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# Economic Evaluation of Open and Hollow Structural Sections in Industrial Trusses

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**ABSTRACT:** This report aims to evaluate the economic significance of the Hollow Structural Sections (HSS) in contrast with open sections. This study was carried out to determine the percentage economy achieved using Hollow Structural Sections (HSS) so as to understand the importance of cost effectiveness. The technique used in order to achieve the objective included the comparison of different profiles for various combinations of height and material cross-section for given span and loading conditions. The analysis and design phase of the project was performed using STAAD PRO V8i. The sample results of STAAD analysis were validated with the results of manual analysis.

**KEYWORDS:** Hollow Structural Sections, Open sections, STAAD PRO V8i, Utility factor, Joint efficiency.

## I. INTRODUCTION

In many situations lighter steel structure were invariably prepare to the heavier alternatives such as reinforce concrete or prestress concrete. The main advantages of steel structure were its intrinsic strength, prefabrication and quicker transportability to the work site and faster erection. Steel structures can easily dismantle without loss to the integrity of the original structure. Most structural steel units were prefabricated in a workshop with a superior quality control compared to In-situ construction. Tolerance specified in the Indian Standard codes for steel structural component during the fabrication erection were small compared to similar reinforced concrete structures. Steel also plays an important role in composite construction in conjunction with reinforced and prestress concrete structure.

With the development of steel as a construction material, the varieties of steel sections were also increased. Among these sections, the Hollow structural sections (HSS) or Structural hollow sections were the most reliable one. Due to their outstanding features, the application of these sections in present commercial market has been tremendously increased.

Hollow sections as steel profiles were not only in competition with concrete, but also they may be substitute for other steel profiles due to their superiority with regard to strength and stability. The mechanical and geometrical properties of the hollow section indicate under which loadings, a saving in material can be obtained.

## II. RELATED WORK

The following are some of the prime objectives of this study:

1. To compare analysis and design of the truss in industrial structures of different span and profiles using hollow structural sections and open sections.
2. To compute the most efficient sections in terms of economy. To study on rate of economy achieved with variations in material of trusses.
3. To determine the utilization percentage of individual member using HSS and open sections.
4. To obtain an aesthetically sound structure as compared to conventional structures.
5. To identify the geometrical advantages of HSS as compared to open section. The profiles and cross sections of trusses with various combinations of span and heights were developed and study was carried out such that the result of study represents the objective of the work.

### III. METHODOLOGY

The modern construction techniques and materials have brought a revolutionary change in the construction industry. The development in construction materials raised the possibility of achieving additional economy. The economy of trusses in industrial shed got adversely affected with the use of these different materials. An extensive study on rate of economy achieved with variation in materials of trusses was proposed in this project. A typical industrial shed is figured out below showing a basic truss model which was examined. Fig. 1. shows the structure of project in which it was executed.

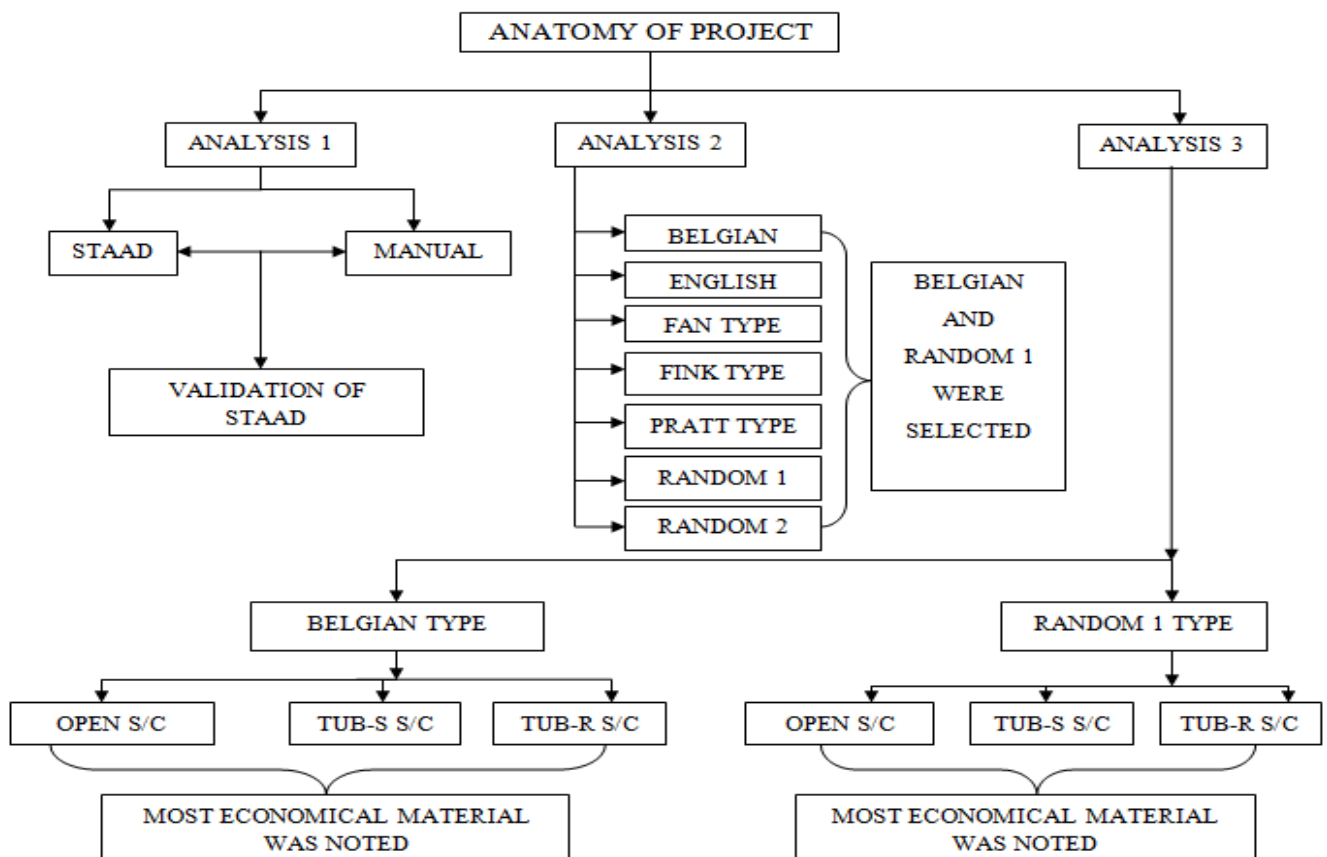


Fig.1. Anatomy of Whole Project

The functioning of the project depends upon the effective planning and management of the proposed work. This generates the importance of distinguishing the work into smaller units which were well controlled. This project comprises of several such units which were broadly classified in the following perspective.

#### 1. Design hypothesis

The design philosophy, requirements and terminology can be considerably varies from country to country e.g. limit states, design details, structural integrity etc. Therefore; It becomes necessary to hold some consistent parameters required for execution of work. The analysis and design is carried out using IS 4923, IS 800, IS 808, IS 875(part1, part2, part3) and other Indian standard code of practice which may be required during work. The following are some considerations made during the execution of the work:

##### 1.1 Theoretical consideration:

- All truss members are subjected to axial load only.
- Bending moment is insignificant and therefore neglected.
- Joint efficiency does not affected the stress.
- The effect of environmental factors are neglected

##### 1.2 Practical considerations:

- The spacing between consecutive trusses is kept 4m upto the length of 40m.

- The pitch of the truss is kept 101.
- The location of industrial shed is in Aurangabad.
- The panel point distance in principal rafter is constant for a particular span.
- Tubular sections used in the analysis were selected from “Tata Structura” steel manual The truss is divided into three groups i.e. principal rafter, web members and tie members.
- The member assigned to each group are independent of others.
- The design of most critically stressed member in the group was assigned to other members of same group irrespective of their individual stress intensities.
- The total weight mentioned in the results represents the weight of half symmetric section of truss.

## 2. Participants

It defines the objects or models on which the analysis is carried out. The selection criteria employed are as follows:

### 2.1 Choice of profile:

Seven different profiles are considerably economical profile. analyzed to determine.

- Of these profiles, five are standard profiles and two are proposed.
- The results of the analysis are compared in terms of overall length (or weight) of material required to construct that profile.
- From below trusses, two profiles of least weight are selected for further analysis.

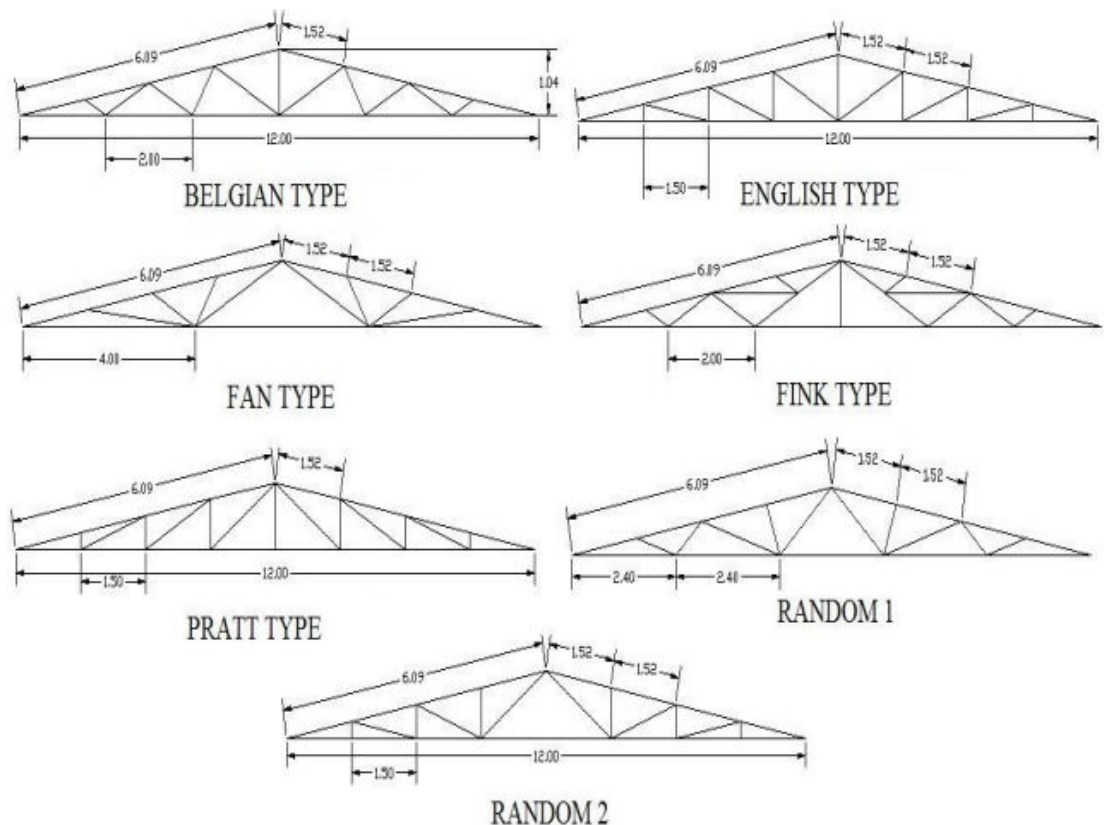


Fig. 2 Types of Trusses

### 2.2 Choice of section:

The design of steel section is governed by the cross sectional area, sectional modulus and radius of gyration. This project is executed considering some fixed cross sectional geometry so that the results obtained can be effectively compared. From open sections; Angle section is selected for final analysis. From tubular sections; Square and Rectangular sections are selected for final analysis The above sections are processed in composition of various profiles, spans, heights.



### 2.3 Choice of geometric parameters

The above selected profiles and cross sectional are merged with the trusses of various spans and heights, so that the wide range of combinations are developed. These combinations are analysed and designed using both open and HSS. Therefore, a total of 72 trusses combinations are obtained.

### 3. Resources

It represents the material and apparatus required for the execution of task. Basic input data, IS codes refers to the material. Apparatus refers to the medium of the analysis i.e. manually are software (STAAD PRO V8i) based.

### 4. Procedure

The feasibility of results depends more or less upon the procedure followed during the examination of the models. A reliable outcome was when the basic need of the project was satisfied. As the software STAAD PRO V8i was used for the analysis and design of the members. The procedure followed to obtain the desired results plays a prominent role. This project has been divided into three major steps (phase). The result of individual phase gives reasonable output and on compiling gives the concluding results.

The following were three major steps followed during the execution of analysis and design work.

Exercise 1: Validation of STAAD PRO V8i.

Exercise 2: Comparison of different profiles.

Exercise 3: Final analysis of truss profile using HSS and open section.

Each exercise mentioned above has their unique procedures which are discussed below:

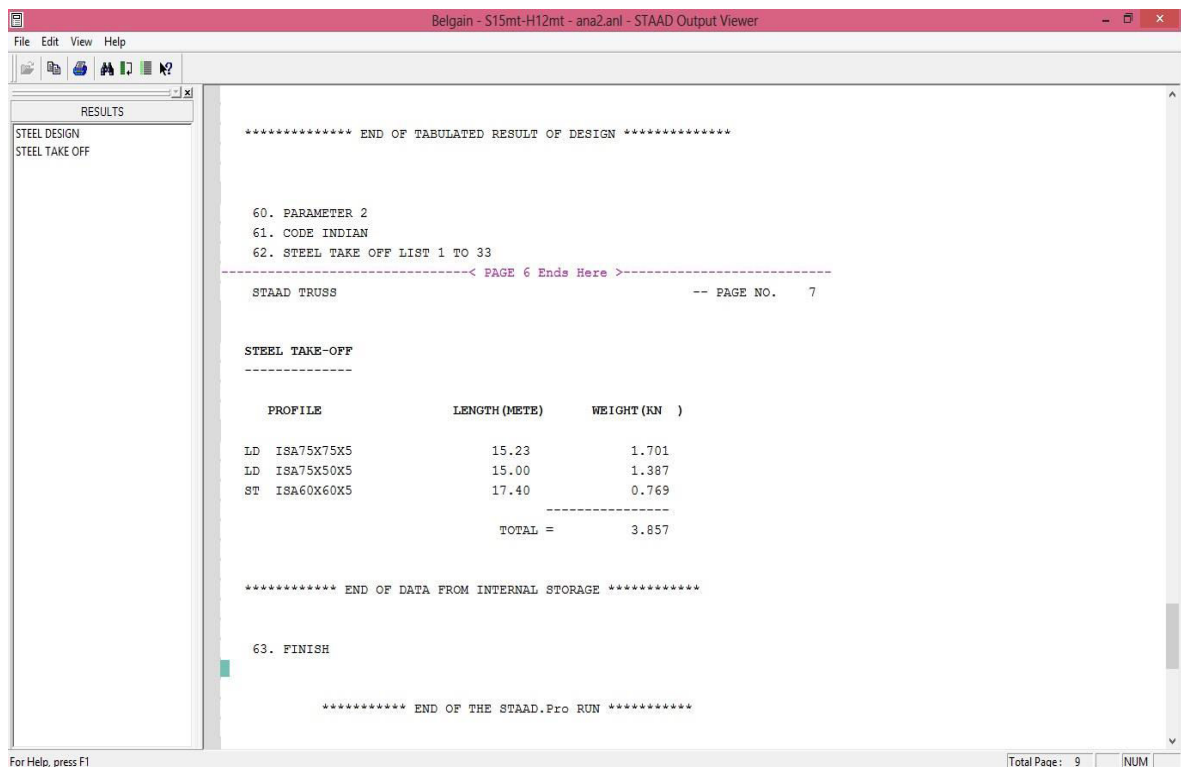


Fig. 3 Output Viewer

The above figures describe the stepwise procedure for analysis of open sections in STAAD. Similarly, the same steps were followed for the analysis of hollow structural sections.

## IV. EXPERIMENTAL RESULT

The analysis and design of all the above 72 truss combinations have been executed using STAAD PRO V8i and the most optimized sections that can be safely used in the truss have been obtained. The results of this analysis have been tabulated individually. The following were tabulated results of each designated truss.

It is observed that the results of this above comparisons indicated the economical profiles that can be obtained among the two. It can be seen that the Belgian gives a considerably economical result. The outcomes of above two tables are represented graphically with span on X-coordinate and weight on Y-coordinate. The variation pattern in terms of economy will be understood using these graphs.

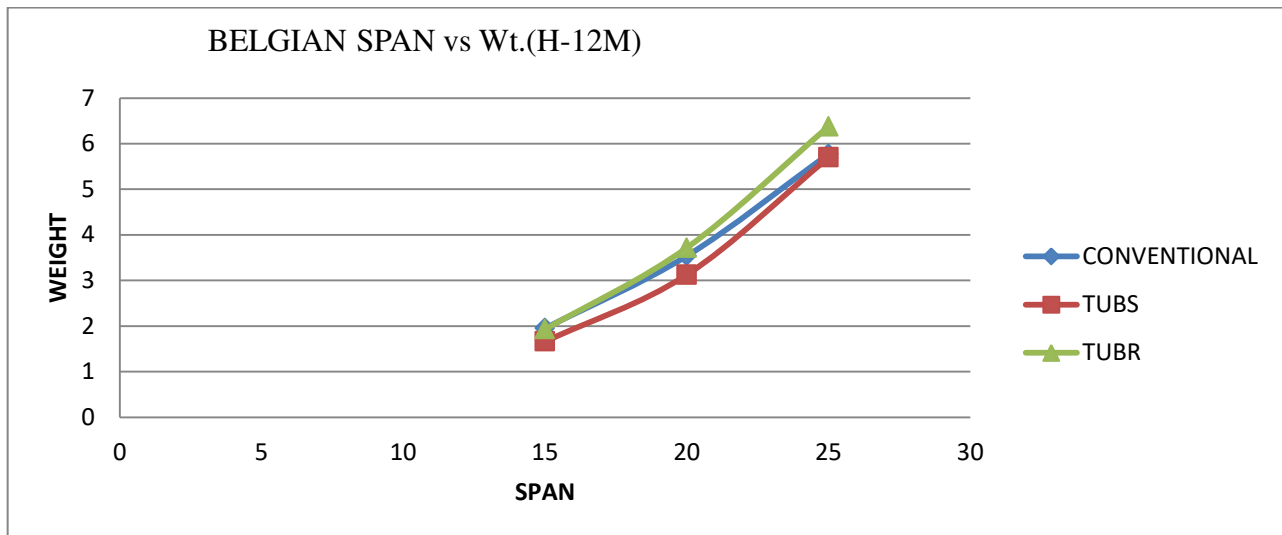


Fig.4 Belgian Span Vs Weight (H-12M)

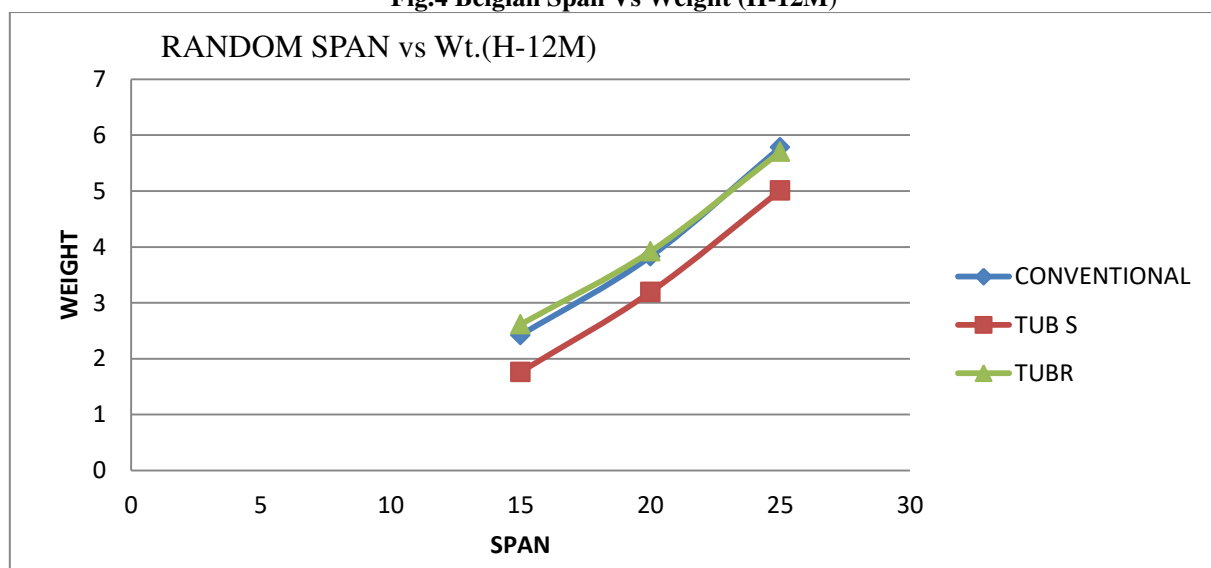


Fig.5 Random Span Vs Weight (H-12M)

From above graph, it was clearly seen that the weight required for SHS sections was considerably less than the weight required for open and RHS sections. The variation pattern was nearly same for different profiles at different heights.

## V. CONCLUSION

After comparison of results obtained from all the 72 analysis of trusses, it is concluded that:

- 1) For Belgian truss profile; the mean economy achieved for Square Hollow Section (SHS) and Rectangular Hollow Section (RHS) was 10.57% and -2.08% respectively when compared to Open Section. (NOTE: Negative sign indicates uneconomical section)



- 2) For Random-1 truss profile; the mean economy achieved for SHS and RHS was 17.82% and 4.25% respectively when compared to open section.
- 3) The overall mean economy achieved for SHS was 14.20% with respect to Open section whereas; RHS was 0.33% uneconomical with respect to open section.
- 4) The economy of SHS when compared to open section decreases with increase in span. This ranges from 27.26% to 5.08% for span of 15 to 25m respectively.
- 5) It was observed that Belgian profile was more cost effective when compared to Random-1

#### REFERENCES

- [1] Yu. I. Katarzhnorr, V. A. Polyakov, V. V. Khitor, "bearing capacity of hollow composite rod in torsion", p.p.-585-592.
- [2] V. I. Alekseev, "stability of hollow shaft in torsion", p.p.-67-73.
- [3] S. Elsayaf, Y. C. Wang, "behavior of restrained structural subassemblies of steel beam to CFT column in fire during cooling stage", p.p.-471-492.
- [4] X. Y. Gao, T. Balenda, C. G. Koh, "buckling strength of slender circular tubular steel braces strengthened by CFRP", p.p.-547-556.
- [5] Esther Real, Enrique Mirambell & Ronado Chacon, "strength & ductility of concrete filled tubular piers of integral bridges", p.p.-234-246.
- [6] T. Sheehan, X. H. Dai, T. M. Chan, D. Lam, "structural response of concrete-filled elliptical steel hollow s/c under eccentric compression" p.p.-314-323.
- [7] J. Haedir, X. L. Zhao, M. R. Bambach, R. H. Grzebieta, "analysis of CFRP externally reinforced steel CHS tubular beams", p.p.-2992-3001.



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