Design and Comparison of Steel Roof Truss with Tubular Section (using SP: 38 And IS: 800-2007)

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Abstract— In this paper, different configuration of steel roof trusses, such as Howe type, Fan type, Fink Fan type, and N-type with different span has 9m, 12m, 15m, 18m and 21m, with varying slopes like 12, 14 and 16 degrees with different wind zones, different spacing have been analyse and design as per SP: 38 and IS: 800-2007 by using tubular section. In this paper involve the study of comparative analysis of a truss using tubular and angled sections under the influence of usual loading values.

Key words: Steel roof Truss, Howe type

I. INTRODUCTION

A roof truss is basically a framed structure formed by connecting various members at their ends to form a system of triangles, arranged in pre-decided pattern and its depends upon the span, type of loading and functional requirements. In industrial buildings, steel trusses are most commonly used. A truss is a structural assembly of various types of interconnected member.

Trusses are formed by an interconnected structure of small members, which create a lattice arrangement. Weight of truss varies with respect to span and slope of roof. However size and shape of the truss is very important like strength of the individual components, and more design options are available. In industrial sector truss is the best option for roof cover the roof. It is very cheap compare to R.C.C. structure. It is also a light weight structure as compare to concrete structure. Trusses are particularly popular and structurally efficient for roof with long span.

Trusses are highly efficient and visually light for long span. The material used in truss is economical if the proper design is prepared. It has led to the use of truss systems in the case of beams in a large number of situations, in the horizontal and vertical planes. Nowadays it is most common solutions for problems in large scale roofing such as factories, workshops and railway stations.

By analyze different types of trusses with different spans and slopes to optimize best roof truss which will be lighter in weight as well as good in strength. By this study it will found that which truss will be more efficient for different spans of roof.

II. LITERATURE REVIEW PAPER

A. Design & Comparison Of Various Types Of Industrial Buildings:

Author:- Sagar D. Wankhade, Prof. P. S. Pajgade
Published in journal: International Refereed Journal of Engineering and Science.
Year: June-2014

Objectives of study: In this study, analysis results of industrial steel truss buildings are compared with Pre-Engineering building. In this paper Industrial steel roof truss buildings dimension of 14m x 31.50m, 20m x 50m, 28m x 70m and bay spacing of 5.25m, 6.25m and 7m respectively having column height of 6m is compared with Pre-engineering buildings with same dimension. Design based on IS 800-2007 (Limit state method). Analysis results are observed for column base as hinge base.

Methodology: The truss having area of 14m x 31.5m, having purlin spacing of 1.489m, having bay spacing of 5.25m and building height 6m. For the truss the dead load, live load and wind load was consider as per IS 875:1987, also same configuration consider for the Pre-engineering buildings. The Purlin have been design as per IS 801:1975 and the design of main frame have been used of built up I section. Design and analysis calculation by the manual and STADD-Pro. Software.

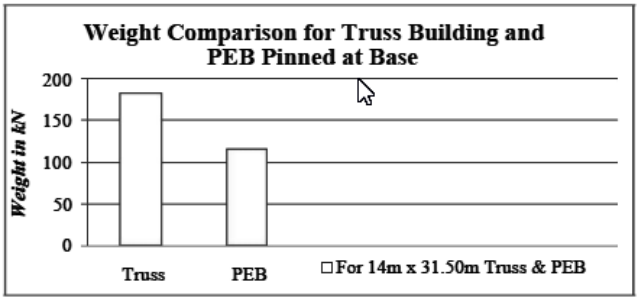
IV. COMPARISON AND DISCUSSION

Table 4.1: Weight for 14m x 31.50m Steel Building Pinned Support at base using Channel purlin & Angle Section Truss

1	Weight of truss and column	55.083	kN
2	Weight of purlin ISMC 125	47.088	kN
3	Tie Runner pipe 80x80x6	19.503	kN
4	Top Bracing LD 60x60x6	22.462	kN
5	Bottom Bracing LD 50x50x6	18.693	kN
6	Column Bracing LD 50x50x6	19.871	kN
	Total	183.45	kN

Table 4.2:Weight for 14m x 31.50m PEB pinned supports at Bas using Z purlins

1	Weight of PEB	56.042	kN
2	Weight of Z- Purlin	17.94	kN
3	Top Bracing LD 60x60x6	22.462	kN
4	Column Bracing LD 50x50x6	19.871	kN
	Total	116.315	kN



Outcome of study:

1) The design it is clear that using angle section for truss and channel section for purlins, Steel truss for building using pipe section and PEB is found to be economical compared to steel truss building using angle section. The percentage savings in results are, savings in weight for PEB 59%, 37%, and 19% also saving in weight for steel truss building using pipe section 47%, 43%, and 98% both results are respectively to dimension of 14m x 31.50m, 20m x 50m, 28m x 70m.
2) Weight of single truss using angle and pipe both is less compared to PEB but due to Weight of channel purlin, Weight of steel is on higher side.

III. COMPARISON OF DESIGN OF STEEL ROOF TRUSS USING IS 875 AND SP 38

Author: Soni Prabhat and Sangamnerkar Prakash
Published in journal: Research Journal of Engineering and Sciences (RJES)
Year: May-2013

Objectives of study: In this paper, the steel roof truss having 12 m span has been analyzed with design of tubular sections of truss members. The analysis presents comparison for weight of tubular member sections, with the help of which, comparative study has been done between design of truss as per revised provisions of wind load calculations given in IS 875 (Part 3):1987 and designs obtained as per calculations made in SP 38(S&T):1987. Indian Standard Code IS: 875(Part 3)-1987 includes consideration for different conditions of class of structure, topography factor, enlarged provisions of permeability conditions, Terrain, height & structure size factor and various wind zones. These provisions of wind load calculations are different from the considerations used in SP 38(S&T):1987.

Methodology: Wind load calculation according to IS: 875 (Part-III)-1987, Design wind speed, Design wind pressure, Wind pressure and Forces on building and results are compare between Criteria for Wind load calculation given in SP:38-1987 to Wind load criteria according to IS: 875(Part-III)-1987

Outcome of study: From the analysis it is found that of weight of tubes as IS: 875 (Part-III)-1987 are greater than SP: 38-1987 in case of terrain category 1 and 2 for large permeability condition. Methodology of analysis given in SP: 38-1987 should be reviewed and various criteria of wind load calculation given in IS: 875-1987 (such class of structure, risk coefficient, terrain conditions, topography factor and permeability conditions) should be incorporated.

IV. COMPARISON BETWEEN CONVENTIONAL STEEL STRUCTURES AND TUBULAR STEEL STRUCTURES.

Author: M. G. Klyanshetti and G. S. Mirajkar
Published in journal: International Journal of Engineering Research and applications.
Year: Nov.-Dec. 2012

Objectives of study: Most of the steel structures are builted-up with conventional sections of steels which are designed and constructed by conventional methods. This leads to heavy or uneconomical structures. Tubular steel sections are the best replacements to the conventional ones with their useful and comparatively better properties. This study is regarding the economy, load carrying capacity of all structural members and their corresponding safety measures. Economy is the main objective of this study involving comparison of conventional sectioned structures with tubular sectioned structure for given requirements. For study purpose superstructure-part of an industrial building is considered and comparison is made. Study reveals that, up to 40 to 50% saving in cost is achieved by using tubular sections.

Methodology:

1) Dead load analysis is done according to IS 875 (Part1) with the help of STAAD-PRO
2) Live load analysis is done according to IS 875 (Part2) with the help of STAAD-PRO
3) Wind load analysis is done according to IS: 875 (part 3) with the help of STAAD-PRO
4) Designing is done according to IS: 800, IS: 806 and STAAD PRO Conventional design is carried out as per IS 800 and tubular sectioned design is carried out as per IS 806.

Outcome of study: Total saving of almost 50 % to 60 % in cost is achieved. Out of circular, square and rectangular shapes, due to connection difficulties of circular tube sections, it is suggested to adopt rectangular or square tube sections. This study is for a given area of 800 sq.m. and truss of modified howe type. From above observations and results one can conclude that, the structural members having larger unsupported lengths can be assigned tubular sections which will derive overall economy. For smaller unsupported lengths one will have to assign minimum sections for both conventional and tubular sections so that economy is not considerably achieved. In such cases due to larger initial cost it becomes uneconomical. Initial cost for tubular sections is more however ,due to reduction in total dead weight, it is overall economic not only for industrial buildings but also for various steel structures like transmission towers, bridge structures etc.

V. THE ECONOMIC AND STRUCTURAL ANALYSIS OF HOLLOW STRUCTURAL SECTIONS

Author: Dhruv S. Agarwal and Ankit C. Chhatwani
Published in journal: International Journal on Recent and Innovation Trends in Computing and Communication
Year: Feb. - 2015

Objectives of study:

1) To study and compare design of roof truss of certain span by using both Open sections and Hollow Sections.
2) To determine most economic sections among the sections used namely Open Sections, Rectangular Hollow Sections, Square hollow sections and Circular Hollow Sections.
3) To study the geometric and physical advantages of hollow sections over Open sections.
4) To calculate percentage saving in steel for given structure.
5) To study various aspects of design and maintenance in Hollow Structural Sections.

Methodology: For this study Fink Type Truss was considered as sample truss for analysis A. Choice of Section: i. Open section:- Equal Angle Section ii. Hollow section:- a) Circular section b). Square section

A. Choice Of Loading:

Three types of loads are considered while designing.
Dead Load:-7.4 kNm, Live Load:-6.7kNm
Wind Load:- For Windward FX 8.407 kNm, FY 16.815 kNm For Leave ward FX -7.826 kNm, FY 15.65 kNm and Load Combinations: - 1.5 (DL + LL), 1.2 (DL + LL + WL) 1.5 (DL + WL) and also involve Design of truss using equal angle section, pipe section and tube section with help of STAAD-PRO. Softwer.
Outcome of study: Total percentage of steel saving:

1) When circular section is used = 33.042%
2) When Square section is used = 26.742%

Quantity of steel required for Open Section Truss become less if Unequal Angle Section is used instead of

Equal Angle Section but it hardly affect the percentage saving in steel. The Hollow Steel Sections are structurally more efficient then Open Steel Sections because of its properties like High Torsional Resistance, Smooth Surface Finish, High Strength to Weight Ratio, Free from Sharp Edges, etc. When Open Sections are replaced by Hollow Sections saving in steel is to the tune of minimum 20 – 30%.

VI. DESIGN AND ECONOMICAL OF ROOF TRUSSES & PURLINS (COMPARISON OF LIMIT STATE AND WORKING STRESS METHOD)

Author: A. Jayaraman, R. Geethamani, N. Sathyakumar, and N. Karthiga Shenbagam
Published in journal: International Journal of Research in Engineering and Technology. (IJRET)
Year: Oct. -2014
Objectives of study:
This paper presents a study on behaviour and economical of roof trusses and purlins by comparison of limit state and working stress method. This paper presents a study on behaviour and economical of fink type roof trusses, channel section purlins by comparison of limit state and working stress method. This study involves in examination of theoretical investigations of specimens in series. Overall two methods were designed and comparison of all the internal force, economical, and hence, to evaluate the co-existing moments and shear forces at the critical cross-section with same configuration area by keeping all other parameters constant. The specimens are designed under uniformly distributed loading with simply supported condition. The research project aims to provide which method is economical, high bending strength, more load carrying capacity and high flexural strength. But working stress method is most economical compare to the limit state method design.

Methodology: Theoretical Investigations of Roof Trusses and Purlins in which dead load, live load and wind load calculation. And Theoretical Investigations of Purlins by Working Stress Method and Theoretical Investigations of Purlins by limit state method.

Outcome of study: In this paper investigation the total roofing load configuration is same in both the working stress and limit state method. But area of section is 37% needed for limit state method in compare to the working stress method.

The theoretical results of the limit state method is bending moment and load caring capacity is 76.25 % and 41.35 % higher than the working stress method. Actual deflection and bending stress is same in both the method. But working stress method is more economical method compare to the limit state method. The working stress method, the total weight of steel is required 1502 kg. The limit state method the total weight of steel is required 2308 kg. The studies reveal that the theoretical investigations limit state method design is high bending strength, high load caring capacity, minimum deflection and minimum local buckling & distortional buckling compare to the working stress method. But working stress method is most economical compare to the limit state method design.

VII. CONCLUSION

In this paper, after the study of different literature review by using proper selection of material truss building can be economical compared to PEB, methodology of SP:38 should be reviewed with IS:875 in relative to wind load criteria, when large area should be covered and large unsupported length can be assigned with tubular section which will be find overall economy, working stress method is more economical compare to limit state method, The tubular steel section are structurally more efficient than conventional section because its resistance of torsional is very high and high strength to weight ratio. So main aim of the study is comparison of angle section to tubular sections as per SP: 38 and IS: 800 and its result will be compared with help of Staad-Pro.

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