



International Journal of Innovative Research in Science Engineering and Technology (IJIRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 8.524

Volume 14, Issue 1, January 2025

Design and Analysis of Roof Truss

Supriya T K, Muralidhara T K

Lecturer, Department of Civil Engineering, DACG Govt. Polytechnic, Chikkamagalur, Karnataka, India

Senior Scale Lecturer, Department of Mechanical Engineering, DACG Govt. Polytechnic, Chikkamagalur,
Karnataka, India

ABSTRACT: The planning a steel roof trusses using the ETABS software the functional parameters relevant to the design of the facility would comprise those related to the user's requirement and guided by the design standard norms, standards by – laws and municipal of different experts such as architect, planner and structural engineer etc.

Based on the final results, the design has been performed and drawings were prepared using ETABS.

KEYWORDS: Roof Truss, ETABS, Structural Analysis, Seismic Design, Steel Structures

I. INTRODUCTION

Roof trusses are widely used structural elements for covering large spans in industrial and commercial buildings due to their high strength-to-weight ratio and economy. In seismically active regions such as Nepal, proper truss design plays a crucial role in ensuring structural safety and performance. Reinforced concrete buildings often face ductility and detailing challenges, while steel trusses provide flexibility, faster construction, and durability. This paper presents an analytical study of trusses with reference to Indian Standards IS 1893-2002, IS 800-2007, and IS 875-1987.

The planned building is single storey tall building with roof truss. The functional parameters relevant to the design of the facility would comprise those related to the user's requirement and guided by the design standard norms, standards by-laws and municipal by-laws. Architectural and planning design criteria have been made with the consultation of different experts such as architect, planner and structural engineer etc.

II. TYPES OF TRUSS

Basically, there are two types of truss on the basis of design and working mechanism.

1. Pitched truss
2. Parallel chord truss

Pitched Truss:

Pitched truss is characterized by its triangular shape. It is most often used for roof construction. In a pitched truss, the chord (upper stringer) and bottom (lower stringer) are not parallel. The chord of the truss is extended outward like an arch or a cone. The extend of the truss provide extra strength to the truss. The pitched trusses are used in constructing roof of the buildings, especially in the area of snowfall. The cone shaped roof does not allow the snowfall to dump on the roof while making the snowfall slip down from the edges of the roof.

Parallel Truss:

It is named from its parallel top and bottom chords. It is often used for roof construction. A parallel truss is made of the parallel chord and bottom. The chord and the bottom run straight in a parallel path. The both the stringers (chord and bottom) are interconnected by means of struts (the connecting rods). If compared, the pitched trusses are stronger than the parallel truss. A parallel truss is generally used instead of girders and beams.

III. LITERATURE REVIEW

Several studies have been conducted on the design and optimization of roof trusses using STAAD Pro and ETABS. Mohakul et al. (2014) discussed industrial shed design, highlighting material economy. Khogare (2014) analyzed multistorey steel buildings under wind and seismic loads. Kumar et al. (2016) studied Howe trusses of varying spans

for optimal geometry. Patrikar et al. (2016) optimized Fink trusses using Fully Stressed Design methodology. Parekh et al. (2017) compared angle and tube sections. Chouhan et al. (2017) compared ETABS and STAAD analysis of trusses. Meher et al. (2018) studied load effects on industrial warehouses. These studies collectively indicate the importance of optimization, load considerations, and software-based modeling for effective truss design.

IV. METHODOLOGY

The analysis was carried out using ETABS Ultimate Version 18.1.1. The process involved defining grid systems, material properties, and sections based on Indian Standards. Dead loads included self-weight of truss members and cladding, while live loads accounted for maintenance activities. Wind and seismic loads were applied in compliance with IS 875 (Part 3) and IS 1893. Load combinations were automatically generated by the software. Models were developed for spans of 9m, 12m, and 15m, and structural elements were checked for strength, deflection, and stability.

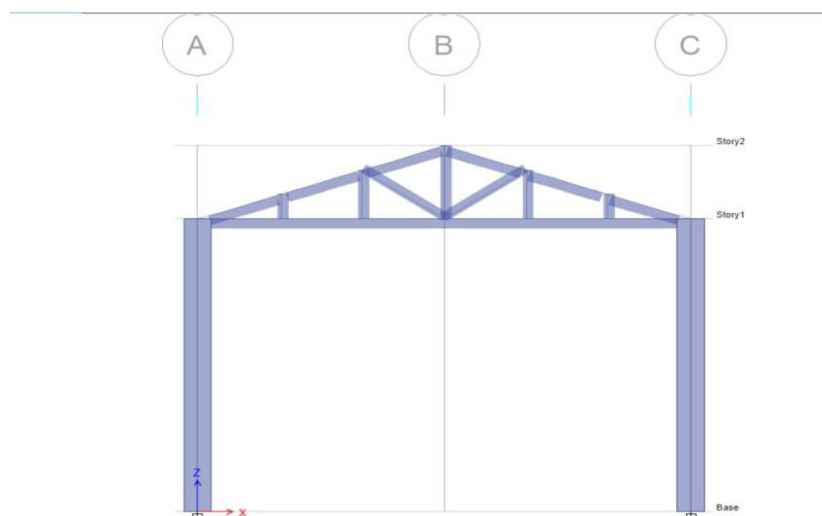
The analysis carried out on ETABS software is performed step by step with the following process.

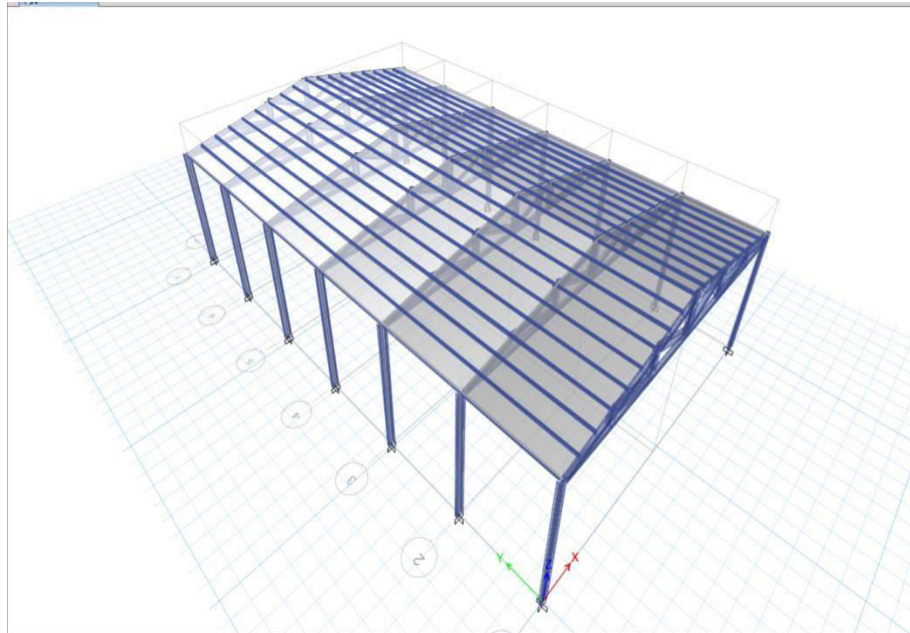
1. Open ETAB software, click on file & select new model
2. Select base units and design code
3. Set up grids and story data according plan
4. Define material properties
5. Define section properties
6. Modelling of structure
7. Assign loads like dead load, live load, wind load, earthquake load.
8. Form the load combinations
9. Do the analysis and model check

V. RESULTS AND DISCUSSION

The ETABS analysis provided shear force diagrams, moment diagrams, and deformation patterns for the modeled trusses. The results demonstrated that trusses efficiently distribute applied loads with minimum material usage. The 15m span truss exhibited higher deflection compared to shorter spans, but remained within permissible limits. Steel sections such as ISA 200x200x25 and ISMB500 were found suitable for the analyzed spans. Comparisons with conventional beams showed that trusses provided greater economy and strength-to-weight ratio.

MODEL ANALYSIS





BEAMS

DESIGN OF STEEL BEAMS

- Beams span between support to carry loads which are resisted by bending and shear. However, deflections and local stresses are also important. Beams may be cantilevered simply supported, fixed ended or continuous.
- The main uses of beams are to support floors and columns, carry roof sheeting as purlins and side cladding as sheeting rails. Common beams sections.

- Universal beam – most efficient section for uniaxial bending
- Universal column - less efficient, can be used where the depth is limited
- Compound beam – universal beam + flanges, used where universal beam are not strong enough.
- Crane beam – universal beam + channel used when the beam has to resist both horizontal and vertical moment.

When composite beam design is performed, the program automatically creates 3 types of load combination design code

1. Calculate Characteristic loads that act on the beam.
2. Define properties of steel beam.
3. Cross section classification.
4. Shear verification.
5. Lateral torsional Buckling verification.
6. Bending verification.
7. Deflection verification.

VI. RESULTS FROM ETABS

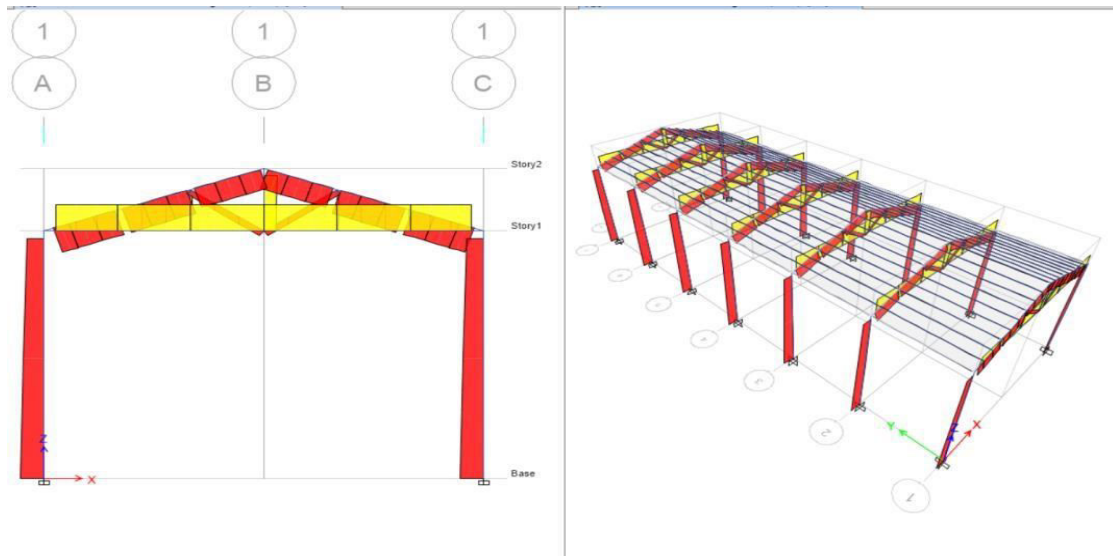


Fig1: Shows the Shear force diagram (live) KN

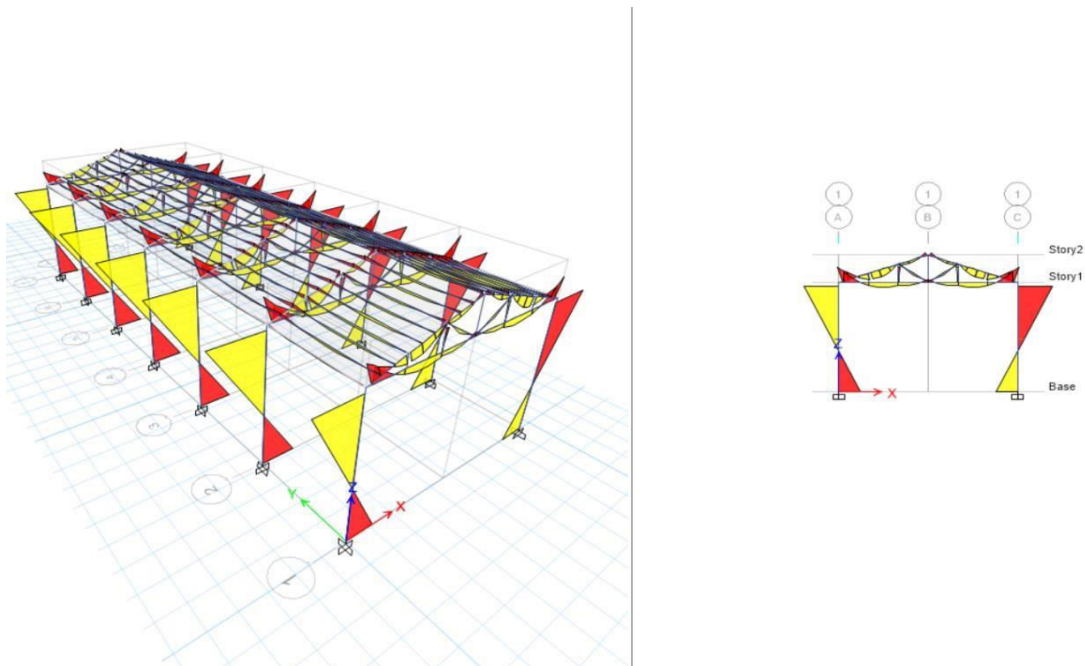


Fig 2: Shows the Moment diagram

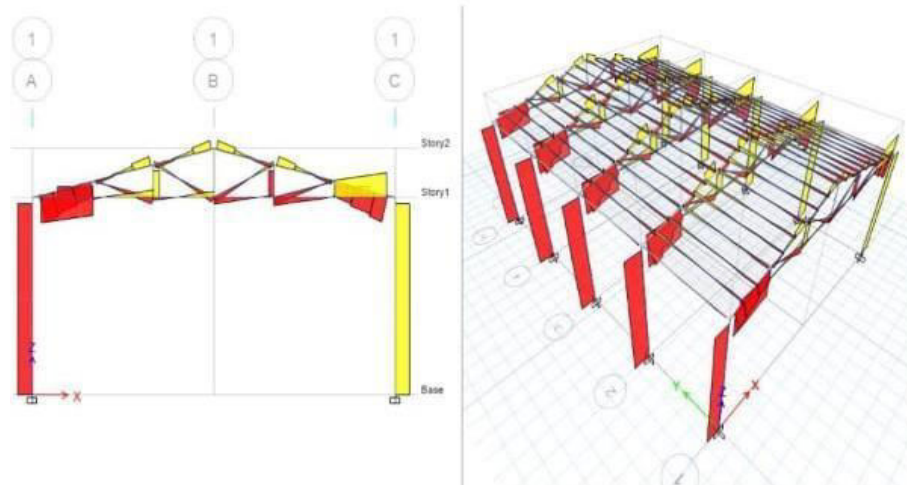


Fig 3: Shows the Shear force diagram (Dead) KN

VII. CONCLUSION

This study confirmed that roof trusses offer an economical and structurally efficient solution for covering large spans, especially in seismic regions. The use of ETABS enabled detailed analysis and optimization of structural members under various load combinations. The findings support the use of steel roof trusses in industrial and commercial applications, offering reduced material consumption and enhanced durability. Future work may involve life-cycle cost analysis and integration of advanced optimization techniques for further efficiency.

- Trusses are used in many structures due to their low weight and high strength in large areas without use of columns, which is one of the advantages of the truss.
- The truss is a building invented that allows the weight of a roof to be distributed to outer walls for better supports.
- Truss gives more supports and allows to the builders to use fewer materials to achieve any construction.
- It increases the mean life span of any construction like bridges and buildings.
- It also have higher maintenance demand of all joint and fitting, more calculation to determine that it will be take maximum load.
- The structure of truss is triangular, which is the most stable and at the same time the simplest possible geometric shape.
- Truss plays a vital role in our surrounding i.e., everywhere like in bridge, building, rooftop, etc.

REFERENCES

- [1] Avanti patrikar, k.k.pathak, "fully stressed design of fink truss using STAAD Pro software", open journal of civil engineering, pp631-642, 2016
- [2] Kavitha ghogare, Dr.Sk deshmun, "stability analysis of industrial shed subjected to wind load", international journal for engineering application and technology, ISSN2321-8134, pp78-81, 2014
- [3] Miss kavitha k ghogare, "seismic analysis and design of multi storey steel building", international journal for researching applied science and engineering technology, vol.2 issue XI, pp.364-372, November 2014
- [4] Subrakant mohakul, Dr. Sheikh yajdani, abhay dhurde, "design of international shed and analysis of stresses produced on failure of a joint", international journal of civil engineering and technology, vol.5 issue 8 pp114-127, 2014
- [5] Er.sanjeev kumar, brahamjeet singh, Er. Bhupendra singh, "optimization of roof truss using STAAD Pro V8i", international journal of recent research ascepts, vol.3, issue1, pp86-90, march 2016
- [6] Tejas D. Parekh, disha parmar, yathi tank "analysis of howe roof truss using different rise and span", international journal and trends technology, vol.47 no.3 pp116-147, may 2017
- [7] Shilpa chaohan, rohith Sharma, abhishek guptha, "optimization of steel truss configuration for structural efficiency using STAAD Pro and ETABS", international journal of advanced research in science and engineering, vol.6, issue 9, pp.994-1004, 2017

- [8] Rajath playa, leependra singh raghuvanshi, “study on different truss structure for wear house design”, international journal of mechanical and production engineering, vol.5 issue11, pp.117-120, November 2017
- [9] Shivani mehar, ruchithanar, sadichha jagadale, gowthami kalal, “design of industrial wear house”, international journal of engineering fresearch and technology (IJERT), vol. 7 issue 02, pp.302-306, February 2018.
- [10] Manoj nallanathe, ramesh bhaskar, kishore, “efficiency study of different steel truss using STAAD Pro”, international journal of pure and applied mathematics, volume 119 no. 17, pp. 3095-3101, 2018
- [11] Chethan G prakash chitte, “analysis and design of pratt truss by IS-800:2007 and IS-800:1984”, IJCEM international journal of computational engineering and management, vol.21 issue to pp.9-14, march 2018
- [12] Manoj nallanathe, ramesh bhaskar, kishore, “efficiency study of different steel truss using STAAD Pro”, international journal of pure and applied mathematics, volume 119 no. 17, pp. 3095-3101, 2018
- [13] Chethan G prakash chitte, “analysis and design of pratt truss by IS-800:2007 and IS-800:1984”, IJCEM international journal of computational engineering and management, vol.21 issue to pp.9-14, march 2018



INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  ijirset@gmail.com



www.ijirset.com

Scan to save the contact details