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A Comparison between STAAD.Pro and Tekla Structure Software for RC Design and Analysis

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Abstract : The purpose of this project is to conduct an in-depth investigation of the major features of two commonly used structural analysis and design software programmes, STAAD.Pro and Tekla Structure software. Each software application has its own set of features, analysis options, design and output options, as well as limitations, and benefits. To avoid failure, it is necessary for the user to exploit all of the advantageous features of a specific software programme. To complete the design and analysis, the geometry has been set before and the materials used to design and analyse the geometry are Columns, Beams and Slabs by using predefined specifications. As a result, STAAD.Pro and Tekla Structure can run and analysis the geometry predefined and produce different output result and data. The data analysis from both softwares show a minor differentiation of unit accuracy and STAAD.Pro has advance features to set up rather than Tekla Structure but Tekla Structure produce easily mainframe for a beginner user.

Keywords: Analysis, RC Design, STAAD.Pro, Tekla Structures, Simulation

1. Introduction

STAAD.Pro is modelling and analysis software that assists in the modelling and analysis of required models, as well as a FEM tool [1]. Tekla Structural software is a design, modelling, detailing, and fabrication tool for structural engineers. Tekla Structure includes interactive modelling, structural modelling and design, and automated drawing generation. It can generate drawings and reports from the 3D model automatically at any time [2]. Tekla Structures design and modelling can be created from 2D drawings, 3D models, or referenced architectural drawings [3]. This project is aimed at carrying out to explain how to use both software by knowing its functions in more detail where it can facilitate users to design a project. It is also to determine which software is more user friendly. In addition, it can also be used as a manual or guide for new users. It is also a comparison between the features found in both software. Other than that, it is to analyse the 3 designs to obtain the main objective which are identify significant features found in both software such as equipment or functions that are only found in one of the more user-friendly software, identify the level of accuracy of units and scales in designing a project

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structure and identify the output of the final result issued by the final report by using both software STAAD.Pro and Tekla Structure.

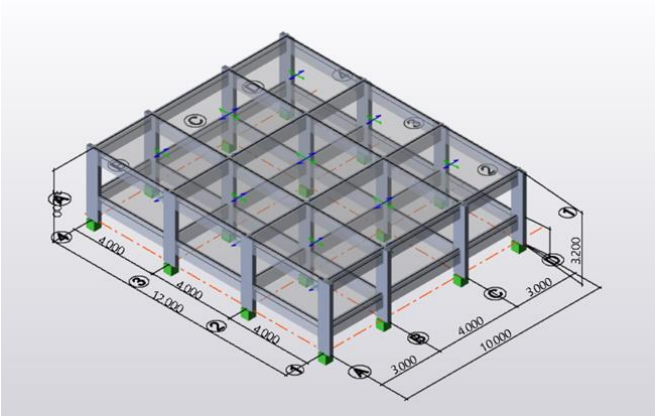

Figure 1: Geometry of RC Design

Figure 1 above shows the geometry to be design and analysis by STAAD.Pro and Tekla Structure. The dimensions of the geometry has been set up for all columns, beams and slabs. The geometry used the same standard that is United Kingdom (Eurocode) specification.

2. Materials and Methods

To conduct this project, the materials and methods of the sproject must be planned thoroughly. This part will be discussed about the materials that have been used and the methodology to run both software to complete the geometry in **Figure 1**.

2.1 Materials

The materials used to produce the geometry using STAAD.Pro and Tekla Structures are column, beam, and slab. The material used for column and beam are the same. Besides, the material used for slab are reinforcement concrete, the concrete type is normal, using concrete class C32/40 [5].

Table 1: Materials used for STAAD.Pro and Tekla

	Material	Fabrication	Concrete type	Concrete class	Section
Column	Concrete	Cast-in-place	Normal	C32/40	200mm x 600mm
Beam	Concrete	Cast-in-place	Normal	C32/40	200mm x 600mm

Slab							
Slab type	Deck type	Concrete type	Concrete class	Dry density	Dry weight/Area	Wet weight/Area	Maximum crack width
Slab on beam	Reinforcement concrete	Normal	C32/40	2500kg/m³	2.452kN/m²	2.550kN/m²	0.3mm

Table 1 shows the specification for each material used for Columns, Beams and Slabs. All of the materials used a same concrete class that is C32/40. Strong commercial grade concrete is C32/40. It can be employed when applying large, heavy weights to constrained spaces and when significant structural strength and support are needed [6].

Type of load used in this geometry is dead load and live load. Dead load using floor load 7kN/m^2 and -1 factor of selfweight and live load using 5kN/m^2 for floor load and -1 factor of selfweight.

2.2 Methods

The modelling and design process in STAAD.Pro [9] and Tekla structurec[10] can be summarized into the following general workflow process, which is implied by the on-screen organization of the program's tabs.

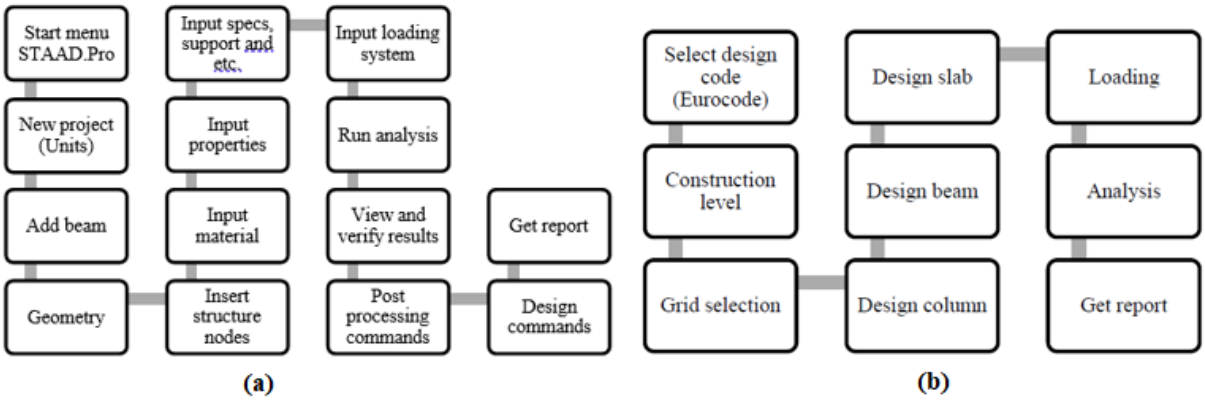

Figure 2: Flow Work of (a) STAAD.Pro and (b) Tekla Structures

Figure 2 shows the flow work of STAAD.Pro and Tekla Structure. [9] [10] It shows that Tekla Structure is more easily and user friendly mainframe and set up rather than STAAD.Pro. However, STAAD.Pro is more advance features and functionality to a high level users.

3. Results and Discussion

After running the analysis test of displacement and moment for the design selected for STAAD.Pro and Tekla Structures, the output data and reports was downloaded and being examined. The recorded result from both software has been compared and the result data has been utilize to discuss the result swiftly. The result might be presented as a table and figures to ease understanding. The result covered design diagram, RC Beam result, RC Column and Slab result.

3.1 Results

After run the analysis, The data has been recorded and compared each software. The data from both software has been compared about bending Moment ($M_{direction}$), Force acting on beams, Shear and Tensile Stress to see the differentiation of unit accuracy.

Table 2: Comparison of Bending Moment on Beam between both software

Software	Beam	Distance (m)	Mx (kN-m)	My (kN-m)	Mz (kN-m)
STAAD.Pro	12	2	-0.058	-42.034	3.541
	54	2	0.069	-137.709	-1.131
Tekla Structure	12	2	-0.063	-42.031	3.547
	54	2	0.072	-138.033	3.551

Table 2 shows the bending moment comparison for the selected beam between STAAD.Pro and Tekla Structure after analysis the geometry predefined. The data shows a minor difference in unit accuracy.

Table 2: Comparison Shear Stress and Tensile Stress and Compressive Stress on Beam between both software

Software	Beam	Distance (m)	Shear Stress (kN)		Tensile Stress (N/mm^2)	Compressive Stress (N/mm^2)
			Max FZ	Max Fy		
STAAD.Pro	12	2	92.089	2.500	-10.712	13.638
	54	2	-89.795	2.336	-10.485	13.032
Tekla Structure	12	2	91.983	2.477	-10.712	13.643
	54	2	-90.014	2.318	-10.369	Error

Table 3 shows the data comparison of Shear Stress and Tensile Stress for the selected beam between STAAD.Pro and Tekla Structure. The data of the comparison shows a little bit difference value of unit accuracy.

3.2 Discussions

STAAD.Pro produce a better platform for analysing at high scales. It is because STAAD.Pro produce more precise range of unit accuracy. STAAD.Pro also comes with a better output result to be deliver to the engineer rather than Tekla Structure. Output result of STAAD.Pro very complete and systematic.

Tekla Structure produce a simple and user friendly platform for analysing. It is suitable for a beginner user to learn about structure analysis and designing geometry. The unit accuary of Tekla Structures is a little bit inaccurate. However, the range value of the result still can be use in the geometry. Output result of Tekla Structure is simple to understand and systematically.

3.3 Figure

Figures shows the result in the diagrams mode from STAAD.Pro and Tekla Structure to show the animations of the simulation. It has different output result of diagrams from both software and deliver with different styles.

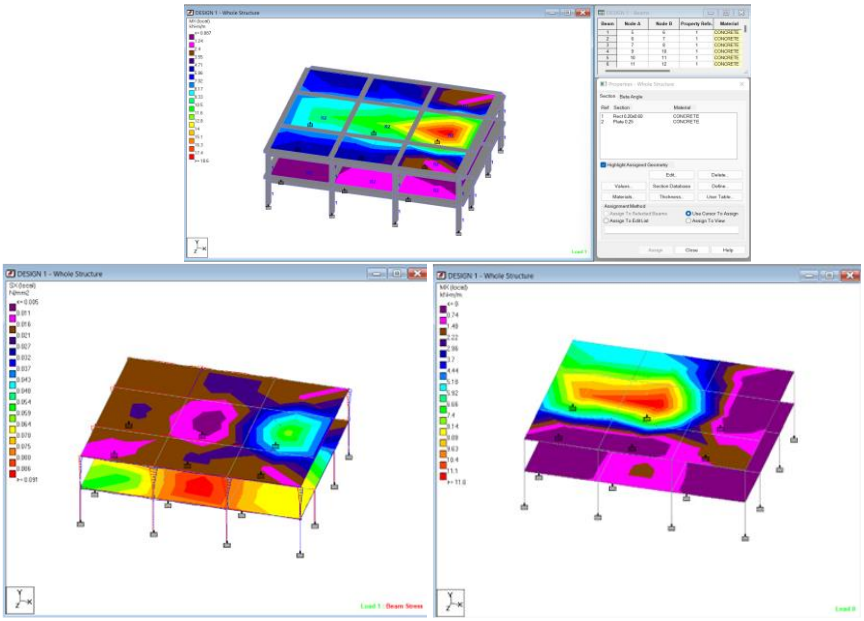

Figure 3: Output Result in Diagrams of STAAD.Pro

Figure 3 shows the output result from STAAD.Pro at post processing mode. At this mode user can get the diagram view or animation of beam stress, plat, stress, animation of deflection, displacement and bending moment. It also shows the diagram by member or whole structure.

4. Conclusion

From the above discussions, it is evident that Tekla structure incorporates well provisions from various standards and therefore the results accordingly are more accurate. However, STAAD.Pro provides more flexibility in modeling the structures and in the design details. [7] There are reports that this software many a times provides results which do not confirm the requirements of codal provisions. Such limitations of every software need to be explored and rectified for better confidence of the designer. Further, the software can be made more users friendly. In conclusion, both software have their own special characteristics but STAAD.Pro provide a better platform to make a design and analysis rather than Tekla Structure. However, Tekla Structure has a simple and user friendly platform for a beginner user to design and analysis because Tekla was automatically set the properties to the user and can combine reinforcement concrete and steel trusses directly.

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Appendix

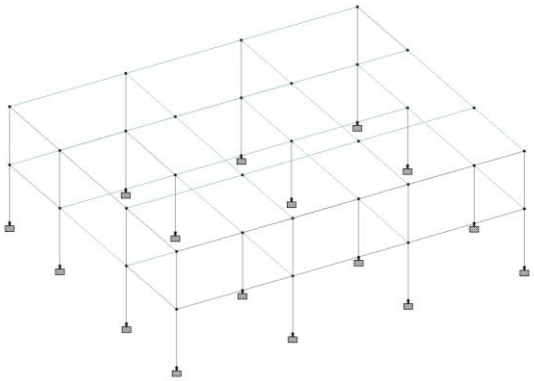

Figure 4: The Mainframe of Geometry in STAAD.Pro

Figure 5 shows the mainframe of geometry in STAAD.Pro. In STAAD.Pro, to make a geometry is using node and line and must be define the material and properties after finish the geometry. It doesn't directly clarify the member as beam or column at geometry process.

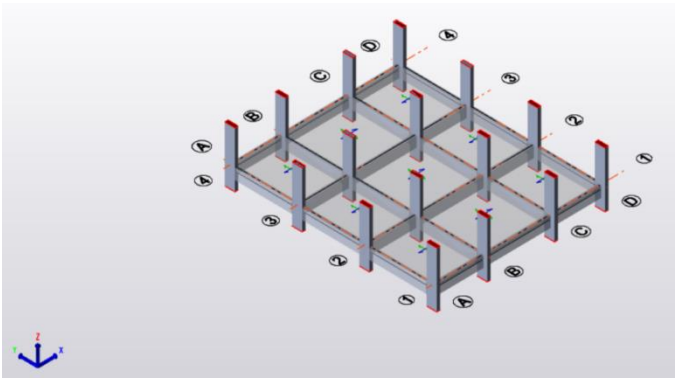

Figure 5: The mainframe of Geometry in Tekla Structure

Figure 6 shows the mainframe of geometry in Tekla Structure. In Tekla Structure, to make a geometry is directly using columns, beams and slabs design. We just need to choose the materials and specification of the columns, beams and slabs before assigning it.

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