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# Material Volume Efficiency Study Using Tekla Structure and Revit Software

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**Abstract**

*The development of technology in the construction industry drives the need for efficient and accurate planning methods, especially in material volume estimation which affects the budget and smooth running of the project. This study aims to compare the efficiency of material volume estimation between Two Building Information Modelling-Base software, namely Tekla Structure and Autodesk Revit. The study was conducted on the construction project of DPRD Building in North Lombok Regency. The method used includes modelling the main building structure such as foundations, sloofs, columns, beams, floor slabs, and roof structures in both software base on the same technical data. The estimated concrete volume and reinforcement weight data from each software were then analyzed quantitatively and compared with the conventional method. The results show that the concrete volume of the conventional method is about 7,8% larger than the results from Revit and Tekla. Meanwhile, the conventional method's estimated reinforcement wight is up to 17,6% higher. Each software provides almost identical outputs, albeit with different approaches and interface. The efficiency is particularly noticeable in structural elements such as beams and floor slabs. These findings suggest that the use of BIM in the planning process can improve the accuracy of material estimation, minimize potential waste, and support more effective and accurate construction planning.*

## Introduction

Material volume estimation is an important part of the construction planning process that directly affects cost efficiency, implementation time, and resource utilization (Salih & El-Adaway, 2024; Naderi et al., 2025; Jayamaha et al., 2024; Tatari et al., 2008). Errors in calculations, especially in key materials such as concrete and reinforcing steel, can lead to waste and the risk of project overbudget (Widhiawati et al., 2019; Maulina et al., 2023).

In the North Lombok Regency DPRD Building construction project, it was found that the material volume estimation process in the field was still using conventional methods, such as manual calculations from 2D working drawings using Excel. This method has weaknesses in terms of accuracy and is not automatically integrated with project design changes that can occur at any time.

This building is a two-story building with a main structure consisting of columns, beams, and floor slabs that all use reinforced concrete materials. Zhang et al. (2021) and Kamai & Hatzor (2008) said that, the foundation system used is a stone mansonary and foot plate that supports



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the load from the upper structure. The roof truss of this building is designed using steel profiles, consisting of IWF 350.175.7.11, IWF 200.100.5.5.8, HWF 200.200.8.12, and CNP 125.50.20.3 as the truss.

As construction technology develops, digital approaches such as Building Information Modeling (BIM) are starting to be widely adopted in the construction industry to answer conventional planning challenges, such as inaccurate material volume estimates, delays due to non-integrated design revisions, and potential cost waste in project implementation (Dewi et al., 2024; Peterson et al., 2011). BIM is widely adopted in infrastructure projects because it provides tangible benefits such as high data quality management, faster project completion, efficient cost management, transparency of information between teams, early detection of design conflicts to reduce project accidents (Umam et al., 2022; Rane, 2023; Thamhain, 2013).

BIM enables three-dimensional modeling of building structures while generating Quantity Take-Off (QTO) automatically, accurately, and efficiently (Meléndez et al., 2025; Azizi et al., 2025). With real-time data coordination features, BIM-based software such as Tekla Structures and Autodesk Revit provide convenience in managing project information and more precise volume calculations (Kaur & Singh, 2024). Quantity Take-Off (QTO) is an important process in the pre-construction phase that aims to calculate the amount of materials needed based on project drawings or models, which directly affects the estimated cost, schedule, and resource expenditure (Sadad, I., & Noviantoro, 2024).

There are two main approaches to QTO: the manual method, which requires measurements from 2D drawings using tools such as rulers and manual calculations, and the digital method, where volume estimation is done through construction software that automatically processes blueprints into a list of required materials (Ferial et al., 2022; Permana & Saputra, 2025). Tekla Structures is a BIM software by Trimble that is used to model steel and reinforced concrete structures in detail and generate volume reports and working drawings (Avendaño et al., 2023). The use of Tekla Structures is proven to provide material volume efficiency of up to 9,64% for concrete work and 8,53% for reinforcement, compared to conventional methods (Farizwan et al., 2024).

Another application, Autodesk Revit, is a BIM software from Autodesk that is used to model architectural elements, structures, and building systems in 3D and produce technical information such as material volumes and working drawings (Waas, 2022; Sari et al., 2024). The use of Autodesk Revit in calculating the volume of concrete work shows an efficiency of 4,32% compared to conventional methods. This result is based on the difference in total volume between BIM and conventional methods, where Revit is able to calculate the net volume automatically and, in more detail, including considering irregular structural shapes (Juliani & Renaningsih, 2023).

## Methods

This research is descriptive quantitative research with a case study approach. The object of this research is the structure of the North Lombok Regency DPRD Building which was built in 2024. The data in this study were obtained from the results of technical data at the North Lombok Regency DPRD Building construction project. The project technical documentation includes shop drawings, as well as other planning documents such as the Cost Budget Plan, which are used as the basis for structural modeling. In addition to documents, field documentation in the form of photographs of construction progress was also used to understand the actual condition of the structure during construction.



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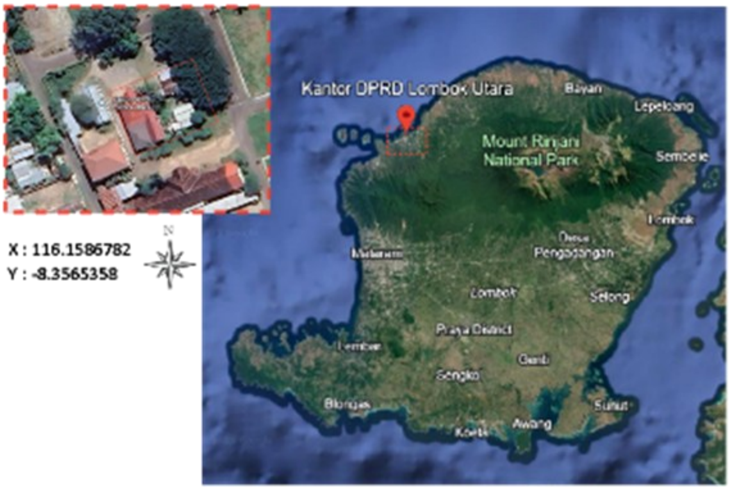


*Figure 1. Research Location*

(Source: Google Earth, 2025)

This research uses secondary data on the North Lombok Regency DPRD Building Construction Project. The data obtained from the implementing contractor, the data obtained is the Shop Drawing which is obtained used as modeling data.

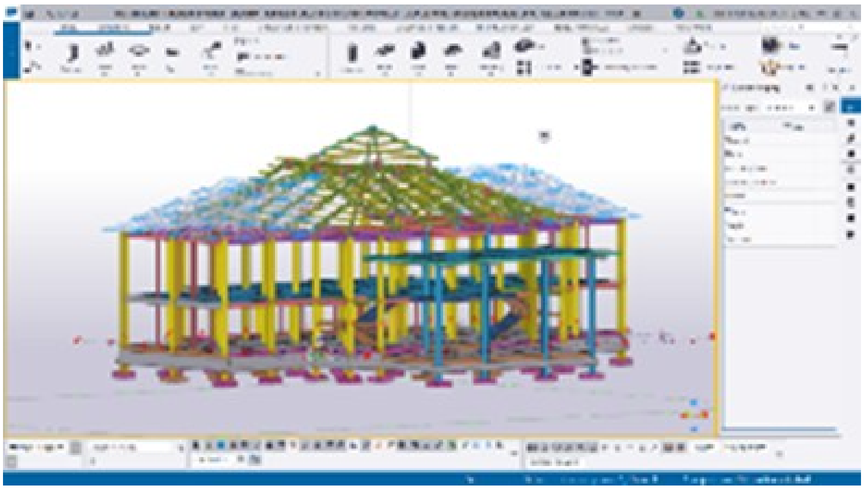

*Figure 2. Tekla Structures Modeling*

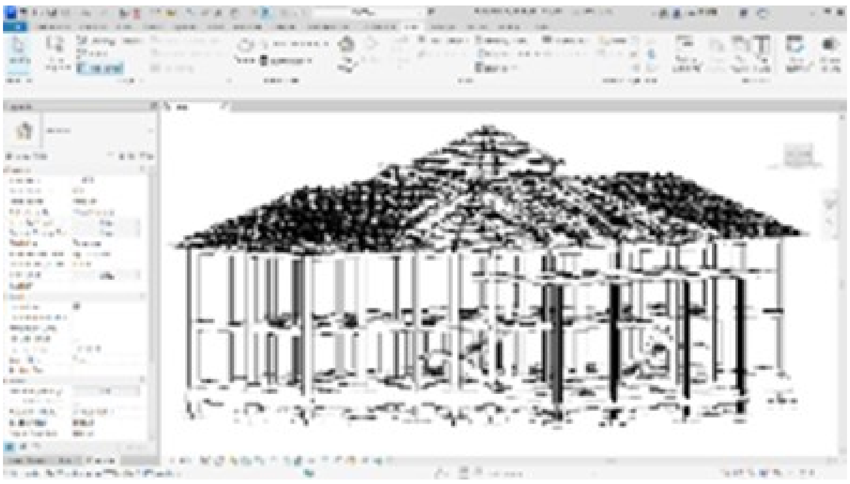

*Figure 3. Autodesk Revit Modeling*



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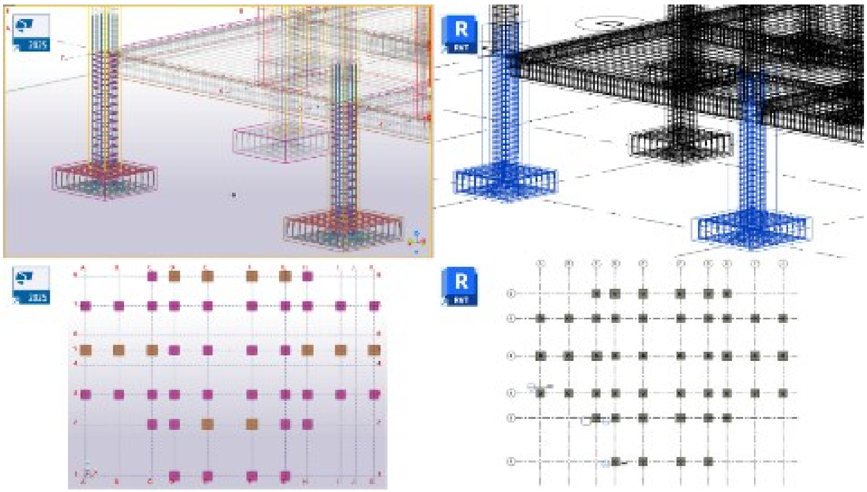

*Figure 4. Modeling of Foot Plate and Pedestal Column*

Figure 4 shows the results of modeling foundation elements and pedestal columns using Tekla Structures (left) and Autodesk Revit (right). Foot Plate 1, 2, and pedestal column models were created based on shop drawings using the pad footing and concrete column features. Reinforcement was inserted according to specifications and adjusted to follow the conditions of the connections between elements. In Revit, elements were inserted using the Structural Foundation and Structural Column features, while in Tekla, the Concrete Pad Footing and Rebar Tool were used for detailing. This modeling demonstrates the consistency between the structural design and the 3D digital representation used for material volume estimation.

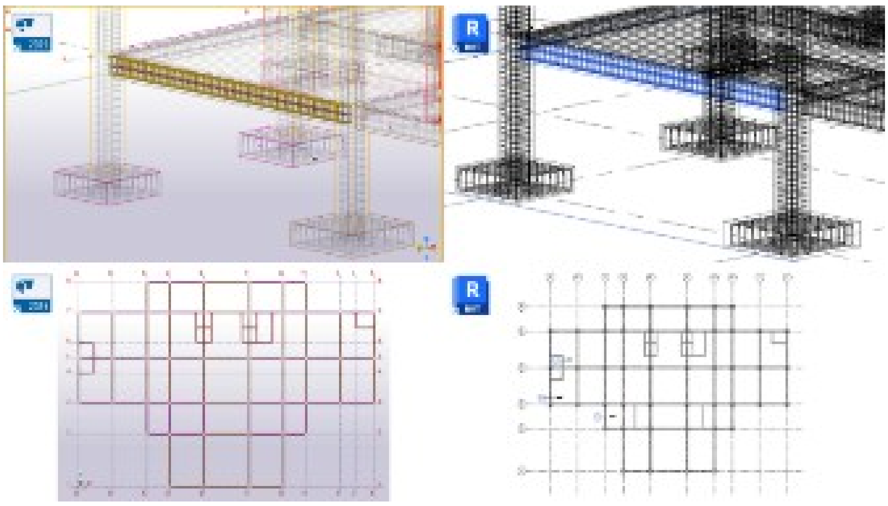

*Figure 5. Sloof Modeling*

The footing is modeled to form a closed path following the grid pattern of the structure at the base level. In Revit, the footing is created using the Structural Beam feature and its elevation is adjusted to be exactly above the foundation. Meanwhile, in Tekla, the modeling is done with Concrete Beam with accurate coordinate placement following the grid layout. Longitudinal and transverse reinforcement is inserted using Rebar Set in both software, adjusted to the connection conditions at the columns and foot plates.



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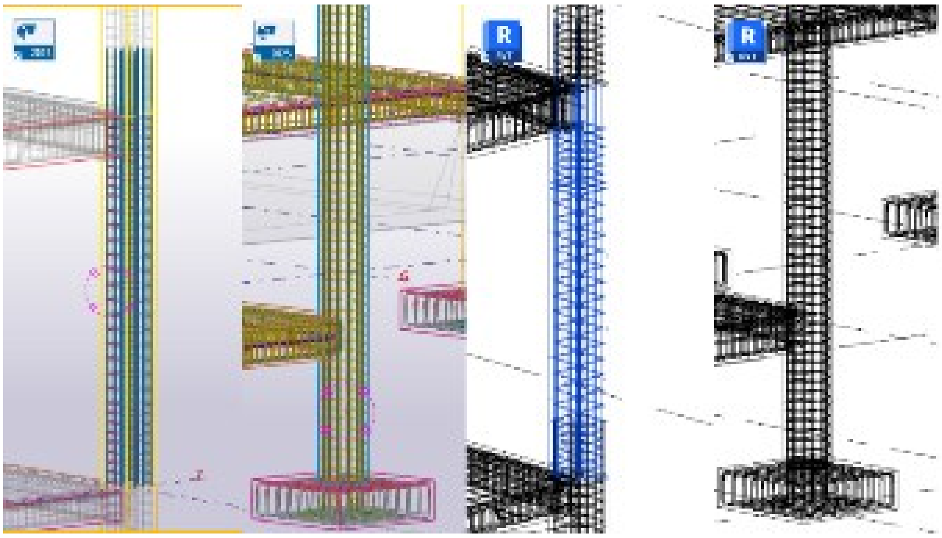

*Figure 6. Column Modeling*

Column elements are modeled in two cross-section types, namely square and round, in accordance with the original structural design of the project. In both software programs, column modeling is performed vertically between floor levels, starting from the foundation up to the beam or floor slab above it. In Tekla Structures, columns are created using the Concrete Column feature with manually specified cross-section size and shape. Main reinforcement and stirrups are installed using the Rebar Set feature, which allows for the adjustment of quantity, spacing, and orientation in accordance with technical standards. The connections between column, beam, and foundation elements are also modeled in detail to reflect actual field conditions. Meanwhile, in Autodesk Revit, column modeling is performed using the Structural Column feature, which is also populated with dimension and concrete material parameters. Reinforcement is manually entered using Rebor Shape and adjusted to the design configuration. Column elements are then automatically connected.

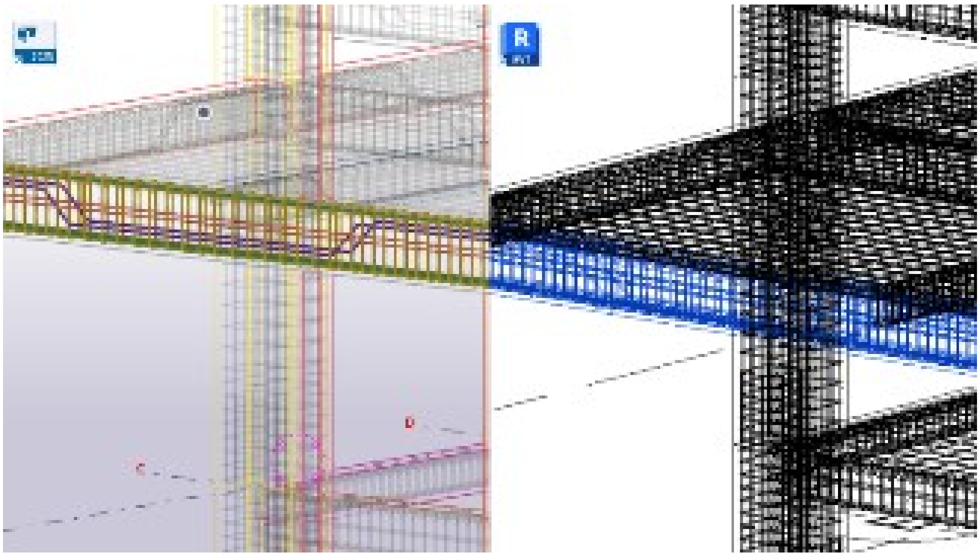

Figure 7. Beam Modeling

The beam elements are modeled following the direction of the structure span between columns and are located precisely at the intersection between floors. The modeling process is carried out by considering the elevation and position of the connection to the columns and floors. In Tekla Structures, beams are modeled using the Concrete Beam feature, with



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dimensions, length, and position adjusted directly based on the grid layout. Longitudinal reinforcement on the top and bottom, as well as stirrups, are added using the Rebar Set feature, with adjustments to spacing and quantity based on structural requirements and connections to columns. Meanwhile, in Autodesk Revit, modeling is performed using the Structural Beam feature. The placement of beam elements is adjusted according to floor levels and reference grids. Reinforcement is manually added via the Rebar feature and adjusted to match the beam's shape.

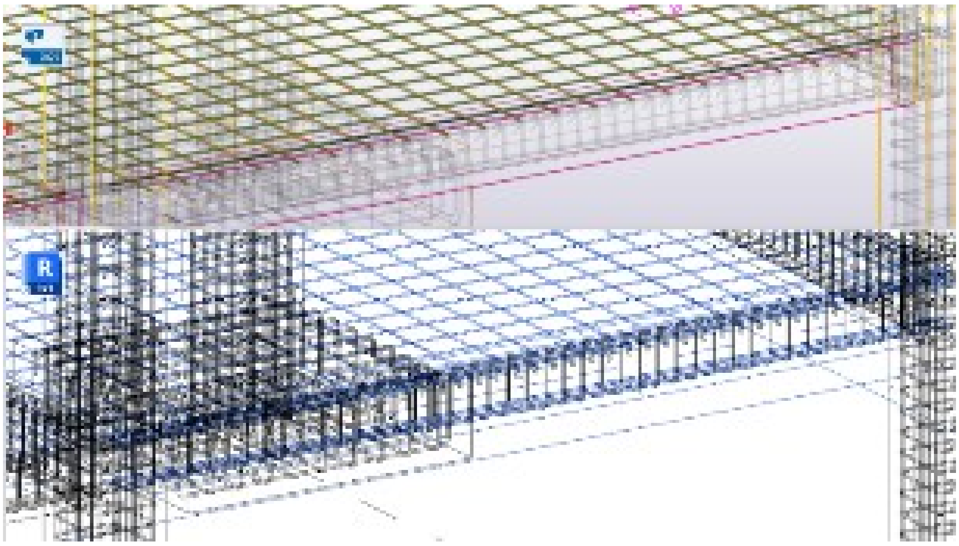

*Figure 8. Modeling of the Base Floor Plate*

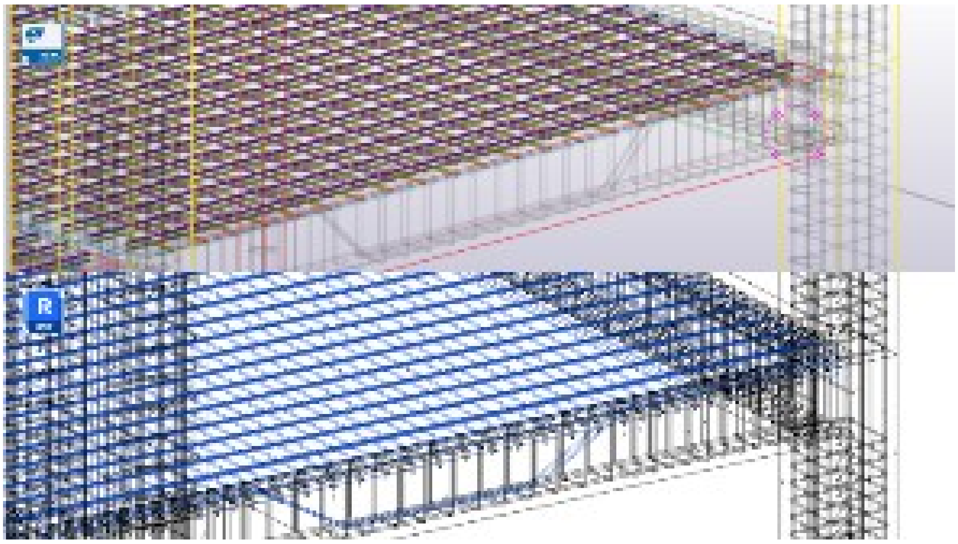

*Figure 9. Modeling of Floor Plate 2*

The ground floor and second floor slabs are modeled as reinforced concrete slabs directly connected to beams and columns. At both levels, the modeling follows the contours and span patterns of the beams that have been modeled. In Tekla Structures, the slabs are created using the Concrete Slab feature, with reinforcement inserted using Rebar By Face. Meanwhile, in Autodesk Revit, the slab elements are created using Structural Floor, then Area Reinforcement is added. The elevation and thickness of the slab are adjusted according to each level, with the reinforcement direction adjusted to suit the span conditions and connections with other structural elements. This modeling allows for detailed and accurate



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visualization of the reinforcement, while also serving as the basis for calculating the volume and weight of the reinforcement for each floor.

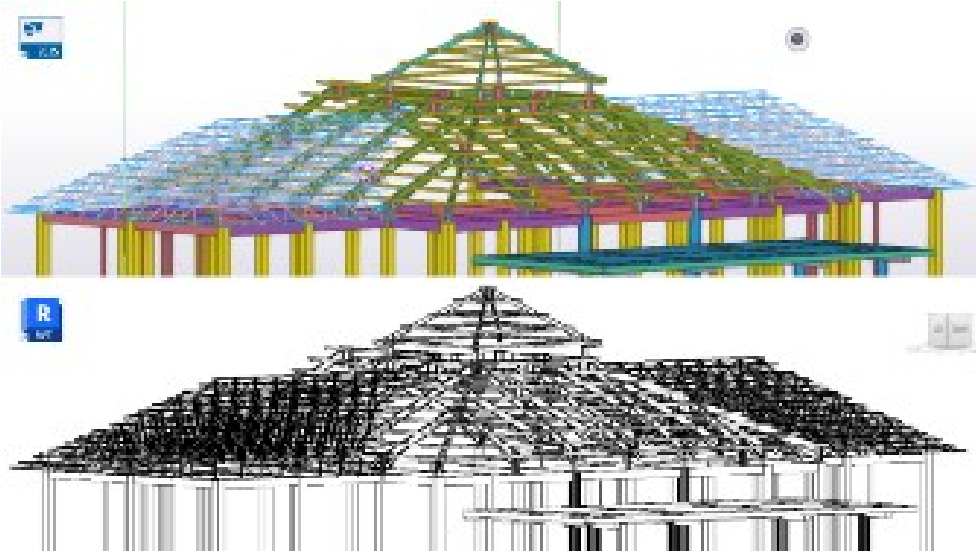

*Figure 10. Roof Modeling*

The roof structure of this building is a combination of steel profiles and lightweight steel. In the central part of the building, a limasan roof system is used with a main frame made of structural steel such as HWF 200.2008.12, IWF 200.100.5.5.8, IWF 350.175.7.11, and CNP 125.50.20.3 (purlin). These elements are modeled with consideration for the slope and connections between the beams. Meanwhile, the right and left sides of the building use a conventional gable roof with a frame made of lightweight steel, such as C75.0.75, and roof battens. In Tekla Structures, all roof elements are modeled using the Steel Beam feature, while in Autodesk Revit, modeling is done using Structural Framing Beam and Truss with appropriate profile types, arranged according to the roof's geometric shape. This combination demonstrates the flexibility of both software in handling complex roof systems with two different structural approaches within a single building model.

## Results and Discussion

### Comparison of Material Volume Estimation Results

After modeling the building structure using Autodesk Revit and Tekla Structures, the results of estimating the volume of concrete and the weight of reinforcement from each software are obtained. The comparison is done to see the extent of the difference in the estimated volume of material produced by the two software. The structural elements analyzed include foundations, sloofs, columns, beams, and floor slabs. The difference in the volume of concrete and reinforcement is calculated based on the estimation results as the main reference. The complete comparison results can be seen in Table 1 and Graph 1.

Table 1. Concrete Volume

| Structural Element | Conventional Concrete Volume ($m^3$) | Tekla Structure Concrete Volume ($m^3$) | Autodesk Revit Concrete Volume ($m^3$) |
|---|---|---|---|
| Foot Plate | 34.74 | 33.92 | 33.92 |
| Pedestal Column | 13.12 | 13.12 | 13.12 |
| Stone Mansonary Foundation | 118.81 | 101.00 | 101.00 |



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| | | | |
|---|---|---|---|
| Sloof | 26.82 | 25.69 | 25.69 |
| Column L1 | 24.64 | 24.64 | 24.64 |
| Ground Floor Slab | 59.84 | 59.69 | 59.69 |
| Beam | 46.092 | 44.50 | 44.50 |
| Column L2 | 27.94 | 27.94 | 27.94 |
| Second Floor Slab | 100.45 | 90.01 | 90.01 |
| Ring Beam | 38.56 | 32.30 | 32.30 |
| Total | 491.01 | 452.81 | 452.81 |

Table 1 provides a comparative perspective of the three methods of calculating the volume of concrete, and the juxtaposition of the three methods instantly reveals the superiority and inferiority of the three methods. The traditional approach gave an overall concrete volume of 491,01 m3, and both Tekla Structures and Autodesk Revit gave the same outcome of 452,81 m3. This overlap between the two BIM software packages is not unusual, as they both use detailed three-dimensional digital models in which each object is drawn in exact dimensions. After the modeling is performed in a manner that is uniform, the software takes it upon itself to generate the volume calculations automatically and in a consistent manner. This is also the reason why Tekla and Revit gave the same results, strengthening the fact that good BIM models can be relied upon to give reproducible data.

As the results are contrasted with the traditional approach, however, the differences may be even more noticeable. The difference of 38,20 m3, or approximately 7,78%, may not sound very huge at the first sight, but with the construction projects in mind, this is by no means insignificant. Any relatively small percentage variation can equate to a big amount of material when we are talking about large structures. The conventional method assumes more concrete being which leads to increased projected costs of materials, labor, and transportation, and may also have an impact on scheduling and resource allocation on-site. This underscores how errors made in the initial calculations could have a trickle-down effect on subsequent phases of a project and impact budgets and planning in a manner that can be hard to rectify once the work has commenced.

Taking a closer look at the data one can see that the greatest discrepancy is occurring in the second-floor slab. Using the conventional approach, it had a volume of 100,45 m3, but both BIM-approaches gave an equal albeit a slightly lesser result of 90,01 m3. The difference of almost 10 m3 is sufficient to reflect a few truckloads of concrete, which, in turn, can also have a quantifiable effect on procurement and logistics. The same trend is observed in the calculation of beam elements, with the standard process giving 46,092 m3 as opposed to 44,50 m3 as was obtained in Tekla and Revit. These differences indicate that manual or semi-manual calculation techniques can add rounding, approximations, or even accidental overestimation, particularly where the geometry of elements is irregular or when elements overlap with other components. In contrast, BIM tools process these geometric details much more accurately, with the probability of systematic error reduced to the minimum.

Other factors like the pedestal column, ground floor slab, columns L1 and L2 and similar features demonstrated comparable outcomes with all the three methods, which means that the traditional approach can be used to interpret simple objects with regular shapes and fewer intersections. But in more complex components, the constraints of manual analysis start to manifest themselves through the inability to capture finer geometry and element interaction. It is at this point that BIM has come into its own and can depict the overall form of the structure and generate more accurate volumes. The difference between the conventional technique and BIM (7.78 percent) shows that precision in the estimation of materials is a



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determining factor in efficiency, cost, and utilization of resources, and, therefore, BIM is a viable requirement in the present-day construction sites.

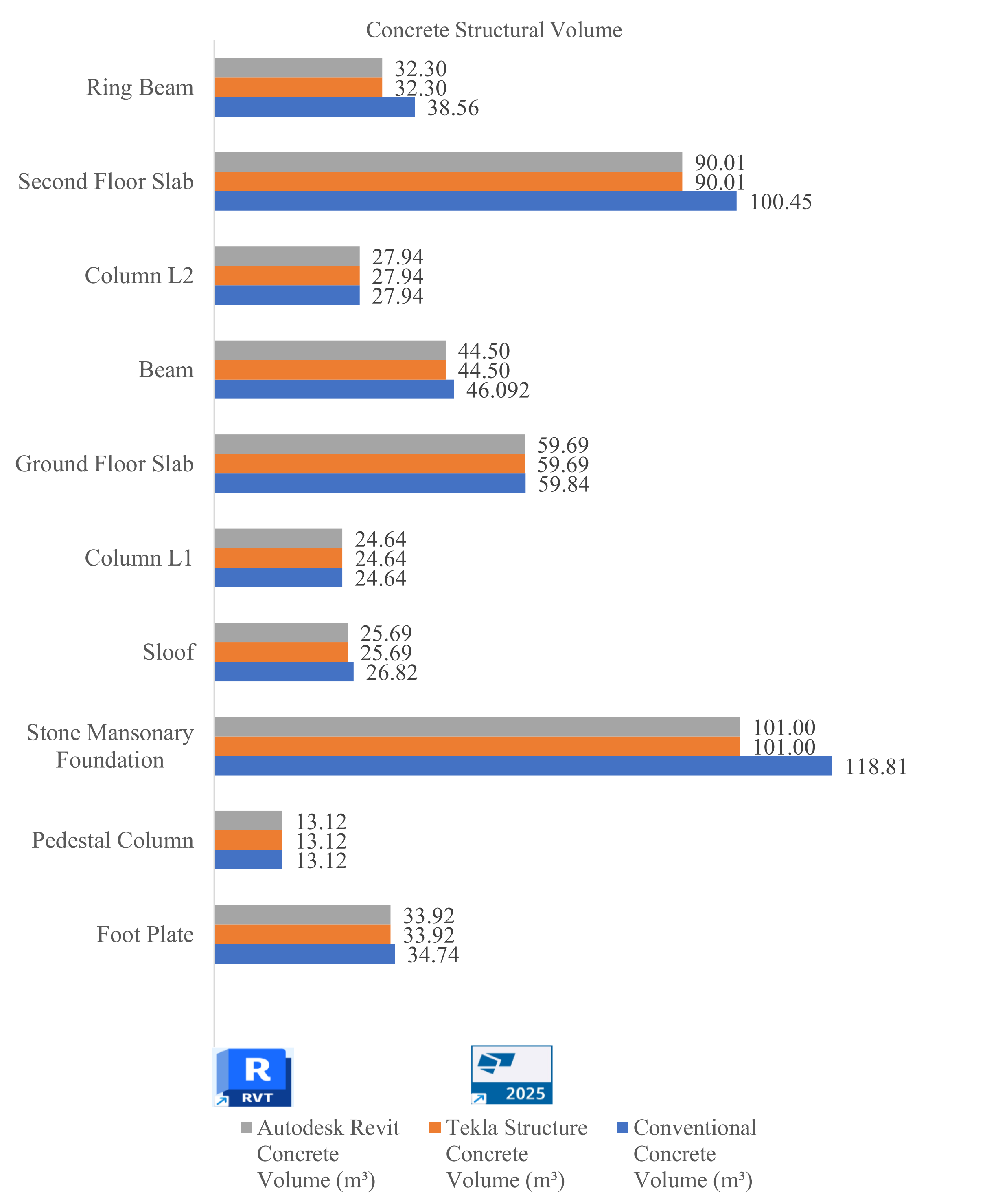


*Figure 11. Comparison of Concrete Volume*

Figure 11 shows the significant difference in concrete volume between the conventional method and the two BIM software, Tekla Structure and Autodesk Revit. The largest difference occurred in the second-floor plate element, where the conventional method recorded a volume of 100.45 $m^3$, while Tekla and Revit only recorded 90.01 $m^2$. This means that there is a difference of 10.44 $m^2$ or about 10.4% greater in the conventional method.



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Another significant difference is seen in the stone mansonary foundation, with a conventional volume of 118.81 m², compared to 101.00 m³ from both software, resulting in a difference of 17.81 m³ or about 15% greater. In the ring beam element, a volume difference of 6.26 m³ was also recorded between the conventional method (38.56 m³) and Tekla/Revit (32.30 m²). Some elements such as foot plates, beams, and sloofs also experienced differences, albeit smaller. averaging below 2 m³. Meanwhile; for elements such as pedestal columns, L1 columns, and L2 columns, there was no difference at all between the three methods, indicating that the volume calculations on simple elements were relatively consistent.

In addition to the concrete volume, the weight of reinforcement for each structural element was also analyzed. This calculation aims to determine the difference in the quantity of reinforcement material produced by the conventional method. Tekla Structure, and Autodesk Revit. The reinforcement modeling in each software is made in detail and equivalent, so that the difference in results is more directed to the calculation system and data processing of each method. Details of the results of the reinforcement weight comparison can be seen in Table 2 and Graph 2 below:

Table 2. Reinforcement Weight

| Structural Element | Conventional Weight (Kg) | Tekla Structures Weight (Kg) | Autodesk Revit Weight (Kg) |
|---|---|---|---|
| Foot Plate | 2,988.22 | 2,954.08 | 2,954.03 |
| Pedestal Column | 4,155.07 | 3,437.56 | 3,444.63 |
| Stone Masonry Foundation | 5,458.50 | 5,008.48 | 5,017.12 |
| Sloof | 5,646.94 | 4,510.52 | 4,521.17 |
| Column L1 | 2,641.50 | 2,546.80 | 2,546.86 |
| Ground Floor Slab | 10,286.14 | 7,337.77 | 7,356.47 |
| Beam | 5,600.15 | 5,268.92 | 5,281.17 |
| Column L2 | 10,064.48 | 9,307.40 | 9,302.47 |
| Second Floor Slab | 8,302.62 | 4,908.12 | 5,000.92 |
| **Total** | **55,143.63** | **45,279.65** | **45,424.84** |

Table 2 shows the comparison of reinforcement weight between the conventional method, Tekla Structure, and Autodesk Revit, Overall, the conventional method produced a total weight of 55,143.63 kg, while Tekla Structure and Autodesk Revit recorded 45,279.65 kg and 45,424.84 kg. respectively. There is a significant difference, which is around 9,700 kg or ±17.6% higher in the conventional method compared to the BIM method.

The largest difference occurred in the beam element, where the conventional method recorded 10,286.14 kg, while the results from Tekla and Revit were in the range of 7,337-7,356 kg, with a difference of more than 2,900 kg. The same was seen for the second-floor slab, with the conventional method recording 10,064.48 kg, while Tekla and Revit each recorded about 9,300 kg, a difference of about 700 kg.

The difference is also significant in the ring beam, with a difference of more than 3,300 kg between the conventional method and the BIM method. On the other hand, in the foot plate, ground floor plate, and sloof elements, the weight difference is relatively small, with a difference of only about 30-100 kg.

This difference in reinforcement weight indicates that the conventional method tends to produce overestimates because it does not consider the shape, effective length, and connections between bars in detail. In contrast, modeling using Tekla and Revit produces a



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more efficient estimate because it models the reinforcement actually according to 3D conditions in the field.

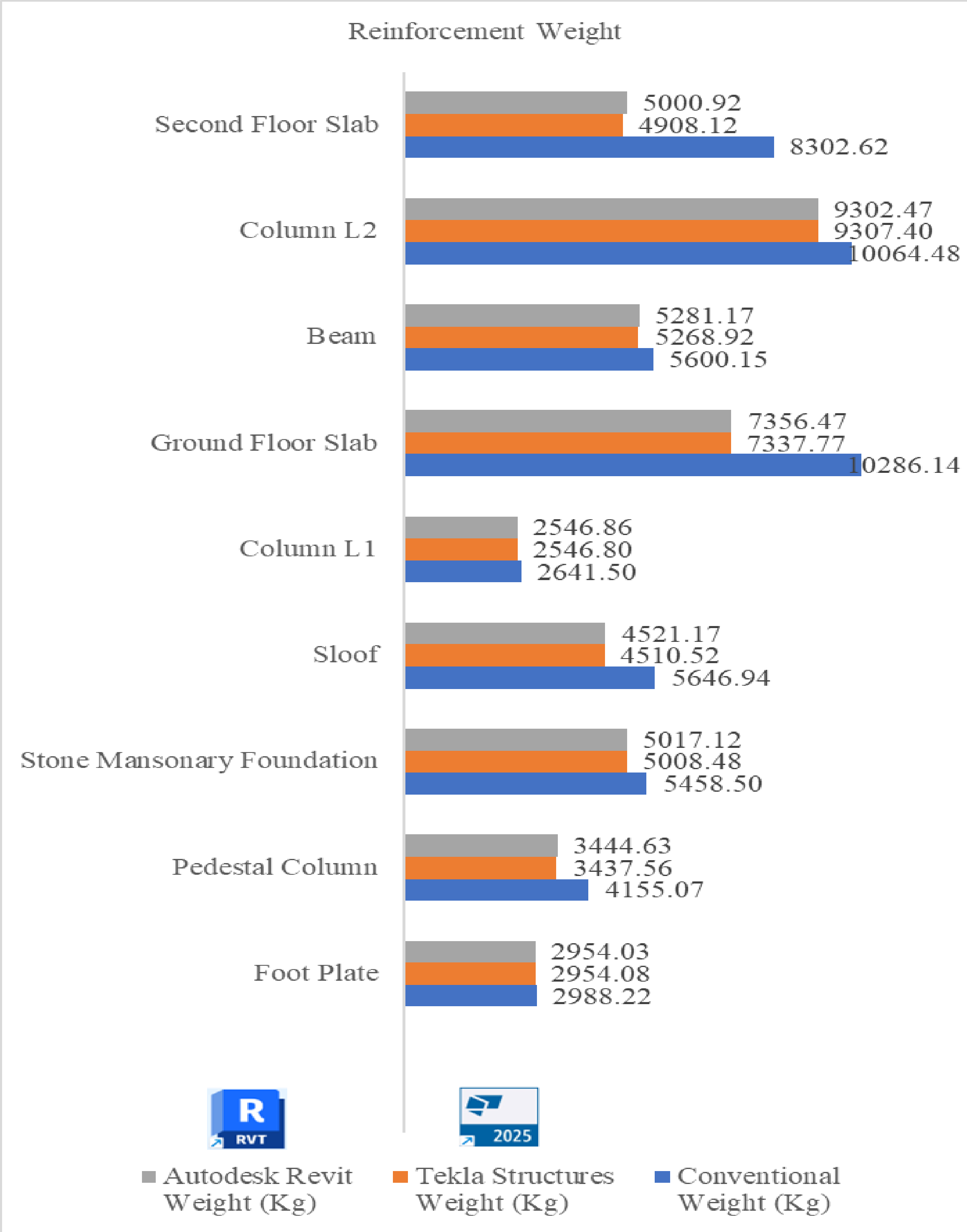


*Figure 2. Reinforcement Weight*

Figure 2 above shows the significant difference in reinforcement weight between the conventional method and two BIM software, Tekla Structure and Autodesk Revit. The element with the largest difference is the beam, with the conventional method recording a weight of 10,286.14 kg, while Tekla is only 7,337.77 kg and Revit 7,356.47 kg, resulting in a difference of about 2,950 kg or almost 30% greater.



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A large difference was also found in the ring beam, which was 8,302.62 kg conventionally, compared to 4,908.12 kg (Tekla) and 5,000.92 kg (Revit). This represents a difference of more than 3,300 kg, which reflects significant material efficiency when calculations are performed based on the 3D model. On the second-floor plate, the difference between the conventional and BIM methods was in the range of 700-760 kg, with the conventional result being 10,064.48 kg, compared to Tekla's 9,307.40 kg and Revir's 9,302.47 kg.

For other elements such as Ll columns, sloofs, and pedestal columns, the difference ranged from 600 to 1,200 kg, while the elements with the smallest difference were the foot plates and ground floor slabs, with a difference of only 30-100 kg. Overall, these consistent differences show that the conventional method tends to produce larger reinforcement weight estimates compared to the two BIM software, even when Revit and Tekla models have been created with the same level of detail. After modeling the roof structure using Autodesk Revit and Tekla Structures, the estimated weight of steel materials for each roof element was obtained. A comparison of these estimation results with the conventional method is presented in Table 3 Roof Structure Weight below:

Table 3. Weight of Roof Structure

| **Structural Element** | **Conventional Weight (Kg)** | **Tekla Structures Weight (Kg)** | **Autodesk Revit Weight (Kg)** |
|---|---|---|---|
| HWF 200.200.8.12 | 728.54 | 1,140.10 | 1,140.10 |
| IWF 200.100.5.5.8 | 79.33 | 854.90 | 854.90 |
| IWF 350.175.7.11 | 9,445.55 | 10,626.30 | 10,626.30 |
| CNP 125.50.20.3 (Purlin) | 3,733.80 | 16,835.40 | 16,835.40 |
| C75.0.75 | 497.80 | 1,245.60 | 1,245.60 |
| Roof Batten | 33.66 | 488.50 | 488.50 |
| Total | 14,518.68 | 31,190.80 | 31,190.80 |

Table 3 shows an impressive difference between the estimates of the structural weight carried out using Building Information Modeling (BIM) systems Autodesk Revit and Tekla Structures, and the traditional approach. The two BIM-based tools were able to give the same estimate of 31,190.80 kg, and the traditional calculation gave 14,518.68 kg. This difference is of large magnitude, in that it demonstrates the possibility of conventional forms of calculation to systematically understate the structural loads of a structure, especially where component parts are interdependent on one another and geometrical forms are convoluted with complex structures.

The biggest difference is seen in the example CNP 125.50.20.3 (Garding), in which the weight difference is more than 12,000 kg. This is a huge difference that cannot be ignored, because it implies that manual or natural approaches could over-simplify the dimensional assumptions of secondary structural members. In practice, these underestimates may turn into perceived risks, including inappropriate material supply, cost increase on the course of construction, or even structural safety in case the mistake remains undiscovered. By contrast, the results created by the BIM combine accurate geometric representation with material characteristics into a single framework, eliminating the chances of these kinds of errors.

This observation supports the claim that BIM tools are not simply auxiliary but critical in current structural design, particularly of roof systems which frequently have irregular spans, irregular cross-sections and many connection points. As demonstrated by the capability of BIM to describe these complexities in detail, the weight distribution and material requirements are faithfully reflected by the conventional methods. The complexity of construction projects is constantly increasing, which makes the use of conventional methods



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less sufficient, and the need to adopt digital model technologies in order to increase the precision and credibility of results should be acknowledged.

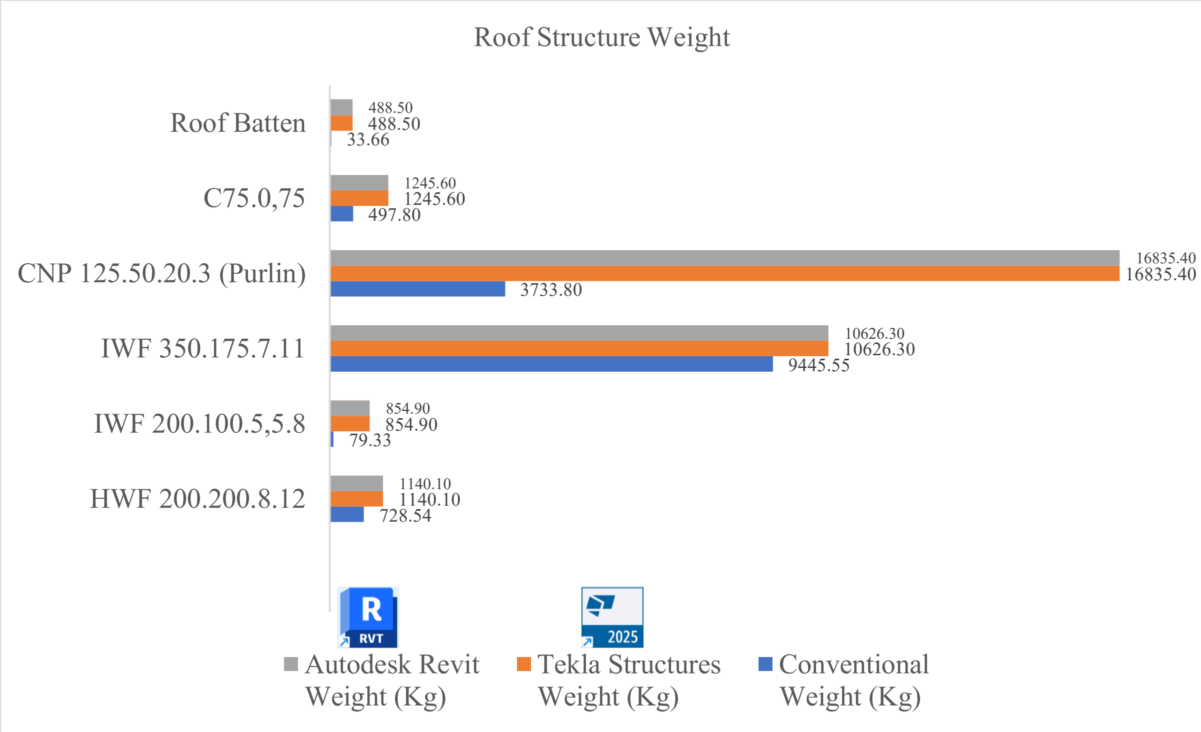


*Figure 3. Weight of Roof Structure*

Figure 3 above shows a comparison of roof structure weights between conventional methods, Tekla Structure, and Autodesk Revit. It can be seen that the estimates using Revit and Tekla show identical figures for each roof element, each producing a total weight of 31,190.80 kg. In contrast, the conventional method only yields a total of 14,518.68 kg, or approximately 53% lower than the results from both BIM software. The largest difference occurred in the CNP 125.50.20.3 (Gording) element, which in the conventional method only reached 3,733.80 kg, while the Revit and Tekla results reached 16,835.40 kg. This striking difference indicates that the conventional method may overlook actual dimensions, the number of elements, or detailed structural connections.

A significant difference also occurred in the IWF 350.175.7.11 element, with a difference of nearly 1,200 kg between the conventional and BIM methods. The large weight difference between the conventional method and BIM could potentially lead to material shortages during the construction process. This could result in work delays, project schedule delays, and additional costs due to unforeseen material requirements. Additionally, estimates that are significantly lower than actual requirements increase the risk of structural failure if the available materials cannot support the load as intended. This inaccuracy can affect workplace safety and the overall structural integrity of the building (Irwanto & Cornelis, 2025).

From a project management perspective, these estimation discrepancies also complicate procurement and logistics processes, as the quantity of materials required can change drastically. As a result, budget adjustments, rescheduling of work, and potential contract changes or additional work may be necessary, which could impact the overall stability of the project. These results further emphasize that the use of BIM enables more accurate, comprehensive calculations that align with the actual complexity of the structure, particularly for steel structural elements such as roof frames.



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## Impact of Volume and Weight Differences

The differences in concrete volume and structural material weight found between conventional methods and BIM software such as Tekla Structure and Autodesk Revit are not only numerical, but also have a significant impact on various aspects of construction project implementation (Sewoko, 2025). These differences can affect cost calculations, material procurement efficiency, structural safety, as well as time and resource management. Therefore, this section will further discuss the implications of volume and weight estimation differences on cost, safety, and overall project management aspects.

### *Impact on Project Costs*

The difference between estimated volume and material weight has a direct impact on the project budget. Inconsistencies in concrete volume calculations or excessive reinforcement weight (overestimation) using conventional methods can potentially lead to material waste, increased procurement costs, and the risk of unused material that is not utilized efficiently. Manual methods take longer and the results tend to be less precise, even though the volume difference may not be significant in numerical terms. However, in large-scale projects, even small differences can have a significant impact on total costs (Artiani & Surya, 2017; Vickerman, 2007; Xu et al., 2012; Cantarelli et al., 2010).

### *Impact on Structural Safety*

Inaccurate estimates are not only a matter of efficiency, but can also have serious implications for structural safety. If the planned volume of concrete or weight of reinforcement does not match the actual conditions on-site, it can result in material shortages during construction or, conversely, excess material without structural function, which can reduce building quality and cause delays in completion (Enshassi et al., 2010; Durdyev & Hosseini, 2020; Alaghbari et al., 2007).

### *Impact on Project Management*

Differences in estimates also affect the managerial aspects of the project, particularly in terms of time, labor, and contract changes. Significant changes in volume are one of the dominant factors in contract change orders (CCOs), which disrupt the flow of project funding and logistics. These changes not only cause difficulties for contractors, but can also disrupt the implementation schedule. Errors in planning and lack of coordination lead to project delays. One of the causes is inaccurate material estimation (Mansfield et al., 1994; Sambasivan & Soon, 2007; Shash & AbuAlnaja, 2023). This indicates that BIM, with its more precise estimation and integrated 3D documentation, can facilitate coordination among parties and reduce the risk of delays or field conflicts (Martanti, 2018; Salem et al., 2024).

Based on the analysis results and literature references, the use of BIM software such as Tekla Structures and Autodesk Revit not only improves the accuracy of material volume and weight estimates but also plays a crucial role in cost control, maintaining structural quality, and enhancing project management efficiency. Therefore, the differences found between conventional methods and BIM are not merely statistical figures but reflect significant disparities in the quality and effectiveness of construction planning.

## Selection of Autodesk Revit and Tekla Structure

Autodesk Revit is widely recognized as a leading software for architectural modeling and multidisciplinary coordination, with a more user-friendly interface. According to Lee et al. (2020), Revit is often used for the initial design stage, volume quantification, and overall building visualization. In contrast, Tekla Structure is more commonly used in the detailing


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stage, particularly for reinforced concrete and steel structures. Tekla excels in producing highly detailed models, including the configuration of joint types, fabrication methods, and accurate reinforcement placement.

This study initially aimed to examine the extent of differences in material estimates generated by the two software programs. However, the comparison results showed that the volume and weight estimates from Revit and Tekla were very similar, even nearly identical, as both models were created with equivalent levels of detail and parameters. This indicates that both Revit and Tekla are equally capable of producing accurate material estimates, with differences primarily in their approaches and the depth of their features. Therefore, the selection of these two software programs is highly relevant for analysis in building structure construction projects, as they complement each other and can be adapted to user needs at both the initial design stage and the detailed engineering stage.

## Conclusion

Based on the results of research and comparative analysis, it can be concluded that the application of Building Information Modeling (BIM) through Tekla Structure and Autodesk Revit software provides more accurate and efficient estimates of concrete volume and reinforcement weight compared to conventional methods. Conventional methods resulted in concrete volume estimates that were approximately 7.8% higher, while rebar weight estimates exceeded BIM results by up to 17.6%. This difference highlights the limitations of conventional methods in accurately representing the geometric shapes and structural connections in detail, as also noted by (Reza Fachlevi et al., 2023), where the volume difference between manual and BIM methods for structural elements ranges from 0.11 to 2.72 $m^2$. Additionally, inaccuracies in volume and material weight estimates can potentially have serious impacts on costs, time, and project management, such as changes to the Bill of Quantities (BoQ), additional work requirements, and the risk of change orders (Yuni et al., 2018). The nearly identical modeling results between Tekla and Revit indicate that both software programs are reliable in producing precise and efficient material estimates. Revit offers ease of use in terms of interface and visualization, making it suitable for beginners, while Tekla excels in detailed modeling and joint configuration, aligning with the needs of professionals in the field. The effectiveness of BIM in detecting design errors (clash detection), accelerating the quantification process, and improving planning accuracy has also been proven by (Manufaktur & Juni, 2023), which recorded cost savings of over 30 million rupiah due to the identification of design conflicts at the beginning of the project. Thus, the integration of BIM into the construction planning process has proven not only to improve estimation accuracy but also to contribute significantly to project cost control, quality improvement, and construction efficiency. Based on experience during the modeling process, Autodesk Revit is more recommended for beginners due to its intuitive and easy-to-understand interface, while Tekla Structure is more suitable for professionals requiring more complex and flexible structural modeling details.

## Suggestion

Based on experience during the modeling process, Autodesk Revit is more recommended for beginners due to its intuitive and easy-to-understand interface, while Tekla Structure is more suitable for professionals requiring more complex and flexible structural modeling details.

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