Implementation Of BIM Software (Tekla Structures) To Steel Work In Surakarta Furniture Center Building Project

Rafi Jati Kusuma[1], Budi Priyanto M.Eng.[2]

[1]College Student, Civil Engineering Study Program, Muhammadiyah University of Surakarta, Indonesia
[2]Assistant Professor, Civil Engineering Study Program, Muhammadiyah University of Surakarta, Indonesia

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Abstract - *The development sector is the main concern of the Indonesian government, especially infrastructure development which basically aims to support the increasing infrastructure needs. This requires the construction industry to implement changes following the industrial revolution 4.0. One of the efforts of the construction industry is to use the concept of Building Information Modeling (BIM). Tekla software is a new revolution in structural design that offers several advantages over other application software. This research was conducted to focus on calculating the volume and weight of the structure which includes steel work, namely the calculation of anchors, columns, beams, haunch, bolts and plates using the help of Tekla Structures as a BIM platform. The research approach used is a quantitative approach, because in drawing conclusions it is formulated based on the results of analysis in the form of numerical data. The data used in this study refers to shop drawing data. The results of this study were obtained from steel structure modeling using Tekla Structures and obtained the total volume weight of column work sizes 500x500x16x25, 450x450x12x22, 500x500x16x22, and 300x300x10x15 with a weight of 284.7 tons. Work beam size 588x300x12x20, 400x200x8x13, and 300x150x6.5x9 with a total weight of 401.3 tons. For a triangular haunch with dimensions of 588x300x12x20 and 400x200x8x13 the total weight is 58 tons. The baseplate measures 700x700x25, 490x490x20 and 540x540x22 with a total weight of 13.15 tonnes. Installation of endplates at the ends of beams with thicknesses of 13, 16, 20, and 25 obtained a total weight of 58.72 tonnes. Installation of stiffeners of a certain size and distance and thickness of 8, 12 and 16, the total weight is 34.56 tons. The number of bolts used with a diameter of 19 mm was 19,498 pieces and the total number of anchors with a diameter of 22 was 900 pieces.*

*Key Words***:** Building Information Modelling (BIM), Tekla Structures, structural modelling, heavy volumes

1.INTRODUCTION

The development sector is a sector that is the main concern of the Indonesian state, especially infrastructure development which basically aims to support the increasing infrastructure needs. Innovation continues to develop in line with technological developments that are increasingly rapidly. These innovations support every area of development, from development speed to ease of implementation and post-development maintenance.

According to a 2015 McKinsey Global Institute Industry Digitization Index study, the construction industry is the second weakest in terms of technological innovation. This requires the construction industry to implement changes following the industrial revolution 4.0. One of the efforts of the construction industry is to use the concept of Building Information Modelling (BIM).

BIM is a set of technologies, processes and practices, all of which are collaborative and integrated into a digital model. The use of information modeling in construction, planning, procurement and construction processes can be combined easily. Moreover, it enables collaboration between stakeholders involved in the project [1]. The form of applying the information model in project planning is a combination of the results of several traditional software at once, which is a step forward in project planning efficiency [2].

BIM uses the concept of drawing visual construction before physical construction which is useful for reducing and solving problems, avoiding uncertainty, increasing safety and analyzing conditions [3]. Building Information Modeling (BIM) offers advantages as a communication tool in collaboration between stakeholders. Using the data model as a communication tool, combining information, ideas, plans and views of stakeholders, it is easier to understand and implement the best plans [4]. One application that can be used for modeling is the Tekla Structure software.

Tekla Structure is a structural design, modeling, detailing and engineering tool that is an integrated 3D model-based solution for multi-material database management [5]. Based on [6] concerning State Buildings and Public Housing for the construction of state buildings, the use of the information model must be applied to non-simple state buildings whose criteria are more than 2000 m2 and more than 2 floors.

Tekla software is a new revolution in the field of structural engineering which has several advantages over other application programs. The advantages of Tekla Software include the integration of modeling, analysis and structural design activities with more detailed detailing, bill quantity, work sequences to scheduling activities and can even be combined with other software such as production planning, resources, machine automation systems, etc. integrated in one modeling that can be accessed in real time [7].

Application of BIM concepts to projects allows for the creation of structural plans, rendering of published models before the building is completed, creation of simulations to represent the work to be performed, analysis of structures, especially in the context of rapid design changes and replacements. Information about project progress and limitations. Tekla Structure is one of the programs used to implement data models. Tekla Structure's strengths include the ease of creating project buildings based on the fact that you can immediately get detailed drawings of the model you want [8].

Based on the above understanding, the application of BIM Software is very necessary, considering that now the requirements for large building auctions use the BIM certificate requirements. This research paper was conducted to focus on modeling and calculating the weight of the structure which includes steel work, namely the calculation of anchors, columns, beams, haunch, bolts, and plates using the help of Tekla Structures as a BIM platform.

2. RESEARCH METHODS

Quantitative data is a type of data that can be measured or calculated directly, in the form of information or explanations expressed in numbers or in the form of numbers [9]. Example: Survey results, processed statistical data. Based on the purpose of quantitative research, it is a type of information that can be measured or calculated directly, in the form of information or explanations expressed in numbers or numbers. The research was carried out to obtain information from the Surakarta IKM Furniture Sentra Building Project in the form of steel weight, so the research approach used was a quantitative approach, because in drawing conclusions it was formulated based on the results of analysis in the form of numerical data. The data used in this study refers to shop drawing data.
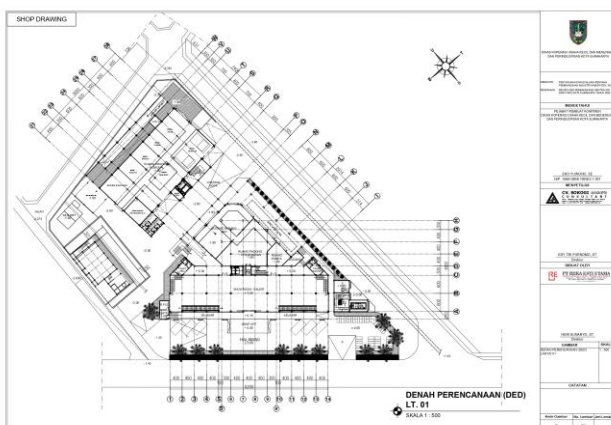

Fig -1: Shop Drawing Surakarta Furniture Center Building Project.

The location of this research is the construction project of the Surakarta IKM Furniture Center building which is located in Banjarsari District, Surakarta City, Central Java Province, Indonesia. In the research conducted at PT Reka Esti Utama, I conducted research using shop drawing data and interviews to find out the weight of the steel work and the modeling using the Tekla Structure software.

Fig -2: Project location.

3. RESULTS AND DISCUSSION

3.1. Tekla Structures Modelling

Tekla Structures BIM is a design encyclopedia-based BIM software that allows you to create and manage data with precision and detail, as well as create 3D structural models without forgetting complex materials and structures [10].

Following are the modeling steps in making the Surakarta furniture IKM center building using the Tekla structures software.

3.1.1. Modelling Grid and Elevation

To create a grid, you can use manual and automatic methods. The manual method is to enter the grid spacing and the number of grids on the "edit" tab then select "grid" select "create rectangular grid". For the automatic way, namely by entering a file from AutoCAD which already contains a grid. First select "menu" then select "Import" and select "DWG" then look for the file from autocad that will be included in Tekla. For research using an automatic method, namely entering the grid from autocad.

To make an elevation, manually use the grid that was entered earlier, then enter the Z value / elevation. The elevations used are -1.90, ±0.00, +3.85, +7.85, and +11.85.
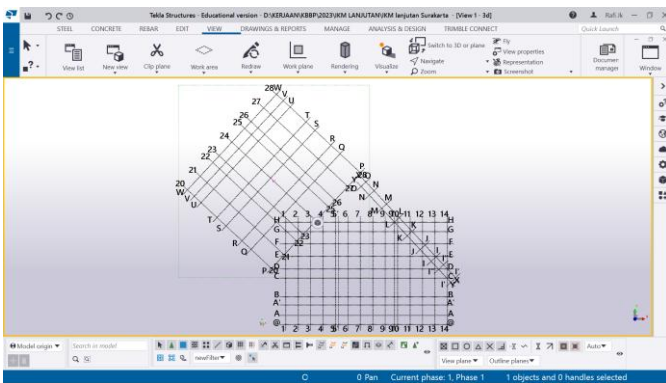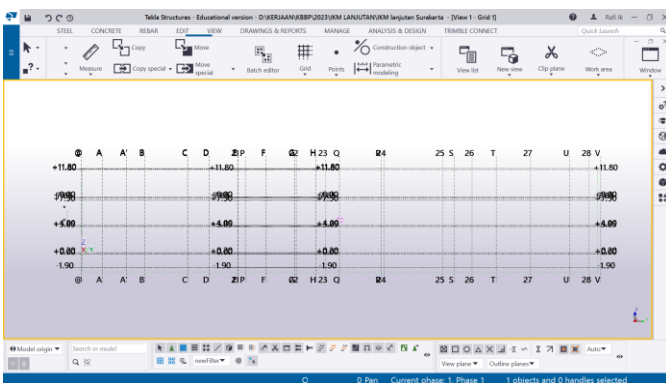
Fig -3: The modeled grid.

Fig -4: The modeled elevation.

3.1.2. Modelling Plate – Baseplate and anchors

The Baseplate modelling stage begins by opening the "edit" tab then selecting "components" and clicking "applications and components". Search by writing "baseplate" then click on the grids that will be given the baseplate, edit the baseplate by clicking 2 times on the baseplate after that set the baseplate and anchors, starting from the number of anchors, baseplate thickness, baseplate size, bolt size, number of bolts, distance bolts, and anchor length.
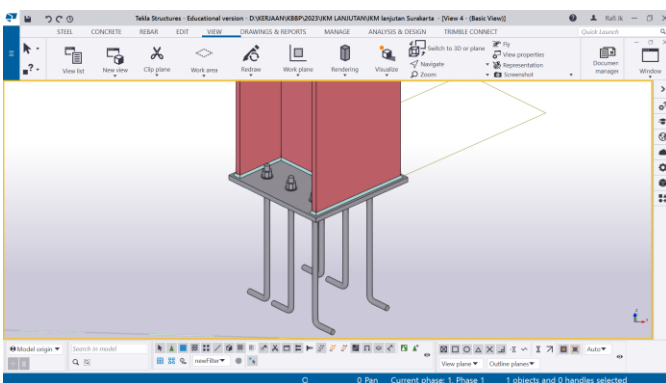

Fig -5: The Modeled baseplate and anchor.

3.1.3. Modelling column

Modelling the column itself is by opening the "steel" tab then selecting "column" entering the size of the steel profile column, the material used, and the length of the column. For columns in this project using H-Beam Columns with column sizes of 500x500x16x25, 450x450x12x22, 500x500x16x22, and 300x300x10x15.
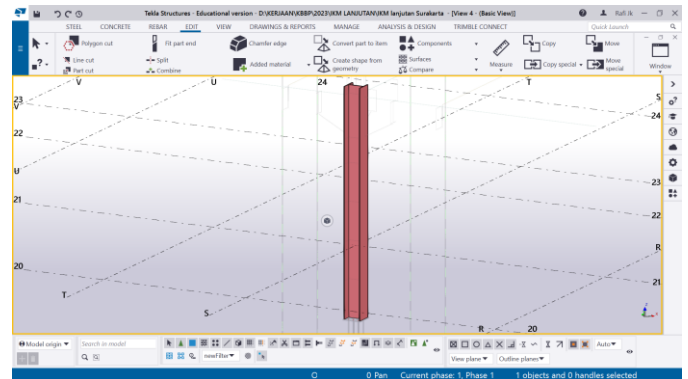

Fig -6: The modeled column.

3.1.4. Modelling Plate – Endplate

The modelling endplate is usually located at the end of the IWF Beam. For endplates used for bolt connections between IWF main beams and H-Beam Columns. Endplates are also used for the connection between IWF joists and IWF main beams. Making the endplate, starting from the "steel" tab, then selecting the "plate" image according to the size needed and entering the required thickness. The thickness of the endplate in this IKM project is 9 mm, 13 mm, 16 mm, and 20 mm thick.
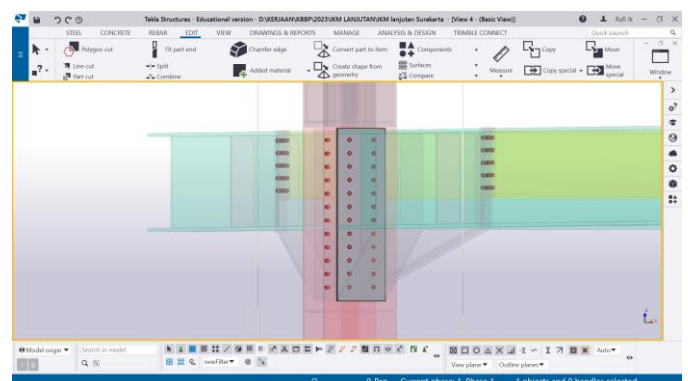

Fig -7: The modeled endplate.

3.1.5. Modelling beam and haunch

IWF beam modeling is by selecting the "steel" tab then selecting "beam" clicking on column to column for the length of the IWF steel, for IWF size enter it in the properties menu. The steel sizes for this project are 588x300x12x20,

400x200x8x13, 300x150x6.5x9, 250x125x6x9, and 194x150x6x9.

For haunch modeling, use steel that is cut to the required size, for haunch it adjusts to the IWF beam that is required and the same, for example IWF 588x300x12x20 beams use haunch which is cut to a certain size in the shape of a right triangle and uses IWF 588x300x12x20 as well.
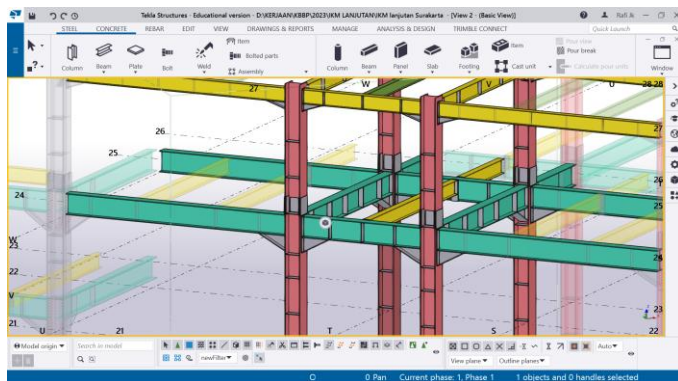

Fig -8: The modeled beam and haunch.

3.1.6. Modelling bolt

The bolts used are 19 mm in diameter, for an IWF 588x300x12x20 main beam that meets the column requires 24 bolts, for IWF 400x200x8x13 joists that meet the main beam requires 10 bolts.
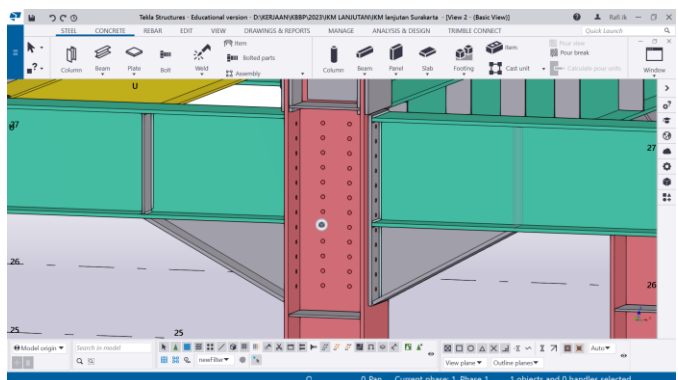

Fig -9: The modeled bolt.

3.1.7. Modelling Plate – Stiffener

The stiffener functions as a stiffener plate, in this project the stiffener is installed on each column and main beam with a distance of 1 m. select the "steel" tab then select "plate" to make according to the size needed and attach it to the main column and beam every 1 m. stiffener thickness on this project 8 mm, 12 mm, and 20 mm.
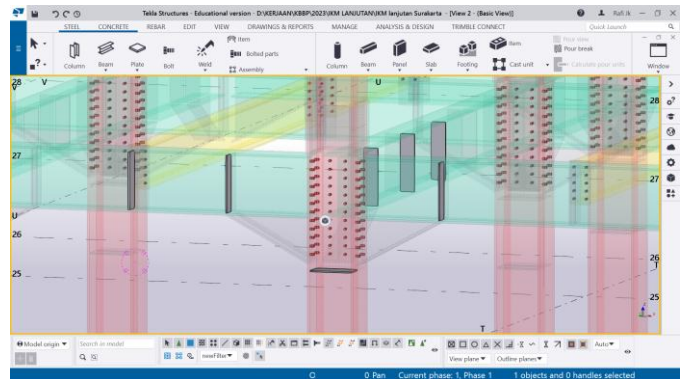

Fig -10: The modeled Stiffener.

3.2. 3D Modeling Results

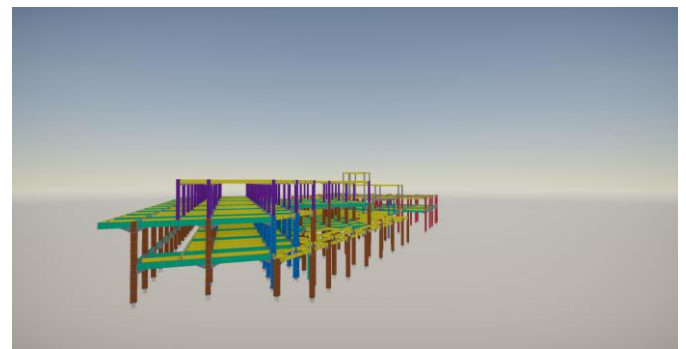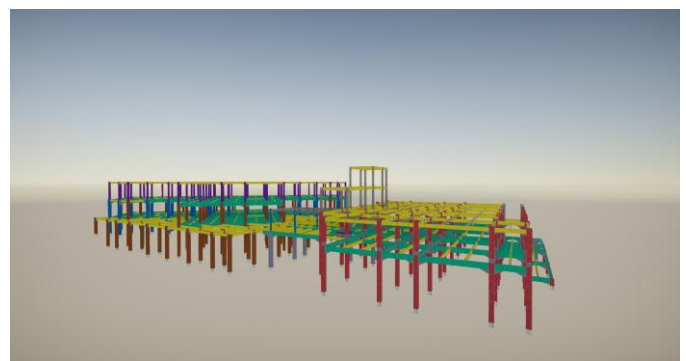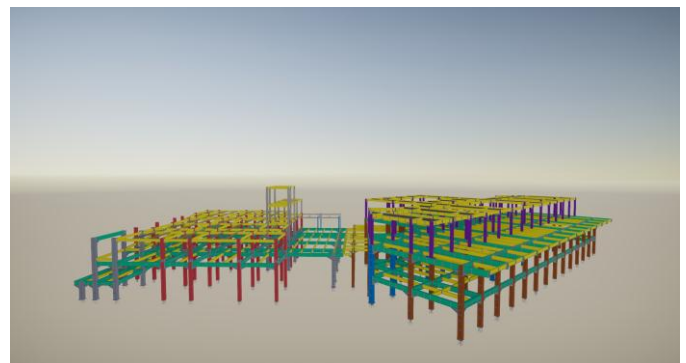The following are the results of the Surakarta IKM Sentra Building modeling using the Tekla Structures software.

Fig -11: 3D Modeling Results.

3.3. Calculation of the volume of Steel Weight

At the calculation stage the weight of the steel is divided into 2 calculations, namely the calculation of the weight/volume of steel and the number of bolts. Calculations are assisted by utilizing the Tekla Structures BIM software which automatically clicks the "drawing and reports" tab and selects "reports".

Table -1: Steel weight/volume calculation

No	Work item	Size	weight
		(mm)	(kg)
1	Column	500x500x16x25	16,277.76
		450x450x12x22	146,399.36
		500x500x16x22	93,741.56
		300x300x10x15	28,239.48
2	Beam	588x300x12x20	240,056.05
		400x200x8x13	146,219.56
		300x150x6,5x9	15,028.92
3	Haunch	588x300x12x20	42,971.70
		400x200x8x13	15,025.54
4	Baseplate	700x700x25	4,231.08
		490x490x20	6,721.38
		540x540x22	2,197.66
5	Endplate	13	1,479.57
		16	312.21
		20	55,035.79
		25	1,892.01
6	Stiffener	8	1,021.49
		12	31,210.21
		16	2,324.60

Table -2: Steel weight/volume calculation

No	Work Item	Size	quantity
		(mm)	(bh)
1	Bolt	Ø 19	19,498.00
2	Anchor	Ø 22	900.00

4. CONCLUSION

Based on the research conducted, it was found that the application of the Tekla Structure BIM Software was only carried out on steel work, which included columns, beams, haunch, baseplate, endplate, stiffener, bolts and anchors. Modeling begins with making the grid, after that making the baseplate and anchors, then making the columns, and making the beams, haunch, and endplates and connecting them with bolts, finally making stiffeners with a predetermined distance.

After calculating using the BIM Tekla structures software, we get the total weight volume of column work measuring 500x500x16x25, 450x450x12x22, 500x500x16x22, and 300x300x10x15 with a weight of 284.7 tons. Work beam size 588x300x12x20, 400x200x8x13, and 300x150x6.5x9 with a total weight of 401.3 tons. For a triangular haunch with dimensions of 588x300x12x20 and 400x200x8x13 the total weight is 58 tons. The baseplate measures 700x700x25, 490x490x20 and 540x540x22 with a total weight of 13.15 tons. Installation of endplates at the ends of beams with thicknesses of 13, 16, 20, and 25 obtained a total weight of 58.72 tons. Installation of stiffeners of a certain size and distance and thickness of 8, 12 and 16, the total weight is 34.56 tons. The number of bolts used with a diameter of 19 mm was 19,498 pieces and the total number of anchors with a diameter of 22 was 900 pieces.

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BIOGRAPHIES

Bachelor Degree of Civil Engineering Student, Muhammadiyah University of Surakarta, Indonesia.

Assistant Professor, Active lecturer in the civil engineering study program at the Muhammadiyah University of Surakarta, Indonesia.