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PROJECT PLANNING DIVERSION TUNNEL BAGONG DAM PROJECT TRENGGALEK REGENCY

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ABSTRACT

On the progress of construction development, especially in the construction of water buildings, one of which is a dam. In Trenggalek Regency a dam was built which was named Bagong Dam. This dam was built to control floods that commonly occur in the area. In the dam construction project there is a diversion tunnel building that is used to divert water flow during the main dam construction period. There were delays in the construction of this evasive building. The tunnel is a limited space, the difficulty of access roads, and equipment damage in some activities cause delays in the project so that it requires proper and efficient project planning. To complete this project, good cost, time, and quality considerations are needed so that it can be realized properly. This project planning aims to plan the organizational structure, strategies and methods, site layout preparation assisted using autocad application and Microsoft excel, quality plan, K3 plan, implementation budget plan, and scheduling using Microsoft Project 2021 application. Pure organizational structure planning is more efficient. By using a comparison of the use of existing and precast, it is found that the use of precast has a faster implementation duration of 180 days while if using the existing for 259 days. In the calculation of the implementation budget plan in precast amounting to Rp170,021,748,985 and in the existing obtained at Rp188,495,961,368. With these results, it is found that the use of precast is cheaper and more effective in the process. Quality planning is carried out according to the quality targets that have been made so that the building is according to plan. OHS planning is carried out to achieve Zero Accident. Effective site layout preparation is carried out for work efficiency.

Keywords : Project Planning; Diversion Tunnel

ABSTRAK

Pada kemajuan Pembangunan konstruksi, khususnya pada Pembangunan bangunan air salah satunya bendungan. Pada Kabupaten Trenggalek dibangun bendungan yang diberi nama Bendungan Bagong. Bendungan ini dibangun untuk mengendalikan banjir yang biasa terjadi pada daerah tersebut. Pada proyek Pembangunan bendungan terdapat bangunan terowongan pengelak yang digunakan untuk mengalihkan aliran air pada saat masa Pembangunan main dam. Pada Pembangunan bangunan pengelak ini terdapat keterlambatan. Terowongan merupakan ruang terbatas, sulitnya jalan akses, serta kerusakan alat pada beberapa kegiatan menyebabkan keterlambatan pada proyek sehingga membutuhkan project planning yang tepat dan efisien. Untuk menyelesaikan proyek ini, dibutuhkan pertimbangan biaya, waktu, dan mutu yang baik agar dapat terealisasi dengan baik. Project planning ini memiliki tujuan untuk merencanakan struktur organisasi, strategi dan metode, penyusunan site layout dibantu menggunakan aplikasi autocad dan Microsoft excel, rencana mutu, rencana K3, rencana anggaran pelaksanaan, serta penjadwalan menggunakan aplikasi Microsoft Project 2021. Perencanaan struktur organisasi murni lebih efisien. Dengan menggunakan perbandingan penggunaan eksisting dan precast, didapatkan bahwa penggunaan precast memiliki durasi pelaksanaan yang lebih cepat yaitu 180 hari sedangkan jika menggunakan eksisting selama 259 hari. Pada perhitungan rencana anggaran pelaksanaan pada precast sebesar Rp170.021.748.985 dan pada eksisting didapat sebesar Rp188.495.961.368. Dengan hasil tersebut didapat bahwa penggunaan precast lebih murah dan efektif dalam pengerjaannya. Perencanaan mutu dilakukan sesuai quality target yang sudah dibuat agar bangunan sesuai rencana. Perencanaan K3 dilakukan untuk mencapai Zero Accident. Penyusunan site layout yang efektif dilakukan untuk efisiensi pekerjaan.

***Kata Kunci** : Project Planning; Terowongan Pengelak*

1. INTRODUCTION

One of the buildings that is being intensively developed is from the water building sector in the form of a dam building. The dam itself is one of the water buildings built to control the flow of water. The main purpose of the construction of dams is to regulate and save water so that it can be regulated according to the needs of residents. With the dam, residents can get benefits such as in the agricultural sector, power generation, flood control, or other purposes.

From the above objectives and benefits, in Trenggalek district a dam was built named Bagong Dam. This dam was built to block the Bagong River, so it was named Bagong Dam. This dam is located in Sumurup Village and Sengon Village, Bendungan District, Trenggalek Regency. The dam has several parts of the building, including the main dam, spillway, access road, tunnel, intake, and public facilities that will be developed. In this thesis the author will discuss the building of the diversion in the form of a tunnel used in the Bagong Dam. This divergent building has a horseshoe-shaped tunnel type, with a length of 537 m. The inlet elevation is +258.00 m and the outlet elevation is +250.95 m. This circumvention channel has a diameter of Ø 4 m and only has 1 line. This building has a function to divert water flow to the main dam so that the main dam can be worked on. Due to this function, this building is one of the critical buildings and must be completed immediately. If this is disrupted, the maindam construction will be delayed

In the construction of this diversion tunnel, there has been a delay in the construction period of 365 days. The delay occurs due to several factors, such as weather factors that make casting can be delayed, labor factors, tool factors such as the occurrence of a malfunction in the concrete pump that makes casting must be stopped first. In addition, there are material delays that make blasting work must be stopped. Access to the diversion tunnel area is also very limited, so this is an obstacle that causes delays. From the factors already mentioned, the SHE system also needs to be considered to minimize the risk of work accidents during the construction period. With structured planning and followed by implementation in accordance with the plan, it can minimize the occurrence of accidents.

With the existence of several problems mentioned, it is hoped that during the construction period, it can minimize the inaccuracy in this project by doing proper project planning. This makes the author take the topic of discussion with the title Project Planning Tunnel on The

2. METHODE

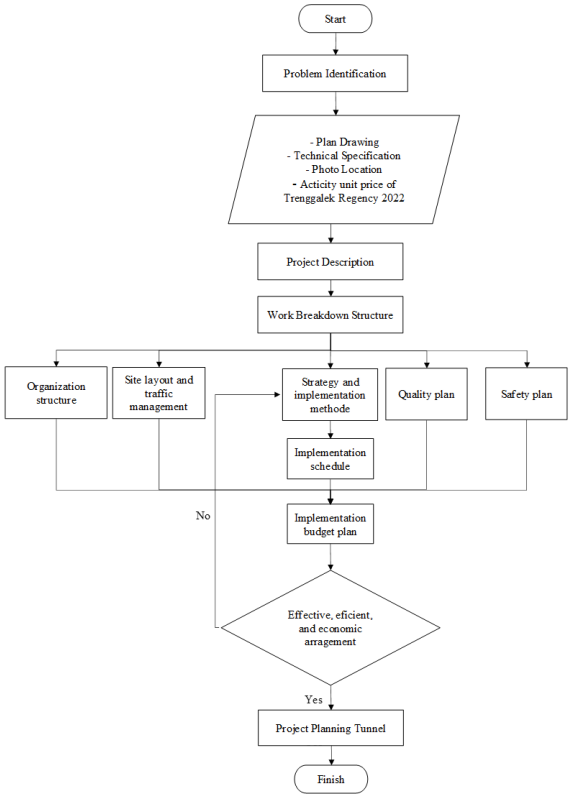

Figure 2. 1 Flowchart of the work

The method in this planning is first by observing the problem first. followed by collecting data. in this planning uses 2 data sources, namely primary data in the form of cycle time calculations and secondary data in the form of project data, working drawings, and other data provided from the project. after the data has been obtained, proceed with data processing to create an organizational structure, site layout, traffic management, safety plan, quality plan, and the creation of methods and strategies to be used. from the selected method, scheduling and calculation of the implementation budget plan will be made. if the calculation of the data is included in the terms, it can be called a project planning document.

For the organizational structure is made based on the needs of resources on the project. Site installation and traffic management are prepared based on the needs and consider the availability of land and security in the project environment. The quality plan is prepared based on predetermined technical specifications to maintain quality from the beginning to the end of the project. The safety plan is prepared considering the level of accidents and identification on the project. The selected implementation method considers the price of the project. Scheduling is compiled using Microsoft Project 2021. the preparation of the

implementation budget plan is based on Permen PU NO. 8 2023.

3. RESULTS AND DISCUSSION

Project Description

Bagong Dam Project is one of the dams located in Trenggalek Regency, specifically in Sumurup Village to Sengon Village, Bendungan District, Trenggalek Regency. The dam is passed by the Bagong River which originates from the Ngasinan - Ngrowo River system. Geographically, the dam is located at 111°41'33.48 "East longitude and 7°59'51.60 "southern latitude.

Bagong Dam is a dam that was built to control floods from the Bagong River which has a record of a large flood discharge. In addition to flood control, this dam has other benefits such as a source of raw water, a source of irrigation, a conservative source of groundwater, and a tourist facility.
In the dam there are parts of the dam such as a diversion tunnel which is used to divert the flow of river water temporarily in order to carry out construction activities on the main dam. The construction of this diversion tunnel building stretches from upstream to downstream of the dam. This tunnel type is horseshoe-shaped on the 422m long diversion tunnel building body

Organizational Structure

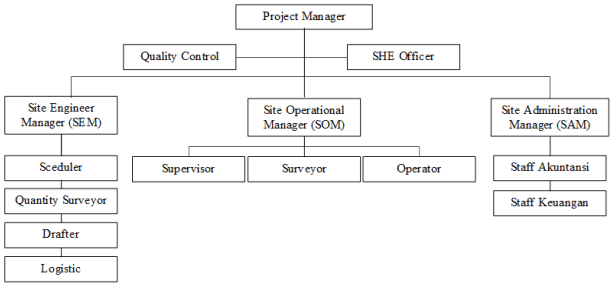

Figure 3. 1 Organizational Structure

Organizational structure is a systematic layout used in an organization to divide, organize, and coordinate tasks and responsibilities between organizational members so that it is easy to determine who is responsible for each task or decision in the organization.

Implementation Strategy and Methode

In the implementation of the diversion tunnel development, there are strategies that are carried out so that the development can run optimally in accordance with the previously designed plan. There are several strategies that will be carried out, namely :

1. Make segmentation every 6.2 meters, so that it is easy to identify the work. If there is damage or deviation from the work, it can immediately know the intended location.
2. Make 2 blasting points, namely from the inlet and outlet.
3. Followed by lean concrete casting from the outlet direction to the inlet.
4. Installation of reinforcement and maintenance pipes is carried out together from the outlet direction.
5. For casting, 3 segments are carried out a day on a cheeseboard or alternating interval.

The method used in this project is first by cleaning from trees and leveling the ground. followed by excavation of the tunnel using the blasting method which is considered effective for breaking hard rock. after blasting is carried out, reinforcement is installed on the tunnel wall so that there is no collapse. when it is ready, it will be continued with the installation of reinforcement in the tunnel invert. If the reinforcement is in accordance with the shop drawing, proceed with casting on the invert. if the invert is ready, rails will be installed for the installation of sliding forms. continued with the installation of precast on the crown of the tunnel. this was chosen because in its implementation the use of precast is faster and cheaper than the use of casting.

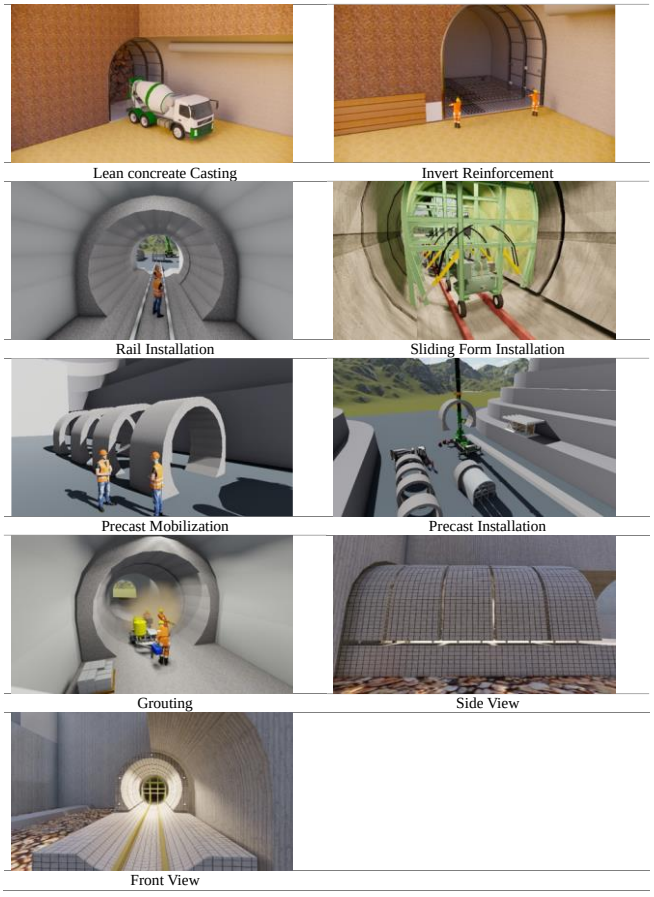

Figure 3. 2 Methode Illustration

Traffic Management

Traffic management aims to organize and manage traffic around the project. Good traffic management planning can affect efficiency, speed, and safety at work. The project site is located on hills that have steep and narrow road conditions. On the road in the project area, only 1 4-wheeled vehicle can pass, so if there is a 4-wheeled vehicle that will enter or exit, it will be arranged to take turns by the security officer. To minimize accidents, at each intersection will be given a Convex Miror so that drivers can find out which vehicles from the opposite direction will pass.

The road on the project will be opened from 06.00 to 22.00 for 2-wheeled vehicles, but if there will be a process of mobilizing and demobilizing vehicles and heavy equipment, it will be carried out at night from 22.00 to 24.00 to avoid congestion that can disrupt traffic flow and reduce work productivity. The purple colored lane will be used as a lane that leads out of the project area. While the black colored lane will be used as the lane leading into the project area.

Figure 3. 3 Traffic Management Plan

Quality plan

In construction projects there are various efforts made to maintain the quality of a job. One of these efforts is to create a quality plan so that the results of this project are in accordance with the quality plan from start to finish. The quality control of this project includes activity control or Standard Operating Procedure (SOP) with assessment criteria referring to quality targets.

The following is a flowchart for quality plan :

1. Shop Drawing

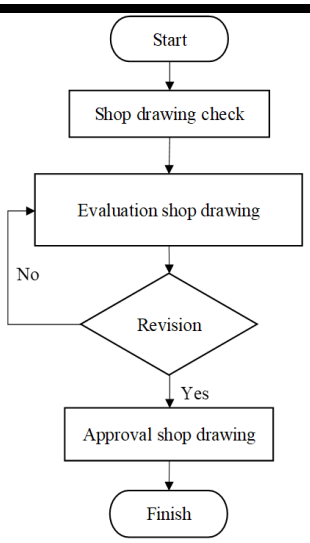

Figure 3. 4 Flowchart of Shop Drawing

2. Supply Material

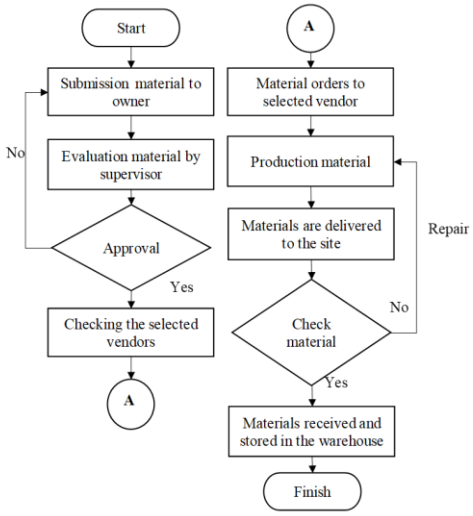

Figure 3. 5 Flowchart of Supply Material

3. Iron Inspection

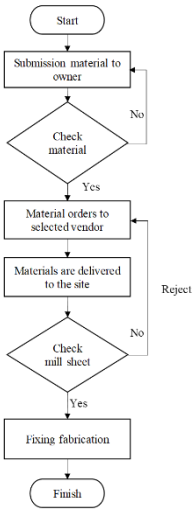

Figure 3. 6 Flowchart of Iron Inspection

4. Quality Inspection of Reinfocement work

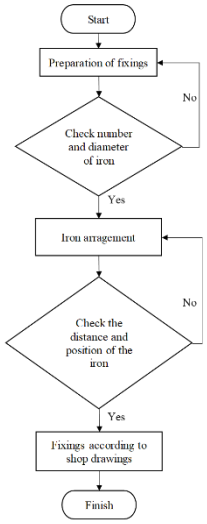

Figure 3. 7 Flowchart of Reinforcement Work

5. Formwork Quality Inspection

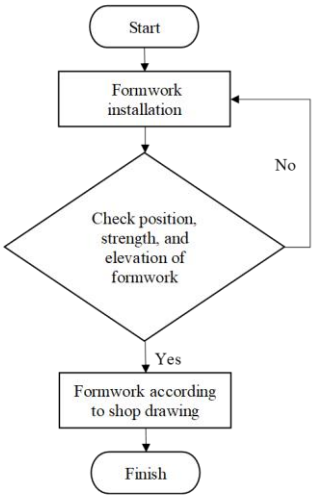

Figure 3. 8 Flowchart of Formwork Quality Inspection

6. Concrete Quality Check

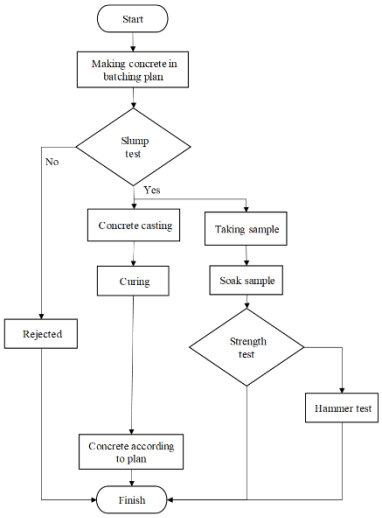

Figure 3. 9 Flowchart of Concrete Quality Check

Safety Plan

The objective of the Occupational and Environmental Health and Safety (OHSE) plan is to realize a safe, healthy, and sustainable work environment by identifying potential hazards, preventing occupational injuries and illnesses, complying with relevant rules and regulations, increasing employee productivity, enhancing the company's reputation, and reducing costs associated with workplace accidents and losses. The application of HSE is one of the important activities to be carried out as an effort to protect the labor during the project so that activities on the project can run smoothly and can achieve zero accident targets.

Item	Hazard	Risk	Who is at Risk	Risk Rating			Necessary control measure	PIC	Residual Risk Rating			Legal References
				S	L	Rating			S	L	Rating	
Preparation Work												
Mobilization & Demobilization												
	Traffic accident	• Hit by vehicle that resulted in disability, died	• General site workers • General site staff • Site visitor	5	4	20	• Carry out site survey in advance of Occupation • Traffic management planning • Arrange occupational health screening • Request Certificates of conformity and calibration at procurement stage	PM	5	2	10	• Permen 8 tahun 2020 tentang K3 pesawat angkat dan pesawat angkut

Figure 3. 10 Example of Hirarc

Scheduling

Project scheduling is an activity to determine the duration of the project. This scheduling has an important relationship with project implementation because the scheduling will contain the duration, weight, productivity, and dependence of each job. This scheduling contains everything about time management that is used to ensure the project is completed

on time by taking into account aspects of cost, quality, and OHS. In Calculation and preparation of the implementation schedule, it is assisted by using the Microsoft project 2021 application.

The construction process will begin on January 1, 2024 with details:

1. Implementation of work on Monday-Friday.
2. Implementation time starts at 08.00 WIB until 12.00 WIB, then there will be a break for 1 hour starting at 12.00 WIB until Implementation of work on Monday-Friday 13.00 WIB, then resumes from 13.00 WIB to 16.00 WIB
3. Implementation on Friday is carried out from 08.00 WIB to 11.00 WIB, then a break is made earlier because male Muslim workers are given time to perform Friday prayers, and will start again at 13.00 WIB until 17.00 WIB.

After scheduling is processed using the Microsoft project application, a critical path will be obtained. This critical path is the path that has the longest duration through the work network. On this path if any work is delayed, the overall project completion time will automatically be delayed. If there is a delay in one of the jobs, action must be taken such as increasing working hours or overtime. The results obtained

between the existing are for 254 working days and using precast is with a result of 180 Therefore, the use of precast will be taken because it has a faster number of days.

Implementation Budget Plan

To determine the price at the end of the work on the diversion tunnel development project, it is necessary to calculate the recapitulation of the cost of implementing the construction project. Calculation of cost recapitulation is the total cost of direct costs and indirect costs during the construction project. The recapitulation results obtained a budget of Rp188.495.961.368 in the existing and Rp170.021.748.985 in the use of precast.

S-Curve

The S curve is a curve created to show the relationship between the cumulative value of costs that have been used or the percentage (%) of work completion against time. The s curve can be described as the progress of the volume of work completed throughout the project. The s-curve is used as a control tool in the implementation of the project in the field for easy supervision. The scheduling results on the use of the existing will result in a duration of 254 days and applied in the form of an s-curve with a weekly period of 44 weeks. while the scheduling results on the use of precast will get a duration of 179 and applied in the form of an s-curve with a weekly period of 33 weeks For the s-curve of the bagong dam diversion tunnel project.

S-CURVE PRECAST

S-CURVE PRECAST DIVERSION TUNNEL BAGONG DAM PROJECT TRENGGALEK REGENCY 2024

No.	Work Item	Volume	Unit	Unit Price (Rp)	Amount Price	Weight	JANUARY				FEBRUARY				MARCH				APRIL				MAY				JUNE				JULY				AUGUST				SEPTEMBER
							1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1
1	Preparation Work																																					
	Clearing Area	4875.00	m2	Rp 34,455.00	Rp 167,968,136.32	0.10%	0.051%	0.051%																														
	Mobilization Heavy Equipment	6.00	Unit	Rp 76,000,000.00	Rp 76,000,000.00	0.05%	0.046%																															
	Water Supply	67.00	Unit	Rp 650,000.00	Rp 43,550,000.00	0.03%	0.026%																															
	Power Supply	2.00	Unit	Rp 27,000,000.00	Rp 54,000,000.00	0.03%		0.033%																														
	Survey	1820.93	m2	Rp 267,450.90	Rp 487,008,297.53	0.29%		0.294%																														
2	Excavation Work			Rp -																																		
	Excavation Work (86,696)	11812.51	m3	Rp 699,873.32	Rp 8,267,264,045.00	4.98%		0.358%	0.358%	0.358%	0.358%	0.358%	0.358%	0.358%	0.358%	0.358%	0.358%	0.358%	0.358%	0.358%	0.358%	0.358%																
3	Dewatering			Rp -																																		
	Dewatering (3,2 m)	416.96	m	Rp 168,291.00	Rp 21,928,317.30	0.01%		0.001%	0.001%	0.001%	0.001%	0.001%	0.001%	0.001%	0.001%	0.001%	0.001%	0.001%	0.001%	0.001%	0.001%	0.001%																
4	Structure Work			Rp -																																		
	Shotcrete	657.99	m3	Rp 2,026,471.72	Rp 1,333,404,082.39	0.80%		0.057%	0.057%	0.057%	0.057%	0.057%	0.057%	0.057%	0.057%	0.057%	0.057%	0.057%	0.057%	0.057%	0.057%	0.057%																
	Wiremesh Installation	5138.69	m2	Rp 231,832.40	Rp 1,191,314,351.84	0.72%		0.051%	0.051%	0.051%	0.051%	0.051%	0.051%	0.051%	0.051%	0.051%	0.051%	0.051%	0.051%	0.051%	0.051%	0.051%																
	Steel Rib Installation (0,63)	57.97	ton	Rp 56,860,365.79	Rp 3,296,229,976.07	1.99%		0.142%	0.142%	0.142%	0.142%	0.142%	0.142%	0.142%	0.142%	0.142%	0.142%	0.142%	0.142%	0.142%	0.142%	0.142%																
	Rockbolt Installation (20m)	2676.00	m	Rp 475,863.96	Rp 1,273,411,963.65	0.77%		0.055%	0.055%	0.055%	0.055%	0.055%	0.055%	0.055%	0.055%	0.055%	0.055%	0.055%	0.055%	0.055%	0.055%	0.055%																
	Lean Concrete	113.83	m3	Rp 903,787.98	Rp 102,878,909.29	0.06%																0.062%																
	Manirean Pipe Installation	833.92	m	Rp 238,090.25	Rp 198,548,221.28	0.12%																0.009%	0.009%	0.009%	0.009%	0.009%	0.009%	0.009%	0.009%	0.009%	0.009%	0.009%	0.009%	0.009%					
	Reinforcement	93.05	Ton	Rp 24,519,039.14	Rp 2,281,417,179.44	1.38%																0.098%	0.098%	0.098%	0.098%	0.098%	0.098%	0.098%	0.098%	0.098%	0.098%	0.098%	0.098%	0.098%					
	Sliding Form Rail Installation	833.92	m	Rp 896,285.47	Rp 747,430,376.36	0.45%																													0.090%	0.090%	0.090%	0.090%	0.090%
	Formwork	21.70	m2	Rp 417,795.00	Rp 9,066,151.50	0.01%																													0.001%	0.001%	0.001%	0.001%	0.001%
	Concrete K-225	1843.26	m3	Rp 40,627,867.69	Rp 74,887,831,874.68	45.14%																													9.028%	9.028%	9.028%	9.028%	9.028%
	Precast Concrete K-225	201.00	panel	Rp 336,151,737.63	Rp 67,566,499,264.43	40.73%		5.091%	5.091%	5.091%	5.091%	5.091%	5.091%	5.091%	5.091%																								
	Precast Mobilization	67.00	segment	Rp 10,447,630.75	Rp 699,991,260.32	0.42%																																0.422%
	Grouting	1146.64	m3	Rp 2,785,288.86	Rp 3,193,723,622.33	1.93%																															0.481%	0.481%	0.481%	0.481%
	TOTAL				Rp 165,899,466,029.73	100.00%																																		
	WEEKLY PROGRESS						0.123%	6.130%	5.753%	5.753%	5.753%	5.753%	5.753%	5.753%	5.753%	0.662%	0.662%	0.662%	0.662%	0.662%	0.831%	0.107%	0.107%	0.107%	0.107%	0.107%	0.107%	0.107%	0.107%	0.107%	0.107%	0.107%	0.107%	0.107%	9.136%	9.226%	9.541%	9.601%	9.601%	0.571%	0.481%
	COMMULATIVE PROGRESS						0.123%	6.253%	12.006%	17.759%	23.512%	29.266%	35.019%	40.772%	46.526%	47.188%	47.850%	48.513%	49.175%	49.837%	50.668%	50.775%	50.882%	50.989%	51.095%	51.202%	51.309%	51.416%	51.523%	51.629%	51.736%	51.843%	60.979%	70.205%	79.746%	89.347%	98.947%	99.519%	100.0%

Figure 3. 11 S-curve Precast

CONCLUSION

In the preparation of the thesis with the title Project Planning Diversion Tunnel Bagong Dam Project Trenggalek Regency can be concluded several things that will be described as follows:

1. The form of the most efficient and effective organizational structure to carry out the construction of the diversion tunnel on the bagong dam project is a pure project organizational structure. The organizational structure of this type has a form of Project Manager has responsibility for the decisions that will be taken because the authority is centralized to the Project Manager. That way decision making can be done quickly.
2. The strategy to be used is to create segmentation to facilitate work monitoring. The work methods to be carried out are preparation work, blasting, tunnel protection, Lc casting, concreting, casting, and grouting. By doing a comparison between using the existing and precast methods,

it is found that the precast method is faster and more efficient than the existing method.

3. Site layout is designed by making 2 other alternatives and 1 existing condition. From the calculation of the 3 alternatives, it is found that alternative 3 has the smallest TD and SI values. That makes alternative 3 declared as the best site layout. In the traffic management that will be used, road arrangements are made according to a predetermined direction so that vehicles in and out can run smoothly. In addition, the mobilization and demobilization process is carried out at night to prevent congestion.

4. Planning and quality control are made in accordance with the project quality plan. Each work item will refer to the technical specifications that have been made. To facilitate the monitoring of the quality of work, the preparation of quality targets that must be carried out on each job is carried out.

5. As a form of fulfill the zero accident target in this tunnel diversion project, all workers are required to wear PPE that has been determined in the safety plan made in the form of HIRARC. Fulfillment of supporting equipment in confined spaces must be ensured to be safe and fulfilled.

6. The duration required to complete the diversion tunnel project is planned to be 179 days after using precast.

7. The implementation cost budget plan for this diversion tunnel project is Rp170.021.748.985 using precast.

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