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Analysis and Design of Conventional Industrial Roof Truss and Compare It with Industrial Tubular Roof truss

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Abstract - *Many of the steel building are made up with orthodox sections of steels which are designed and built by conventional approaches. This directs to weighty or too expensive structures. Tubular steel is the best possible alternatives to the conventional with their comparatively better specifications. Dead weight is tending to be decreased for many structural members so it is clear that because of the tube section, it helps in reducing overall economy. This is regarding the economy, load carrying capacity of all members and their relative safety measures. Economy is the main goal of the present work including comparison of conventional structures with tubular structure for given conditions. Results show that up to 15 to 25% saving in expense is accomplished by using tubular sections. Analysis of truss was carried out by Staad Pro V8i computer software, with manually applying Indian Standards. Several excel sheets for various structural elements like Purlin, Roof Truss, compression member, Tension member etc. Were carried out using Microsoft office excel. Lastly estimation sheet is prepared for each Conventional Roof Truss section as well as Tubular roof truss section.*

Key Words: *Conventional Steel truss, Tubular section, STAAD Pro V8i, AutoCAD, IS 800 and IS 806.*

1.INTRODUCTION

Industrial sheds are low rise steel buildings generally used as workshops, factories or industries in absenteeism of interior walls.
Any building used by the industry to stock raw materials is known as an industrial building. Roof truss and portal frame is used to cover and shelter the area of an industrial building. As per the requirement of an industrial building the suitable kind of roof truss and portal frame is utilized. There are three kinds of truss namely Pitched roof truss, Parallel chord truss, and Trapezoidal truss.
Roof truss are designed for dead load, live load, wind load and their combinations as per Indian Standards. An economy of an industrial building depends on the configuration of structure, type of roof truss and portal frame utilized, forces acting on building and selection of steel sections needed as per force employed. Steel sections are categorized namely as conventional steel section (channel, angle, rolled etc.), and Hollow steel section (square hollow section, rectangular hollow section, circular hollow section).
The Present work includes designing Roof truss components for an industrial building using conventional steel sections and Tubular steel sections (circular hollow section) and selecting most suitable section according to its advantages and disadvantages...

Advantages of Tubular sections:

- Economy is achieved as strength to weight ratio is more.
- Compressive strength and torsional. Because of that Tubular sections behave more efficiently than conventional steel
section.
- Ease of maintenance.
- Free from sharp edges.
- Ease in fabrication and erection compared to conventional steel section.

From the point of view of corrosion, the tubes are subjected to corrosion on the other surface only, because of having the ends sealed. So, protection by means of paints and other processes involve a lesser surface area on the outside face only which is reflected in the code of practice allowing less wall thickness for tubes than in conventional sections.

1.1 LOADS ON TRUSS

Dead load: The dead load in a building shall comprise of the weight of all walls, partitions, floors and roofs and shall include the weights of all permanent constructions in the buildings. The unit weight per mass of the materials and parts or components of the building that applied for the determination of dead load calculations are obtained by referring to IS:875-1987(Part 1)
Live load :The live load on roof trusses consist of the gravitational load due to erection and servicing as well as dust load etc. excluding wind, seismic, snow loads due to temperature changes, creep, shrinkage, differential settlements, etc. and the intensity is taken as per IS:875-1987(Prat-2). Additional special live loads such as snow loads in very cold climates, crane live loads in trusses supporting monorails may have to be considered.

Wind load**:** Wind is air in motion relative to the surface of the earth. The exact estimation of the force exerted by the wind on any surface is a complex problem of aerodynamics. For the present structure wind load is estimated by adopting the method suggested in IS:875-1987(Part-3).

1.2 DESIGN OF ROOF TRUSS

The design of a roof truss consists in selecting a suitable type of truss, estimation of loads and design of purlins, members of the roof truss and the connections. Depending upon the span, lighting, roofing material etc. available the type of truss is decided. The members meeting at a joint are so proportional that their centroid axes intersect at one point.

Span of roof truss = 16m.

Spacing of truss = 7.5m.

Pitch of the roof truss = 1/5.33

Rise of roof truss = 3m.

Angle of roof truss = $\theta = \tan^{-1}(3/16) = 10.62°$

Length along sloping roof = $\sqrt{3^2+16^2} = 16.28$m

Length of spacing roof is divided into 10 equal parts.

Therefore, Length of each panel = 16.28m./10 = 1.628m.

For the above proportions North Light Roof Truss is provided by keeping in view of sufficient natural lighting and ventilation.

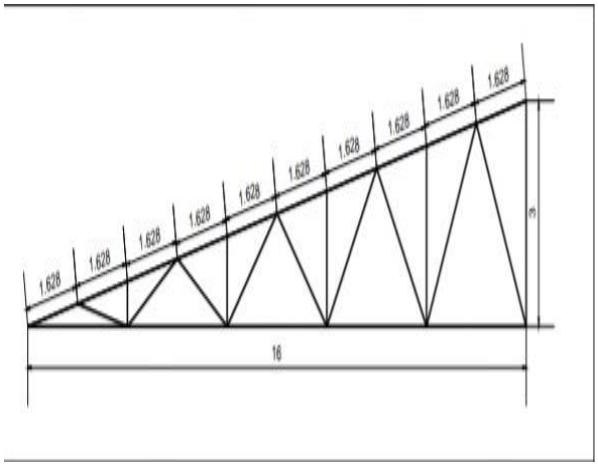

Fig.1 North light roof truss

The truss has been analysed for Dead load ,Live load and wind load according to code book mentioned above using the STAAD pro software.

2. SUMMARY OF LOADS

Load combination	**Loads(KN)**			
	Intermediate node		**End node**	
1.5(DL+LL)	1.5(4.92+8.88)=20.7		1.5(2.46+4.44)=10.35	
1.5(DL+WL)	Vertical	Horizontal	Vertical	Horizontal
	-5.96	-2.43	-2.81	-1.22
	-6.69	-2.64	-3.35	-1.32
DL+LL+WL	This case will not be critical as WL acts in the direction opposite to DL and LL			

Table -1: Summary of nodal loads

The above values has been assigned to nodes of the truss in STAAD pro software and has been analysed for the same. Total weight of one roof truss components in Kg was calculated for Top chord members, Bottom chord members and other members of conventional steel section as well as Tubular steel section .Comparison is made between both type of sections and from the results of weight of roof truss members cost estimation sheet is carried out. That helped us to witness advantages of Tubular steel section over Conventional steel section.

Type of truss	Member configuration	Section used (Angular)	Total length of member	Weight in KN
North light roof truss	Top chord member	2-ISA100X100X8	16.28	3.852
	Bottom chord member	2-ISA75x75x8	16	2.802
	Web member	2-ISA65x65x8	30.24	4.535
TOTAL				11.189

Table 1:Weight calculations for conventional section

Type of truss	**Member configuration**	**Section used (Tubular)**	**Total length of member**	**Weight in KN**
North light roof truss	Top chord member	TUB1251256	16.28	3.451
	Bottom chord member	TUB11011004.5	16	2.274
	Web member	TUB1001004	30.24	3.462
TOTAL				**9.187**

Table 2:Weight calculations for tubular section

Type of section	**Total weight in Kg**
Conventional section	1140.96
Tubular section	936.813
Difference in weight	**204.147**

Table 3: Weight comparison of roof truss

Type of section	**Cost**
Conventional section	51343.2/-
Tubular section	42156.585/-
Difference in cost	**9186.615/-**

Table 4: Cost comparison of roof truss

2. CONCLUSIONS

Above work shows that Tubular section has proved to be more economical. Saving of **9186.615** INR per one roof truss is achieved with assigning Tubular steel sections instead of conventional steel roof truss. Overall 18% saving has been achieved during this project work. From the present study and results we can conclude that because of comparatively less dead weight tubular section has proved more economical for the industrial roof truss as well as for other steel structures.

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