

Design Of Structural Truss And Fabrication Modeling In Tekla

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Abstract- This project focuses on the modeling and detailing of a structural truss using Tekla Structures software, aiming to understand the complete process of planning, modeling, and preparing fabrication drawings within one integrated platform. Tekla Structures is used to create an accurate 3D model of truss components, including members, gusset plates, and connections, ensuring that every part is represented correctly. From this detailed model, general arrangement (GA) drawings and fabrication drawings are automatically generated, which help in construction and workshop manufacturing. The use of Tekla Structures improves precision, minimizes human errors, and saves time when compared to traditional manual drafting methods. The software allows easy modification and updates, which makes it convenient when any design changes occur during the project. All modeling and detailing work in this project follows relevant Indian Standard codes to maintain the structural safety, stability, and reliability of the truss. The project also highlights how Tekla integrates design, detailing, and fabrication in a single workflow, allowing engineers, fabricators, and contractors to collaborate effectively. This integration not only enhances productivity but also improves communication between different project teams. Through this project, it becomes clear that Tekla Structures is a highly effective tool for truss modeling and detailing, as it provides a realistic 3D visualization and ensures that fabrication drawings are accurate and ready for use in construction. Overall, the project demonstrates the practical benefits of using Tekla Structures in modern structural engineering, especially for improving accuracy.

Keywords- Tekla Structures, Truss, Fabrication.

I. INTRODUCTION

Structural steel trusses are one of the most important load-carrying systems used in modern civil engineering construction. They are widely adopted in industrial buildings, warehouses, workshops, bridges, stadiums, railway platforms, aircraft hangars, and roof structures because of their high strength, lightweight nature, and economical performance. A truss is formed by connecting straight members in a triangular arrangement so that loads are transferred efficiently through axial tension and compression forces. Due to this triangular configuration, trusses can cover large spans without the need for intermediate supports, thereby providing large open spaces and better functional utility in structures.

In recent years, the construction industry has shifted from traditional manual drafting methods toward digital modeling and Building Information Modeling (BIM) technologies. Among the available BIM software applications, Tekla Structures has become one of the most advanced and reliable tools for structural steel modeling, detailing, fabrication, and project coordination.

One of the major advantages of Tekla Structures is its ability to integrate modeling, analysis, detailing, and fabrication within a

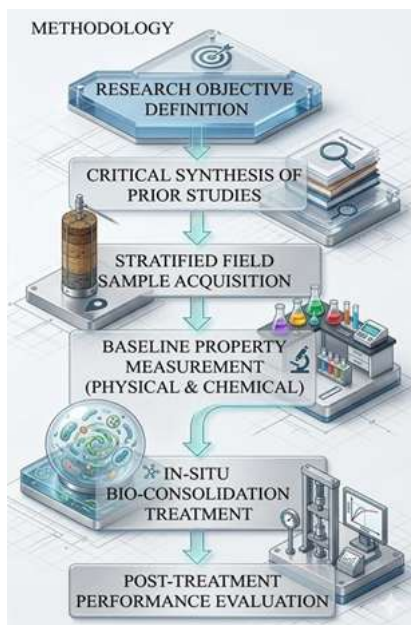
single platform. In conventional drafting methods, engineers spend significant time preparing manual drawings and revising them whenever design modifications occur. The software enhances detailing accuracy, minimizes drafting errors, and streamlines the fabrication process. This integrated workflow improves project efficiency, ensuring that the truss design meets structural stability, fabrication precision, and construction quality standards.

Tekla Structures enables engineers and designers to create accurate three-dimensional models of structural components with precise dimensions, material specifications, and connection details. The software also allows automatic generation of fabrication drawings, general arrangement drawings, material lists, bolt schedules, and CNC data for manufacturing processes. The main purpose of this project is to study the design, modeling, detailing, and fabrication process of a structural steel truss using Tekla Structures software. The project focuses on understanding how modern digital tools improve the efficiency, accuracy, and quality of structural engineering works. Through Tekla Structures, every member of the truss such as top chord members, bottom chord members, verticals, and diagonals. The software enhances detailing

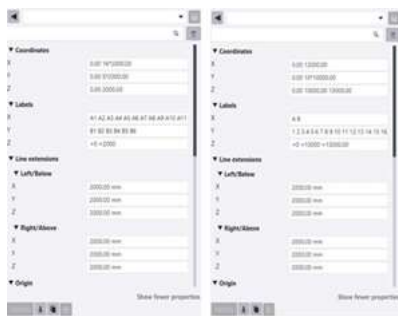
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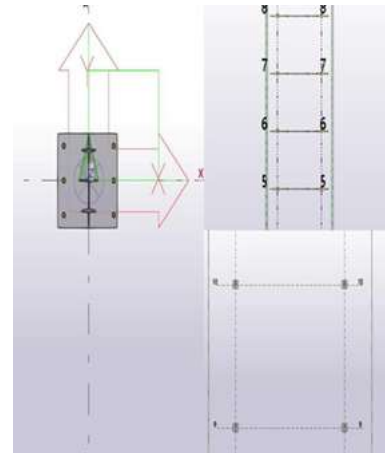
II. METHODOLOGY



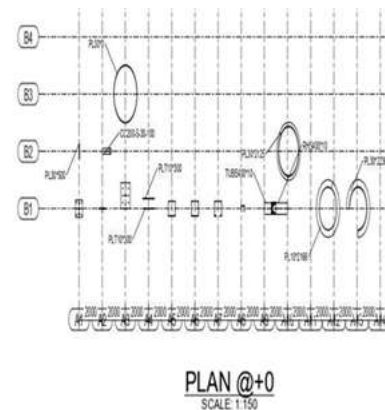
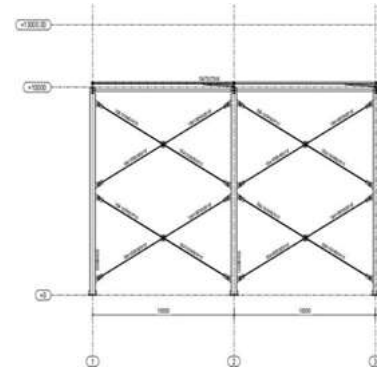
GRID PLANS (TRUSS AND FABRICATION)



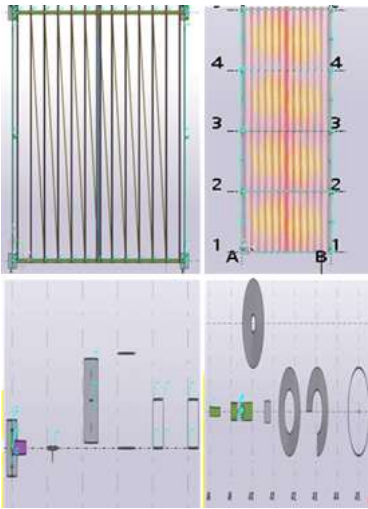
Base Plate



Cross Section



TOP VIEW



Plan And Details

1. Breadth & Length of Truss = 12 m x 10 m (10 Pannels)
2. Square feet of a Truss = 40' ft x 32' ft
3. Clear Span = 11m
4. Total sq.m = 1190 Sq.m
5. Number of Panels = 10
6. One Roof Panel Size = 12m x 10m
7. Truss Rise (Depth) = 1.0m
8. Floor Levels in Model = Ground floor only
9. Support Condition = One end hinged, one end roller
10. Material Grade = Steel Fe415
11. Section Types Adopted = ISMB, ISA, RHS
12. Load Data (as applied) = Bolted and welded gusset plate connections
13. Analysis Method = D.L = 1.0Kn/m, L.L = 1.0kN/m = 2.0Kn/M
14. Analysis Method = Pin-jointed truss, axial forces computed
15. Deflection Check = Max Δ = 21 mm \leq Allowable Δ = 33.8 mm

III. ANALYSIS

General

Tekla structures 2025 has been used in this project to create a detailed 3D model of the structural truss system. The software allows accurate modeling of members, connections, plates, and supports, which can be directly used to generate fabrication

drawings, part lists, and assembly details. Tekla ensures precision in dimensions, material quantities, and detailing, thereby reducing human error and improving constructability.

Analysis Report

The structural truss has been modeled in Tekla Structures 2025 according to the required span and geometry. Member properties such as section sizes, lengths, and material grades were assigned. Connections were detailed using gusset plates, bolts, and welds. The software provides tools to visualize the structure under applied loads and to extract fabrication-ready information.

Geometry Creation – Defining gridlines, levels, and the overall span of the truss.

Member Modeling – Assigning sections to top chords, bottom chords, and web members.

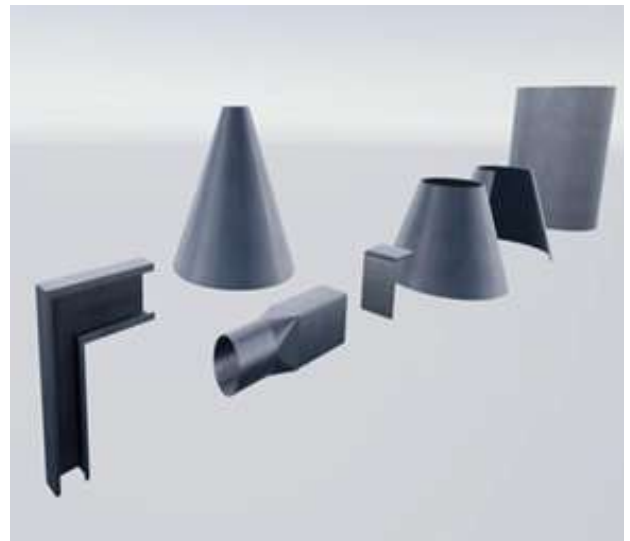
Connection Detailing – Adding gusset plates, bolts, and welds for stability.

Support Definition – Specifying column supports and base plate connections.

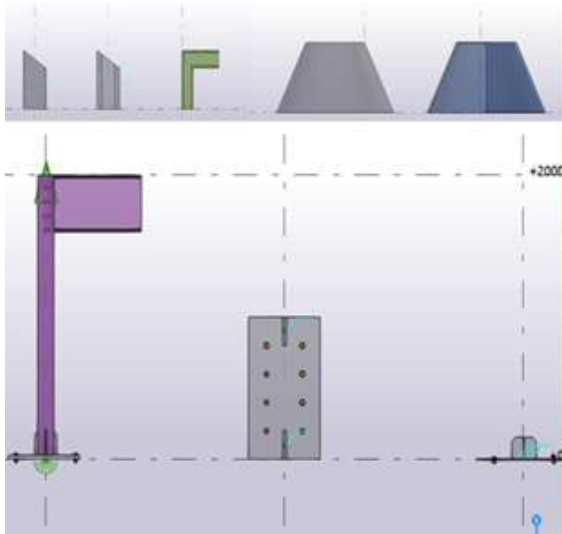
Drawing Generation – Extracting general arrangement drawings, fabrication drawings, and shop drawings.

Reports – Generating bills of materials (BOM), part lists, and assembly details).

Realistic View



Fabrication Views



Base Plate Connection

The base plate is an essential structural component that connects the steel column or truss end to the foundation, ensuring proper load transfer and alignment. In industrial truss systems, it plays a vital role in transmitting compressive, shear, and bending forces safely to the supporting concrete pedestal or footing. The base plate distributes the concentrated load over a larger foundation area, preventing local crushing and improving overall structural stability.

The Tekla structures, the modeling of base plates is performed with high precision using built-in connection tools. Engineers can define parameters such as plate thickness, material grade, bolt layout, weld size, and anchor rod configuration. Tekla automatically generates 3D connection models, fabrication drawings, and material takeoff lists, which minimize human error and enhance productivity during detailing and erection stages.

The industrial truss applications, base plates are mainly used at support nodes and column ends to ensure rigidity and prevent uneven settlements. Tekla's integrated modeling and detailing tools make base plate design accurate, economical, and compliant with modern steel fabrication standards. IS 800, AISC, and Eurocode specifications. Additionally, Tekla's interoperability with CNC and fabrication management systems streamlines the production process, reducing human errors and optimizing cost and time in industrial truss construction projects.

Technical Importance:

- Provides uniform load transfer from truss members to foundations.
- Maintains alignment and stability of industrial truss columns.
- Allows code-based verification and design optimization.
- Generates accurate hole locations, weld lengths, and cutting profiles.
- Facilitates smooth assembly and quality control during fabrication.

IV. MATERIAL LIST MATERIAL LIST IN TEKLA

In Tekla Structures, the material list serves as a comprehensive report generated in compliance with Indian Standard (IS) codes for structural steel design and detailing. It systematically presents the specifications of all modeled components, including member designation, section profile, material grade, cutting length, unit weight, and quantity. This report facilitates precise material estimation, procurement scheduling, and fabrication planning. The list conforms to IS 2062 for steel grades, IS 808 for hot-rolled sections, IS 1730 for plate dimensions, and IS 800 for general construction practices. All parameters are represented in millimeters (mm) and kilograms (kg) as per Indian measurement standards. In industrial truss assemblies, it enumerates members such as rafters, tie beams, columns, base plates, and gusset plates. Overall, the material list enhances accuracy, optimizes resource management, minimizes manual intervention, and ensures standardization in fabrication and erection processes within the structural steel industry.

Key Points:

- Standards Used: IS 2062 (Steel Grade), IS 808 (Sections), IS 1730 (Plates), IS 800 (Construction).
- Information Shown: Type of member, dimension, length, weight, and total number.
- Units: All values are shown in millimeters (mm) and kilograms (kg).
- How to Create: Go to Reports → Material List → IS Template in Tekla.
- Use in Truss Projects: Includes rafters, tie beams, columns, and base plates.
- Benefits: Increases accuracy, reduces mistakes, helps in estimation, and follows Indian standards.

V. RESULTS AND DISCUSSION

The results obtained from the modeling, analysis, and fabrication detailing of the structural steel truss using Tekla Structures clearly demonstrate the effectiveness of modern digital tools in structural engineering. The project aimed to design a safe, economical, and fabrication-ready truss system, and the outcomes confirm that these objectives have been successfully achieved. The discussion below critically evaluates the structural performance, modeling accuracy, fabrication efficiency, and practical relevance of the results obtained.

The truss system considered in this study has a span of 12 m with 10 panels and is subjected to a uniformly distributed load of 2.0 kN/m, which includes both dead load and live load. The total load acting on the truss was calculated as 22 kN and was distributed as joint loads at the top chord nodes. The structural analysis performed in Tekla confirms that the load distribution is uniform and symmetric. The reactions at both supports were found to be equal, each carrying 11 kN, which validates the assumption of symmetrical loading and proper modeling of boundary conditions. This result indicates that the support conditions—one hinged and one roller—are correctly defined and allow the structure to behave as expected.

The internal force distribution in the truss members follows the classical theory of pin-jointed trusses. The top chord members are primarily subjected to compressive forces due to their position in resisting downward loads, while the bottom chord members experience tensile forces. The web members, including diagonals and verticals, carry either tension or compression depending on their orientation and position within the truss. This alternating force pattern confirms that the structure is efficiently transferring loads from the roof to the supports. The absence of significant bending moments in the members further validates the assumption that the joints behave as pin connections, which is a fundamental principle in truss analysis.

One of the most important parameters in structural performance is deflection. The analysis results show that the maximum deflection of the truss is 21 mm, which is well within the permissible limit of 33.8 mm as per IS 800:2007. This indicates that the structure is sufficiently stiff and will not experience excessive deformation under service loads. The deflection result also reflects that the selected member sizes are appropriate and that the truss geometry provides adequate rigidity. A lower deflection value improves the durability of the structure and ensures user comfort in practical applications such as industrial sheds and roof systems. The geometric

proportions of the truss were verified using the span-to-depth ratio (L/D), which was calculated as 11. This value lies within the recommended range of 6 to 12, confirming that the truss design is both structurally efficient and economical. A proper L/D ratio ensures that the truss is neither too shallow, which would increase bending stresses, nor too deep, which would increase material usage and cost.

Another critical aspect of the design is the slenderness ratio of compression members. The analysis confirms that all compression members satisfy the slenderness limit of 180 as specified in IS 800. This ensures that the members are safe against buckling failure, which is a major concern in steel structures. The selection of appropriate cross-sections such as ISMB, ISA, and RHS contributes to maintaining the slenderness within acceptable limits. The utilization ratio of the members is also maintained below 0.85, indicating that the members are not overstressed and have an adequate margin of safety. The connection detailing plays a significant role in the overall performance of the truss. In this project, gusset plates, bolted connections, and welded joints were modeled accurately using Tekla Structures. The base plate connections effectively transfer loads from the truss to the foundation, ensuring stability and proper alignment. The end plate connections provide rigidity and ensure efficient transfer of axial and shear forces between members. The precise modeling of connections ensures that there are no misalignments or fabrication errors, which are common in manual drafting methods.

A major advantage observed in this project is the high level of accuracy achieved in 3D modeling. Tekla Structures enables the creation of a detailed and realistic model that includes all structural components such as members, plates, bolts, and welds. This level of detail helps in visualizing the entire structure before actual construction, reducing the chances of errors. The realistic views generated in the software provide a clear understanding of the structural arrangement, which improves communication between engineers, fabricators, and contractors.

The fabrication outputs generated from the model are highly accurate and ready for practical use. The software automatically produces general arrangement drawings, fabrication drawings, and shop drawings. These drawings include all necessary details such as dimensions, connection layouts, and material specifications. The automation of drawing generation significantly reduces the time required for manual drafting and eliminates human errors. This is particularly beneficial in large-scale projects where accuracy and speed are critical.

The bill of materials (BOM) generated from the model provides a comprehensive list of all structural components, including their sizes, quantities, lengths, and weights. This information is essential for material procurement, cost estimation, and project planning. The accuracy of the BOM ensures that there is no shortage or excess of materials, thereby reducing wastage and improving cost efficiency. The ability to extract quantities directly from the model is a significant advantage over traditional methods, where manual calculations are prone to errors.

VI. CONCLUSION

The project titled “Design of Structural Truss and Fabrication Modeling in Tekla” was successfully completed with the objective of understanding the planning, modeling, analysis, detailing, and fabrication processes involved in steel truss construction. The study mainly focused on the use of Tekla Structures software for creating a detailed three-dimensional model of a structural steel roof truss system. Through this project, the importance of modern Building Information Modeling (BIM) technology in structural engineering and steel fabrication was clearly understood.

Steel trusses are widely used in industrial sheds, warehouses, workshops, and long-span roof structures because of their high strength, lightweight nature, and economical performance. In this project, the truss members, gusset plates, purlins, columns, base plates, and structural connections were modeled accurately using Tekla Structures. The software provided a realistic visualization of the structure, helping to understand the arrangement and interaction of all structural components. The use of a 3D modeling environment improved design clarity and reduced the possibility of errors during fabrication and erection stages.

The structural design and analysis of the truss were carried out according to Indian Standard codes such as IS 800:2007 and IS 875. Important structural checks including span-to-depth ratio, support reactions, axial force calculations, slenderness ratio, buckling resistance, and deflection limits were studied and verified. The analysis confirmed that all structural members were within permissible stress and deflection limits, ensuring the safety, stability, and serviceability of the structure under the given loading conditions. One of the major advantages observed during this project was the integration capability of Tekla Structures. The software combines modeling, detailing, fabrication drawing preparation, and material quantity estimation within a single platform. Unlike conventional manual drafting methods, Tekla automatically updates

drawings and reports whenever modifications are made in the model. This feature reduces human errors, saves time, improves accuracy, and enhances coordination between engineers, fabricators, and contractors.

The project also emphasized the importance of fabrication detailing in steel construction. Tekla Structures automatically generated fabrication drawings, assembly drawings, bolt schedules, weld details, and bills of materials directly from the 3D model. These outputs are highly useful in workshop fabrication and site execution because they provide precise dimensions and connection information. The software also supports CNC data generation, which improves fabrication quality and minimizes material wastage during production.

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