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# Analysis and Comparative Study of Steel Dome Structure for Open Stage Ground of S. A. T. I Using Different Steel Section

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## ABSTRACT

The Truss Structure consists of members/elements that takes only tension or compression and no bending moment in what so ever form. In the engineering term the Truss is defined as the two-force member, where the members are so assembled that the assemblage works as a single unit. The truss structure is generally provided when we need a large open space.

In this study we are presenting finite element analysis for a long span open area of dimension 66 x 49 m to be covered with steel structure frame.

In this study we are modelling roof for the proposed location of SATI college Vidisha. In this roof analysis we are considering wind load as per I.S. 875-I:2015 and using analysis tool Staad.pro.

In this study we are assigning sections as per Steel table (INDIAN) and three different sections i.e. angle, beam and pipe is considered for comparative analysis.

Here it is concluded that pipe section is comparatively more stable than other two cases whereas beam section is second best and angel section is observing least stability in terms of resisting forces, displacement and cost cutting (optimization of steel sections).

**Keywords :** Steel Structure, Analysis, Truss, Staad.Pro, Steel Sections, Displacement, Roof, Forces.

## I. INTRODUCTION

Steel frames are usually the choice when constructing a larger building that needs a big open space because of the economical aspect and efficiency of building a single-storey unit. However, a problem that might occur is when designing for a cost effective solution the slenderness may be decreased, that in the end may contribute to an instability of the entire structure.

A typical frame will in ultimate limit state (ULS) have compression forces and bending moments that are of big concern. The reason for this is that they may cause one element to buckle and deform. Because the elements are connected to each other, this may result in a deformation of the neighbouring

element which in the end may lead to severe deformations and instability of the entire system of the frame.

Structural steel is a category of steel used as a construction material for making structural steel shapes. An auxiliary steel shape is a profile, framed with a particular cross segment and keeping certain models for substance structure and mechanical properties. Basic steel shapes, sizes, piece, qualities, stockpiling rehearses, and so forth., are managed by principles in most industrialized nations. Basic steel individuals, for example, I-shafts, have high second snapshots of region, which enable them to be exceptionally hardened in regard to their cross-sectional territory.

There are an assortment of basic steel frameworks accessible for use in multi-story private construction. Common models incorporate show pillars and supports, Girder-Slab, stunned bracket, and stub support. Traditional shafts and supports are not ordinarily utilized in multi-story private construction because of the profundity and huge load of the individuals that would be required. The Girder-Slab is a protected surrounding and floor framework created in the 1990's to contend with the cast set up solid industry. The amazed support is a non-licensed effective surrounding framework created in the 1960's, however has never observed across the board use. Be that as it may, the framework has as of late picked up consideration as it has been utilized to construct various mid-ascent inns, lofts, and quarters. AISC distributed a Design Guide Series on the amazed support in 2002. The stub brace framework was created in the mid 1970's essentially for office construction, however it never again contends monetarily in the present construction advertise because of high work costs and was never effectively utilized in private construction because of the huge floor profundities.

In this study we are modelling roof for the proposed location of SATI college Vidisha. In this roof analysis we are considering wind load as per I.S. 875-I:2015 and using analysis tool Staad.pro.

In this study we are assigning sections as per Steel table (INDIAN) and three different sections i.e. angle, beam and pipe is considered for comparative analysis.

**Fig 1.** Steel Frame structure

### 1.2 Objectives of the study

The main objectives of this study are as follows:

1 To determine the most suitable type of truss arrangement for long span steel structure.
2 To determine the type of steel section most effective for resisting deformation.IS 800:2007 was used for designing and analysis of the structure in analytical application Staad.Pro V8i.
3 Study the impact of lateral forces on steel structure.
4 Optimization of steel sections in order to minimize the quantity of steel sufficient for structure safety.
5 Cost analysis of the steel sections on the basis of SOR.

## II. LITERATURE SURVEY

**Javiya and Ramani (2017) [2-d finite element analysis and optimization of temporary steel structure covering large span]** In this research work author performed finite element analysis of a 2 dimensional long span

temporary steel structure using ansys software. Here he observed that the weight obtained in by using Response surface optimization toolbox in Ansys is optimized successfully for the proposed models and the deflection and stress criteria are satisfied. It has been concluded that the optimization by using Response surface optimization toolbox gives more reliable and satisfying results. Hence it is advantageous to use this method for different varieties and configuration of the structure.

**Thirumalai et. al. (2018) [Comparative Analysis of steel portal frame using FEM software]** Here author illustrated the design and analysis of steel portal frame considering bolted connections. The flexibility of the connection affects the behavior of the frames

**Site Inspection**

design and analysis. In this research work author utilized etabs and ansys analysis tool for modelling, analysis and design. In this study analysis output of both the software is compared.

## III. METHODOLOGY

The development in steel structures in long span structures has drive towards progressively exact and yet more innovative investigation strategy. In the present situation, due to the extensive variety of plans and structures, truss arrangement are very useful to provide stability and rigidity to the structure.

**Fig 2** Site Inspection

In this study we are designing and analyzing proposed section for roof of SATI college vidisha using analysis tool staad.pro. In this study we are considering three different sections i.e. angle, channel and beam is assigned to determine the most suitable type.

**Step-1: Modelling of the structure in Staad.pro**

A Truss arrangement is a combination of structure joined in vertical, inclined and horizontal members working together to distribute compression and tension.

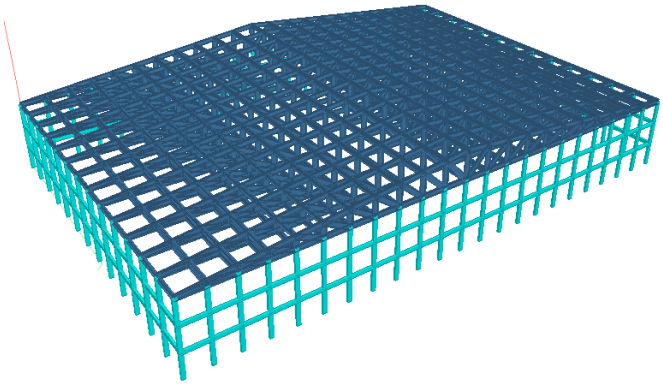


**Fig 3 :** Modelling of truss in staad.pro

**Step-2: Assigning Sectional properties and members as per Steel Table.**

Staad.pro give us access to Indian steel tables as weel as other countries and companies tables. This helps us to provide suitable section types which are available and valid as per Standard provision.

**Step-3: Assigning Support Condition**

Support conditions are assigned to retrain loads in direction, Supports are provided at the joints using node cursor, these supports are generally assigned at the join and end conditions of the members.

**Step-4: Assigning load conditions:**

In this study we are considering Dead load of the structure, super dead load of the shed and other attached members, lateral load considered as per wind pressure in Bhopal region i.e. 39 m/s as per appendix A (I.S. 875-III).

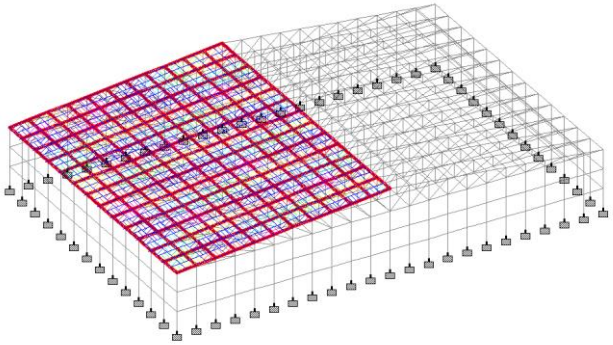
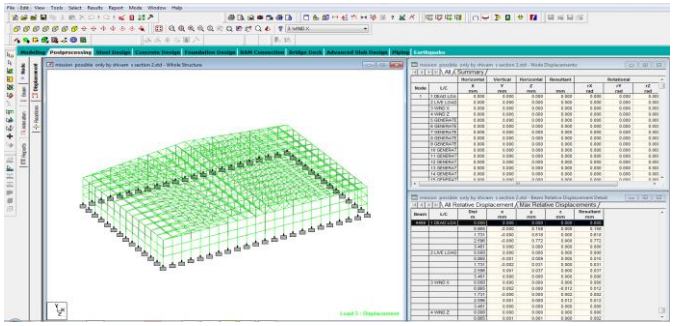


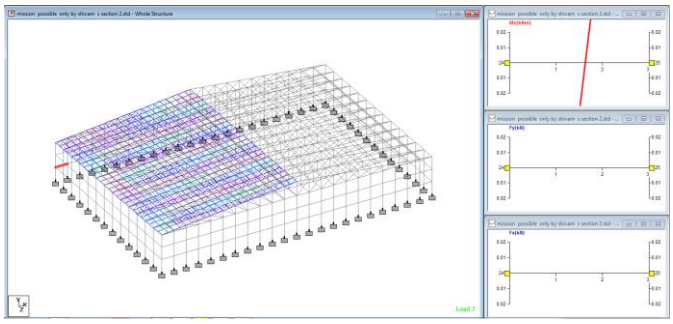
**Fig 4 :** Wind Pressure

**Step-5: Analysis of structure**

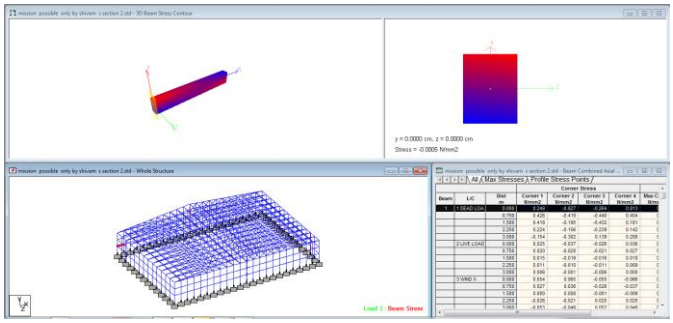
Analysis of structure is done as per finite element analysis considering lateral forces



**a. Lateral Load Analysis**



**b. Member stresses**



**c. Sectional Stresses**

**Fig 5** : Analysis

**Step-6: Cost Analysis**

## IV. GEOMETRICAL DETAILS

**Table 1 :** Geometrical details

| Design data of building | Dimension |
|---|---|
| Plan dimension | 66 x 49 m |
| No. of bay in X direction | 22 Bay |
| No. of bay in Y direction | 13 Bay |
| Typical Truss Height | 3.50 m |
| Sections | I.S.M.B, CHANNEL & ANGLE |
| Truss | Howe |
| Grade of steel | Fe-345 |

## V. ANALYSIS RESULT

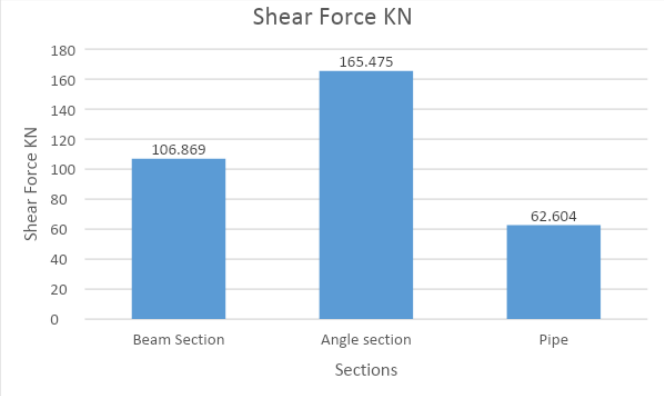



**Fig 6 :** Shear force in KN

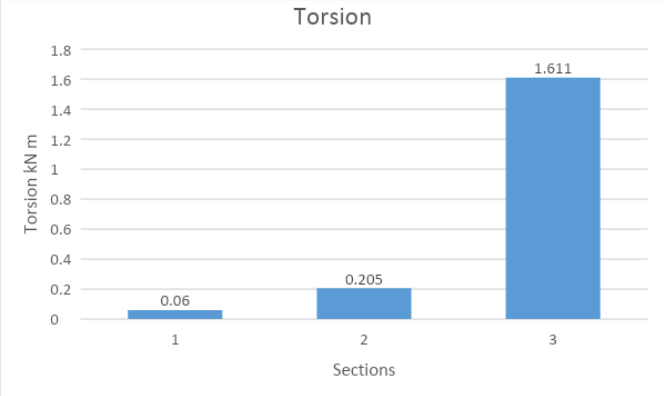



**Fig 7** : Torsion

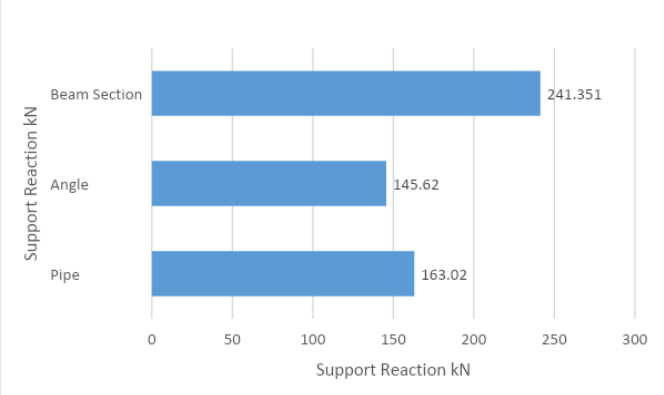



**Fig 8** : Support reaction

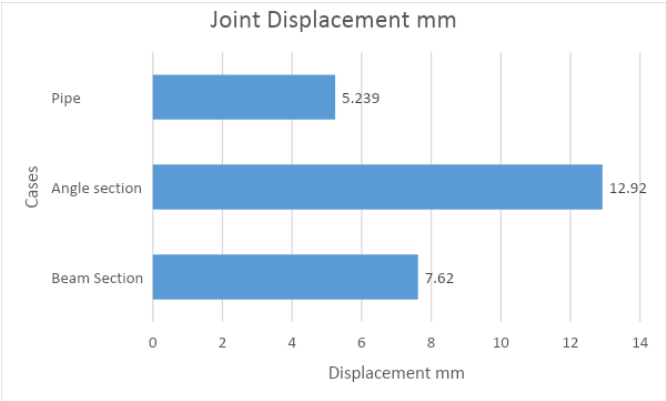



**Fig 9** : Joint Displacement

**Table 2** : Section Optimised

| Sections Assigned | | |
|---|---|---|
| Sections | Section Maximum | Section Optimization |
| Angle | 200*200*25 | 90*90*6 |
| Beam | ISWB600H | ISLB125 |
| Pipe | PIP3556H | PIP603L |

**Table 3 :** Cost Analysis

| Cost Analysis | | | | | |
|---|---|---|---|---|---|
| Section | Weight (KN) | Weight (kg) | S.O.R Rate (Kg) | Total Cost (Rs.) | 3234 square meter |
| Angle | 2087.636 | 212876.243 | 67 | 14262708.28 | 409 |
| Beam | 2922.354 | 297992.437 | 67 | 19965493.28 | 573 |
| Pipe | 1186 | 120936.42 | 67 | 8102740.14 | 232 |

## VI. CONCLUSION

In this study we are modelling roof for the proposed location of SATI college Vidisha. In this roof analysis we are considering wind load as per I.S. 875-I:2015 and using analysis tool Staad.pro. In this study we are assigning sections as per Steel table (INDIAN) and three different sections i.e. angle, beam and pipe is considered for comparative analysis.

- Unbalance forces are less in pipe section whereas observed maximum in angel section, thus pipe section can be said as more stable and resisting.
- Where pipe section was found with least shear force of 62 kN and maximum unbalanced force was seen in Angle with.
- Vertical forces are distributing through trusses to the connecting joints in a linear vertical direction, where it was observed that pipe section is distributing linear in comparison as values are comparatively less than other two cases due to linear distribution.
- Torsion is observed maximum in pipe section due to Diagonal torsion stresses, which occurs

due to steel sections generating load over the section.

- Distribution of total load from the bottom end condition to the supportive member is observed as support reaction. Here it is observed that beam section is distributing total load more precisely than other two cases.
- Displacement is maximum in angel section which shows that angel section structure is not stable and rigid where as pipe section shows minimum displacement which makes it comparatively more stable and rigid.
- While planning the structure and assigning the sections in the analysis, it was stated as Angle 50% reduction, Beam 5 times reduction was seen and Pipe showcased 6 times reduction in size of the section.
- The quantity was derived from Staad.ProV8i in kN and was later converted to kilograms for cost analysis. Pipe sections proved to be quite economical with total cost of Rs. 8102740.14 in comparison to other sections namely Angle sections with cost Rs. 14262708.28 and beam with maximum cost Rs. 19965493.28.

## VII.REFERENCES

[1]. Avanti Patrikar & K. K. Pathak(2016) Fully Stressed Design of Fink Truss Using STAAD.Pro Software] Open Journal of Civil Engineering, 2016, 6, 631-642

[2]. Azaz Pathan (2018) Design of Large Span Roof Truss under Medium Permeability Condition], IJSTE - International Journal of Science Technology & Engineering | Volume 4 | Issue 10 | April 2018

[3]. Chetan Jaiprakash Chitte (2018)Analysis and Design of Pratt Truss by IS 800:2007 & IS 800:1984] , IJCEM International Journal of Computational Engineering & Management, Vol. 21 Issue 2, March 2018

[4]. Chhasatia et.al (2016) Analysis and Design of Conventional Industrial Roof Truss and Compare it with Tubular Industrial Roof TrussIJMPE Volume- 5, Issue-11, Sept. 2016

[5]. Chandresh Kumar Jha and M.C. Paliwal(2017) Fully Stressed Design of Howe Truss using STAAD.Pro Software], 2017 IJEDR | Volume 5, Issue 3 | ISSN: 2321-9939

[6]. Dheeraj Harod and Sumit Pahwa(2019) Static Structural Analysis of Pratt, Flink and Howe Steel Truss using Ansys Software], (IJRASET), Volume 7 Issue III, Mar 2019

[7]. Goraviyala Yogesh and K. C. Koradiya(2016)Design and Comparison of Steel Roof Truss with Tubular Section (using SP: 38 And IS: 800-2007), IJSRD, Vol. 4, Issue 02, 2016

[8]. Heena dewangan & kaushik majumdar (2018)a review on comparision of different types of trusses in vibration analysis using staad pro] IJESRT, ISSN: 2277-9655, CODEN: IJESS7

[9]. Jyoti .P. Sawant and Vinayak Vijapur(2013)Analysis and Design of Tubular and Angular Steel Trusses By Post-Tensioning Method], JEC&AS, Volume 2, No.8, August 2013

[10]. J. Pavan Kumar et. at. (2016) Quantitative Study of Howe Truss (A- Type) and Parallel Chord Scissor Truss (B- Type) by Applying External Pre-Stressing], International Journal of Engineering Research & Technology (IJERT), Vol. 5 Issue 01, January-2016

[11]. J.M. Branco & P.J.S. Cruz (2008) Diagnosis and analysis of two king-post trusses] 2008 Taylor & Francis Group, London, ISBN 978-0-415-46872-5

[12]. M.Indrajit et. al. (2018)standardization of truss profile for various span and loading conditions] , ISSI, 2018.

[13]. Ola Adel Qasim (2017)Analysis and Design of Steel Truss Stadium] , IInd edition, 2017

[14]. Parmar et. al. (2017) Analysis of Howe Roof Truss using Different Rise and Span]

[15]. Pradeepa. S, Monika N.R (2015)Design And Comparison Of Various Types Of Long Span Roof Trusses] International Journal of Science and Engineering Research (IJ0SER), Vol 3 Issue 10 October-2015

[16]. Rajat palya & deependra singh raghuvanshi (2017) study on different truss structures for ware house design], IJMPE Volume- 5, Issue-11, Nov.-2017

[17]. Soni Prabhat, Dubey S.K.et.at(2013)Comparison of Design of Steel Roof Truss using IS 875 and SP 38] RJES, Vol. 2(5), 47-49, May (2013)

[18]. Takao nakazawa et. al. (2004) dynamic characteristics of king-post truss road bridge made of glued laminated wood], 13th World Conference on Earthquake Engineering Vancouver, B.C., Canada August 1-6, 2004, Paper No. 2246

[19]. Tejas D. parekh, Disha parmar, Yati tank(2017) Analysis of Howe Roof Truss using Different Rise and Span] International Journal of Engineering Trends and Technology (IJETT) – Volume 47 Number 3 May 2017

[20]. Upendra Pathak and Vivek garg (2015)optimization and rationalization of truss design], IRJET, Volume: 02 Issue: 05 | Aug-2015

[21]. Yash Patel, Shreepalsinh Gohil et.at,(2016) Analysis and Design of Conventional Industrial Roof Truss and Compare it with Tubular Industrial Roof Truss], IJSTE | Volume 2 | Issue 10 | April 2016

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