Analysis Of The Implementation Of Building Information Modeling For Time Control And The Implamation Methode Of Water Way Tunnel Construction In Way APU DAM, Buru District

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Abstract: The waterway tunnel construction work for the way apu dam is an underground work that includes several complex works, with the possibility that the fulfillment of the construction schedule may be delayed. On the other hand, there is information technology using Building Information Modeling (BIM) which can help smooth development. Researchers are interested in examining how the three building image modeling that has been given complete information can affect the implementation method and time control. The researcher formed a model 3 building image and filled it with detailed construction information, then from the 3-dimensional model image an analysis was made to improve the implementation method and time control analysis using the Network Planning Critical Patch method. By using this case study of the waterway tunnel construction , an acceleration of the provision of information is obtained to improve the implementation method and the spatial insight of the workplace to facilitate decision making. Controlling the implementation time by utilizing information from BIM resulted in an acceleration of the implementation completion time of 2 months from 12 months to 10, with a performance efficiency level of time control to 83.3%

Keywords: BIM, Information, time control, effective performance.

1. INTRODUCTION

The construction of the waterway tunnel at the Way Apu dam project has a complexity of work that is limited by the space that is not too large. Most of the work is in the ground, so the smooth running of civil building works is very dependent on the geological conditions and soil movements at the time of construction. herefore innovation is needed to control time and ensure the quality of work. Some of the problems that occur in late project activities are incomplete design drawings, limited resources and inappropriate work methodsBuilding Information Model (BIM) is an information technology in the field of Architecture, Engineering and Construction based on three-dimensional (3D) images. Currently the use of BIM information technology in Indonesia is still in a slow and immature condition (Wong et al, 2013). In theory, using BIM for project activities will become easier. Based on this explanation, the researcher intends to conduct research to find out how the influence of the use of BIM information technology on the implementation and time control method which is based on time management principles.

2. LITERATURE REVIEW

2.1 Building Information Modelling (BIM)

Building Information Modeling (BIM) is a complete building information concept that is projected into a 3D image then followed by related steps (Ilham, 2016) and not a specific software. so that in this study we will use the Autocad, Sketchup, microshoft word and microshoft excel programs.

2.2 Construction Management

Management is a process of planning, organizing, coordinating and controlling or controlling resources in achieving targets efficiently and effectively. (Fiki at all, 2016). Construction management includes work methods, equipment used, materials, finance and human resources and is equipped with time management.

2.3 Working method

The work method is an orderly action and is made technically to complete a job which includes mastering the drawing and the field and setting the stages of work at one time.

2.4 Work Breakdown Strukture Theory

Work Breakdown Structure is a technique for dividing a single job into several smaller work stages. The work that has been identified will be arranged sequentially in a complete and continuous hierarchy with respect to the duration of the work completion.

2.5 Network Planning

Networking planning is a technique for scheduling and monitoring work activities using a time approach which is depicted in the form of symbols and diagrams. One type of network planning is the critical path diagram method which uses a circle as an event and an arrow as an activity. When analyzing using the critical patsch method, the critical path will be obtained. The critical path shows the same number of EET (Early Event Times) and LET (Lates Event Times). If activities on this route are postponed, it will cause completion of work to be delayed

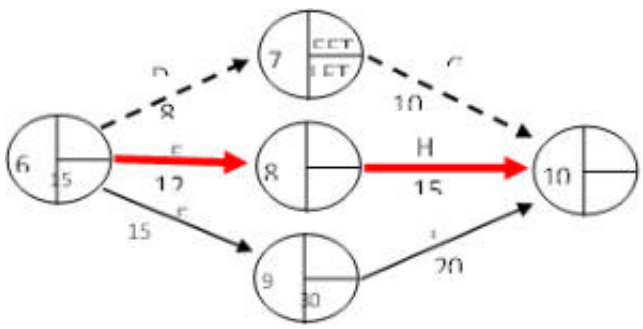


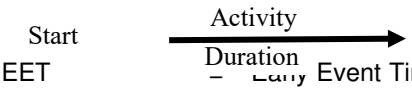
Figure 2. *Relationship between activities, events and critical paths*

Source : Agus (2018)

Information :

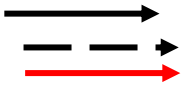
D,E,F,G,H,I = work carried out.

= Event = shows the beginning of an activity or the end of an activity



EET = Early Event Time = counted forward the number of the last activity plus the number of activities in front of it. If there are two activities, the largest number is taken.

LET = Late Event Time = counted back from the last activity, if there are two or more activities, the displayed result is the largest reduction result.



= The Symbol of activity

= The Symbol of dummy activity

= The Critical patch of activity.

3. RESEARCH METHODOLOGY

The research method was carried out using the BIM concept, namely doing 3 D depiction using the Skethcup software and then utilizing the information from the image to improve the implementation method and control of work scheduling by using Network Planning in the form of a Critical Path Method (CPM)research is included in the type of quantitative research that aims to prove the theory and research hypotheses based on the results of measurement data.

a Data Retrieval

The data used is secondary data taken from Balai Wilayah Sungai Maluku in the form of Tunnel technical data, work methods, and work implementation schedules

b Schedule of Implementation of The Work Under Study

The construction of the Wae Apu Dam Barrier Tunnel construction is carried out for 12 months, with the work implementation schedule as presented as follows :

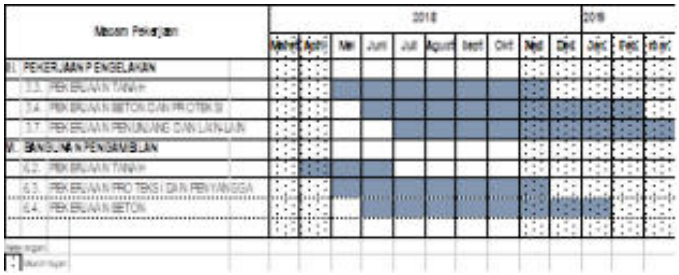


***Figure 3 work** implemation Schedule Plan for Tunnel Works*

4. RESULT AND DISCUSSION

c Making Three-Dimensional Modeling Of The Tunnel

The working drawing provided by the designer is a 2-dimensional autocad drawing in the form of a floor plan of the tunnel along with the open excavation at the inlet, tunnel outlet and open excavation in the floor plan shaft along with separate details in several parts. as in figure 4.

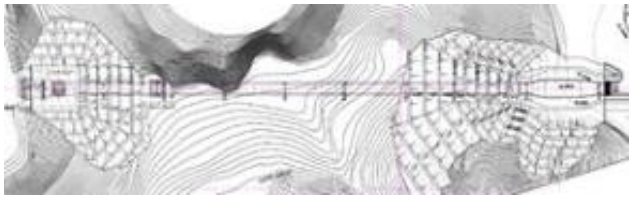


***Figure 4:** Tunnel plan in two-dimensional Auto cad drawing*

***Figure 5**. Tunnel longitudinal section in two-dimensional form*

Based on the contours of the land in the design included in the plan, an overall image model of the excavation of the soil outside and inside the tunnel is formed in 3 dimensions which is equipped with building shapes such as inlets, outlets and shafts as shown in figure 6 and figure 7.

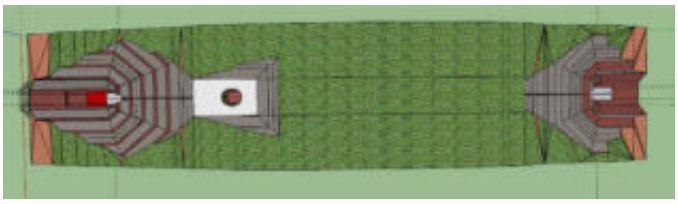


***Figure 6** Top View of the Tunnel*

The longitudinal section of the tunnel is seen from the side by means of the land being cut in half so that it can show the longitudinal view of the tunnel building

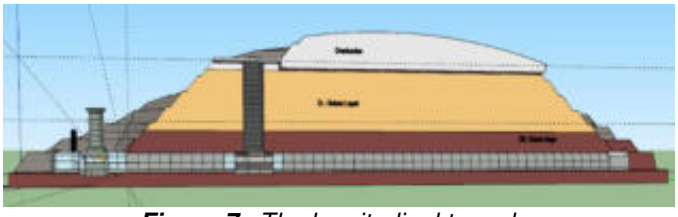


***Figure 7**. The longitudinal tunnel*

In the three-dimensional model that is formed, all the necessary information is entered, including building tunnel protection, iron work for concrete. It is hoped that all experts can consider all the difficulties that may occur in the implementation of construction.

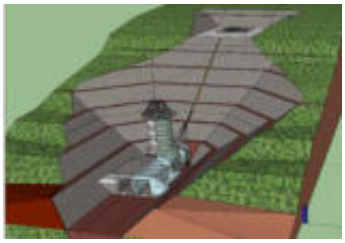


Figure 8 inlet and shaft construction

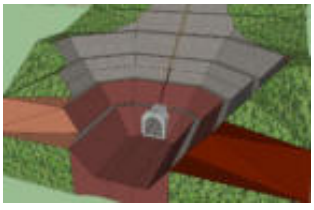


Figure 9 Outlet construction with channel normalization to the river

d **Analysis of the Effect of Information Technology on Implementation Methods**

Analysis of the influence of technology is carried out during pre-construction in the form of a study of design drawings to be applied to construction as well as a study of the implementation method used. Thus it is as if construction experts have worked together to carry out construction virtually.

Based on this study, the following activities were produced:

1. Design Collision Detection

There were design improvements for implementation that were useful in assisting the preparation of construction work, including repairing the joints of laying walls with different heights, as shown in Figure 10

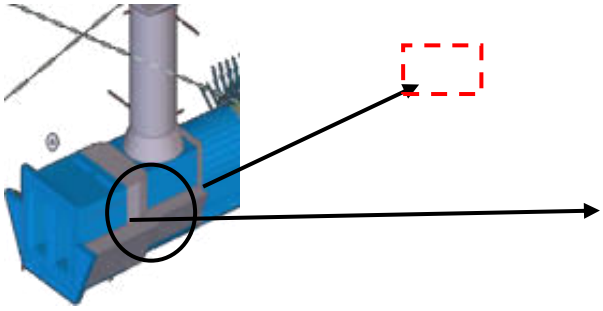


***Figure 10 Detailed** explanation of model wings*

2. Minimizes the risk of work errors

There were several risks of work errors that would hinder implementation, including the difficulty of installing a steel liner on the shaft connection to the tunnel, namely from a circle to a horseshoe shape. In the initial work method, the steel liner was installed completely, but in fact there was a condition of movement from a circle to a horseshoe shape with different building dimensions. Based on the study, the installation of the stell liner at the top is easier if it is divided in half, while the lower part is divided into several small parts which are attached when changing the intake function. The location of the steel liner can be seen in Figure 11:

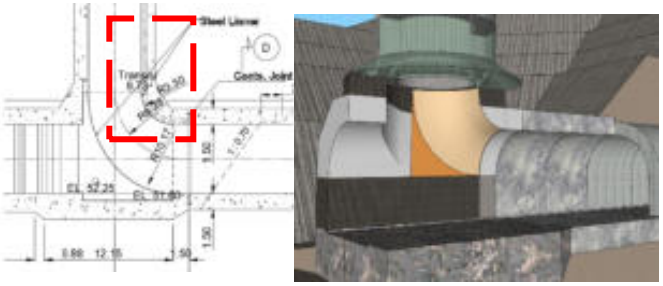
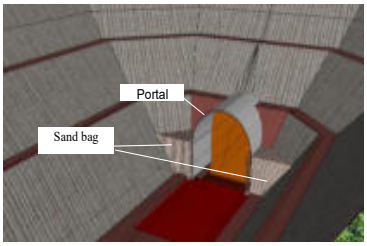


***Figure 11** steel liner installation*

3. Improved implementation methods.

There is an improvement in the implementation method which has resulted in several additional new equipment for implementation such as gantry cranes as a means of transporting material in the shaft work section, steel staging and sliding forms for cast work in tunnels. Among the improvements to the implementation method are as follows:

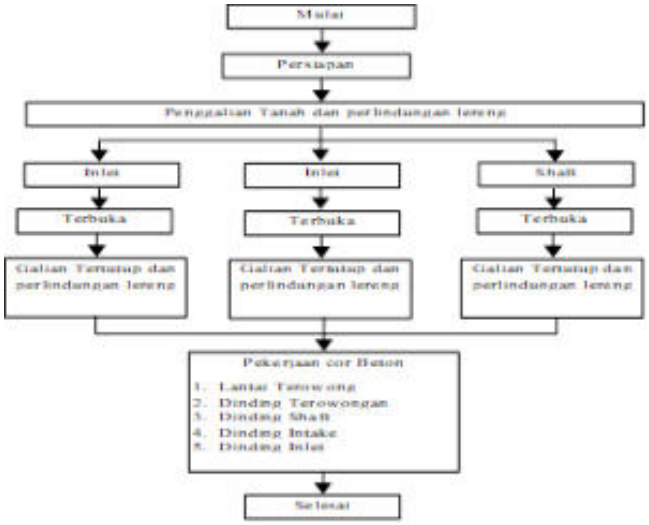
a. Making a portal at the end of the tunnel for protection of work safety equipped with a sandbag for security stability

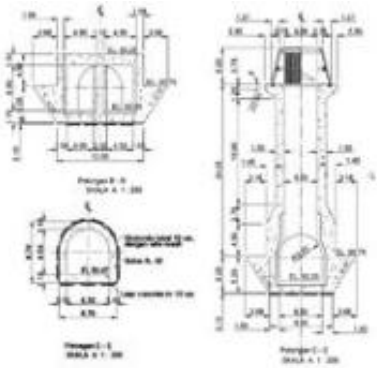


b. The method of excavating the shaft is started from top to bottom, so that the material taking from the shaft uses a basket from the gantry crane. Likewise, concrete materials can be lowered using a gantry crane

3. Concreting

D. Concrete work is refined into continuous concrete activities so that wall concreting can be carried out after the floor concrete work in front of the state is at least 15 days old, thus this work will be controlled. The adding tools used were steel staging and sliding form. The steps for the concreteing work are: reinforcing and concreting the work floor approximately 4 blocks where 1 block is 12 m. It is estimated that the age of the concrete at the beginning of the floor is more than 15 days, then a sliding form is installed for the formwork and starts concreting. After the concrete is 3 days old, this sliding form can be removed and continued on the next block.





4. Facilitate and speed up decision making

When working using conventional methods, the spatial layout of the work location is still a two-dimensional image, so there are often errors in setting the use of tools and labor, improving work drawings when problems occur in the development area. When using the Information Technology Building Information Modeling (BIM) application, stake holders, both contractors, consultants or owners, will be able to see calmly in one image and get all the information in the field along with the layout of the work location. This condition will be very beneficial when arranging work, distributing human resources, tools and materials, monitoring work and making decisions to solve problems and to accelerate the implementation of construction activities as well as to save financing..

e **Analysis of Testing Construction Implementation Schedule with Construction Management Principles.**

The construction of the Way Apu Dam tunnel construction work includes several works such as excavation of earth and concrete works. All stages of work will be identified and arranged in a hierarchical order of work such as the following flow chart:

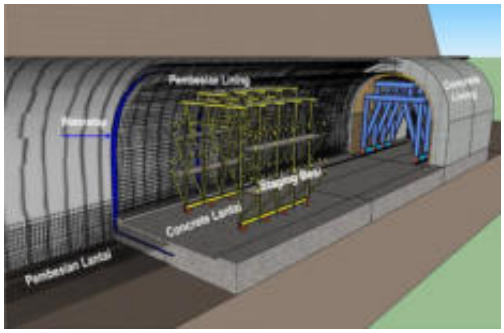


Figure 12 *Flowchart of the structure of the construction stages*

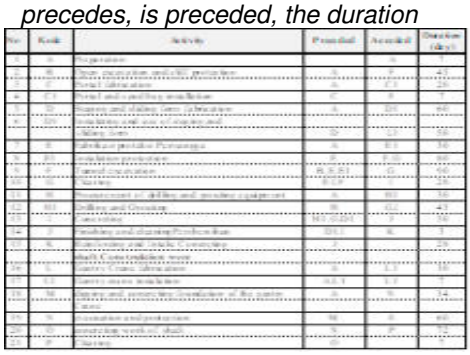
The next step is to determine the completion time of each activity that has been adjusted to the construction implementation method into a systematic work sequence. Then the results are arranged in a beating diagram which states the time in months.

Table 1*. Analysis of Initial Work Implementation Schedule*

No	Jenis Pekerjaan	Bulan ke 1	2	3	4	5	6	7	8	9	10	11	12	Ket
1	**Pekerjaan Tanah**													
1.1	Galian Terbuka inlet dan outlet													
1.2	Galian Terowongan													
a.	Dari Inlet													
b.	Dari Outlet													
1.3	Galian Shaft													
a.	Instal gantry crane													
b.	galian Fondasi gantri crane													
e.	Tahapan 2													
d.	Bottom Shaft													
2.0	Pekerjaan Beton													
a.	pondasi gantri crane													
b.	Portal shaft													
e.	pembetonan lantai terowong													
d.	Pembetonan dinding terowong													
e.	dasar shaft													
f.	dinding shaft													
i.	intake													
3.0	Proteksi dan penyangga													
a.	Lereng tebing													
b.	dinding Terowongan													
c.	Dinding Shaft													
4.0	**Pekerjan Lain-lain**													
a.	pembersihan													
b.	pengeboran dan grouting													

The results of the bar chart are arranged in a table that states the work that precedes, the work that is preceded and the duration of the work

Table 2 *Description of the types of work with work that precedes, is preceded, the duration*



After all the relationships between existing activities and their duration can be found, the next step that must be taken is to make a CPM diagram as shown in Figure 13. The critical path of work will be obtained, then the researcher will analyze the possibility of occupation or acceleration of work by utilizing work outside the critical path that still has Long free time

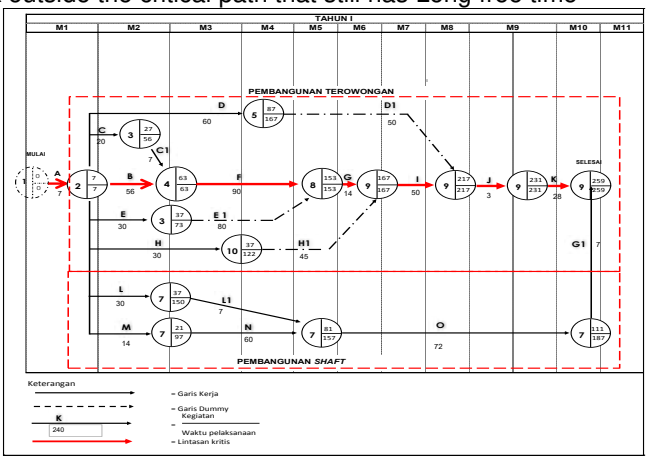
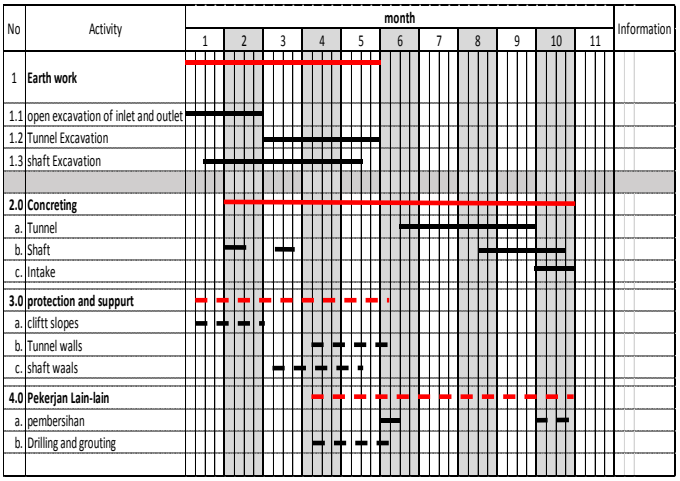


Figure 13 *Network Planing of waterway Tunnel Construction Works*

The critical path obtained from the CPM diagram is the A-B-F-G-I-J-K path.
From Network Planning Analysis using the Critical Path Method, it is described again into a bar chart to compile an implementation schedule as in table 3.

***Table 3**. Final construction schedule plan*



In testing research instruments, validity and reliability test resFrom the results of the analysis, it can be seen that there is a time acceleration for two months from 12 months to 10 months which also affects the effective level of performance, as presented in table 4.

***Table 4** Results of the analysis of time and cost control functions*

No	Activity	Result being analyzed		Keuntungan
		Before	after	
1	Construction Schedule	12 month	10 month	2 month
2	Work effectiveness	100 %	83,33 %	16,77 %

f **Discussion**

1. The Effect of the Use of Information Technology BIM on the Implementation of Construction Work

The use of Building Information Modeling (BIM) information technology in the construction work of Dodge Binoculars based on the analysis that has been carried out, can facilitate the implementation of the Way Apu Dam circumvention tunnel construction activities, because it can improve implementation methods, avoid design collisions during construction, and provide information from all personnel. experts making it easier to make decisions quickly.

2. The Effect of BIM Technology on Time and Cost Control Functions.

By exploring the potential of BIM as a tool for the characteristics of construction projects in the early stages of implementation, it is very helpful to study the implementation method, show the types of assistive equipment that will be used as additional tools, show simulations of the use of the amount of work equipment that goes into the waterway tunnel for construction, and changes in traffic in the implementation of construction work. When reviewing the construction plan, all experts will provide input according to their fields in a tunnel building model..
Based on time management analysis assisted by information from Information Technology, BIM can control the construction time from 12 months to 10 months with an effective time saving rate of = 10/12 x 100% = 83.33% or equivalent to 16.77%

5. CONCLUSIONS AND SUGGESTIONS

5.1 Conclusions

Based on the results of the analysis and discussion, the conclusions are obtained

2. The use of Building Information Modeling (BIM) information technology in the implementation of work can affect the process of development activities because all information can be entered into a virtual model. Stake holders can analyze the overall work by using a construction concept that takes into account the space affected by the work, so that the use of heavy equipment can be trimmed closer to reality in the field, facilitates management of the use of human resources, tools and materials, perfects more detailed work methods, lacks detailed building plans can be immediately found and refined, make design changes, detailed errors can be found before implementation.
3. The use of Building Information Modeling (BIM) information technology in time control analysis can accelerate the time of execution of work from 12 months to 10 months

5.2 Suggestions

Researcher's suggestions regarding research using BIM Information Technology can be developed to improve implementation methods, human resource planning, tools and materials as well as study development plans related to space and time of completion of work.

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