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Design and Analysis of Stage Roof Truss for College Campus

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ABSTRACT

In the cutting-edge task take a look at, we're going to analyses and layout a roof truss for the stage present within side the college campus, it is being a live project. Aim of the project is to offer the detail report and drawing of the stage roofing. For the referred to be counted numerous sorts and configuration of the trusses are analyzed and pick the correct layout for the truss. This initiative is a vital a part of college engineering projects, offering college students with hands-on experience in making use of theoretical information to actual-global problems. The key advantages of the stay task are practical software of information, growing a hassle fixing skill, broaden tender skill, beautify actual task publicity etc. In this task we pick out the want of improvement with inside the university campus, pick unique case take a look at with inside the shape of roof truss for the degree to be had on the university campus. Further we take a look at the requirement and feasibility of the shape then analyses and broaden it on paper. For the sake of take a look at, we pick the few business software program like auto cad and E-tabs. Following script consist of information about the whole project.

Index Terms—Roof Truss.

1.INTRODUCTION

Trusses may be characterized as profound, long-span bars with open networks. Trusses offer a lighter, stiffer and more conservative development for generally expansive ranges when standard rolled bars or built-up supports may not be satisfactory. They are costly to manufacture, transport and erect. In any case, the reserve funds in their weight in comparison with comparable built-up braces frequently offsets these impediments to a substantive degree. For brief ranges rolled pillars are nearly continuously more conservative. Trusses may be utilized for ranges extending from 10 m to 90 m in spite of the fact that the bigger span is an exemption instead of run the show, essentially in any

case trusses are barely utilized for ranges littler than approximately 12 m in length, since rolled bars are more reasonable for such ranges. The roof trusses are the outline structures in which isolated straight individuals are methodicallly orchestrated and associated at their closes. The system by and large comprises of a framework of triangles with the hub of the individuals assembly at one joint intrigued at a common point. The bolt joints utilized for the associations of the individuals are considered to act as pin-joints. The outside loads acting on the joints cause as it were coordinate powers within the individuals. The quality of the part is completely used. The individuals carrying compressive strengths in a roof truss are called struts, and those carrying pliable strengths are called ties. In a roof truss, individuals are so organized that the length of individuals in compression are small, while the lengths of the individuals in pressure are long. The individuals of a truss are classified as "primary individuals" and "auxiliary individuals".

The most individuals are the auxiliary individuals which are capable for carrying and conveying the connected loads and steadiness of a truss. The auxiliary individuals are the structural individuals which are given for stability or controlling the most individuals from buckling or comparable modes of disappointment.

The essential work of a roof truss is to bolster the material and ceiling fabric. The outside loads carried by roof covering are transmitted as responses to the dividers or to the supporting stanchions. In common, these loads are connected at the joints of the truss. Some of the time it gets to be fundamental to apply loads at middle focuses. In such cases, the individuals are subjected to twisting in expansion to coordinate powers. The roof trusses are used at places which require slanting rooftops.

The inclining rooftops are vital at places where precipitation is more and at places where snowfall happens. The roof trusses are moreover utilized in numerous single storeyed mechanical buildings, workshops, godown, ware-houses, where huge column free spaces are required for operational purposes. The roof trusses have the focal points of allowing a more extensive assortment of roof shapes and more noteworthy unhampered insides floor region at less fetched.

Points of interest of Steel Structure:

- The most focal points of basic steel over other development materials are its strength and ductility. It features a higher quality to cost proportion in pressure and a marginally lower quality to taken a toll proportion in compression when compared with concrete. The firmness to weight proportion of steel is much higher than that of concrete. Hence, basic steel is an efficient and financial fabric in roof truss.

From the Mechanical Insurgency within the 19th century, truss frameworks of steel fashioned press were created for bigger bridges, but press did not have the malleable quality to bolster huge loads. With the coming of steel, which incorporates a tall pliable quality, much bigger trusses were built, numerous utilizing the thoughts of Gustave Eiffel. Bridges are classified on the premise that how the four powers to be specific shear, compression, pressure, and minute are dispersed within the bridge structure.

Foundation:

- Steel is broadly utilized in building as fabric. since of steel have numerous variables influencing in mechanical properties, availability in a assortment of valuable and commonsense shapes, more economy, plan effortlessness, and ease and speed of development. In another hand Steel can be produced with a assortment of properties by including numerous improvements to suit our distinctive prerequisites. The guideline prerequisites are quality, ductility, weld capacity, and erosion resistance. Steel plan, or more specifically, structural steel plan, is an area of information of auxiliary building utilized to plan steel structures. The structures can run from towers to homes to bridges. There are as of now two common strategies of steel plan:

The primary and older method is the working stretch strategy (WSM). The moment and more current is the restrain state strategy (LSM).

Objectives

After studying this unit, you should be able to understand various terms used in roof trusses, distinguish among various types of roof trusses,

Evaluate forces in truss members under dead, wind, and live load combinations, design purlins under various conditions, design ‘wind bracings, truss members and joints.

Analyse the stage roof truss and compare the different configuration.

Prepare the details report and working drawing of a roof truss.

Terms used in Truss

Top Chord, Bottom Chord, Webs, King Post, Rafters, Tie Beam, Struts., Apex, Fascia Boards

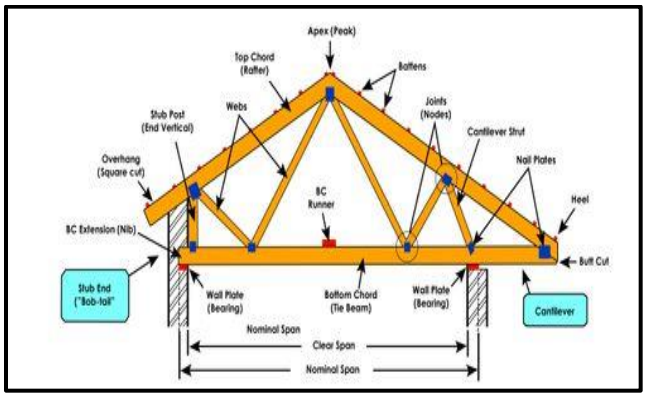

Image 1: component of roof truss

2.LITRERURE REVIEW

1. Review Paper on Analysis and Design of Steel Truss by using Angle and Tube Section

Above study shows that tubular sections are more efficient to be economical. Total saving of almost 36% in cost is achieved. Effectiveness and flexural strength of Tube section can be compared for different plan areas for different types of trusses. Structural members such as top chord, bottom chord and bracing between the top and bottom chord having larger unsupported lengths can be assigned tubular sections so that it will determine overall economy.

2. Research Paper on Analysis and Design of Steel Truss by using Angle and Tube Section

Therefore 60.83% of the total cost saving in tube section so that tube section is proved to be economical section for steel roof truss of Industrial Warehouse. Advantages of Tube Section over Angle Section: -

- Assured yield strength Ideal surface for smooth paint finish.
- Low carbon content for a strong weld joint.
- Good formability and ductility.

3. Analysis and design of roof truss by software method

To construct a howe truss for industrial shed with angle section requires less steel as compared with the truss construct with I section hence angle section howe truss is economical

Similarly, to construct a partt truss for industrial shed with angle section requires less steel as compared with the truss construct with I section hence angle section partt truss is economic.

Similarly, to construct a fink truss for industrial shed with angle section requires less steel as compared with the truss construct with I section hence angle section fink truss is economical

On the other hand, to construct an industrial shed by using Angle section, fink truss is requires less steel as compare to the other two trusses and cost of steel is also less hence fink truss economical.

Similarly, to construct an industrial shed by using I-section, fink truss is requiring less steel as compare to the other two trusses and cost of steel is also less hence fink truss economical. From above possibilities finally it is concluded that Fink truss with Angle section is economical.

4. Design and analysis of roof truss using stadd

Latticed column is designed and I section is provided for column.

For column design provide 48 ISF 6mm flats at 45˚ and connect them to centre of gravity of channels with one bolt of 16mm nominal diameter.

A rectangular steel base plate is used for slab base. The dimensions are 190 × 140 × 20 mm. The steel plate is fixed on concrete base with bolted connections.

I-section of ISMB 100 with 1.4m c/c spacing is provided for purlins

5. Design of a steel structure for a large span roof with emphasis on the verification of bolted connections

The conclusion is more striking than one would expect, as there is a 15% increase from considering axial compression and bending (if only the axial compression is considered, $NEd\ Nb,\ Rd$ = 711.5 1168.3 = 0.61 instead of 0.70).

3.METHODOLOGY

A steel structure truss roof frame with elevation 4.5m subjected to earthquake and wind loading in Zone IV, V has been considered. In this regard, ETABS-2016 software have been considered as tool to perform. Hence in this chapter we will discuss the parameters defining the computational models, the basic model truss frame is drawn and consider for analysis and design there is no throughout iterations are taken place. Frame is model with the reference of TATA steel structure manual. The structural frames are analyses with different parameter taken into account.

1	Plan Dimension	13MX8M
2	Number of Stories	SINGLE ROOF TRUSS
3	Total Height of building	7.5M
4	Size of column	As per Design
5	Size of Beam	As per Design
6	Seismic zone	II (Z=0.16)

7	Soil condition	MEDIUM
8	Importance Factor	1
9	Response Reduction	5
10	Damping of Structure	0.05
11	Wind load	Vb= 33 m/s
12	Terrain Category	2 (K1=K2=K4=1)

Table 1 - BUILDING DESCRIPTION

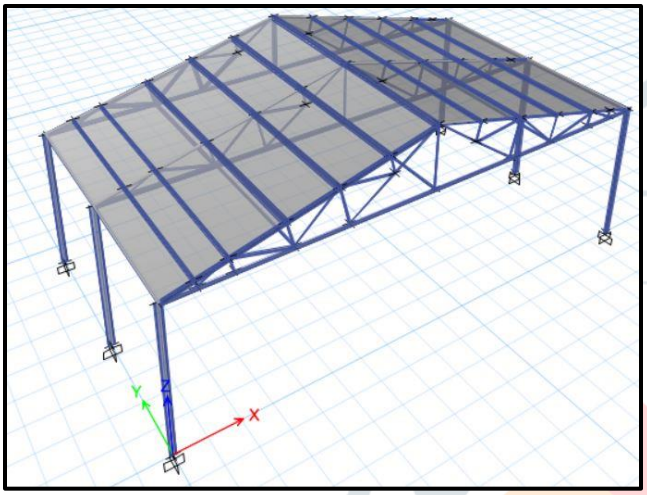

Image: component of roof truss

Name	Height mm	Elevation mm
Story2	3000	7500
Story1	4500	4500
Base	0	0

Table 2 – Story Data

Name	Type	Self-Weight Multiplier	Auto Load
Dead	Dead	1	AUTO
Live	Live	0	IS 875: PART 1
WLX	Wind	0	Indian IS 875:2015
EQX	Seismic	0	IS1893 2002
EQY	Seismic	0	IS1893 2002

Table 3– Load Parameters

4. Results and Discussion

Following diagram shows the analysis and design results which checked with the help of soft, all the truss passed the stressed/ capacity check.

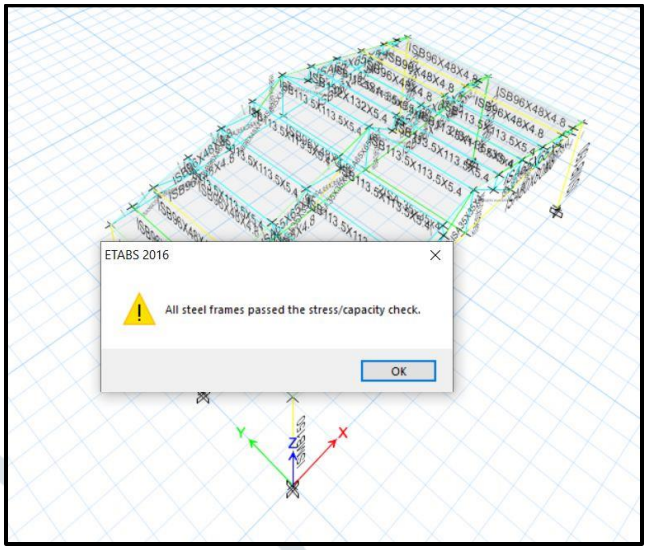

Image 2: Member Check

1. Base Shear

Base shear is an assess of the maximum expected lateral force on the base of a structure due to seismic movement. It is calculated utilizing the seismic zone, soil fabric, and building code horizontal force conditions. The base shear is an imperative parameter in seismic plan, because it makes a difference to decide the auxiliary capacity of a building to stand up to sidelong strengths caused by seismic tremors.

Load Case/Combo	FZ kN	MX kN-m	MY kN-m	MZ kN-m
1.2(DL+LL+WLX)	86.2115	348.0731	637.2206	0
1.2(DL+LL+EQX)	161.658	650.1593	1213.4599	14.4017

Table 4 – Load Combination

2. Story Drift

Story	Load Case/Combo	Drift	X m	Y m	Z m
Story1	1.2(DL+LL+WLX	0.001711	0	0	4.5
Story1	1.2(DL+LL+EQX)	2231352193	0	0	4.5

Table 5 – Story Drift

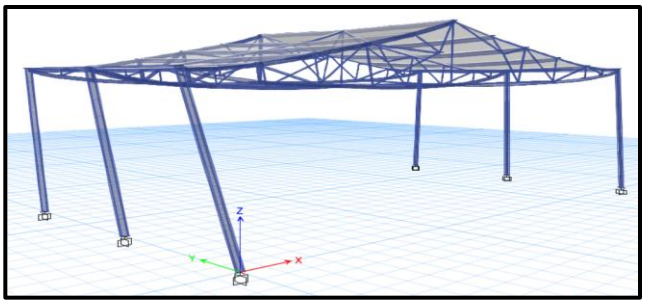

Image 3: Drift

3. Axial force

Following table shows the Axial force that is acted on the column C6 for the mentioned load case.

Story	Column	Load Case/Combo	P kN
Story1	C6	1.2(DL+LL+EQX)	-22.9849
Story1	C6	1.2(DL+LL+EQX)	-22.5984
Story1	C6	1.2(DL+LL+EQX)	-22.212

Table 6 – Axial Force

This designed frame is analyzed, gives the results as given above further this given frame is designed assigned members are given in following table.

Story	Unique Name	Design Type	Length mm	Design Section
Story2	29	Column	1875	ISA35X35X4
Story2	32	Column	1875	ISA35X35X4
Story2	66	Column	1875	ISB96X48X4.8
Story1	1	Column	4500	ISMB150
Story1	4	Column	4500	ISMB150
Story1	51	Column	4500	ISMB175
Story1	52	Column	4500	ISMB175
Story1	85	Column	4500	ISMB150
Story1	86	Column	4500	ISMB150
Story2	2	Beam	7730.8	ISB96X48X4.8
Story2	3	Beam	7730.8	ISA65X65X5
Story2	19	Beam	1713.8	ISA50X50X4
Story2	26	Beam	1619.3	ISA35X35X4
Story2	113	Beam	1703.4	ISA50X50X4
Story2	121	Beam	1612.1	ISA35X35X4
Story2	5	Beam	7730.8	ISA65X65X5
Story2	6	Beam	7730.8	ISA65X65X5
Story2	9	Beam	1713.8	ISA65X65X5
Story2	16	Beam	1619.3	ISA35X35X4
Story2	42	Beam	1703.4	ISA65X65X5
Story2	50	Beam	1612.1	ISA35X35X4
Story2	53	Beam	7730.8	ISB96X48X4.8
Story2	54	Beam	7730.8	ISA65X65X5
Story2	57	Beam	1713.8	ISB96X48X4.8
Story2	64	Beam	1619.3	ISA35X35X4
Story2	76	Beam	1703.4	ISA50X50X4
Story2	84	Beam	1612.1	ISA35X35X4
Story2	91	Beam	4000	ISB96X48X4.8
Story2	92	Beam	4000	ISB96X48X4.8
Story2	93	Beam	4000	ISB96X48X4.8
Story2	94	Beam	4000	ISB96X48X4.8
Story2	95	Beam	4000	ISB113.5X113.5X5.4
Story2	96	Beam	4000	ISB113.5X113.5X5.4
Story2	97	Beam	4000	ISB113.5X113.5X5.4
Story2	98	Beam	4000	ISB113.5X113.5X5.4
Story2	99	Beam	4000	ISB113.5X113.5X5.4
Story2	100	Beam	4000	ISB113.5X113.5X5.4
Story2	125	Beam	4000	ISB113.5X113.5X5.4
Story2	126	Beam	4000	ISB113.5X113.5X5.4
Story2	35	Beam	4000	ISB96X48X4.8
Story2	36	Beam	4000	ISB96X48X4.8
Story2	37	Beam	4000	ISB113.5X113.5X5.4
Story2	38	Beam	4000	ISB96X48X4.8
Story2	39	Beam	4000	ISB113.5X113.5X5.4
Story2	69	Beam	4000	ISB113.5X113.5X5.4
Story2	70	Beam	4000	ISB113.5X113.5X5.4
Story2	71	Beam	4000	ISB132X132X5.4
Story1	30	Beam	7500	ISA80X80X8
Story1	31	Beam	7500	ISA80X80X8
Story1	33	Beam	7500	ISB96X48X4.8
Story1	34	Beam	7500	ISB96X48X4.8
Story1	67	Beam	7500	ISB96X48X4.8
Story1	68	Beam	7500	ISB96X48X4.8
Story1	87	Beam	4000	ISA35X35X4
Story1	88	Beam	4000	ISA35X35X4
Story1	89	Beam	4000	ISB96X48X4.8
Story1	90	Beam	4000	ISB96X48X4.8
Story1	127	Beam	4000	ISB96X48X4.8
Story1	128	Beam	4000	2ISA-35x35x4
Story1	129	Beam	4000	ISB96X48X4.8
Story1	130	Beam	4000	ISB96X48X4.8
Story1	131	Beam	4000	2ISA-35x35x4
Story1	132	Beam	4000	2ISA-35x35x4
Story2	17	Brace	216.7	ISA35X35X4
Story2	18	Brace	880.8	ISA35X35X4
Story2	20	Brace	1697.1	ISA35X35X4
Story2	21	Brace	432.8	ISA35X35X4
Story2	22	Brace	807.8	ISA35X35X4
Story2	23	Brace	1182.7	ISA50X50X4
Story2	24	Brace	1612.4	ISA35X35X4
Story2	25	Brace	1612.4	ISA35X35X4
Story2	28	Brace	591.4	ISA35X35X4
Story2	111	Brace	218	ISA35X35X4
Story2	112	Brace	892.3	ISA35X35X4
Story2	114	Brace	1703.9	ISA35X35X4
Story2	115	Brace	807.7	ISA35X35X4
Story2	116	Brace	432.7	ISA35X35X4
Story2	117	Brace	1182.7	ISA50X50X4
Story2	118	Brace	1612.4	ISA35X35X4
Story2	119	Brace	1612.4	ISA35X35X4
Story2	120	Brace	591.4	ISA35X35X4
Story2	7	Brace	216.7	ISA35X35X4
Story2	8	Brace	880.8	ISA35X35X4
Story2	10	Brace	1697.1	ISA35X35X4
Story2	11	Brace	432.8	ISA35X35X4
Story2	12	Brace	807.8	ISA35X35X4

Story2	13	Brace	1182.7	ISA65X65X5
Story2	14	Brace	1612.4	ISA35X35X4
Story2	15	Brace	1612.4	ISA65X65X5
Story2	27	Brace	591.4	ISA35X35X4
Story2	40	Brace	218	ISA35X35X4
Story2	41	Brace	892.3	ISA35X35X4
Story2	43	Brace	1703.9	ISA35X35X4
Story2	44	Brace	807.7	ISA35X35X4
Story2	45	Brace	432.7	ISA35X35X4
Story2	46	Brace	1182.7	ISA65X65X5
Story2	47	Brace	1612.4	ISA35X35X4
Story2	48	Brace	1612.4	ISA65X65X5
Story2	49	Brace	591.4	ISA35X35X4
Story2	55	Brace	216.7	ISA35X35X4
Story2	56	Brace	880.8	ISA35X35X4
Story2	58	Brace	1697.1	ISB96X48X4.8
Story2	59	Brace	432.8	ISA35X35X4
Story2	60	Brace	807.8	ISB96X48X4.8
Story2	61	Brace	1182.7	ISB96X48X4.8
Story2	62	Brace	1612.4	ISB96X48X4.8
Story2	63	Brace	1612.4	ISA35X35X4
Story2	65	Brace	591.4	ISA35X35X4
Story2	74	Brace	218	ISA35X35X4
Story2	75	Brace	892.3	ISA35X35X4
Story2	77	Brace	1703.9	ISA35X35X4
Story2	78	Brace	807.7	ISA35X35X4
Story2	79	Brace	432.7	ISA35X35X4
Story2	80	Brace	1182.7	ISA65X65X5
Story2	81	Brace	1612.4	ISA35X35X4
Story2	82	Brace	1612.4	ISA35X35X4
Story2	83	Brace	591.4	ISA35X35X4

Table 7 – Assigned Members

5. Conclusion

- We complete the literature review and the analysis and design of the project with the help of the few manual available by Tata Steel and commercial software E-Tab.
- These drawings have been automatically generated from information that is based only on calculated strength requirements. All the details should be reviewed for compliance with details and requirement before application.
- From this study it is conclude that students are able to understand the various term used in the roof truss, distinguish among the various types of truss with its application.
- Evaluation of forces in truss members under dead, wind, and live load combinations is taken place and assigned in the given frame with the help of Indian code of practice, it helps to understand utility and necessity of the codes.
- This project is considered to be a live project for the students This design and drawing can be utilize on site with the expert structural consultancy.

6. REFERENCES

- Review Paper on Analysis and Design of Steel Truss by using Angle and Tube Section Prince Bhanarkar1, Prof. Deepak Irkullawar2
- Research Paper on Analysis and Design of Steel Truss by using Angle and Tube Section Prince Bhanarkar1, Prof. Deepak Irkullawar2
- Analysis and design of roof truss by software method H. Kodag1, Avinash A. Kore2, Gourav S. Shinde3
- Design and analysis of roof truss using stadd, (International Journal of Research in Engineering and Applied Sciences), k. Narendhar
- Design of a steel structure for a large span roof with emphasis on the verification of bolted connections (International Journal of Research in Engineering and Applied Sciences) David Alexandre Ferreira
- Structure Optimization Assessment for Steel Truss (International Journal of Scientific Research in Civil Engineering) Himanshu Makode Sachin Nagayach
- Cost Comparison of Roof Truss Angle Section and Channel Section Purlins by Working Stress and Limit State Method (International Journal of Recent Technology and Engineering (IJRTE) A Jayaraman, N Sathyakumar, S B Prasath
- Design of Large Span Roof Truss under Medium Permeability Condition (IJSTE - International Journal of Science Technology & Engineering) Dr. S. Biswas Azaz Pathan
- Analysis and Design of Conventional Industrial Roof Truss and Compare it with Tubular Industrial Roof Truss (IJSTE - International Journal of Science Technology & Engineering) Yash Patel Yashveersinh Chhasatia Shreepalsinh Gohil
- Design & Comparison of Various Types of Industrial Buildings (International Refereed Journal of Engineering and Science) (IRJES) Sagar D. Wankhade1 , Prof. P. S. Pajgade
- Dheeraj Harod and Prof. Sumit Pahwa (Feb2019), “Study of Structural Analysis of Roof Structure Steel Truss”, International Journal for Research in Applied Science & Engineering Technology, Volume 7, Issue II, PP. 121-125.

- Alena Mathew and Reshma (Apr-2019), "Comparative Study of Buckling and Wind Analysis by Changing Different Truss Parameter", International Research Journal of Engineering and Technology, Volume 6, Issue 4, PP. 4149-4154.
- Himanshu Makode and Sachin Nagayach (2019), "Structure optimization Assessment for Steel Truss", International Journal of Scientific Research in Civil Engineering, Volume 3, Issue 5, PP. 25-34.
- SP38(S&T)-1987-Handbook of typified designs of structures with steel roof trusses (with or without cranes) based on IS Codes (1987).
- IS 875(Part I) – 1987: Dead Loads. Code for practice of design loads (other than earthquake) for buildings and structures.
- IS 875(Part II) – 1987: Live Loads. Code of practice for design loads (other than earthquake) of buildings and structures.
- IS 875(Part III) – 1987: Wind Loads. Code of practice for design loads (other than earthquake) of the buildings and structures.
- IS 800:2007 Code of Practice (Third Revision) for General Construction in Steel.
- Duggal S. K. (1993) Design of steel structures, Tata McGraw Hill Publications: Chapter Roof trusses.
- Tata steel Designer Manual Volume-II