

Climate Change and Sustainability Engineering in ASEAN 2019

Jember, Indonesia • 13 November 2019

Editors • Khairul Anam, Retno Utami Agung Wiyono,
Rizki Fitria Darmayanti, Felix Arie Setiawan and Abdur Rohman





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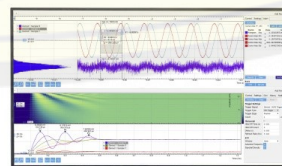
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Modeling and Scheduling Engineering Biotechnology Building Using Bim and Microsoft Project

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Abstract. The development of education today is required to reflect specificity in future development achievements, the needs of infrastructure related to Biomass and Bioenergy shall be facilitated well. Related to this goal shall be supported with facilities and infrastructure that is integrated laboratory building. The construction activity of the laboratory that develops massively made complexity of work that needs quick method IT and project management based on monitoring and minimize mistakes in development process. The performance of integrated project management overall is obtained using Building Information Modeling (BIM) concept. This article is using one of the features from BIM program that is Revit Architecture because it is capable to give 2D work picture output, 3D modelling and the volume of each work. The aim of this article is to model the building using BIM and to arrange scheduling using Ms.Project. Modelling only consider the structure and architecture work. The study case of this research is IsDB Engineering Biotechnology. Validation is done to check the volume of work from the result of modelling. The result of validation obtained is error (%). The result of Revit Architecture modelling that is done to the whole work has volume that corresponds to DEDC volume except to the reinforcement work. This happened because of the bending and hook reinforcement settings are using default setting so that the error is more than 0%. The result of Revit Architecture modelling is used as the guidelines for scheduling using Ms.Project. The length of time needed in building the IsDB Engineering Biotechnology building is 232 days.

INTRODUCTION

Traditionally trading information between parties involved in project is done linearly resulting in the information is difficult to interpret and clarify. Alteration in designing project logistic is a construction project problem where could increase cost and needed quite long time, resource used is not efficient so that it could interfere construction process activity. Problem in pre-construction like logistic can be minimized by the presence of technology information especially in early construction design concept and can be studied from traditional design until development design with technology information [1].

The use of computing technology by designer and construction practitioner have been common used in Indonesia. The development of technology in construction grows from the document form to 3D visualization, then developed another dimensions in cost, time, schedule, and so forth. This development become evolution of technology information which then called Building Information Modeling (BIM). The basic principle from this modelling is able to use 3 dimension (3D) model building to get all the project picture that is needed, including look, cut, presentation picture and rendering and detail construction picture, quantity calculation and estimated price to make the designing process easier [2].

Scheduling is important in construction, because besides quality and cost which is one measure of success of a project is time [3]. Project management is a process of management project which cover designing, organizing, and settings resource tasks to reach the aim to be achieved, by considering cost and time factors [4]. Therefore every project should do the development just at the planned time.

The performance of integrated management project construction with building model can be drawn through Building Information Modeling (BIM) concept. In this research, it will use Autodesk Revit as the software. Revit Architecture will be used in this research because it could give 2D picture, 3D picture and volume calculation in

each work as output. The result of calculation volume will be the basic in arranging scheduling project using Microsoft Project program.

METHODS

This research is using Revit Architecture program guided by shop drawing IsDB Engineering Biotechnology picture project. Scheduling is done with Microsoft Project program.

Location Of Research

Study case used in this article is in one of the building in UniversitasJember with IsDB funds of 2018 exactly on Engineering Biotechnology building. The building is located in Jln. Kalimantan No. 37, KabupatenJember – JawaTimur. The specific location is on the development of IsDB Engineering Biotechnology building with 4.888 m2 land area, 6 floors, 4 m tall of each floor. Location can be seen on **Figure 1**.



FIGURE 1. Location of Faculty of Agriculture

Types and Data Sources

The types of this research is quantitative research with Engineering Biotechnology building object. The data used in this research is secondary data. Secondary data needed is in the form of shop drawing data, Bill of Quantity (BQ) and S curve and AHSP of KabupatenJember 2018.

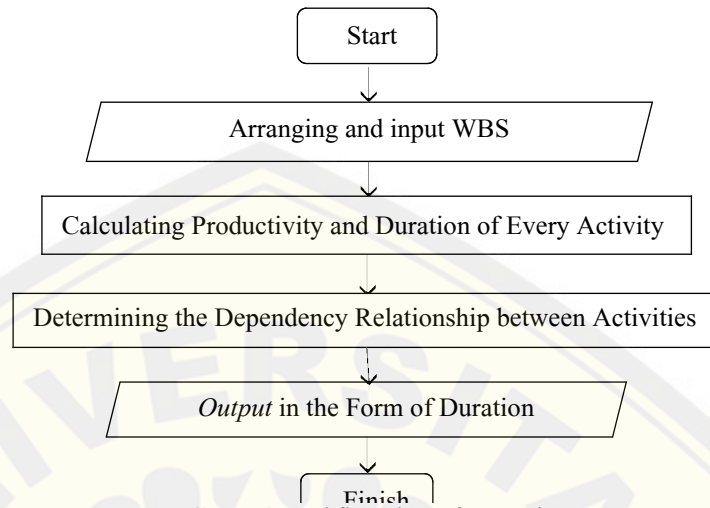


FIGURE 3. Workflow chart of Ms. Project

Initial set up of building modelling using Revit Architecture

1. Login Program
2. Unit set up
3. Grid set up
4. Level set up

Building modelling in this research is divided into 2 stages of modelling, which are bottom structure modelling and top structure modelling. Bottom structure modelling models pile cap, bored pile, tie beam, and river stone foundation. Top structure modelling models beam, plate, column, and shear wall and architecture as wall, floor, ceiling, door, and window.

Structure Modeling (Column)

Column works for holding all building loads. In this building construction, type of material that is used for column is Concrete K-350. Stages in creating column from Engineering Biotechnology building UniversitasJember is as follows:

1. Insert cad file in the format of .dwg.
2. In the tool bar, select "Column".
3. Then click twice and "Properties Column" will be displayed.
4. Select load family to choose column form > set up column dimension according to parameter.
5. After that, give name for each column > OK.
6. Put all the building column in the available template image.

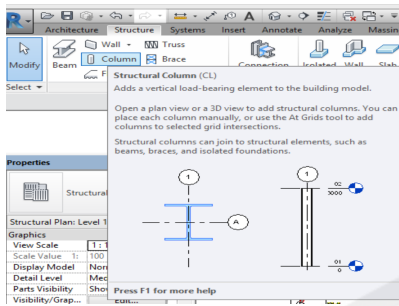


FIGURE 5. Toolbar Column

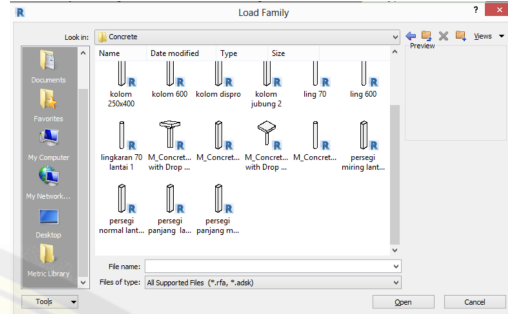
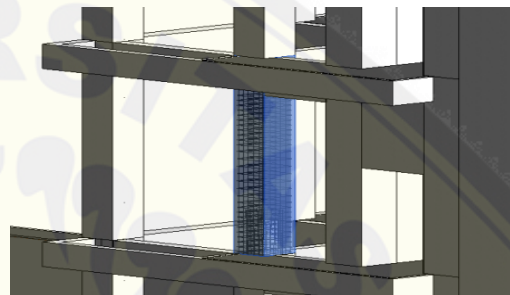
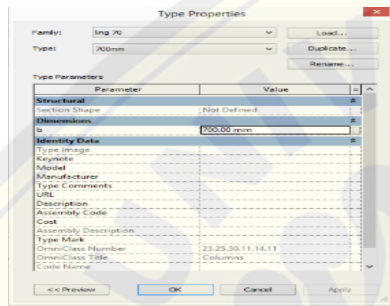


FIGURE 4. Load Family Column



Modelling reinforcement column

1. Select the column to be reinforced
2. Select menu bar extension > click Column
3. Next, the reinforcement can be modelled by inserting number in the parameters > OK.

FIGURE 6. Set up Column Dimension



FIGURE 8. Selecting column

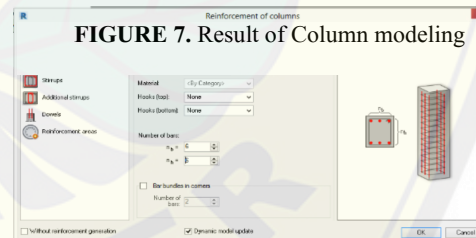


FIGURE 9. Set up main reinforcement column

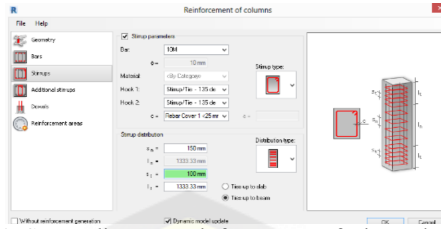


FIGURE 10. Set up diameter reinforcement of stirrup, length between stirrup and Stirrup type.

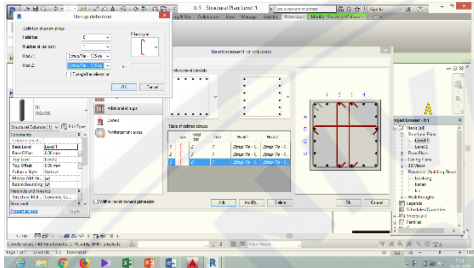


FIGURE 11. Lapsed reinforcement

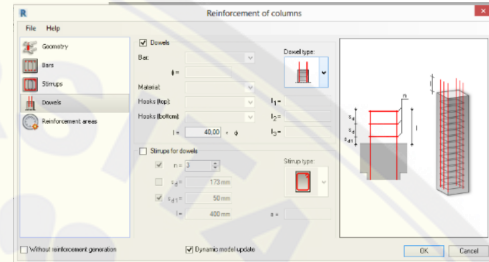


FIGURE 12. Addition reinforcement

Modelling architecture (Wall)

Wall is a solid structure that functions to limit a room and sometimes protecting an area.

1. In tool bar, select “Wall”
2. Then click twice and “Properties Wall” will be displayed
3. Size and material is set as desired and put in the template image
4. After that, give name for each wall > OK

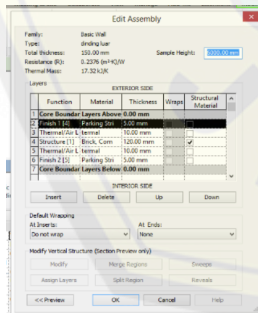


FIGURE 13. Set up material and wall thickness

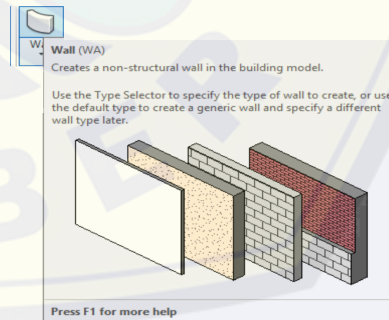


FIGURE 14. Tool Bar Wall

Validation

Validation is done to check the accuracy of modeling result that had been done. Validation is done by comparing between manual calculations with modeling result. The result of validation obtained is error (%). The result of validation has 0% error but in the reinforcement calculations. Validation in foundation reinforcement has 1.54% error. This is happen because of the bending calculation or hook in reinforcement based on project picture and SNI 03-2847-2013. But, reinforcement setting in Revit is using default setting so that causes it to occur more than 0% error.

Work Breakdown Structure (WBS)

Work Breakdown Structure (WBS) is useful to decipher every work occurred in Engineering Biotechnology building, as basic logical job description.

Works which are on Engineering Biotechnology building are follows:

1. Preparatory work
2. Structure work
3. Architecture work
4. MEP (Mechanical, Electrical, Plumbing) work
5. Supporting building work
6. Outdoor work

Calculation of Productivity

Formula used to calculate the productivity of worker according to [5] is as follows:

Worker Productivity and Equipment productivity

$$(1) \quad \text{Worker Productivity} = \frac{1}{\text{worker coefficient}}$$

The calculation of labor in the measurement and installation work 1m³ bouwplank. Coefficient data from AHS Jember 2018 is as follows:

TABLE 1. Coefficients of measurement and installation work 1m³ Bouwplank

(Source : AHSP Jember City, 2018)

$$(2) \quad \begin{aligned} \text{Labor Productivity} &= \frac{1}{\text{Head of worker coefficient}} \\ &= \frac{1}{0.100} \end{aligned}$$

Labor	Coefficient	unit
Worker	0.100	PD
Carpenter	0.100	PD
Head of worker	0.010	PD
Foreman	0.005	PD

$$= 10 \text{ m}^3/\text{PD}$$

Productivity of 1 carpenter is 10 m³ per a day. Then it can be conclude that in one day, 1 carpenter could carry out 10 m³ to do the measurement and installation bouwplank work.

Formula used to calculate the productivity of equipment according to [6] is as follows:

$$\text{Equipment productivity} = q \times N \times E \quad (3)$$

Equipment productivity calculation in the supply work of concrete K-250 is as follows:

- a. Capacity = 3m³
- b. Efficiency factor = 0.81 (in good condition)
- c. Total cycle time = 5 minute

$$\begin{aligned} \text{Equipment productivity} &= q \times N \times E \\ &= 3\text{m}^3 \times \frac{60}{5} \times 0.81 \\ &= 29.16 \text{ m}^3/\text{h} \end{aligned}$$

Duration calculation

Formula used to calculate duration according to [7] is as follows:

$$\text{Duration} = \frac{\text{work volume}}{\text{Productivity} \times \text{total labor}}$$

(4)

Duration calculation in the measurement and installation bouwplank work, with the obtained data:

- a. Volume = 140 m¹
- b. Labor productivity = 10 m¹/PD
- c. Total labor = 7 person

$$\begin{aligned} \text{Duration} &= \frac{\text{work volume}}{\text{Productivity} \times \text{total labor}} \\ &= \frac{140 \text{ m}^1}{10 \frac{\text{m}^1}{\text{PD}} \times 7 \text{ PD}} \\ &= 2 \text{ days} \end{aligned}$$

Measurement and installation bouwplank work with 140 m¹ volume and 10 m¹/PD productivity need 2 days duration with 7 carpenter.

Duration calculation in the supply concrete K-250 work, with the obtained data:

- a. Volume = 252.64 m³
- b. Equipment productivity = 29.16 m³/h
- c. Total equipment = 1

$$\begin{aligned} \text{Duration} &= \frac{\text{work Volume}}{\text{Productivity} \times \text{total worker}} \\ &= \frac{252.64 \text{ m}^3}{\left(29.16 \frac{\text{m}^3}{\text{hour}} \times 8 \text{ hour} \right) \times 1} \\ &= 1.08 \text{ days} \\ &= 2 \text{ days} \end{aligned}$$

The supply of K-250 concrete supply work with 252.64 m³ and equipment productivity 29.16 m³/hour need 2 days duration with 1 equipment.

TABLE 2.Calculation of Productivity and Duration

QUANTITY	COEFFICIENT (PD)	(/day)
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The determination of dependency relationship between work

According to [8], there are 4 kinds of dependency relationship between works in Microsoft Project:

1. FS : Finish to Start (work can be started after the previous work is finish)
2. FF : Finish to Finish (previous and next work are finish together)
3. SS : Start to Start (previous and next work are started together)
4. SF : Start to Finish (previous work can be only finished when the next work have been started)

TABLE 3. Dependency relationship between work

CONCLUSION

Based on the discussion above, it can be concluded that:

1. Stages of modelling IsDB Engineering Biotechnology building Universitas Jember using BIM with Revit Architecture program started from Login program Revit Architecture with initial set up in each unit, then structure and architecture modelling are carried out, so that volume in each work which has been modelled is obtained
2. The length of time needed in the development of IsDB Engineering Biotechnology building is 232 days (with the start of work on September 1st 2018 until April 28th 2019).

The recommendations is doing modelling in building structure analyse using BIM program but Revit in order to give larger knowledge about BIM and scheduling result from this research can still be accelerated that the project could be finished faster.

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