13 weeks with the initial design reconstruction (Melissa & Basabih, 2023). Along with the work there is an increase in area which causes an increase in the volume and duration of the work which causes a delay in the progress of the work, (Assefa Tsehayae & Robinson Fayek, 2016). One strategy to overcome the problem of work delays is to use the project scheduling method. The Tangerang regional hospital development project carried out a network analysis consisting of several methods, namely related to labor and work duration managed with the microsft project tool so that jobs on the critical path are obtained and the value of worker needs and optimum time duration.

Research Problems

Based on the background that has been discussed above, questions arise that are used as the formulation of the problem in the research conducted, namely:

1. What is the time and cost of the project if it is accelerated (crashing) with additional work hours for the development of Hemodialysis amendments?
2. What is the time and cost of the project if it is accelerated (crashing) with the addition of working hours and labor in Hemodialysis amendments?
3. What is the optimum ratio of project time and cost with the addition of working hours and the addition of manpower

Research purposes

The purpose of the background that has been discussed above in the research conducted, namely:

1. Determining the time and cost of the project (during the transitional period of the remaining work implementation after the amendment) if crashing is carried out by adding working hours in the development of the advanced stages of the amendment to the Hemodialysis unit.
2. Determine the time and cost of the project if it is carried out with the addition of labor and the duration of work time with the construction of Hemodialysis amendments?
3. Determine the optimum project time and cost by adding working hours and adding labor to the duration of the work?

RESEARCH METHODS

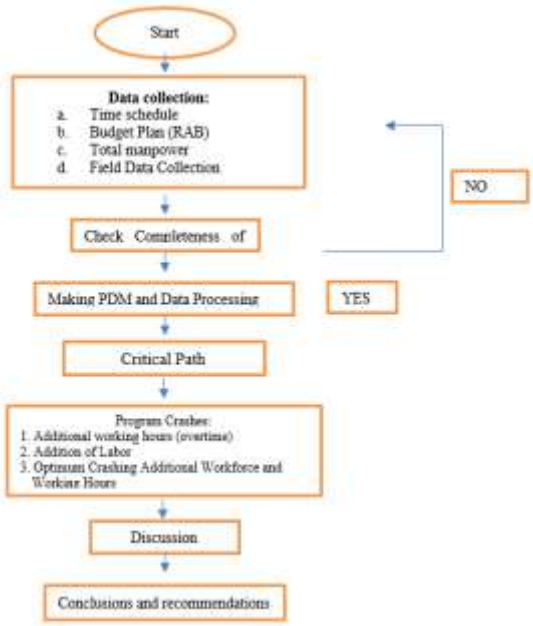
Research Process

Consistent with the emerging methodology of qualitative research, as a matter of generality so as not to limit the views. For grounded theory, questions need to discuss processes while in ethnomethodology and discourse analysis questions relate to verbal interaction and dialogue (Creswell & Creswell, 2017). He pointed out that the wording of the research questions determines the focus and scope of the research.

After all the data that has been obtained from the field then data processing is carried out. Because the field data does not have a network diagram, both the Critical Path Method (CPM) (Tao et al., 2017). CPM or also known as AOA (Activity On Arrow) is a basic project management model in terms of planning, scheduling, and controlling organizational resources. The purpose of the analysis of the CPM method is to determine the first critical path for the project to start until the project is finished, because on this path there are activities which, if implemented late, will cause a delay in the overall project (Sakka & El-Sayegh, 2007). Preliminary deterministic analysis In this stage the implementation schedule obtained from the project will be processed, and a network that has dependencies between activities will be created, then a critical path is created using the Critical Path Method (CPM) and calculating the float value of the project. The project duration and costs generated at this stage serve as the baseline for the project

Scheduling using the PDM (Precedence Diagram Network) method which aims to determine the comparison of planning duration between existing schedules (Sutrisno et al., 2018). Precedence Diagram Method (PDM), where the field only has a time schedule in the form of bar charts and S-curves. The initial step for network calculations is in the form of PDM using the Ms. Office so that jobs on the critical path are obtained (Suputra, 2011). For work that is included in the critical path, crashing (accelerated) calculations are carried out using two alternatives, namely additional working hours (overtime) for 1 and 2 hours and additional labor. From these two alternative calculations, the acceleration of a project's time and costs will be obtained as optimally as possible.

Research Flowchart



Research data

The data needed in this study is secondary data which includes:

1. Time schedule and weekly project report
2. Budget Plan (RAB)
3. The number of workers per work item

Research Object and Subject

1. The object used in this research is the Hemodialysis Development Project at a

hospital in the Tangerang area.

2. The subject of this study is the analysis of project crashes with additional working hours (overtime) and additional manpower.

RESULTS AND DISCUSSION

Problem Analysis

The work on the construction of a Hemodialysis unit located at a hospital in the Tanggerang area, the work has been completed 100% from the contractor, but the owner wants to add some further work that was agreed upon by the hospital team as a result of the review of the issuance of work on the procurement of isolation rooms, amendment 1 and amendment 2

Figure 1

Weigth to Work

NO	ACTIVITY DESCRIPTION	WEIGHT TO WORK
I	PREPARATORY WORK	2%
II	WORK OF RO WAREHOUSE ROOM AND REUSE ROOM	
	II.a EXCAVATION OF SOIL AND FOUNDATION WOR	3%
	II.b STEEL AND ROOFING WORK	5%
	II.c WALL WORK	6%
	II.d CEILING WORK	3%
	II.e FLOOR WORK	3%
	II.f DOOR AND WINDOW FRAME WORK	2%
	II.g PLUMBING AND SANITARY WORK	1%
	II.h ELECTRICAL WORK	3%
III	HEMODIALYSIS ROOM WORK	
	III.a ARCHITECTURAL WORK	15%
	III.b RO WATER AND DIRTY WATER (RO Piping)	5%
	III.c OTHER PROCUREMENT	7%
IV	INTERIOR WORK OF THE HEMODIALYSIS ROOM	13%
V	ISOLATION ROOM WORK	
	V.a ARCHITECTURAL WORK	5%
VI	AMANDEMENT WORKS	
	VI.a Isolation Chamber Work	5%
	VI.b Amendments 1	6%
	VI.c Amendments 2	7%
TOTAL BUDGET VALUE		92%
VALUE OF VAT AMOUNT 11%		8%
TOTAL BUDGET + VAT		100%

Data consisting of S-Curve and Bar Chart scheduling with a duration of 7 days for each work item from the contractor.

The duration of 7 days for each work item determines the number of days for each work with reference to the max unit, the max unit is the maximum value of the labor available by the contractor. After getting the duration of the day using the AHSP SNI and co-contractor coefficients:

Figure 2

AHSP SNI and co-contractor coefficients

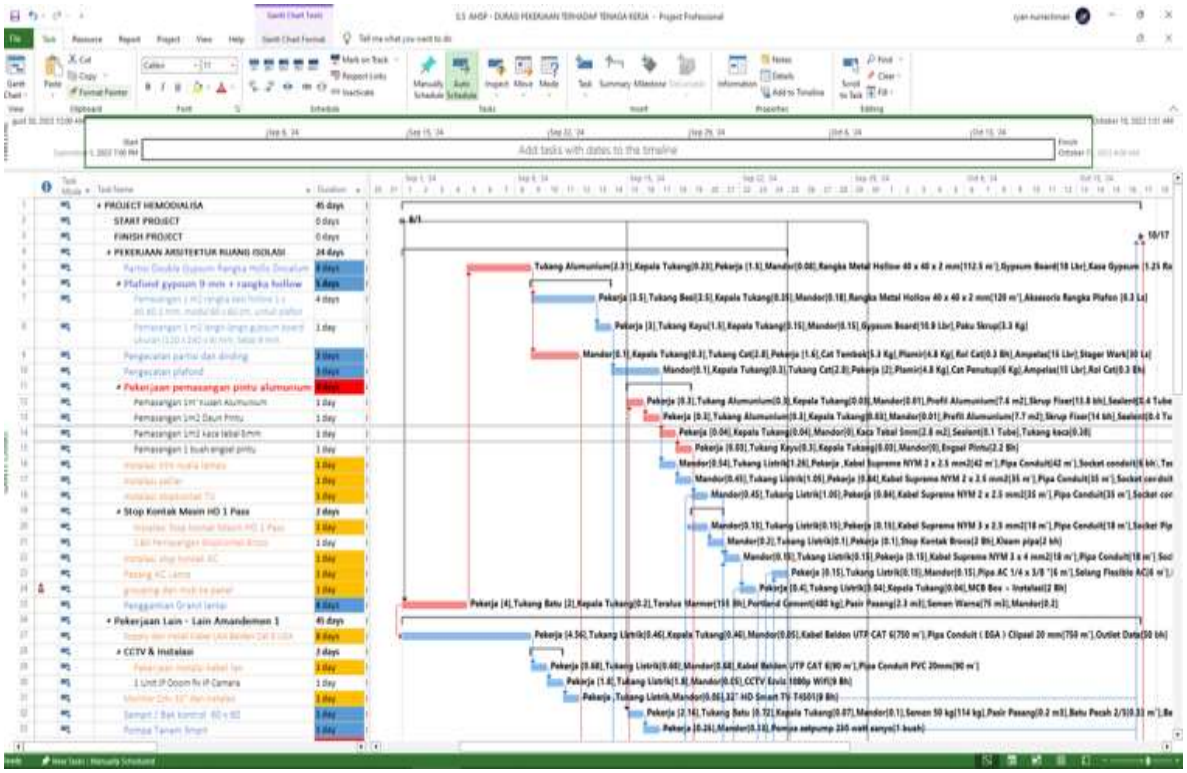
No	LABOR	AMOUNTS	WAGES	
1	Foreman	1	Rp	180,000
2	Head Handyman	1	Rp	160,000
3	Aluminum Handyman	3	Rp	144,000
4	Electrician	3	Rp	144,000
5	Carpenter	3	Rp	144,000
6	Mason	2	Rp	144,000
7	Painter	6	Rp	144,000
8	Blacksmith	4	Rp	144,000
9	Worker	11	Rp	120,000
10	Glazier	4	Rp	144,000
11	Plumber	2	Rp	144,000

An analysis was carried out using Ms Project by specifying a work diagram link with the addition of Start to Start and Finish to Start to 35 working days.

From the results of the project analysis, the critical path is obtained which will be accelerated in the duration of the work implementation, the following is the critical path obtained by the MS project.

Figure 3

Critical Path Obtained By The MS Project



The results of the critical path analysis show that the following crash duration items are crash duration work items:

Figure 4

Crash Duration Items are Crash Duration Work Items

No	Activity Description	Volume	Sat	Duration Normal
1	Granite Floor Replacement	50	m^2	3
2	Double Gypsum Partition Hollo Zincalum Frame	25	m^2	4
3	Painting partitions and walls	30	m^2	3
4	HD Patient Glass Aluminum Partition	12	m	5
5	RO Room Double Door Door	1	Unit	1
6	HD Doble Door (Custom Aluminum)	1	Unit	1
7	Door Single Door HD (Custom Aluminum)	1	Unit	1
8	Credanza Storage	1	Set	1
9	100 Meter Thrust Water Pump	1	Set	1
10	RO 1" raw water pipe	109	m	5
11	RO Pipe Cover box	10	m^1	7

2. Acceleration Analysis on the Critical Path With Additional Working Hours

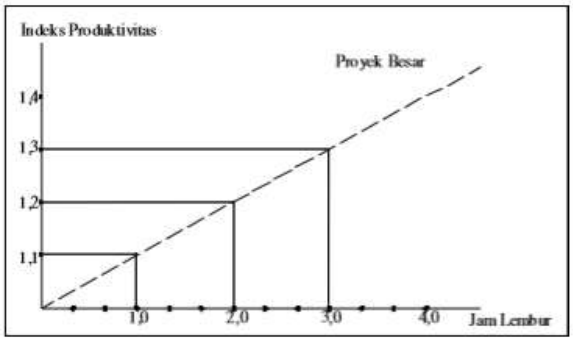
(Anugerah et al., 2021) According to the regulation of the Minister of Manpower No. KEP. 102 /MEN/ VI / 2004 Article 3, Article 7 and Article 11 regarding the standard of overtime pay for workers are:

1. Timeovertime can only be done for a maximum of 3 (hours) in 1 (one) day and 14 (fourteen) hours in 1 (one) week.
2. Provide food and drink of at least 1,400 calories if overtime work is done for 3 hours or more
3. For the first overtime work must be paid at 1.5 times the hourly wage.
4. For each subsequent overtime hour, wages must be paid 2 times the hourly wage.

(Soeharto, 1995) Reinforced based on theory explaining that there is a decrease in worker productivity due to overtime work, what is meant is a productivity index perpendicular to the need for workers' overtime hours, if 1 hour of overtime then the productivity index is 1.1, if 2 hours of overtime the productivity index is 1.2, likewise 3 hours of overtime, the productivity index is 1.3 and the maximum index for maximum overtime hours is 4 hours where the productivity index is 1.4.

Figure 5

Productivity Index



(Source: Suharto, 1995)

Figure 6

Analysis Obtained Overtime Wages for the Duration of Work 1 Hour And 2 Hours of Work

No	LABOR	WAGES	HOURLY CHARGE	OVERTIME FEE	
				1 HOUR	2 HOURS
1	Foreman	Rp 180,000	Rp 22,500.00	Rp 33,750.00	Rp 39,375.00
2	Head Handyman	Rp 160,000	Rp 20,000.00	Rp 30,000.00	Rp 35,000.00
3	Aluminum Handymar	Rp 144,000	Rp 18,000.00	Rp 27,000.00	Rp 31,500.00
4	Electrician	Rp 144,000	Rp 18,000.00	Rp 27,000.00	Rp 31,500.00
5	Carpenter	Rp 144,000	Rp 18,000.00	Rp 27,000.00	Rp 31,500.00
6	Mason	Rp 144,000	Rp 18,000.00	Rp 27,000.00	Rp 31,500.00
7	Painter	Rp 144,000	Rp 18,000.00	Rp 27,000.00	Rp 31,500.00
8	Blacksmith	Rp 144,000	Rp 18,000.00	Rp 27,000.00	Rp 31,500.00
9	Worker	Rp 120,000	Rp 15,000.00	Rp 22,500.00	Rp 26,250.00
10	Glazier	Rp 144,000	Rp 18,000.00	Rp 27,000.00	Rp 31,500.00
11	Plumber	Rp 144,000	Rp 18,000.00	Rp 27,000.00	Rp 31,500.00

3. Calculation of Worker Productivity

(Kinasih, 2018) When the number of hours per day and days per week increases. Calculation of decreased work productivity:

$$\text{Daily productivity} = \frac{\text{Volume}}{\text{Dn}}$$

$$\text{Worker productivity} = \frac{\text{Produktivitas perhari}}{\text{Jumlah Manpower}}$$

$$\text{Normal productivity per hour} = \frac{\text{Produktivitasper tenaga}}{\text{Durasi Jam}}$$

4. Labor productivity with overtime hours

Crashing duration or acceleration with the crashing method, for an alternative to adding working hours, a reduction in total cost is obtained.

The conclusion of the calculation of the addition of overtime wages to the workforce that is implemented on the critical path with the addition of 1 hour and 2 working hours, the following is a table of the critical path that has been implemented on the critical path in the work of amendments to Hemodialysis hospitals in the Tangerang area.

Figure 7
Acceleration Duration Against the Addition of One Hour Overtime

NO	Code	Activity description description Crashing Jobs	Duration Normal	Duration Crash 1 Hour	DC - DC
1	25	**Granite Floor Replacement**	3	0.295	2.71
2	5	**Double Gypsum Partition Hollo Zincalum Frame**	4	0.393	3.61
3	9	**Painting partitions and walls**	3	0.295	2.71
4	12	**HD Patient Glass Aluminum Partition**			
		Aluminum Partition	1	0.098	0.90
		Install glass 5 mm	2	0.196	1.80
5	51	**HD patient glass aluminum partition**			
	12	Installation of 1m' Aluminum Frame	1	0.098	0.90
		Installation of 1m2 Door Leaf	1	0.098	0.90
		Installation 1 m2 glass 5 mm thick	1	0.098	0.90
		Installation of 1 Door Hinge	1	0.098	0.90
6	35	**RO Room Double Door Door**			
		Installation of 1m' Aluminum Frame	1	0.098	0.90
		Installation of 1m2 Door Leaf	1	0.098	0.90
		Installation 1 m2 glass 5 mm thick	1	0.098	0.90
		Installation of 1 Door Hinge	1	0.098	0.90
7	54	**New HD Space Procurement Double Door**			
		Installation of 1m' Aluminum Frame	1	0.098	0.90
		Installation of 1m2 Door Leaf	1	0.098	0.90
		Installation 1 m2 glass 5 mm thick	1	0.098	0.90
		Installation of 1 Door Hinge	1	0.098	0.90
8	59	**Procurement of new HD Space Single Door**			
		Installation of 1m' Aluminum Frame	1	0.098	0.90
		Installation of 1m2 Door Leaf	1	0.098	0.90
		Installation 1 m2 glass 5 mm thick	1	0.098	0.90
		Installation of 1 Door Hinge	1	0.098	0.90
9	75	**Credanza Storage**	3	0.295	2.71
10	80	**100 Meter Thrust Water Pump**	1	0.098	0.90
11	81	**RO 1" raw water pipe**	5	0.491	4.51
12	44	**RO Pipe Cover box**	7	0.687	6.31

The concluding results in finding the value of the duration of crashing against the normal duration of work can be seen that the normal duration without a Finish to Start / Start to Start link is carried out for a total of 45 working days.

Figure 8
Duration of Acceleration Against the Addition of Two Hours of Overtime

NO	Code	Activity description description Crashing Jobs	Duration Normal	Duration Crash 2 Hours	DC - DC
1	25	**Granite Floor Replacement**	3	0.537	2.46
2	5	**Double Gypsum Partition Hollo Zincalum Frame**	4	0.715	3.28
3	9	**Painting partitions and walls**	3	0.537	2.46
4	12	**HD Patient Glass Aluminum Partition**			
		Aluminum Partition	1	0.179	0.82
		Install glass 5 mm	2	0.358	1.64
5	51	**HD patient glass aluminum partition**			
	12	Installation of 1m' Aluminum Frame	1	0.179	0.82
		Installation of 1m2 Door Leaf	1	0.179	0.82
		Installation 1 m2 glass 5 mm thick	1	0.179	0.82
		Installation of 1 Door Hinge	1	0.179	0.82
6	35	**RO Room Double Door Door**			
		Installation of 1m' Aluminum Frame	1	0.179	0.82
		Installation of 1m2 Door Leaf	1	0.179	0.82
		Installation 1 m2 glass 5 mm thick	1	0.179	0.82
		Installation of 1 Door Hinge	1	0.179	0.82
7	54	**New HD Space Procurement Double Door**			
		Installation of 1m' Aluminum Frame	1	0.179	0.82
		Installation of 1m2 Door Leaf	1	0.179	0.82
		Installation 1 m2 glass 5 mm thick	1	0.179	0.82
		Installation of 1 Door Hinge	1	0.179	0.82
8	59	**Procurement of new HD Space Single Door**			
		Installation of 1m' Aluminum Frame	1	0.179	0.82
		Installation of 1m2 Door Leaf	1	0.179	0.82
		Installation 1 m2 glass 5 mm thick	1	0.179	0.82
		Installation of 1 Door Hinge	1	0.179	0.82
9	75	**Credanza Storage**	3	0.537	2.46
10	80	**100 Meter Thrust Water Pump**	1	0.179	0.82
11	81	**RO 1" raw water pipe**	5	1.325	3.68
12	44	**RO Pipe Cover box**	7	1.252	5.75

The concluding results in finding the value of the duration of crashing against the normal duration of work can be seen that the normal duration without a Finish to Start / Start to Start link is carried out for a total of 45 working days.

5. Calculation of Acceleration Costs Due to Additional Overtime Hours

The calculation of the addition of overtime hours is carried out at 1 hour and 2 hours of overtime, the following is the result of the analysis of the calculation of additional working overtime hours.

Figure 9
Working Overtime Hours

Total duration of days on the criti	Days
Normal Duration	45
Overtime Duration 1 working hour	40.6
Overtime Duration 2 Working Hours	36.5

Analysis of Critical Path Duration Against Normal Duration, 1 Hour Acceleration Duration and 2 Hours Working Hours Acceleration Duration. Comparison of the value implemented on the critical work that can be obtained with the total cost Rp.21,484,500 and the total value of the fee for 2 hours of overtime is Rp. 23,921,365 The total duration of work in the critical path, labor wages from the review of the critical

value and the difference in costs from the critical value to the presence of 1 hour overtime work and 2 hours of overtime work.

Obtained accelerated project duration without any influence on the Link Diagram – Days on the critical path of work to get a total normal work duration of 45 working days, overtime duration of 1 working hour 40.6 working days and overtime duration of 2 working hours 36.5 working days.

Labor Wage Analysis for Normal Duration, 1 hour acceleration duration and 2 hours acceleration duration on a critical path:

Figure 10

Labors Wages

Total Wages of Workers On the Critical Line	Labor Wages	
Normal Duration	Rp	19,822,435
Overtime Duration 1 working hour	Rp	21,484,500
Overtime Duration 2 Working Hours	Rp	23,921,365

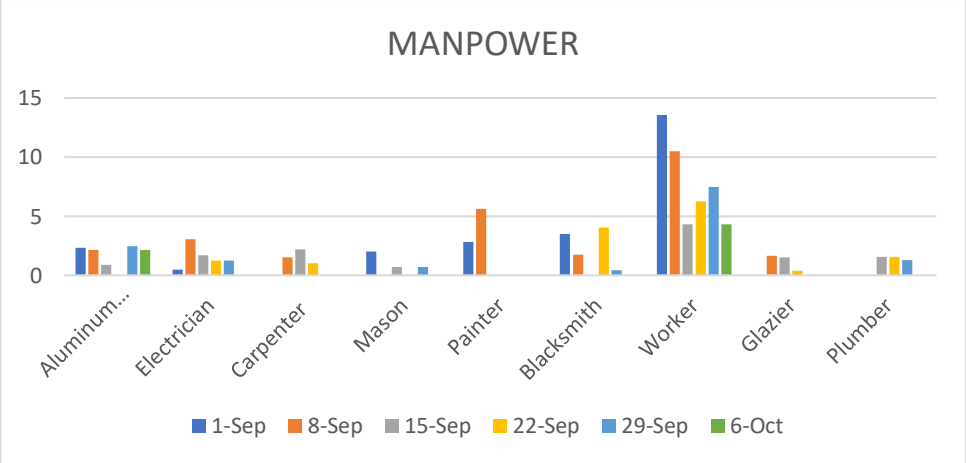
In connection with the addition of overtime to the workforce, the normal duration value is obtained without the addition of overtime hours of Rp. 19,822,435, the total labor wage for the 1 hour overtime duration analyzed at the critical value is Rp. 21,484,500 and the total labor wage for the 2 hour overtime duration worked on the critical path is Rp. 23,921,365.

Results Input duration of acceleration on the critical path to Ms Project with the addition of 1 working hour of overtime is 31.78 working days.

The analysis of the number of workers implemented is the same as the normal duration, it can be seen that the level of labor productivity is the need for more workers in week 1 in September with a level of need of 14 workers, the following is a picture of the need for labor:

Figure 11

Labors Needs



(Manpower Needs Analysis)

The results of the value of labor requirements implemented for the normal duration, 1 hour overtime and 2 hours overtime are:

Figure 12

Normal Duration Labor Needs Analysis

No	WORKFORCE	Total Works	WAGES		Duration Normal					
					M1	M2	M3	M4	M5	M6
1	Mandor	1	Rp	180,000	0.20	0.34	1.28	1.10	1.46	0.57
2	Kepala Tukang	1	Rp	160,000	0.20	1.24	1.45	28.11	1.63	1.75
3	Tukang Alumunium	3	Rp	144,000	0.00	2.31	2.16	0.90	2.14	2.44
4	Tukang Listrik	3	Rp	144,000	0.00	0.46	2.26	0.34	1.26	0.00
5	Tukang Kayu	3	Rp	144,000	0.00	1.50	2.20	1.90	1.00	0.00
6	Tukang Batu	2	Rp	144,000	2.00	2.00	0.72	0.00	0.72	0.00
7	Tukang Cat	6	Rp	144,000	0.00	5.60	5.60	0.00	0.00	0.00
8	Tukang Besi	4	Rp	144,000	3.50	1.75	0.00	4.04	0.18	0.00
9	Pekerja	11	Rp	120,000	4.00	9.91	12.07	2.20	6.27	7.48
10	Tukang kaca	4	Rp	144,000	0.00	1.65	1.50	0.00	0.00	0.00
11	Tukang Pipa	2	Rp	144,000	0.00	0.00	0.00	1.58	1.58	1.31

Figure 13

Analysis of Manpower Needs Overtime 1 hour

No	WORKFORCE	Total Works	WAGES		Crashing 1 Hour					
					M1	M2	M3	M4	M5	M6
1	Mandor	1	Rp	180,000	0.33	0.92	1.26	1.46	1.46	0.43
2	Kepala Tukang	1	Rp	160,000	1.11	1.37	28.07	0.54	1.75	1.43
3	Tukang Alumunium	3	Rp	144,000	2.31	2.16	0.90	0.00	2.44	2.14
4	Tukang Listrik	3	Rp	144,000	0.46	3.06	1.70	1.26	1.26	0.00
5	Tukang Kayu	3	Rp	144,000	0.00	1.50	2.20	1.00	0.00	0.00
6	Tukang Batu	2	Rp	144,000	2.00	0.00	0.72	0.00	0.72	0.00
7	Tukang Cat	6	Rp	144,000	2.80	5.60	0.00	0.00	0.00	0.00
8	Tukang Besi	4	Rp	144,000	3.50	1.75	0.00	4.04	0.45	0.00
9	Pekerja	11	Rp	120,000	13.56	10.47	4.29	6.27	7.48	4.29
10	Tukang kaca	4	Rp	144,000	0.00	1.65	1.50	0.38	0.00	0.00
11	Tukang Pipa	2	Rp	144,000	0.00	0.00	0.00	1.58	1.58	1.31

Figure 14

2 Hour Overtime Labor Requirement Analysis

No	WORKFORCE	Total Works	WAGES		Crashing 2 Hours					
					M1	M2	M3	M4	M5	M6
1	Mandor	1	Rp	180,000	0.43	1.33	0.89	1.42	0.53	0.00
2	Kepala Tukang	1	Rp	160,000	1.24	1.37	28.16	1.84	1.75	0.00
3	Tukang Alumunium	3	Rp	144,000	2.31	2.16	0.90	0.00	2.44	2.14
4	Tukang Listrik	3	Rp	144,000	0.46	3.06	1.70	1.26	1.26	0.00
5	Tukang Kayu	3	Rp	144,000	1.50	2.20	1.90	1.00	0.00	0.00
6	Tukang Batu	2	Rp	144,000	2.00	2.00	0.72	0.72	0.00	0.72
7	Tukang Cat	6	Rp	144,000	5.60	5.60	0.00	0.00	0.00	0.00
8	Tukang Besi	4	Rp	144,000	3.50	1.75	0.00	4.04	0.45	0.00
9	Pekerja	11	Rp	120,000	4.00	13.56	10.47	3.66	9.56	7.48
10	Tukang kaca	4	Rp	144,000	0.00	1.65	1.50	0.00	0.00	0.00
11	Tukang Pipa	2	Rp	144,000	0.00	0.00	0.00	1.58	1.58	1.31

The results of the data analysis that has been calculated using the Ms Project and the calculation of the analysis of the number of workers needed in the duration of the week, can be seen from the following table Table 4.11, which concludes the value of the minimum workforce, the maximum workforce and the average workload implemented per week:

Figure 15
Average Workload

No	WORKFORCE	Total Works	WAGES		MIN	MAX	AVG
1	Mandor	1	Rp	180,000	0.00	1.46	0.86
2	Kepala Tukang	1	Rp	160,000	0.00	28.16	5.42
3	Tukang Alumunium	3	Rp	144,000	0.00	2.44	1.66
4	Tukang Listrik	3	Rp	144,000	0.00	3.06	1.10
5	Tukang Kayu	3	Rp	144,000	0.00	2.20	0.99
6	Tukang Batu	2	Rp	144,000	0.00	2.00	0.84
7	Tukang Cat	6	Rp	144,000	0.00	5.60	1.71
8	Tukang Besi	4	Rp	144,000	0.00	4.04	1.61
9	Pekerja	11	Rp	120,000	2.20	13.56	7.61
10	Tukang kaca	4	Rp	144,000	0.00	1.65	0.55
11	Tukang Pipa	2	Rp	144,000	0.00	1.58	0.71

6. Determination and addition of manpower

(Fathonah & Saputrab, n.d.) From the previous calculation, the number of workers (resources) in normal work is obtained. The normal number of workers can be used as a reference in determining the number of additional workers. In order to add manpower, one must consider costs and time by finding the most optimal one. From the analysis, experiments were carried out to increase the workforce, namely by using the addition of 10%, 20%, 30%, 40% and 50% of the normal number of workers. From the addition experiment, the most optimal addition of labor will be obtained. Below is an example of increasing the workforce using an addition of 50% of the normal number of workers

Figure 16

Example of Granite Teralux 60x60 Job Analysis

Total Manpower				Total Manpower	Total Fee		Summary	
10%	20%	Normal Worker + Crash			Fee x DC x Total Manpower			
		Eq10%	Eq 20%	Days				
0.40	0.80	4.40	4.80	2.727	Rp	1,570,909		
0.20	0.40	2.20	2.40	2.727	Rp	942,545	Rp	2,736,000
0.02	0.04	0.22	0.24	2.727	Rp	104,727		
0.02	0.04	0.22	0.24	2.727	Rp	117,818		

7. Additional manpower with crashing duration of 1 hour overtime

He obtained the addition of work duration to the workforce and the calculation of the addition of 1 hour overtime which has a crashing value. The following is the crashing value for optimizing the addition of labor and 1 hour of overtime:

Figure 17. Duration of Acceleration Due to Additional Labor

No	CP	CRITICAL PATH ACTIVITY DESCRIPTION	DC Overtime 1 Hour + Labor
1	25	**Granite Floor Replacement**	2.43
2	5	**Double Gypsum Partition Hollo Zincalum Frame**	3.24
3	9	**Painting partitions and walls**	1.66
4	12	**HD Patient Glass Aluminum Partition**	
		Aluminum Partition	0.81
		1m2 Glass Work	1.62
5	11	**Aluminum Door Installation Work**	
		Installation of 1m' Aluminum Frame	0.81
		Installation of 1m2 Door Leaf	0.80
		Installation 1 m2 glass 5 mm thick	0.81
		Installation of 1 Door Hinge	0.81
6	35	**RO Room Double Door Door**	
		Installation of 1m' Aluminum Frame	0.81
		Installation of 1m2 Door Leaf	0.81
		Installation 1 m2 glass 5 mm thick	0.81
		Installation of 1 Door Hinge	0.81
7	54	**HD Doble Door (Custom Aluminum)**	
		Installation of 1m' Aluminum Frame	0.81
		Installation of 1m2 Door Leaf	0.81
		Installation 1 m2 glass 5 mm thick	0.81
		Installation of 1 Door Hinge	0.81
8	59	**Door Single Door HD (Custom Aluminum)**	
		Installation of 1m' Aluminum Frame	0.81
		Installation of 1m2 Door Leaf	0.81
		Installation 1 m2 glass 5 mm thick	0.81
		Installation of 1 Door Hinge	0.81
9	75	**Credanza Storage**	0.81
10	80	**100 Meter Thrust Water Pump**	0.81
11	81	**RO 1" raw water pipe**	4.05
12	44	**RO Pipe Cover box**	5.68

The stages of the combination of accelerated work are carried out by adding labor to work. It can be seen that the total duration of work with the addition of labor and the addition of 1 hour of overtime is 35.7 days.

Calculation of the value of workers' wages in the addition of 1 hour of work and additional labor:

Figure 18.

Addition of 1 Hour of Work and Additional Labor

No	CP	CRITICAL PATH ACTIVITY DESCRIPTION	DC Overtime 1 Hour + Labor	Total Overtime Pay 1 hour and Labor		DC Difference 1 Hour- DN	
1	25	**Granite Floor Replacement**	2.43	Rp	2,978,250	Rp	470,250
2	5	**Double Gypsum Partition Hollo Zincalum Frame**	3.24	Rp	2,676,625	Rp	422,625
3	9	**Painting partitions and walls**	1.66	Rp	2,355,525	Rp	371,925
4	12	**HD Patient Glass Aluminum Partition**					
		Aluminum Partition	0.81	Rp	396,036	Rp	62,532
		1m2 Glass Work	1.62	Rp	677,787	Rp	107,019
5	11	**Aluminum Door Installation Work**					
		Installation of 1m' Aluminum Frame	0.81	Rp	101,209	Rp	15,980
		Installation of 1m2 Door Leaf	0.80	Rp	102,676	Rp	16,212
		Installation 1 m2 glass 5 mm thick	0.81	Rp	77,021	Rp	12,161
		Installation of 1 Door Hinge	0.81	Rp	61,617	Rp	9,729
6	35	**RO Room Double Door Door**					
		Installation of 1m' Aluminum Frame	0.81	Rp	123,211	Rp	19,454
		Installation of 1m2 Door Leaf	0.81	Rp	205,352	Rp	32,424
		Installation 1 m2 glass 5 mm thick	0.81	Rp	308,085	Rp	48,645
		Installation of 1 Door Hinge	0.81	Rp	123,234	Rp	19,458
7	54	**HD Doble Door (Custom Aluminum)**					
		Installation of 1m' Aluminum Frame	0.81	Rp	123,211	Rp	19,454
		Installation of 1m2 Door Leaf	0.81	Rp	205,352	Rp	32,424
		Installation 1 m2 glass 5 mm thick	0.81	Rp	308,085	Rp	48,645
		Installation of 1 Door Hinge	0.81	Rp	123,234	Rp	19,458
8	59	**Door Single Door HD (Custom Aluminum)**					
		Installation of 1m' Aluminum Frame	0.81	Rp	101,209	Rp	15,980
		Installation of 1m2 Door Leaf	0.81	Rp	102,676	Rp	16,212
		Installation 1 m2 glass 5 mm thick	0.81	Rp	77,021	Rp	12,161
		Installation of 1 Door Hinge	0.81	Rp	61,617	Rp	9,729
9	75	**Credanza Storage**	0.81	Rp	940,500	Rp	148,500
10	80	**100 Meter Thrust Water Pump**	0.81	Rp	79,990	Rp	12,630
11	81	**RO 1" raw water pipe**	4.05	Rp	1,848,368	Rp	291,848
12	44	**RO Pipe Cover box**	5.68	Rp	9,381,250	Rp	1,481,250
		TOTAL	**34.1**	**Rp**	**23,539,142**	**Rp**	**3,716,707**

The results of the analysis can be seen that for a critical duration, the number of additional workers is enough to influence the increase in costs for each work item that is being accelerated. The duration of the acceleration in adding workers and the duration of 1 hour overtime is 34 working days with a total worker wage of Rp. 23,539,141.80, the difference between the budget value and the normal duration is Rp. 3,716,706.60.

8. Additional manpower with a crashing duration of 2 hours overtime

Same as the quote above regarding the addition of labor with the addition of 2 hours of overtime, the calculation of the implementation of the increase in labor with the addition of 2 hours of overtime. The following is the result of calculating the duration acceleration work analysis with the addition of labor and the addition of 2 hours of overtime.

Figure 19

Duration of Acceleration Due to Additional Labor

No	CP	CRITICAL PATH ACTIVITY DESCRIPTION	DC Difference 2 Hours- DN	Total Overtime Pay 2 Hours and Labor	DC Difference 2 Hour-DN
1	25	**Granite Floor Replacement**	2.19	Rp 3,605,250	Rp 1,097,250
2	5	**Double Gypsum Partition Hollo Zincalum Frame**	2.92	Rp 3,240,125	Rp 986,125
3	9	**Painting partitions and walls**	1.41	Rp 2,851,425	Rp 867,825
4	12	**HD Patient Glass Aluminum Partition**			
		Aluminum Partition	0.73	Rp 479,412	Rp 145,908
		1m2 Glass Work	1.46	Rp 820,479	Rp 249,711
5	11	**Aluminum Door Installation Work**			
		Installation of 1m' Aluminum Frame	0.73	Rp 122,516	Rp 37,288
		Installation of 1m2 Door Leaf	0.72	Rp 124,292	Rp 37,828
		Installation 1 m2 glass 5 mm thick	0.73	Rp 93,236	Rp 28,376
		Installation of 1 Door Hinge	0.73	Rp 74,589	Rp 22,701
6	35	**RO Room Double Door Door**			
		Installation of 1m' Aluminum Frame	0.73	Rp 149,150	Rp 45,394
		Installation of 1m2 Door Leaf	0.73	Rp 248,584	Rp 75,656
		Installation 1 m2 glass 5 mm thick	0.73	Rp 372,945	Rp 113,505
		Installation of 1 Door Hinge	0.73	Rp 149,178	Rp 45,402
7	54	**HD Doble Door (Custom Aluminum)**			
		Installation of 1m' Aluminum Frame	0.73	Rp 149,150	Rp 45,394
		Installation of 1m2 Door Leaf	0.73	Rp 248,584	Rp 75,656
		Installation 1 m2 glass 5 mm thick	0.73	Rp 372,945	Rp 113,505
		Installation of 1 Door Hinge	0.73	Rp 149,178	Rp 45,402
8	59	**Door Single Door HD (Custom Aluminum)**			
		Installation of 1m' Aluminum Frame	0.73	Rp 122,516	Rp 37,288
		Installation of 1m2 Door Leaf	0.73	Rp 124,292	Rp 37,828
		Installation 1 m2 glass 5 mm thick	0.73	Rp 93,236	Rp 28,376
		Installation of 1 Door Hinge	0.73	Rp 74,589	Rp 22,701
9	75	**Credanza Storage**	1.56	Rp 1,138,500	Rp 346,500
10	80	**100 Meter Thrust Water Pump**	0.73	Rp 96,830	Rp 29,470
11	81	**RO 1" raw water pipe**	3.22	Rp 2,237,498	Rp 680,978
12	44	**RO Pipe Cover box**	5.11	Rp 11,356,250	Rp 3,456,250
		TOTAL	**31.0**	**Rp 28,494,751**	**Rp 8,672,315**

The results of the analysis can be seen that for a critical duration, the number of additional workers is enough to influence the increase in costs for each work item that is being accelerated. The duration of the acceleration in adding workers and the duration of 2 hours of overtime is 31 working days with a total worker wage of Rp. 28,494,751, the difference between the budget value and the normal duration is Rp. 8,672,315.

9. Cost and Time Analysis of the Project with Normal Duration, Adding 1 hour Overtime and Adding 2 Hours of Overtime to the Critical Path

The results of the Normal Duration Job Analysis are:

1. Calculation of Critical Value Without the influence of Link Start to Start – Finish to Start is 45 Days with a total wage budget of Rp. 19,822,435
2. The results of job analysis with 1 hour of overtime duration, the total wage is Rp. 23,539,142 with a duration of 40 days and the results of job analysis with an overtime duration of 2 hours, the total wage for labor is Rp.28,494,751 with a duration of 36.5 days.

3. The difference between the normal duration fee and 1 hour crashing. duration is IDR 3,716,707 and the difference between the normal duration fee and 2 hours crashing duration overtime is IDR 8,672,315

10. The Effect of Additional Working Hours on the Productivity of Working Time on the Critical Path

Normal work execution is 45 working days with a total cost of Rp. 19,822,435 and the implementation of accelerated work with the addition of labor is 42 working days with a total cost of IDR 21,886,341, the difference in the duration of work is 3 working days and the difference in the budget for the duration of work is IDR 2,063,906. The following is a table of job details for the duration of additional manpower:

Figure 20
Analysis of Work Acceleration with Additional Labor

Description	DC due to additional manpower		Normal Duration		Crash Duration - Normal Duration	
Time Scdule	42 Days		45 Days		3 Days	
Cost	Rp	21,886,341	Rp	19,822,435	Rp	2,063,906

11. Analysis of Time and Cost of Adding Labor and Working Hours to the Critical Path

Crash duration work obtained in completing a project with a duration of work in one day is 8 hours of work plus a maximum of overtime in the Hemodialysis project of 1 hour of work and 2 hours of overtime work. The results of the analysis of the acceleration of the duration of work with overtime can be seen that the total work without the effect of Finish to Start - day / Start to start is 45 working days with a total wage budget of Rp. 93,917,040 and the duration of work implemented on the Ms Project is 35 working days using a work time schedule adjustment.

The normal duration work results on the left track without the addition of Start to Start & Finish to Start project analysis can be seen that the total normal duration of crashing is 45. Results of job analysis with 1 hour overtime duration total pay is Rp. 23,539,142 with a duration of 34 days and the results of job analysis with an overtime duration of 2 hours, the total wage for labor is Rp.28,494,751 with a duration of 31 days.

The difference between the normal duration fee and the 1 hour crashing duration is Rp.3,716,707 and the difference between the normal duration and the 2 hour crashing duration overtime is Rp.8,672,315 and the duration of the work implemented

on the Ms Project is 31.78 working days using the work time schedule adjustment and the results of the 2 hour overtime crashing work are 36.5 working days with a worker wage value of 31,592,006, the duration of the accelerated implemented on the Ms project is 29 working days on the Ms Project calculation.

12. Comparison of Time and Cost of Work Acceleration

Acceleration of work obtained when completing the project without a combination with normal duration is 45 working days, for the duration of additional working hours the duration of 1 hour of overtime is 40.58 days and 2 hours of overtime on the critical path is 36.52 days, while the duration of additional working hours and labor on the left track is additional labor plus 1 hour of overtime is 38.78 days and additional labor plus 2 hours of overtime is 34.88 days, the following is a comparative job analysis table time and cost with acceleration duration:

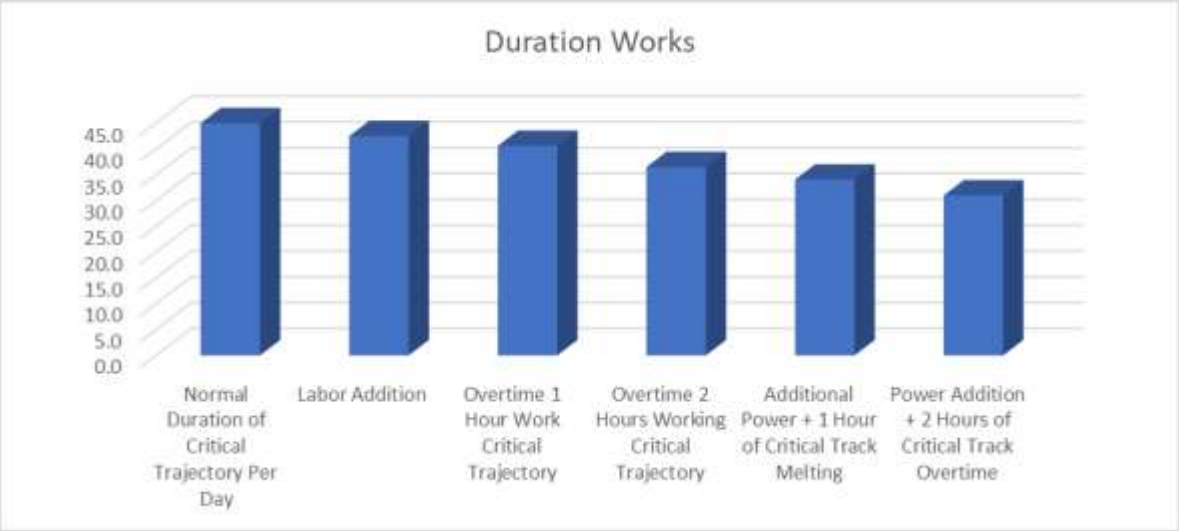
Figure 20

Time and Cost With Acceleration Duration

Comparative Analysis of Time, Cost and Labor Against Critical Trajectory	Days
Normal Duration of Critical Trajectory Per Day	45
Duration of Increasing Critical Track Working Hours Per Day	
Overtime 1 Hour Work Critical Trajectory	40.60
Overtime 2 Hours Working Critical Trajectory	36.50
Duration of Increasing Working Hours and Critical Track Workforce per Day	
Additional Power + 1 Hour of Critical Track Melting	34.08
Additional Power + 2 Hours of Critical Track Overtime	31.01

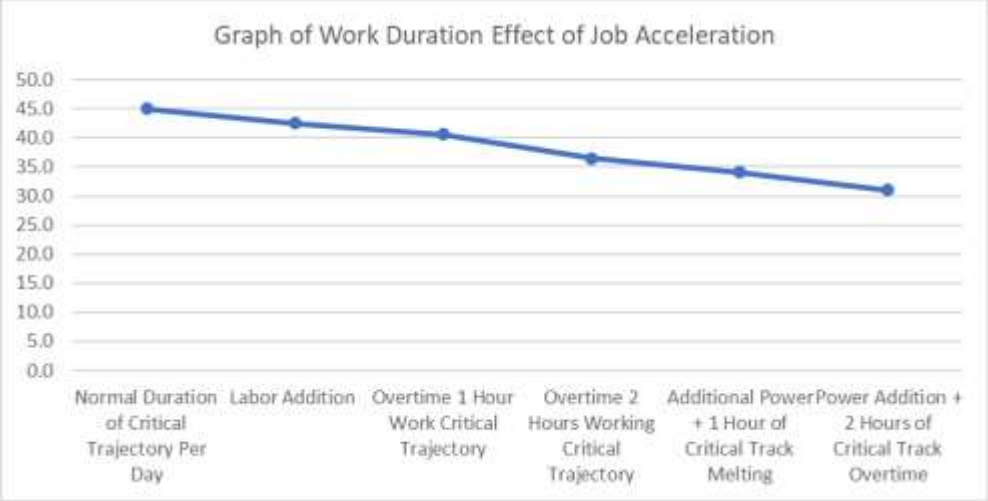
The results of the analysis of the accelerated work implemented can be seen that there is a decrease in the number of working days that are implemented without the influence of link-days. The following is a detailed image of the table.

Figure 21
Duration Works



The following is a job analysis graph of the duration of work time that affects the acceleration of work:

Figure 22
Graph of Work Duration Effect of Job Acceleration



The results of a comparative analysis of costs reviewed with the duration of the critical value that is implemented for the duration of the project, it can be seen that the normal duration value on the critical path is Rp. 22,300,240 and the 2-hour overtime on the critical path is Rp. 24,778,044, and the duration of additional working hours and labor on the critical path is Rp. 23,539,142 and the additional workforce with 2 hours overtime on the critical path is 31,580,834.

The following is a description table of the cost values obtained. The results of the analysis of the accelerated work implemented can be seen that there is a decrease in the number of working days that are implemented without the influence of link-days. The following is a detailed image of the table.

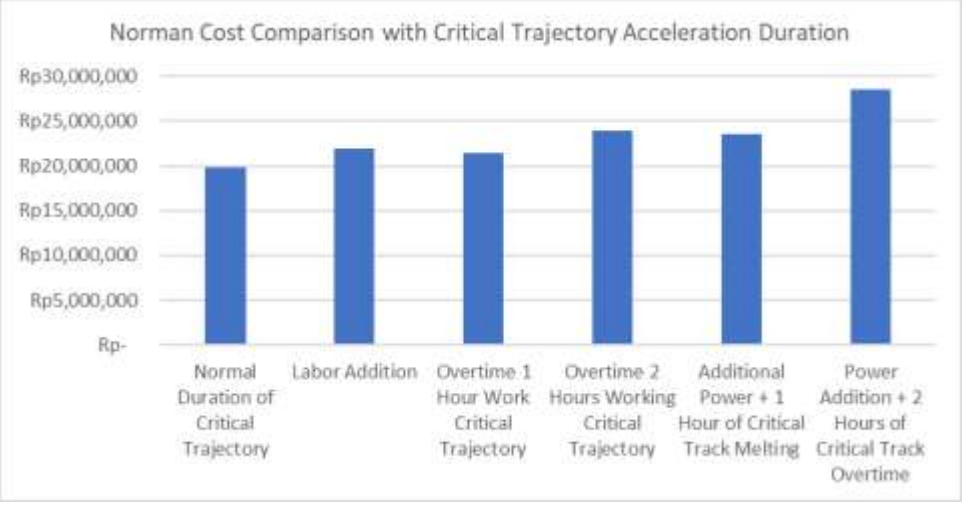
Figure 23

Description Table of The Cost Values Obtained

Norman Cost Comparison with Critical Trajectory Acceleration Duration		Total
Normal Duration of Critical Trajectory	Rp	19,822,435
Labor Addition	Rp	21,886,341
Overtime 1 Hour Work Critical Trajectory	Rp	21,484,500
Overtime 2 Hours Working Critical Trajectory	Rp	23,921,365
Additional Power + 1 Hour of Critical Track Melting	Rp	23,539,142
Power Addition + 2 Hours of Critical Track Overtime	Rp	28,494,751

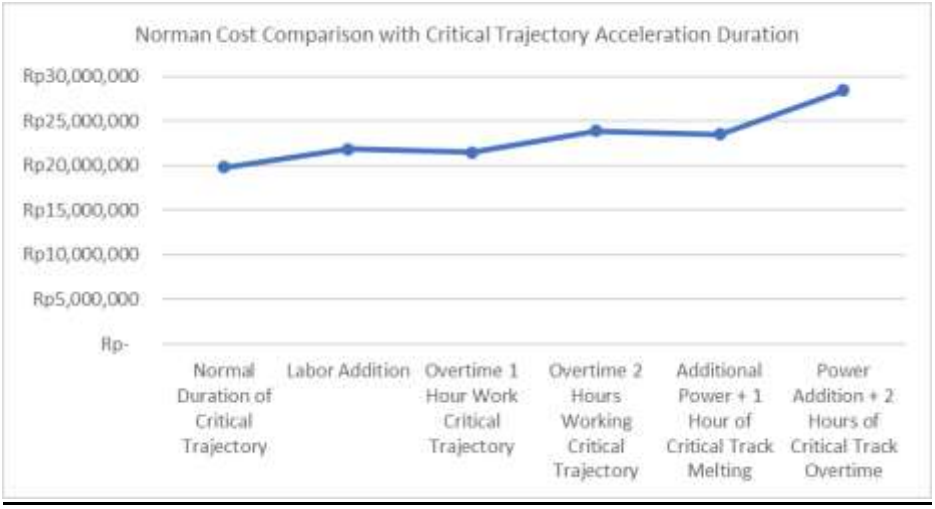
Figure 24

Norman Cost Comparasion with Critical Trajectory Acceleration Duration



The following is a job analysis of the cost graph of the influence of the acceleration of work:

Figure 25
Norman Cost Comparasion with Critical Trajectory Acceleration Duration

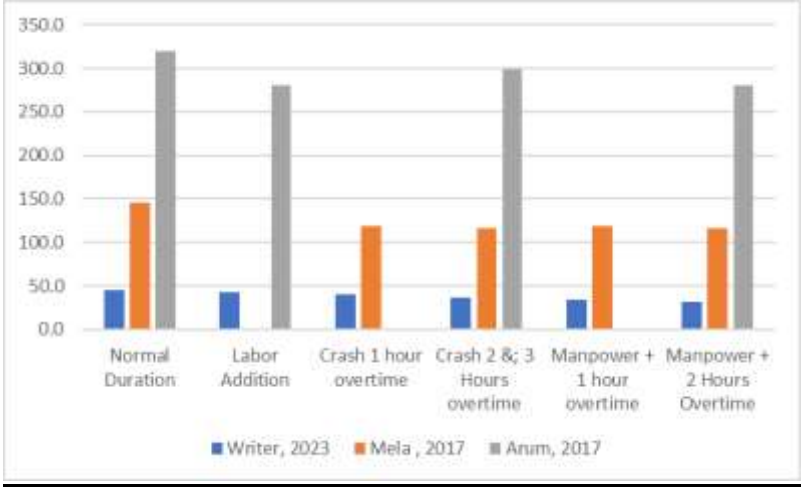


From the results of the study coupled with the work literature implemented on the researcher's work, the following is a comparative data on the analysis of the work implemented on the duration of the work, the results of the accelerated work analysis implemented can be seen that there is a decrease in the number of working day duration with the addition of working hours and additional workforce

Figure 26
Comparison of Job Values and Job Literature Value Analysis

Comparative Literature	Writer, 2023	Mela , 2017	Arum, 2017
Normal Duration	45.0	146	320
Labor Addition	42.5		281
Crash 1 hour overtime	40.6	119	
Crash 2 &; 3 Hours overtime	36.5	116	299
Manpower + 1 hour overtime	34.08	119	
Manpower + 2 Hours Overtime	31.01	116	281

Figure 27
Comparison of Job Value and Job Literature Value Analysis



The results of the analysis can be seen that the comparison of the decrease in normal duration to the acceleration duration is directly proportional to the acceleration value implemented by the author's analysis with the literature review, the value of work duration to normal duration if time is accelerated and the addition of bar chart workers will decrease the duration of work time.

CONCLUSION

Based on the results of the analysis of the acceleration of the addition of working hours and the addition of labor in the construction period, the amendments consist of

1. Isolation Room Work
2. Amendment Work 1
3. Amendment Work 2

It can be concluded that the recap value of the amendments to the construction of hospitals in the Tangerang area is as follows:

The total duration acceleration with the addition of 1 hour of overtime work and 2 hours of work on the critical path is:

1. Total Work Duration without PDM link adjustment to the work time schedule with additional working hours:

The duration of the Crashing job is 1 hour of work : 42.5 Days
Total Wages of Critical Path Workers
: IDR 21,484,500

The duration of the Crashing job is 2 hours Kejra : 36.5 Days
Total Wages of Critical Path Workers
: IDR 23,921,365

2. Total duration of work In the absence of PDM link adjustments to the work schedule time line with the addition of manpower:

   Duration of Work Time for Additional Labor : 42.5 Days
   Total Wages of Critical Path Workers
   : IDR 21,886,341

3. Total duration of work without PDM Link adjustment to the work time schedule with additional working hours and manpower:

   The duration of the Crashing work is 1 hour and the addition of labor

   : 34.1 Days
   Total Wages of Critical Path Workers
   : IDR 23,539,142

   The duration of the Crashing work is 2 hours and the addition of manpower

   : 31.0 Days
   Total Wages of Critical Path Workers
   : IDR 28,494.75

BIBLIOGRAFI

Anugerah, Z. S. P., Pratami, D., & Akbar, M. D. (2021). Designing Project Schedule Using Crashing Method To Compress The Fiber To The Home Project Schedule. *International Journal Of Industrial Optimization*, *2*(1), 51.

Assefa Tsehayae, A., & Robinson Fayek, A. (2016). Developing And Optimizing Context-Specific Fuzzy Inference System-Based Construction Labor Productivity Models. *Journal Of Construction Engineering And Management*, *142*(7), 4016017.

Balderrama, F. E., & Rodríguez, R. (2006). *Decade Of Betrayal: Mexican Repatriation In The 1930s*. Unm Press.

Creswell, J. W., & Creswell, J. D. (2017). *Research Design: Qualitative, Quantitative, And Mixed Methods Approaches*. Sage Publications.

Fathonah, N., & Saputrab, A. H. (N.D.). Measuring Information System Success And Acceptance Of Kemenkeu Learning Center (Klc) Of The Ministry Of Finance Of Indonesia. *Collaborative Innovation Of Economic Society In The Era Of The Fourth Industrial Revolution (Industry 4.0)*, 193.

Kinasih, A. P. (2018). *Evaluasi Waktu Dan Biaya Dengan Metoda Crashing Pada Proyek Pembangunan Rumah Sakit Uii (Time And Cost Evaluation Using Crashing Method On Uii Hospital Construction Project)*. Universitas Islam Indonesia.

Melissa, H., & Basabih, M. (2023). Analysis Of Hospital Emergency Department Performance Measurement With Balanced Scorecard. *Jurnal Health Sains*, *4*(7), 34–40.

Sakka, Z. I., & El-Sayegh, S. M. (2007). Float Consumption Impact On Cost And Schedule In The Construction Industry. *Journal Of Construction Engineering And Management*, *133*(2), 124–130.

Soeharto, I. (1995). Project Management: From Conceptual To Operational. *Jakarta: Erland*.

Suputra, I. G. N. O. (2011). Penjadwalan

Proyek Dengan Precedence Diagram Method (Pdm) Dan Ranked Position Weight Method (Rpwm). *Jurnal Ilmiah Teknik Sipil Vol*, *15*(1).

Sutrisno, S., Ahmadi, A., & Suharyo, O. S. (2018). The Optimization Of Multipurpose Building Development On Project Scheduling Using Precedence Diagram Method (Pdm). *Journal Asro*, *9*(1), 1–7.

Tao, L., Wu, D., Liu, S., & Lambert, J. H. (2017). Schedule Risk Analysis For New-Product Development: The Gert Method Extended By A Characteristic Function. *Reliability Engineering & System Safety*, *167*, 464–473.