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Analysis and Design of Truss by Various Sections

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Abstract- **Now a day, our observation about the steel structures, Industrial trusses form one of the major structural systems, which require accurate and economic design. Their span and corresponding weight plays an important role in planning the industrial area. The shape and configuration is decided upon the span, pitch, spacing of truss, various loads and naturally the weight. In this project a humble attempt is made to compare various truss configurations with different span, pitch, spacing of truss regarding the weight aspects. All the types of trusses have been analysed and designed by STAAD PRO, software for the different span (12 m to 20 m) which are the most common spans used in practices. From the parametric study, the most appropriate span will be formulated considering geometric shape, weight, economy and other criteria.**

Index Terms- STAAD Pro Software, Analysis and Design of Industrial Truss, AutoCAD drafting, 3D frame

I. INTRODUCTION

The principal modern building materials are masonry, concrete (mass, reinforced and pre-stressed), glass plastic, timber and structural steel (in rolled and fabricated section). All the mentioned materials have particular advantages on a given situation and hence the construction of particular building type may involve the use of various materials, e.g. a residential building may be constructed using load-bearing masonry, concrete frame or steel frame. The designer has to think about various possible alternative and suggest a suitable material which will satisfy economical, aesthetic and functional requirements.

Steel has been known since 3000 BC. Foam steel was used during 500 – 400 BC in China and then Europe. The Ashokan pillar made with steel and iron joints used in puri temples are more than 1500 years old. The demonstrate that this known how was available before the modern blast furnace technology, which was developed in AD 1350 (Gupta 1998).

Steel was first introduced in1740, but was not available in large quantities until sir henry Bessemer of England invented and patented the process of making steeling 1855. The first major structure t use the new exclusively was Flower and Baker's Railway Bridge at Firth of Forth. At that time, generally engineers' uses conventional sections like angle or plates etc.

II. AIM AND OBJECTIVE

A. AIM

Aim of the present work is to carry out analysis and design for a industrial truss using computer aided analysis and design.

B. OBJECTIVES

Following are the main objectives of the present study:

1. To study the basic geometry of truss
2. Prepare excel sheet for load calculation on truss
3. Software (STADD PRO) validation of truss
4. Analysis and design of truss by using STAAD PRO
5. Result interpretation (weight comparison for different comparison)
6. To design the truss by using various section

III. LITRETURE REVIEW

A. Trilok Gupta, Ravi K. S Harma, "Analys Is of Industrial Shed using Different Design Philosophies" International Journal of Research In Advent Technology, Vol.1, Iss Ue 5, Dec Ember 2013

The research involves various kinds of industrial roof trusses by using computer software. It also involves the knowledge regarding steel roof trusses and the design philosophies with worked examples. From the observations they concluded that, the sections designed using limit state methods are more economical than the sections using working stress method. It was observed that the tubular section designed by limit state method was the most economical among the three sections which were used

B. *Vaibhav B. Chavan, Vikas N. Nimbalkar and Abhishek P. Jaiwal " Economic Evaluation of Open and Hollow Stuctural Sections in Industrial Trusses", Aci Structural Journal, March-April 1990*

This research's objective was to estimate the economic importance of the Hollow Sections in contrast with conventional sections. This paper was carried out to find out the percentage economy accomplished using Hollow Sections so as to understand the importance of cost efficiency. The technique used in order to reach the objective involves the comparison of various profiles for different combinations of height and material cross - section for given span and loading conditions. The analysis and design phase of the project was done utilizing STAAD PRO V8i. The results of STAAD analysis were validated with the results of Manual analysis.

IV. DATA COLLECTION

STEP NO	REFERENCE	CALCULATION	OUTPUT
1	Structural Design & Drawing (STEEL)	GIVEN DATA:- a) Span of truss = L = 15 half = 7.50m b) Pitch, p = 0.25 c) Spacing of truss = S = 4m d) Rise of truss = R = 3m e) Height of truss = G.L. = H = 20m f) Wt. A.C.C. sheet = 150N/m^2 g) Wt. of purlins = 120N/m^2 h) Wt. of wind bracing = 12N/m^2 i) Ground slope θ = 0 degree j) Total panel point P.P. = 8 half = 4 k) Life of structure = 25yrs l) Wall opening = 0.10 m) Length of shed = 50m	
2		PRELIMINARY CALCULATION :- 1. Angle of roof truss :- Tan ∝ = 0.40 So, ∝ = 21.81 degree 2. Length of P.R. :- Length of P.R. = 8.08m 3. Half plan area :- Half plan area = L× spacing of R.T. = 30m^2 4. Half slope area :- Half slope area = length of P.R.×spacing of R.T. = 32.31m^2	∝ = 21.81^0 L = 8.08m H.P.A = 30m^2 H.S.A = 32.31m^2
3	From IS 875, Part-1	DEAD LOAD:- 1. Weight of roofing material = 4846.65N 2. Weight of purlins = 3600N 3. Self wt. roof truss = 10(span/3+5)N/m^2 = 100N/m^2(per plan area) So, self wt. roof truss = 3000N 4. Weight of wind bracing = 360N TOTAL DEAD LOAD = (1)+(2)+(3)+(4) = 11806.65 N DEAD LOAD PER FULL P.P = 2.95kN DEAD LOAD PER HALF P.P = 1.48 kN	Total D.L= 11.81kN Per F.P.P = 2.95kN Per H.P.P=1.48kN
4	From, IS: 875, Part-2	LIVE LOAD:- 1. Live load on purlin = 750-20(α - 10)N/m^2 = 513.75 N/m^2 > 400N/m^2 So, Take live load = 513.75 N/m^2 2. L.L. on roof truss = 2/3 × L.L on purlins = 342.50 N/m^2 TOTAL LIVE LOAD = 10275.01 N LIVE LOAD PER FULL P.P = 2.57kN LIVE LOAD PER HALF P.P = 1.28 kN	Total L.L=10.275kN Per F.P.P =2.57kN Per H.P.P= 1.28kN

5	From, IS: 875,Part-3	WIND LOAD:- 1. Design wind speed:- $V_z = V_b \times k1 \times k2 \times k3$ 2. Basic wind speed:- V_b = 39.0 m/s for ahmdabad 3. Risk coefficient k_1 = 0.92 for all general bldg. for 25yrs 4. Terrain coefficient k_2 = 1.01 terrain category – 3, & class – A 5. Topography factor k_3 = 1.00 upwind slope - 0^0 So, V_z = 36.24 m/s 6. Design wind pressure:- $p_z = 0.6\ V_z^2$ p_z = 787.95 N/m^2 7. Wind load:- $F = (C_{pe} + C_{pi}) \times A \times P_z$ Where, C_{pe} = external pressure coefficient Here, H/w = (20/15) = 1.33 And, α = 21.81 degree For wind angle, $\theta = 0^0$ EF side, C_{pe} = 0.61 GH side, C_{pe} = 0.50 For wind angle, $\theta = 90^0$ EG side C_{pe} = 0.80 FH side C_{pe} = 0.64 So, taking max of all the values. C_{pe} = 0.80 C_{pi} = internal pressure coefficient Here, wall opening percent. = 0.10 C_{pi} = 0.50 WIND LOAD from above equation F = 33097.29 N WIND LOAD PER FULL P.P = 8.97kN WIND LOAD PER HALF P.P = 4.14kN	V_z = 36.24 m/s p_z = 787.95N/m^2 F = 33097.29 N Per F.P.P = 8.27 kN Per H.P.P = 4.14 kN
6		FINAL RESULT: 1. DEAD LOAD PER PANAL = 2.95Kn 2. LIVE LOAD PER PANEL = 2.57kN 3. WIND LOAD PER PANEL = 8.27kN	

V. DESIGN STEPS IN STAAD PRO SOFTWARE

Fig-1: Create A Model In STAAD Pro

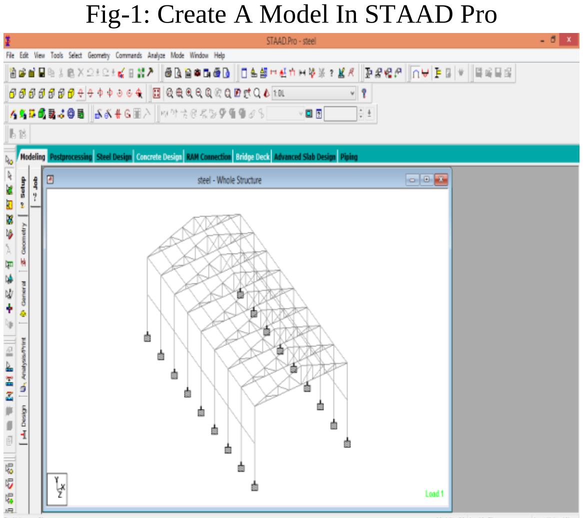


Fig-2: Assign Material And It's Propety

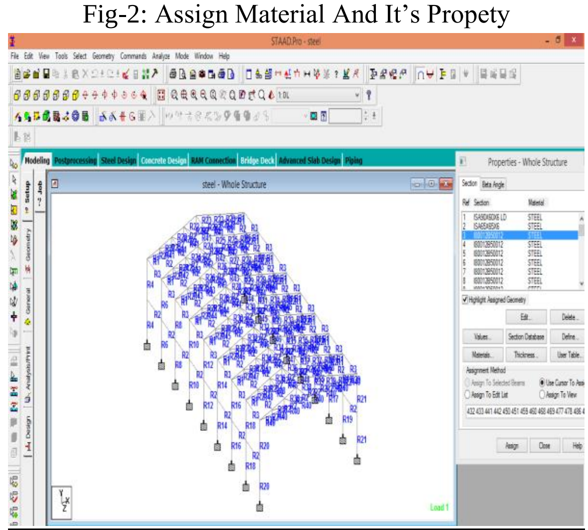


Fig-3: Assign Support

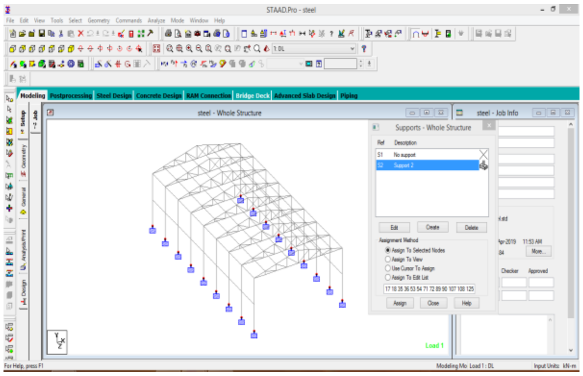


Fig-4: Assign Loads

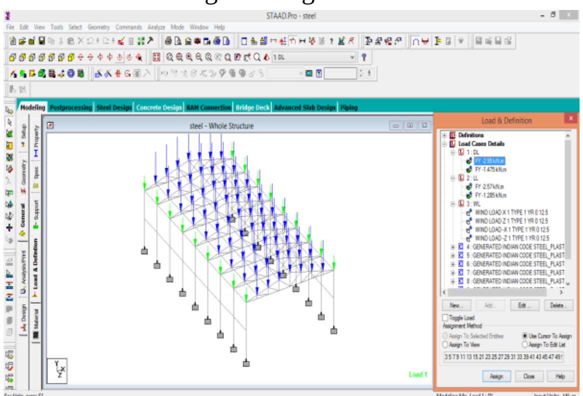


Fig-5: Analysis of Structure

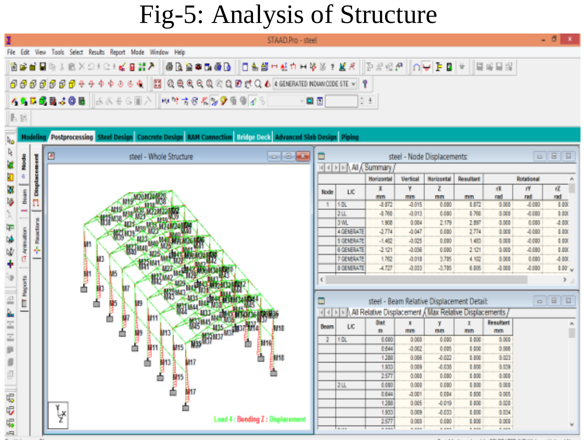
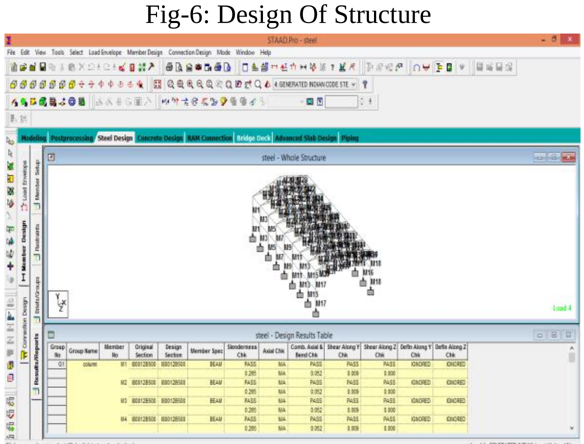


Fig-6: Design Of Structure



VI. CONCLUSIONS

1) It has been observed during the analysis of triangular and curved truss, the top and bottom rafter having a same nature of axial load in curved truss for various load combination and they have opposite nature in triangular truss.
2) In the design of curved trusses for different span, it has been seen that rate of saving in weight varies from 7 % to 15 % depending upon the span of truss. For the smaller span rate of saving in weight is more and it reduces approximately parabolic with increase in span.
3) The reduction rate of saving with increase in span, this occurs due to the reduction in saving in compression members under the increased axial force It also seen that the stress reduction factor for both the section is approximately same after some stage (with decrease in F_{cd}/F_y).
4) The Hollow steel section (H.S.S) is better option under compression. For the same cross section area and same length, the compressive strength of H.S.S is very much higher than conventional section (about 1.45 to 7.0 times). For smaller length the strength ratio of H.S.S (Hollow Steel Section) to l-sections small and increases gradually up to some length after that this ratio increases in parabolic nature. C.H.S (Circular Hollow Section) gives highest strength in above analyzed sections.
5) Hollow Section used as flexural member, it has been observed that H.S.S (Hollow steel Section) gives the same moment capacity as given by conventional sections. One advantage while using H.S S (Hollow Steel Section) is that the shear capacity is very much higher than conventional sections.
6) Hollow section used as tension member no economy is achieved. Its strength is quite same or less than conventional sections.
7) C.H.S is the most economical and strong sections as per all the observation.

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