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Enhancing Cast Unit List Reports in Tekla Structures: A Guide to Template Modification

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ABSTRACT
This paper offers a comprehensive guide for refining Structural Cast Unit Reports within Tekla Structures via template modification. Tekla Structures, a powerful Building Information Modeling (BIM) software developed by Trimble, specializes in creating detailed 3D models for structural engineering projects. The Volume Recapitulation Reporting System in Tekla Structures facilitates precise measurement and reporting of structural element volumes, streamlining material estimation, cost analysis, clash detection, and progress tracking. An intriguing observation in Tekla Structures version 2023 revealed ambiguous cast unit volume data, varying between users on the same project based on their modeling approaches. This highlights the critical need for examining the reporting system's accuracy and consistency. The guide outlines a step-by-step approach to customize cast unit reports, ensuring reliable volume calculations. The method entails independent modeling of a structure using Tekla Structures, revealing a discrepancy in total cast unit volume, prompting the need for template modification. The guide then details the template modification process, including accessing the Template Editor and incorporating a new calculation column. Results demonstrate a significant enhancement in volume reporting accuracy. By modifying the template, discrepancies in cast unit volume data are rectified, ensuring consistent and reliable reporting across different users and devices. In conclusion, template customization in Tekla Structures significantly enhances project efficiency and reliability by providing accurate and consistent volume data, which is essential for transparent communication, competitive bidding, and effective project management. Future advancements in AI could further streamline these adjustments, amplifying the practical value of this approach. This guide provides actionable insights for optimizing Tekla Structures to support consistent and reliable project reporting.

Kata Kunci: *Tekla Structures, Cast Unit Reports. Template Modification*

1. PENDAHULUAN

Residential construction demands special attention. Building Information Modeling (BIM) is poised to revolutionize and enhance construction industry practices soon. Among the array of software available for BIM development, it's important to note that no single program can seamlessly cover all stages, especially in intricate infrastructure projects. Nonetheless, it's worth highlighting that Tekla stands out as a highly proficient system in the realm of BIM. Autodesk and Bentley also hold prominent positions as leading companies in the production of BIM modeling software [1].

Tekla Structures, developed by Trimble, is an industry-leading Building Information Modeling (BIM) software tailored for structural engineering and construction endeavors. This powerful platform specializes in crafting intricate 3D models of structures, enabling precise design, coordination, and construction processes. With its advanced capabilities in modeling, detailing, and clash detection, Tekla Structures effectively streamlines the entire project lifecycle, ensuring accuracy and efficiency from initial concept to final completion [2].

Tekla BIMsight has proven adept at handling substantial changes driven by architectural elements. Yet, there is potential for further improvement to ensure a smooth information flow in harmony with the design intent [3]. Continuous software refinement

is paramount to fully leverage its capacities and streamline construction processes. Tekla is pioneering a progressive development path, seeking potential synergies between the structural model, task management, and building classification systems [4].

A cornerstone of Tekla Structures is its Volume Recapitulation Reporting System, a pivotal tool for precisely measuring and reporting structural element volumes within 3D models [5]. This system plays a crucial role in streamlining various aspects of structural engineering projects, including material estimation, cost analysis, clash detection, and progress tracking. The integration of the BIM system in generating Mutual Check-0 (MC-0) documents expedites the volume verification process [6].

Punuindoong et al. conducted a comparative analysis of the BIM method and conventional calculation approaches, focusing on a single structural element, Column K1. Their study identified a discrepancy of 1,201.62 kg in reinforcement calculations, representing a 2.45% difference between the two methods [7].

Notably, an intriguing observation emerged in the report concerning Tekla Structures version 2023. It revealed ambiguous cast unit volume data, exhibiting disparities between users on the same project, attributed to their distinct modeling approaches. This revelation highlights the critical need for a comprehensive evaluation of the reporting system's accuracy and consistency. With a solid grasp of the formulation and its practical application, an approach can be effectively employed in the analysis [8].

The customization of Cast Unit Reports proves to be an essential undertaking for several compelling reasons [9]. It provides users with the capability to tailor content and layout to align precisely with specific project requirements and industry standards. This degree of customization ensures that reports effectively convey essential information to stakeholders, enhancing clarity and comprehension. Moreover, by adapting reports to suit the unique demands of each project, users can streamline workflows, eliminating extraneous details and focusing on data that holds the greatest relevance. In Hamid et al.'s research, workers' knowledge of the method for calculating concrete steel material requirements was 85.4%, highlighting the importance of precise calculations in the construction process [10]. This optimization not only enhances project management but also fosters a more efficient and organized working environment. This optimization not only enhances project management but also fosters a more efficient and organized working environment.

In the competitive realm of tender submissions, accurate volume calculations hold exceptional significance. Discrepancies in reported volumes due to software inconsistencies can lead to substantial variations in cost estimates. Such discrepancies could potentially impact the competitiveness of a bid and even give rise to disputes. Therefore, it is imperative to ensure consistent and precise volume reporting across all platforms used for tender submissions to uphold transparency and fairness in the bidding process [11]. To enhance the maturity level of knowledge management, it is essential to adhere to a regular schedule for updating information [12]. This practice ensures that knowledge remains current and relevant, contributing to the effectiveness of knowledge management processes.

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2. METHODS

When two individuals independently model the structure shown in Figure 1 using Tekla Structures, a noteworthy observation arises: upon generating the report, a discrepancy in the total cast unit volume becomes evident, as illustrated in Figure 2.

In the cast unit coding system, 'B' designates beam, 'C' stands for column, and 'PF' denotes foot plate. The column 'No' displays the quantity of units in the cast unit code, 'Name' reflects the dimensions of the cast unit, 'Area' represents the cross-sectional area of the cast unit, 'Weight' denotes the weight per unit, and 'Volume' indicates the volume per unit.

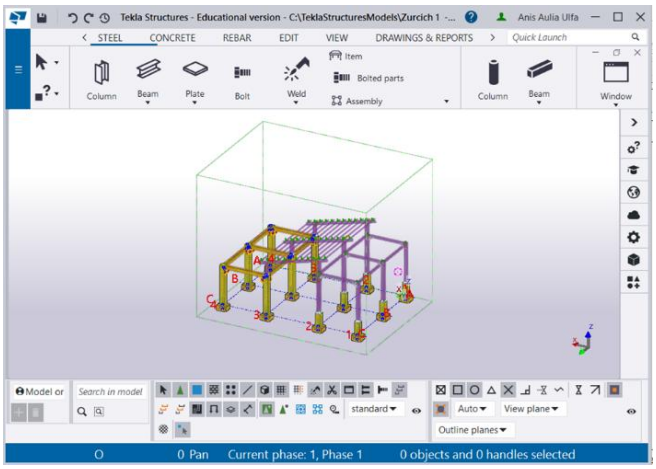

Figure 1. Basic Model in Tekla Structures

(a)

CAST UNIT LIST PROJECT NO: 0 Page: 1
PROJECT NAME: Training Project Date: 20.10.2023

Cast unit	No.	Name	Area (m²)	Weight (kg)	Volume (m³)
B1	2	300x400	6.7	1300.4	0.53
B2	1	300x400	6.7	1300.4	0.53
B3	2	300x400	6.7	1300.4	0.53
B4	2	300x400	7.4	1447.2	0.59
C1	1	500x500	3.5	917.7	0.38
C2	5	500x500	3.5	917.7	0.38
C3	1	500x500	12.0	3078.9	1.26
C4	1	500x500	12.0	3078.9	1.26
C5	1	500x500	12.0	3078.9	1.26
C6	1	500x500	12.0	3078.9	1.26
C7	1	500x500	13.3	3241.7	1.33
C8	1	500x500	13.3	3241.7	1.33
PF1	1	1000x500	4.0	1223.7	0.50
PF2	11	1000x500	4.0	1223.7	0.50
Total for 31	cast units:		117.1	28430.0	11.62

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(b)

CAST UNIT LIST PROJECT NO: 0 Page: 1
PROJECT NAME: Training Sipil Date: 20.10.2023

Cast unit	No.	Name	Area (m²)	Weight (kg)	Volume (m³)
B1	5	300x400	6.7	1300.4	0.53
B2	2	300x400	7.4	1447.2	0.59
C1	1	500x500	12.0	3078.9	1.26
C2	1	500x500	12.0	3078.9	1.26
C3	1	500x500	12.0	3078.9	1.26
C4	1	500x500	12.0	3078.9	1.26
C5	1	500x500	13.3	3241.7	1.33
C6	1	500x500	13.3	3241.7	1.33
C7	6	500x500	3.5	917.7	0.38
PF1	12	1000x500	4.0	1223.7	0.50
Total for 31		cast units:	96.3	23687.8	9.68

Figure 2. Difference report cast units on the same model, (a) report by modeler A, (b) report by modeler B

Figure 2 illustrates the same number of items with identical dimensions, yet it highlights a distinct contrast in their total volumes. Without a clear explanation, the modeler may mistakenly assume that the total volume represents the entire concrete structure. In reality, it signifies the combined volume of one representative item for each type. This total volume is contingent on the number of unique cast unit position types.

Changing the cast unit list calculation template is a skill not commonly known among modelers. For beginners, manually calculating the volume of each element by multiplying it with the total quantity can be a daunting task. This process requires extracting data and conducting calculations outside of Tekla, which proves to be time-consuming and inefficient. To streamline this process, it is crucial to enhance the formula within the cast unit report template [13]. The steps for modifying the cast unit list template are summarized in Figure 3.

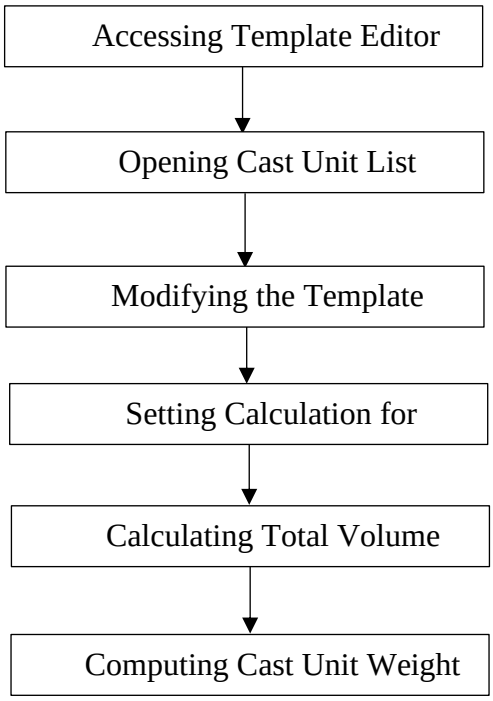

Figure 3. Steps for modifying the cast unit list template

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To access the Template Editor, follow steps in Figure 4:

- **Open the 'Tools' Menu**: Start by navigating to the top menu bar in Tekla Structures. Locate and click on 'Tools,' typically found in the upper-left corner of the screen. This initiates the first step.
- **Select 'Editor'**: After clicking on 'Tools,' a dropdown menu will appear. From this menu, choose 'Editor.' This action will open a sub-menu with various options.

Choose 'Template Editor': In the 'Editor' sub-menu, locate and select 'Template Editor.' This step is crucial for entering the template editing interface, where you can customize and modify templates according to your specific requirements.

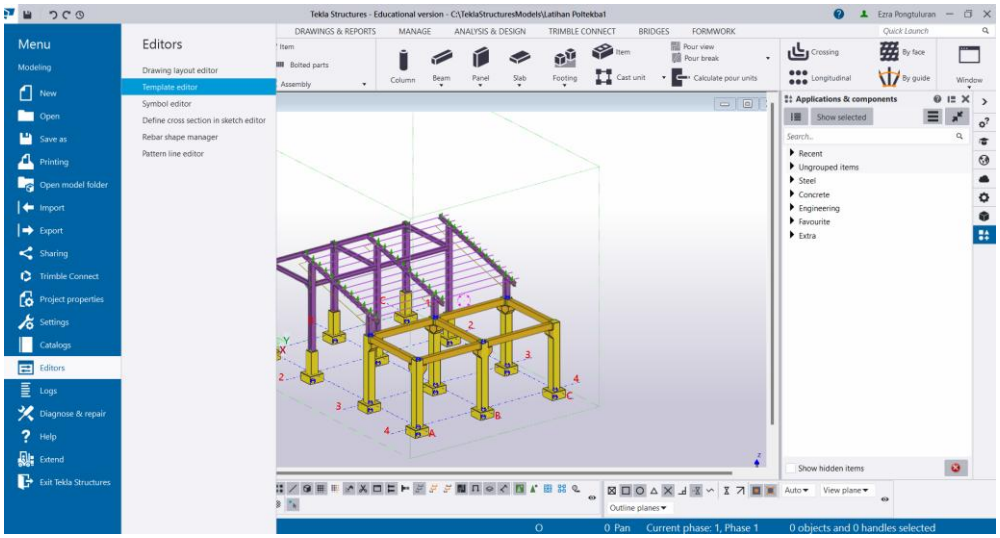

Figure 4. Steps to template editor

To access the Cast Unit List Template Editor, follow steps in Figure 5(a), (b), (c):

- **Open the Template Editor Window**: Launch Tekla Structures and navigate to the Template Editor. You can do this by clicking on "File" in the menu bar and selecting "Open."
- **Load the Template Files**: In the Template Editor window, you will need to load the relevant template files. Click on "File" in the menu bar and choose "Open." This will prompt a dialog box.
- **Locate the Cast Unit Report and Tekla Structure Template**: In the dialog box, browse to the location where your Cast Unit Report and Tekla Structure Template are saved. For instance, you can navigate to 'Windows (C:) > Program Data > Trimble > Tekla Structures > [Version] > Environments > [Your Environment] > Concrete > Reports and Templates'. Remember to adapt this path to match the environment you are using.
- Once you have opened the report file and selected the concrete template, locate and choose 'cast unit list.rpt' to access the specific cast unit list template for concrete. This step is crucial for making precise customizations to suit your project's unique requirements.

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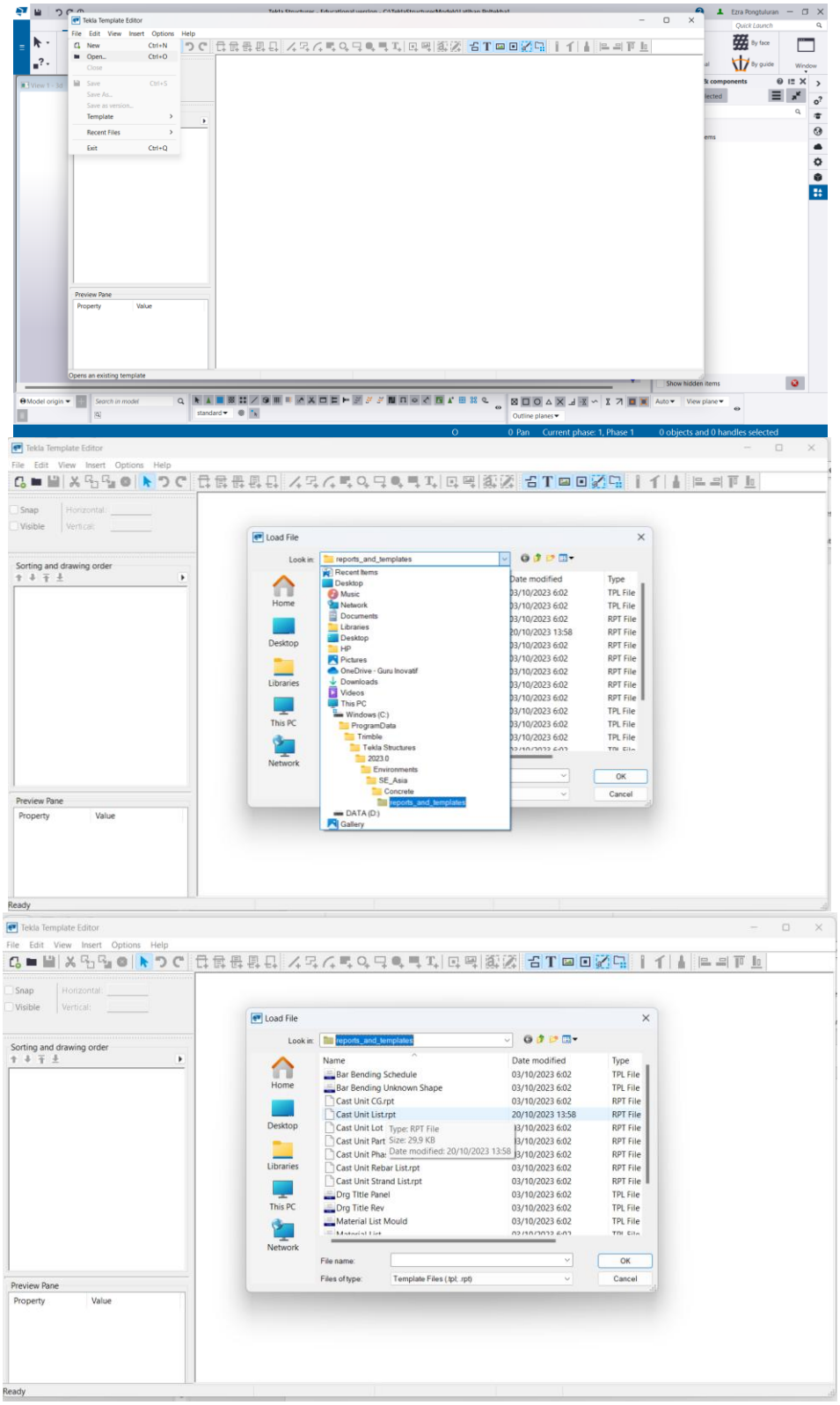

Figure 5. Steps to cast unit list template editor

Tekla Template Editor as shown in Figure 6 can customize or modify the templates to suit specific needs. Keep in mind that any changes made here will affect the way reports

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are generated in Tekla Structures. Remember to save changes before exiting the Template Editor.

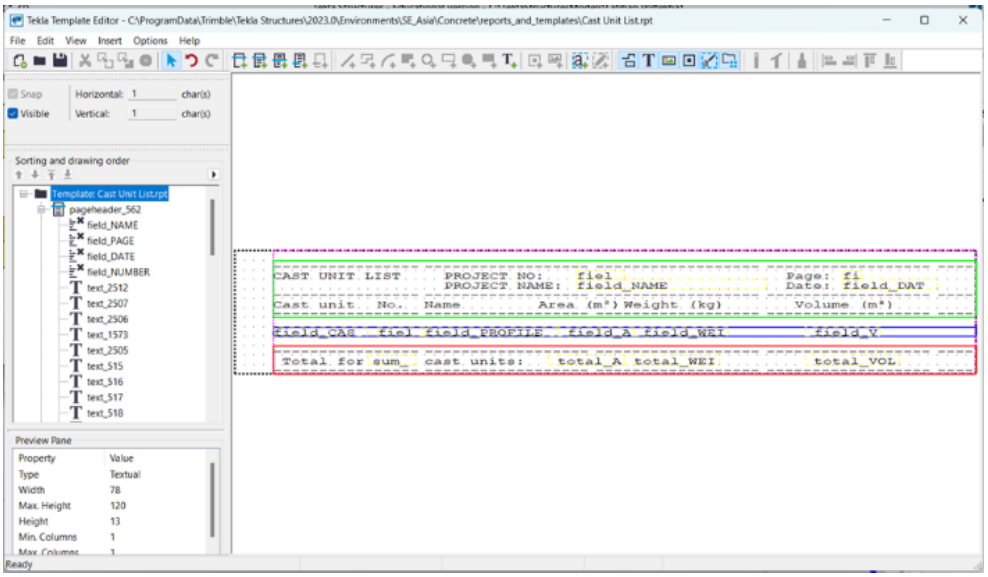

Figure 6. Tekla Template editor

The template displayed in this cast unit list currently does not aggregate volumes to provide a per-item type total. To preserve this data, keep the existing volume calculations intact and incorporate an extra column for volume summary calculations.

To seamlessly add a new calculation column to your template, follow these straightforward steps:

- **Select the Column to Duplicate:** Begin by identifying the existing column in the template that you want to duplicate. This column should serve as a reference for creating the new calculation column.
- **Highlight the Column:** Click on the existing column to highlight it. This indicates that it's the column you intend to duplicate.
- **Duplicate Using Keyboard Shortcuts:** Utilize the 'ctrl+c' keyboard shortcut to copy the highlighted column. This action stores a duplicate of the selected column in your clipboard.
- **Position the Cursor:** Move the cursor to the location in the template where you want to insert the new calculation column. This will determine the placement of the duplicated column.
- **Paste the Duplicated Column:** Press 'ctrl+v' to paste the duplicated column from your clipboard into the designated location. This creates an identical copy of the original column, complete with its associated properties and settings.
- **Customize the New Column:** With the duplicated column in place, you can now customize it to suit your specific needs. This may involve adjusting properties, formulas, or other attributes as required for your project.

By following these steps, you'll effectively incorporate a new calculation column into your template. This method offers a quick and efficient way to expand the functionality of your templates, allowing you to adapt them to the precise requirements of your

projects. To effectively differentiate between the original volume column and the newly calculated volume as shown in Figure 7, follow these steps:

- **Locate the Original Volume Column:** In your cast unit list editor template, identify the original volume column that you want to rename. This column displays the calculated volume for a specific type of item.
- **Initiate the Renaming Process:** To begin the renaming process, double-click on the section displaying the current title of the column. In this case, it will be labeled as 'Volume'.
- **Enter the New Column Title:** A text box will appear, allowing you to edit the column title. Replace the existing title, 'Volume', with the new designation you want to assign. For instance, you can name it ‘Volume Item’. This new title accurately reflects that it represents the calculated volume for a single type of item.
- **Confirm the Renaming:** After entering the new title, press 'Enter' or click outside the text box to confirm the change. The column will now display the updated title, clearly indicating its purpose.

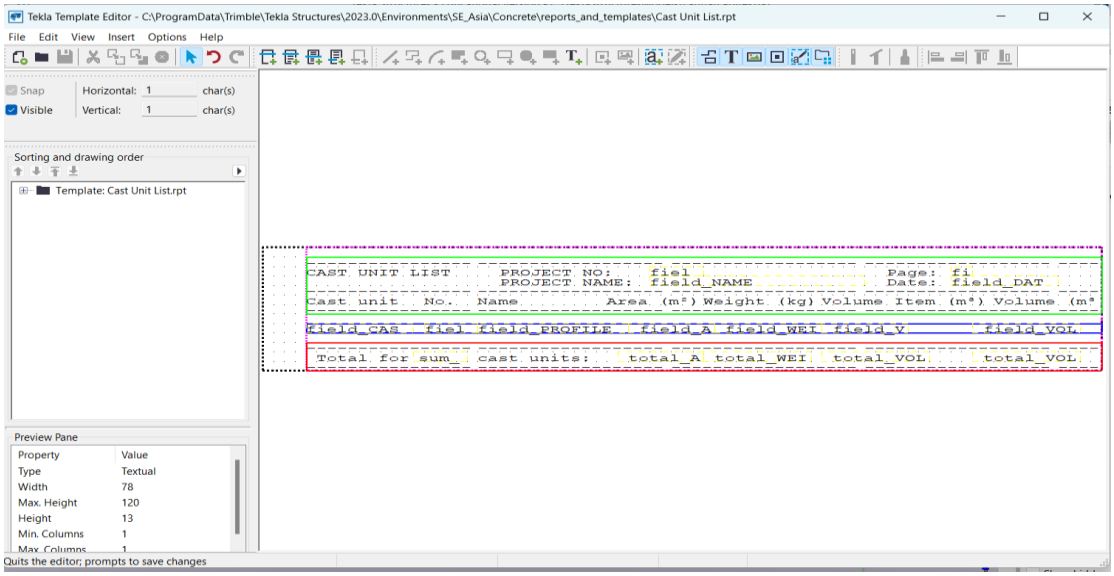

Figure 7. The alterations cast unit list editor template

- **Visualize the Alterations:** The adjustments in the column count display will be readily visible within the cast unit list editor template. These changes serve to clarify the distinction between the original and newly calculated volume columns.

By following this action, a window or dialog box (as illustrated in Figure 8) will likely appear. Within this window, you'll discover options to tailor or adjust the volume calculation to meet your specific requirements. To refine the representation of volume per item, modify the 'Format: Name' in this field to 'field_VOLUME_ITEM'.

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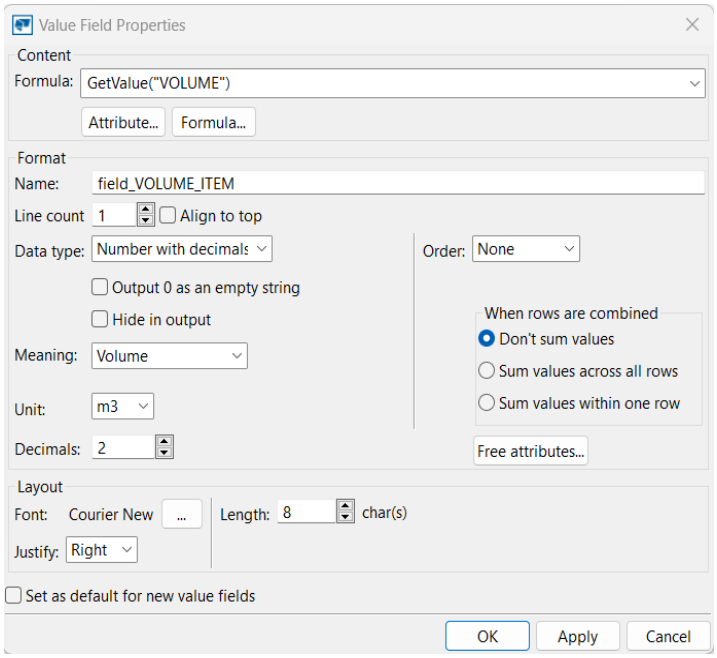

Figure 8. 'VOLUME_ITEM' field properties

Given the alteration in the name format to 'field_VOLUME_ITEM', it follows that the formulation for total item volume must also be adjusted to 'Total("field_VOLUME_ITEM")' as shown in Figure 9.

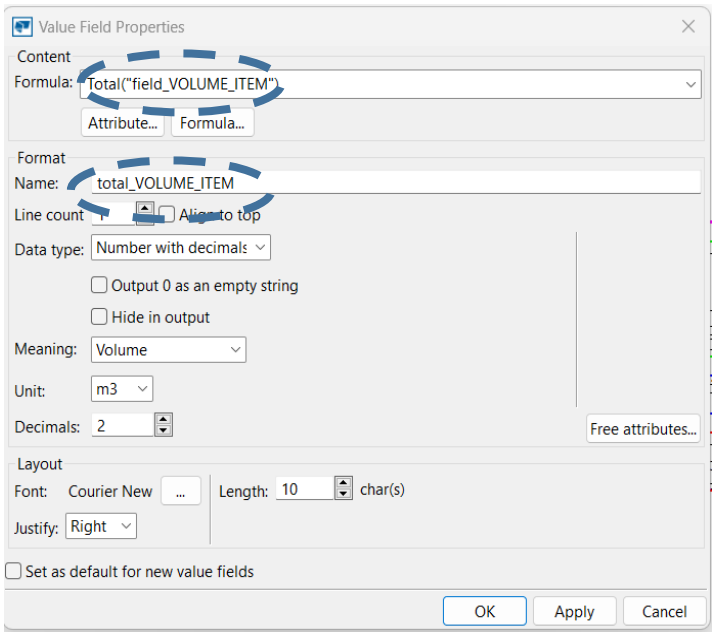

Figure 9. 'total_VOLUME_ITEM' field properties

A new calculation field has been introduced, as illustrated in Figure 6. To modify the formula for calculating the total volume of concrete to be cast, double-click on the new 'field_Vol' and make the adjustments as depicted in Figure 10.

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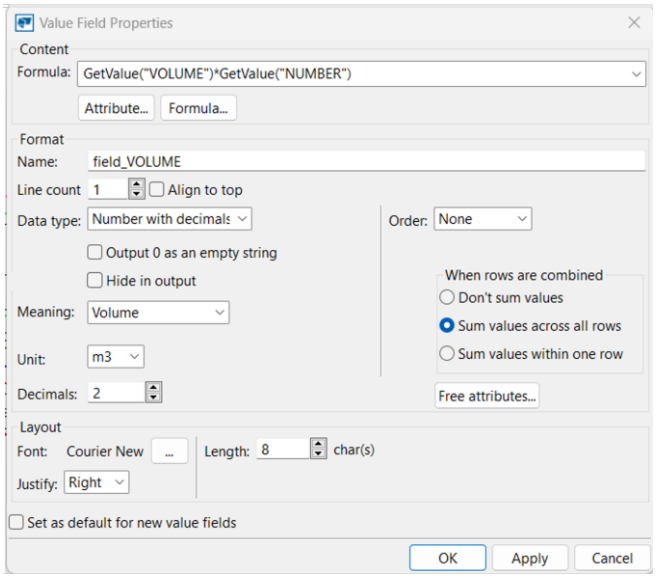

Figure 10. 'VOLUME' field properties

To calculate the total concrete volume, multiply the volume per unit item by the quantity of each item. This can be achieved using the formula 'GetValue("Volume") *GetValue("Number")'. The initial formula 'GetValue("Volume")' is applicable, provided 'Sum values across all rows' is selected. To differentiate the volume calculation per item from the overall volume, it's essential to specify a unique 'Format: Name' in the template editor. The modified properties of the new value field can be observed in Figure 11. Ensure that the total volume formula corresponds to the 'Format: Name', specifically 'Total("field_Volume")'.

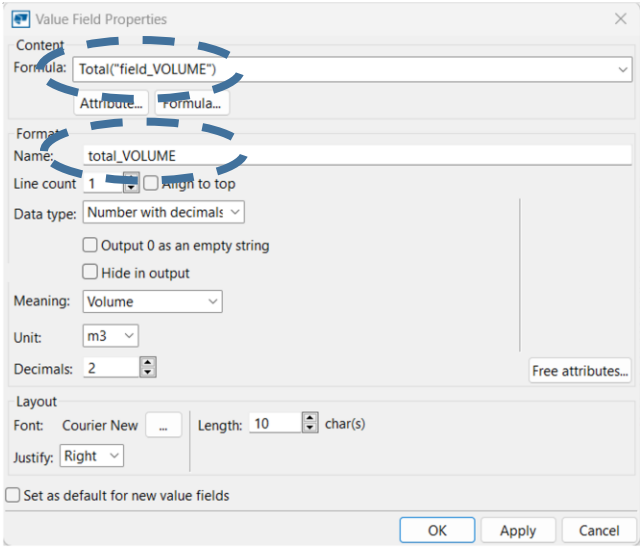

Figure 11. 'Total_VOLUME' field properties

To compute the cast unit weight in the cast unit list, follow the same steps. Double-click on 'total_WEIGHT' in the editor, and choose 'sum values across rows' under 'when rows are combined'. Refer to Figure 12 for a visual guide.

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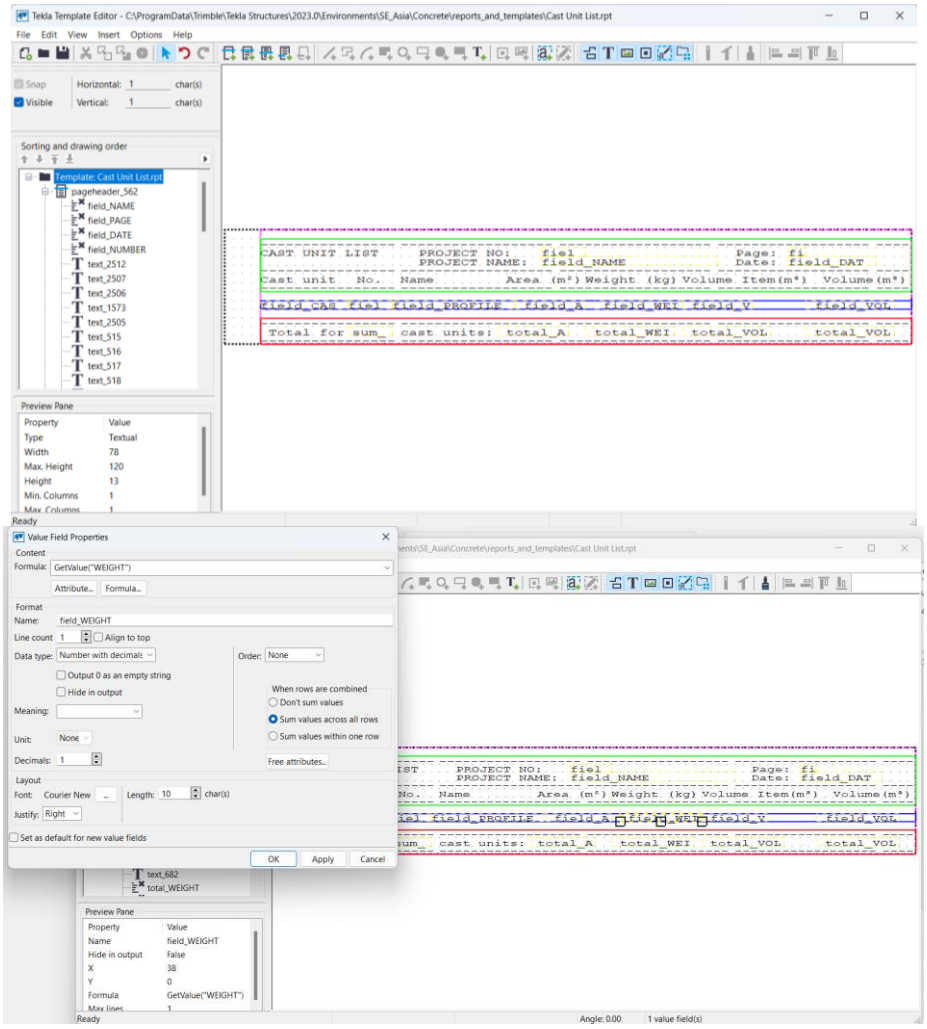

Figure 12. 'Total_WEIGHT' field properties

3. RESULTS AND DISCUSSION

The new cast unit list report streamlines the process of obtaining detailed information about concrete elements. By clicking on 'Drawings & Reports > Reports' and selecting 'cast unit list' from the available templates, users can efficiently generate this report. For a comprehensive view, it's advisable to choose 'Create from all'. If any existing files need to be replaced, simply follow the prompts.

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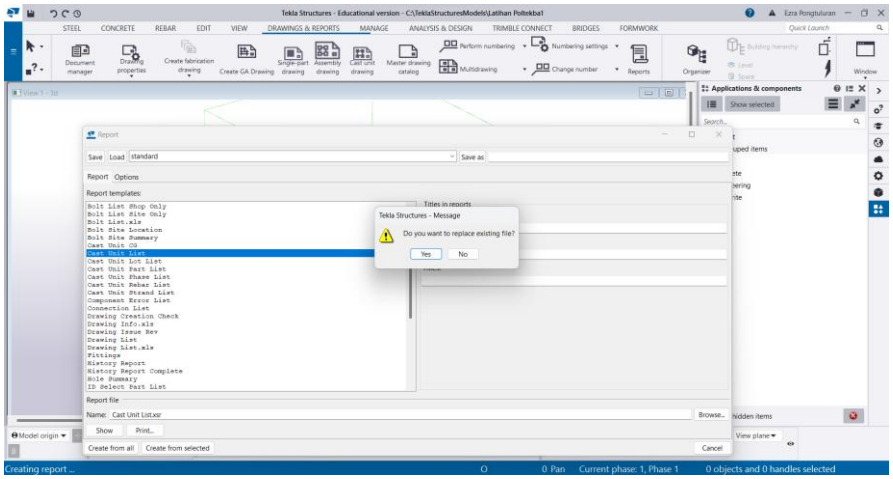

Figure 13. Steps to cast unit list report

This straightforward process is depicted in Figure 13, ensuring that you have access to an updated and precise cast unit report. When the template editor has been modified and subsequently applied to the same project, even when handled by different modelers or on various devices, the total volume and weigth results will consistently yield the same outcome. In comparison with Figure 2, Modeler A initially calculated a cast unit volume of 11.62 m³, whereas Modeler B arrived at 9.68 m³. However, following modifications, Figure 14 demonstrates a clear alignment in the total cast unit volume and weight obtained by both modelers working on the same project. Both Modeler A and Modeler B achieved a consistent volume of 19.78 m³, indicating a successful standardization of results. This uniformity persists even though the modelers employed different approaches and varied the number of cast unit types. Importantly, the overall weight and volume of the cast unit remain unchanged across both modeling methods.

CAST UNIT LIST PROJECT NO: 0 Page: 1
PROJECT NAME: Training Project Date: 25.10.2023

Cast unit	No.	Name	Area (m²)	Weight (kg)	Volume Item (m³)	Volume (m³)
B1	2	300x400	6.7	2600.8	0.53	1.06
B2	1	300x400	6.7	1300.4	0.53	0.53
B3	2	300x400	6.7	2600.8	0.53	1.06
B4	2	300x400	7.4	2894.5	0.59	1.18
C1	1	500x500	3.5	917.7	0.38	0.38
C2	5	500x500	3.5	4588.7	0.38	1.88
C3	1	500x500	12.0	3078.9	1.26	1.26
C4	1	500x500	12.0	3078.9	1.26	1.26
C5	1	500x500	12.0	3078.9	1.26	1.26
C6	1	500x500	12.0	3078.9	1.26	1.26
C7	1	500x500	13.3	3241.7	1.33	1.33
C8	1	500x500	13.3	3241.7	1.33	1.33
PF1	1	1000x500	4.0	1223.7	0.50	0.50
PF2	11	1000x500	4.0	13460.2	0.50	5.50
Total for 31		cast units:	117.1	48385.7	11.62	19.78

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CAST UNIT LIST PROJECT NO: 0 Page: 1
PROJECT NAME: Training Sipil Date: 25.10.2023

Cast unit	No.	Name	Area (m²)	Weight (kg)	Volume Item(m³)	Volume(m³)
B1	5	300x400	6.7	6502.0	0.53	2.66
B2	2	300x400	7.4	2894.5	0.59	1.18
C1	1	500x500	12.0	3078.9	1.26	1.26
C2	1	500x500	12.0	3078.9	1.26	1.26
C3	1	500x500	12.0	3078.9	1.26	1.26
C4	1	500x500	12.0	3078.9	1.26	1.26
C5	1	500x500	13.3	3241.7	1.33	1.33
C6	1	500x500	13.3	3241.7	1.33	1.33
C7	6	500x500	3.5	5506.5	0.38	2.25
PF1	12	1000x500	4.0	14683.9	0.50	6.00
Total for 31		cast units:	96.3	48385.7	9.68	19.78

Figure 14. Modified report cast units on the same model, (b) modified report by modeler B

The implementation of custom templates in Tekla Structures serves as a pivotal advancement in optimizing project workflows. By aligning templates with specific project requisites and industry benchmarks, essential tasks such as material estimation, cost analysis, clash detection, and progress tracking are expedited. This streamlined process significantly enhances overall project efficiency, ultimately leading to timely and cost-effective project deliveries.

Moreover, the enduring value of custom templates extends beyond the immediate project. They serve as invaluable documentation and references for future endeavors. This repository of knowledge streamlines the initiation and planning phases of subsequent projects, offering a substantial competitive advantage. As a result, the adoption of custom templates in Tekla Structures not only brings about immediate efficiency gains but also establishes a foundation for sustainable success in future projects.

In essence, custom templates represent a transformative tool within Tekla Structures, revolutionizing the way structural engineering projects are approached. Their impact spans the entire project lifecycle, from expediting critical tasks to bolstering stakeholder relationships and providing a reservoir of knowledge for future endeavors. The adoption of custom templates is not merely an enhancement; it is a strategic imperative that empowers projects to reach new levels of efficiency and effectiveness.

4. CONCLUSION

In conclusion, this guide highlights the essential steps to enhance Structural Cast Unit Reports in Tekla Structures through template modification. By customizing templates, users can align reports with specific project requirements and industry standards, optimizing communication and project management. The observed discrepancies in cast unit volume data in Tekla Structures version 2023 underscore the need for accurate reporting. Through template modification, users can ensure consistent and reliable volume calculations. This process not only improves efficiency but also enhances transparency in tender submissions. By leveraging custom templates, projects in Tekla Structures stand to benefit from heightened efficiency, improved stakeholder communication, and long-term value through reusable designs. Remember to save changes before exiting the Template Editor to implement these enhancements effectively. Customizing templates in Tekla Structures is paramount for precise and efficient structural engineering projects. It enables tailored communication, streamlines workflows, and ensures accurate reporting. The observed discrepancies in version 2023 highlight the need for consistent reporting. Looking ahead, as technology advances, we anticipate even more sophisticated customization options. Integration of AI and machine

learning may automate template adjustments, further enhancing efficiency. Staying updated with these technological trends will be crucial for the future of structural engineering.

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