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IMPLEMENTATION OF 4D BUILDING INFORMATION MODELING (BIM) USINGTEKLA STRUCTURES

(Case Study: Follow-on Project of the Tapin Regency Regional Secretariat Office Building)

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ABSTRACT

Follow-on Project of the Tapin Regency Regional Secretariat Office Building located on Jalan Datu Suban, Tapin Utara, Kalimantan Selatan is a reinforced concrete building project that only applies manual scheduling which is present in the form of S Curve, PUPR Ministerial Regulation Number 9 of 2021 states that projects ought to be base on BIM. Therefore, this research will discuss implementing 4D BIM (scheduling) using Tekla on the Follow-on Project for the Construction of the Tapin Regency Regional Secretariat Office using Tekla to determine the use of BIM on scheduling obtained from contractors.

This research method starts from studying the software and the object to be modeled, collecting the data such as as-build, S Curve, RAB. Data processing start from 3D modeling using Tekla Structures 2020, scheduling with Tekla Task Manager, and then 4D modeling with object representation.

Scheduling made from the Budget Plan (RAB), S Curve, and interviews of related parties are then inputted into the Tekla Task Manager with dependencies which are applied into the bar chart. The 4D model is created using the visual logic with the integration of the 3D model created by scheduling, the development planning stages can be displayed according to the reviewed date. It was concluded that Tekla Structures could be applied in scheduling the follow-up project for the construction of the Tapin Regency Regional Secretariat Office Building.

Keyword : scheduling, *Tekla Structures, Tekla Task Manager, Model 4D,* Follow-on Project.

1. INTRODUCTION

The use of BIM helps the stakeholders by improving the project schedule, visualizing it. Also find issues such as clashes in the design before heading into the construction phase. A better time, cost effectiveness and project quality are the

advantages of using BIM (Kermanshahi et al., 2020). BIM allows coordination with multiple designers which can shorten design time, reduce errors, and reveal design problems and solutions (Eastman et al., 2011). BIM can influence time management for project completion and help projects finish on time (Issa & Suerman, 2009). The advantages of BIM are that the use of applications with the BIM concept can speed up project planning time by ±50%, BIM reduces Human Resource requirements by 26.66%, and saves personnel costs by 52.25% compared to conventional applications (Adhi et al., 2016).

The follow-on project for constructing of the Tapin Regency Regional Secretariat Office Building is located on Jalan Datu Suban, North Tapin, South Kalimantan. This building consists of 3 floors with an area of 6,200 m^2. This project is divided into 2 stages, the first phase in 2012 and the second phase in 2020. The first phase in 2012 includes earthworks, foundations, up to 2nd- floor column work. Meanwhile, the second phase in 2020 includes follow-up work development to completion.

This project only applies manual scheduling in the form of an S Curve, while based on the Regulation of the Minister of Public Works and Public Housing of the Republic of Indonesia Number 9 of 2021 concerning Guidelines for the Implementation of Sustainable Construction in article 3 paragraph 1 and article 6 paragraph 3 states that constructing buildings The implementation of Construction Services must implement Sustainable Construction and be carried out in an integrated and efficient manner by taking into account the use of building information modeling technology. Therefore, this study will appoint the issue of implementing 4D BIM (scheduling) using Tekla in the Advanced Project for the Construction of the Tapin Regency Regional Secretariat Office using Tekla to determine BIM's use on scheduling obtained from contractors.

2. LITERATURE REVIEW

Project Scheduling

Every project has its own risks and uncertainties due to time and costs limitations that can lead to project failure. Therefore, scheduling is needed in a construction project so that the project being worked on can be determined what work must be done so that the

project can be completed according to the specified time and cost.

Bar Chart

A bar Chart is used to show when the start and end of an activity and the duration of the activity. Bar charts have several advantages and disadvantages, one of the advantages of bar charts is that they are simple, easy to understand and, easy to make. Meanwhile, the disadvantage of the bar chart are that it cannot show the relationship between activities in a scheduling plan.

S Curve

The S curve contains information about the progress of the project, which is depicted through a graph between the time of project implementation and the accumulated value of the progress of project implementation from the beginning of implementation to the completion of project, the S curve also provides an overview of the progress of work types on the time function which consistsof two aspects, planning and control aspects.

***Building Information Modeling* (BIM)**

Building Information Modeling (BIM) contains information that aims to design, build and operate a project in the most efficient way possible. BIM also has a function to reduce errors, damage to construction designs and during the implementation process so that the projects being worked on can be carried out well. BIM is divided into several dimensions, namely D3-D7, each dimension represents information, namely, based on parametric modeling objects (3D), material scheduling, workers, area, time (4D), cost estimates, and part-lists (5D), considerations impact on the environment including energy analysis and conflict detection (6D) facility management, life cycle costs, and impact on the environment (7D)

BIM 4D

BIM 4D is a combination of 3D models with scheduling to visualize and simulate the process of construction stages. The 4D model allows planners to communicate visually and plan activities in space and time conditions. 4D models can be generated by visualizing the construction sequence to a three-dimensional model, and 4D BIM modeling allows the contractor to simulate and evaluate the planned construction

sequence and share it with others in the project team.

Tekla *Structures* 2020

Tekla enables users to create, combine, manage and share multi-material 3D models packedwith construction information that can be used on projects, from conceptual planning of buildingsand infrastructure to fabrication, construction, and maintenance, to detailing, and informationmanagement. Some of the advantages that Tekla has are sharp detail and precision, results that areautomatically updated even though changes are made to the model also, efficiency and easymanagement. Some of the formats supported by Tekla include IFC, CIS/2, SDNF, and DSTV.

Trimble Connect

Trimble Connect is a tool that offers project information on the data needed for successful construction projects. The information distributed in real-time, for example, if the foreman enters the status information on the tablet into the data model, it is simultaneously visible to other parties in the project, regardless of which device has the program open. Trimble Connect is available on desktop, mobile, and browser versions, so that the app can be used almost anywhere.

Level of Development (LOD)

Level Of Development (LOD) is used to identify a BIM model at a spesific time. LOD It is used to reduce the problem of insufficient information on a project, LOD can define and articulate 3D models at various stages of implementation. LOD itself is divided into levels 100, 200, 300, 350, 400, and the last level 500.

3. RESEARCH METHODS

Research Procedure

In this research, the modeling of the concrete structure of beams, columns, and plates on the 3rd floor and Dak will be carried out using Tekla Structures. Modeling will refer to plan drawing, details and use the Southeast Asian environment. The model generated by Tekla Structures is a 3D model of reinforced concrete buildings.

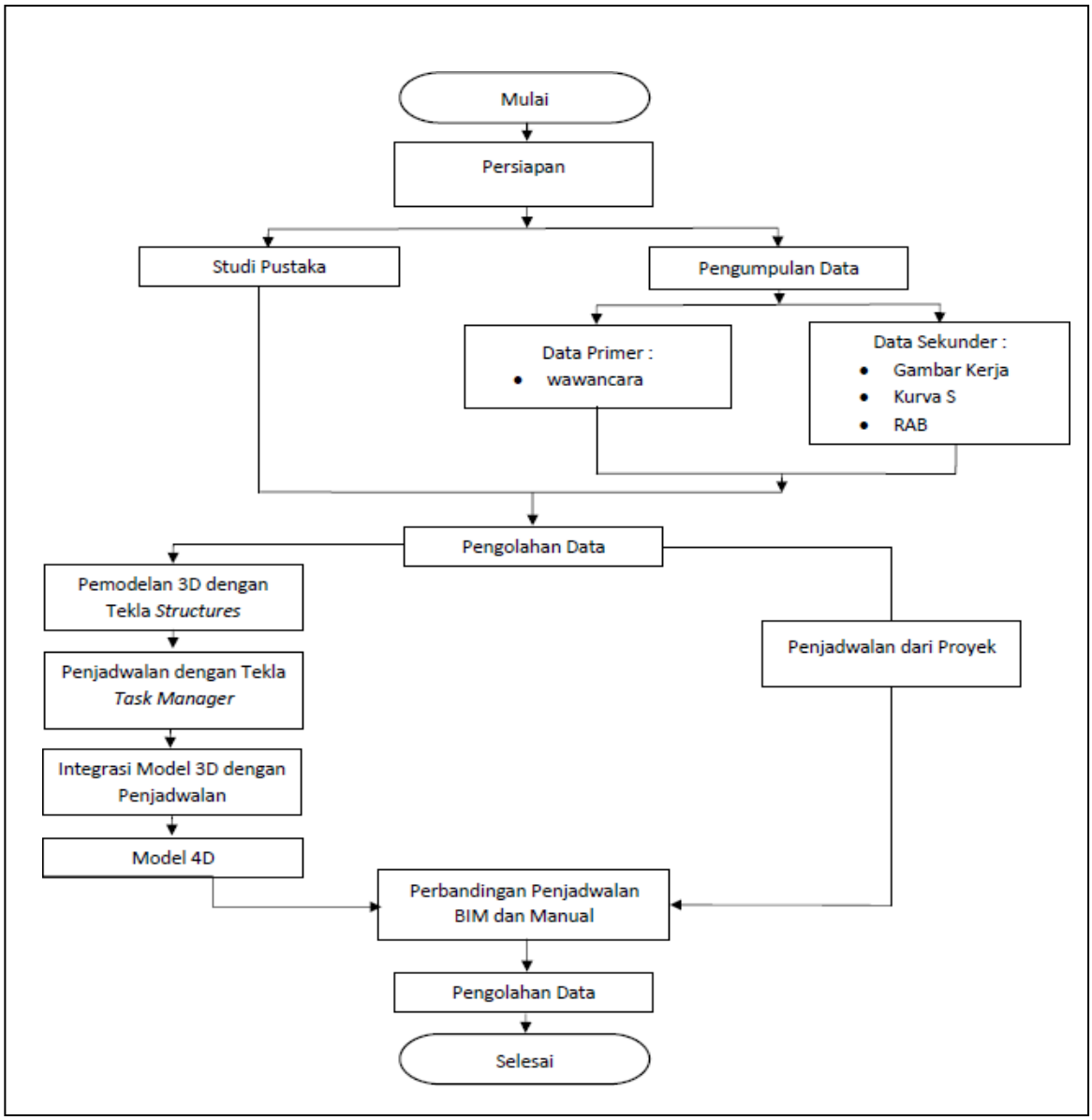

Figure 1. Flow Chart

4. RESULT AND DISCUSSION

Modeling on Tekla

The modeling is made using the Tekla Structures 2020 software using the South-East Asia environment because the project location is in the Southeast Asian region. Before making a structural model, first, make a grid according to the plan drawing as a

fundamental reference. The next step is to make the type of material according to the material used in the project. The model made in this project is a reinforced concrete building consisting of pile caps, sloof, beams, columns,and floor plates. The results of the modeling are shown in the following figure.

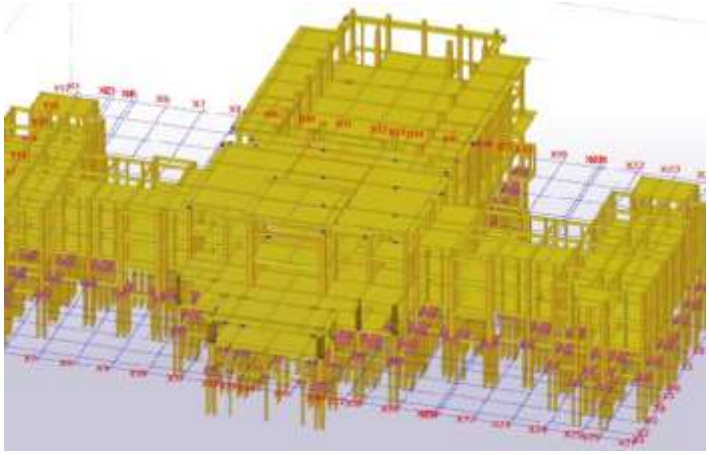

Figure 2. Building Model Results

Model Organizer

Model Organizer functions to group each model made according to its type. Not only that, but the Organizer menu also provides additional information in the form of material type, profile,height, length, width, volume, position.

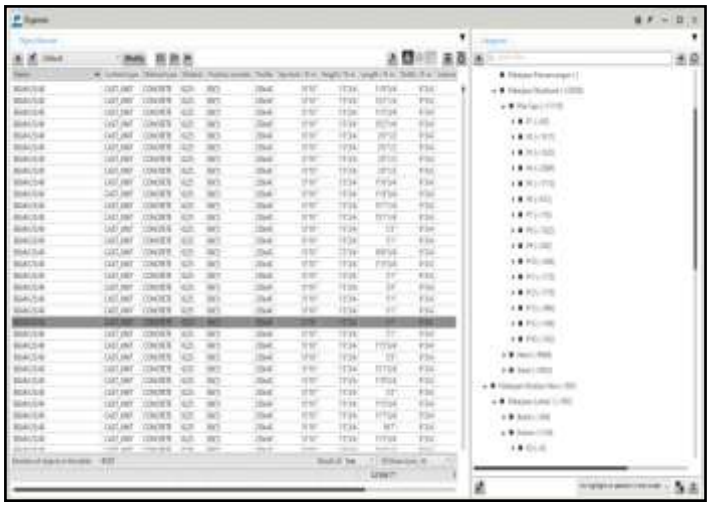

Figure 3. Organizer Window

Scheduling with Tekla Task Manager

Scheduling is made from available project data, namely the S Curve, and Budget Plan. JobDuration is obtained from the S Curve data. Dependence between jobs is obtained from interview,or the results of other research analyses. Dependencies between jobs indicate when the next job can be done. Dependence between jobs can be seen in the table below.

Table 1. Activity Dependency Relationship

No.	Item Pekerjaan	Satuan	Volume	Durasi (hari)	*Predecessor*
	Pekerjaan Lantai 3 Elevasi +11800 mm				
1	Pembesian balok lantai 3 Zona A	Kg	5118,55	9	Start
2	Pembesian plat lantai 3 Zona A	Kg	260,14	3	3SS7
3	Cor beton balok lantai 3 Zona A	m^3	27,54	4	3FS1
4	Cor beton plat lantai 3 Zona A	m^3	3,17	1	4FS0
5	Pembesian balok lantai 3 Zona C	Kg	5118,55	9	5FS0
6	Pembesian plat lantai 3 Zona C	Kg	260,14	3	8SS7
7	Cor beton balok lantai 3 Zona C	Kg	27,54	4	8FS1
8	Cor beton plat lantai 3 Zona C	m^3	3,17	1	9FS0
9	Pembesian balok lantai 3 Zona B	Kg	21903,89	15	9SS0
10	Pembesian kolom lantai 3 Zona B	Kg	10774,67	15	13SS0
11	Pembesian Plat Lantai 3 Zona B	Kg	8515,66	15	13SS1
12	Cor beton balok lantai 3 Zona B	m3	107,19	3	13FS0
13	Cor beton kolom lantai 3 Zona B	m3	66,33	3	14FS0
14	Cor beton plat lantai 3 Zona B	m3	106,06	3	17SS0
	Pekerjaan Lantai Dak Elevasi +15800				
15	Pembesian balok Lantai Dak	Kg	10620,90	8	18FS0
16	Pembesian kolom Lantai Dak	Kg	1870,44	5	20SS0
17	Pembesian Plat Lantai Dak	Kg	4962,37	8	20SS1
18	Cor beton balok lantai Dak	m^3	54,52	2	20FS0
19	Cor beton kolom lantai Dak	m^3	11,11	2	23SS0
20	Cor beton plat lantai Dak	m^3	67,76	2	23SS0

The schedule made can be inputted into the program to be integrated into the 3D model using theTask Manager so that it becomes a 4D model.

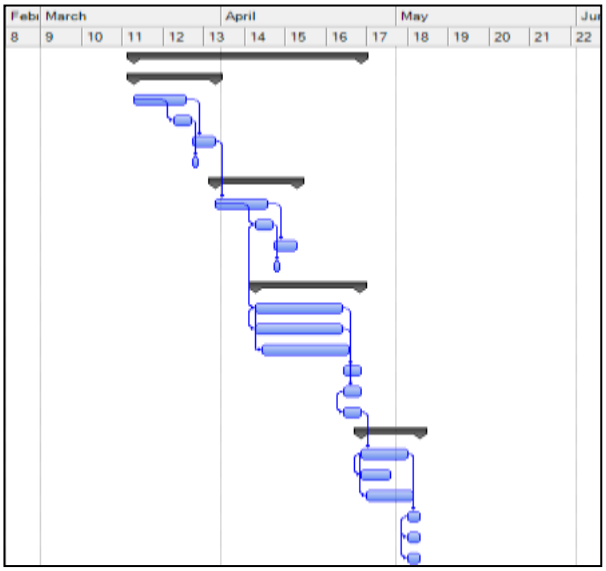

Figure 4. Tekla Task Manager Output

Visual 4 Dimensions is a visual logic that displays the model according to the date inputted. The results of 4D visuals can be seen in the progress of the project over time using the Project Status Visualization.

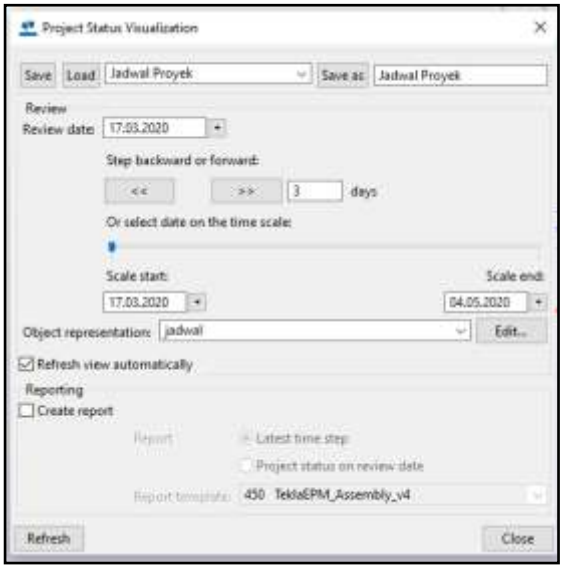

Figure 5. Window Project Status Visualization

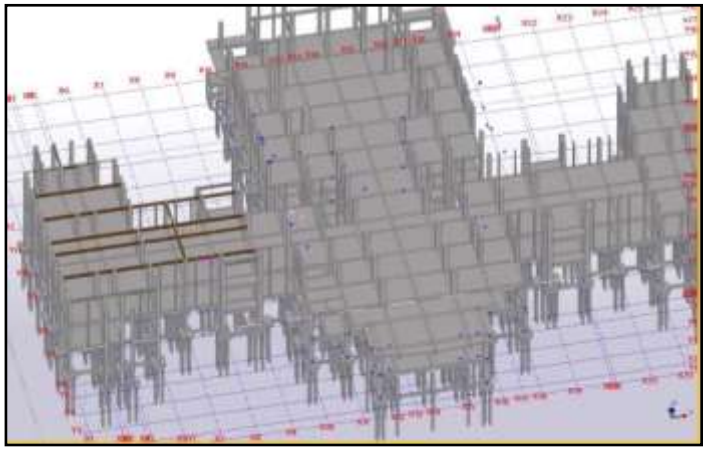

Figure 6. Visualization of March 17, 2020 (start of work)

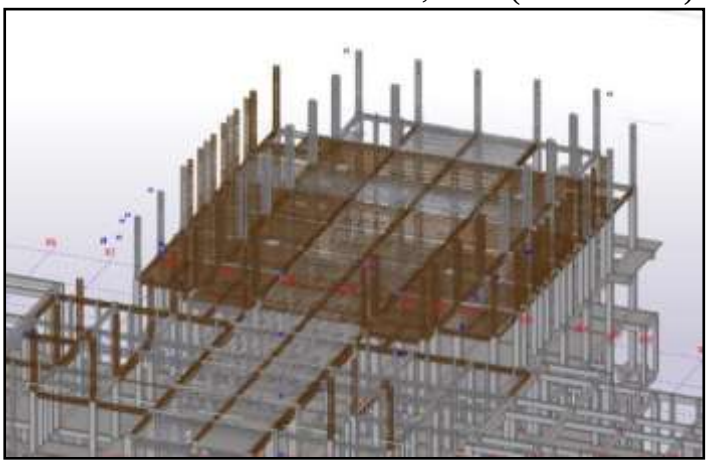

Figure 7. Visualization of April 14, 2020

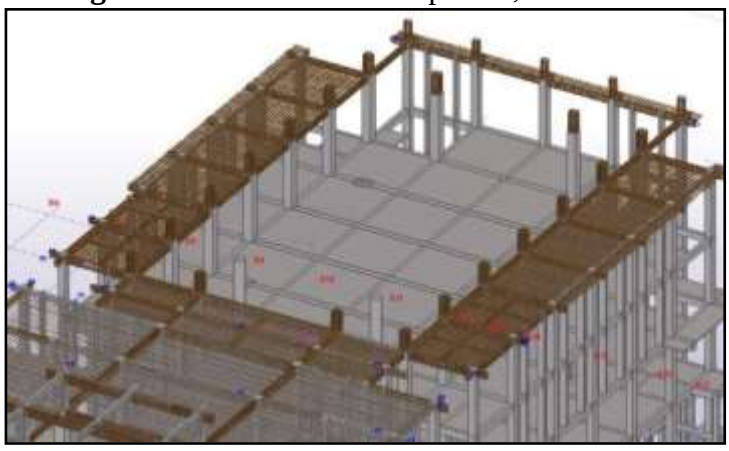

Figure 8. Visualization of April 28, 2020

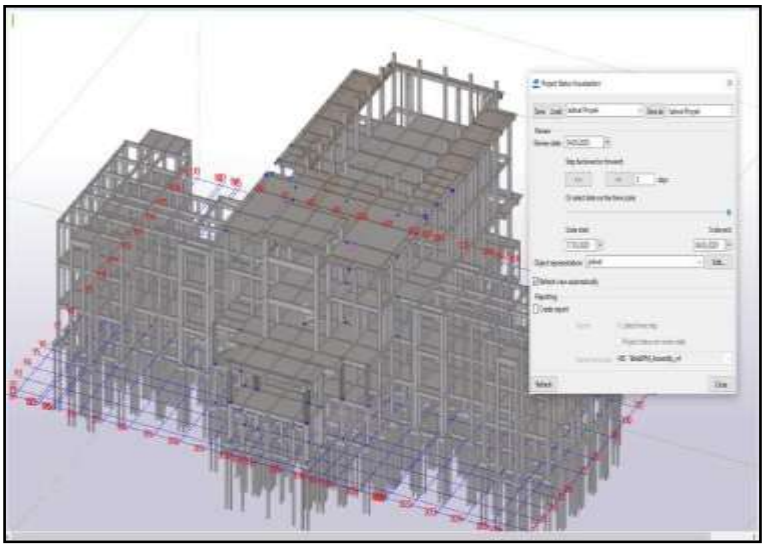

Figure 9. Visualization of May 4, 2020 (end of work)

Manager Results and Scheduling Comparison of S Curve with Tekla Task Manager

From the S curve in Figure 10, it can be seen that for Structural work in phase two, starting from March 17, 2020, to May 4, 2020, 49 calendar days were obtained. From the results of the Tekla Task Manager output in Figure 4, it can be seen that for all structural work in phase two work, a total of 49 calendar days were obtained. So it can be seen that both have similarities in theduration of their work.

5. CONCLUSIONS AND SUGGESTIONS

Conclusions

Based on the results of the analysis and discussion described previously, the conclusions of thisresearch are:

1. Tekla can model the follow-on work of the Tapin Regency Regional Secretariat OfficeBuilding project by making a 3D model based on the plan drawings.
2. The comparison between Tekla scheduling and the scheduling obtained from the project is thatthe two schedules have the same work duration, which is 49 calendar days.

3. Tekla software can provide information related to the volume, length, and weight of the model object that has been created. In producing 4D Visualizations, Tekla can display the stages of work with the visualizationlogic that has been made.

Suggestions

1. It is better to use S Curve data detailed for each work item so that it can be compared with Tekla scheduling.
2. It is recommended to use a device with high specifications because the specs of the laptop used by the author have problems when modeling, and sometimes Not Responding occurs in the Tekla Software when entering the schedule into the model so that time is wasted because the author has to wait for it to return to normal.
3. It is recommended to use the latest version of software to get newer features and optimal software.
4. BIM is starting to be used in the teaching process on campus so that students can increase their competitiveness and competence in anticipating market demand which will lead to the use ofBuilding Information Modeling (BIM)-based aid programs

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