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# DESIGN & OPTIMIZATION OF STEEL STRUCTURE FOR SOLAR ELECTRICAL PANEL

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**ABSTARCT:**
**Structural are the basic part for support of any mechanical machine in the industry. These are not only designed to support the basic Weight of the machine but also support in terms of vibrations produced by the mounted machine. The project considered is an activity that has interfaces with basic structural sections to make it a complete mechanical structure. We intent to work for an industry that develops support structures to various electrical units. On initial study we could see that such industries are into manufacturing and provide the structure for various control panel. This is done based on their experience. We could see the structures are overdesigned because of conventional manufacturing and past experience. No FEA or theoretical calculation methods were used. We propose to introduce latest FEA knowledge and concepts to work on this sector to provide a detail optimized design.**

***Keywords:*** *Transmission line tower, Optimize, STAAD-PRO, ANSY*

## 1. INTRODUCTION

THIS is a study about designing a structure for solar electrical panel using various sections , square tube, circular tube, rectangular sections. Sections is to be considered according to the dead load information received. Design calculations according to the IS standard has to be done for Stress, Deflection & Weight & results will be compared with ANSYS results to get most suitable & economical structure. First we will see what is structure , its advantages & disadvantages& also what is ANSYS & its use.

### *1.1 What is a Steel Structure?*

- Variety of heavy steel shapes used as a load bearing members of a structural frame & joined by means of bolts, rivets & welding process.
- Structural steel is steel construction material, a profile formed with a specific shape or cross section and certain standards of chemical composition and mechanical properties.

### *1.2 Structural design requirement*

- Determination Of Overall portion & dimensions of supporting framework & selection of individual members.
- It should according to the requirements of customer or client.
- It should be according to safety requirements.
- Serviceability ( How well structure performs in terms of appearance & deflection)
- 5) Economy ( Structure should be rudge with efficient use of material)

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### *1.3 Why to use Steel Structure?*

- High Strength , High ratio of strength to weight.
- Excellent ductility & seismic resistance.
- Withstand excessive deformation without failure even under high tensile stress.
- Elasticity, uniformity of material Predictability of properties, close to design assumptions.
- Ease of fabrication & speed of errection.

### *1.4 Where & when to use steel structure?*

- Long Span Structure
- Multi Storey & High Rise Building
- Buildings Of Heavy Duty Plants
- Tower Structures
- Portal Frames
- Bridges & Infrastructures
- Deployable Structures
- Generalized Mechanical structures.

## 2. EXISTING SYSTEM

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. It is obvious that due to profile of tube section ,dead load is likely to be reduced for many structural members. This is a study regarding economy, load carrying capacity of all structural members & their corresponding safety measures. Economy is main objective of this study involving comparison of conventional sectioned structures with tubular sectioned structure with tubular sectioned for given requirements. For study purpose super structure part os an industrial building Is considered & comparison is made. Dead load analysis, live load analysis , wind load analysis is done for each individual members & compared with conventional design & STAAD PRO results.[1]

In this effectiveness of Tubular section is determined & compared with other sections. Also cost comparison is done with other conventional sections. Above study reveals that tubular section proves to be economical. Total saving of almost 50 % to 60 % in cost is achieved.

Chimneys are required to carry vertically and discharge, gaseous products of combustion, chemical waste gases, and exhaust air from an industry to the atmosphere. Chimneys are tall structures and the major loads acting on these are self-weight of the structure, wind load, imposed load due to lining and other mountings, thermal load, earthquake load. In this project a steel chimney will be designed considering dead load, wind load and thermal load. The Bureau of Indian Standards (BIS) design codes procedures will be used for the design of the chimney. After designing the chimney is modeled using ANSYS. Then both wind load and structural load analysis will be carried out using ANSYS. Finally the thickness of the steel shell is optimized which will result in material saving and reduction of weight of the structure.[2]

The paper conclude that analysis was carried out and the stresses were plotted. And the maximum value is found out. The analysis is done for different shell thickness, ie 12mm, 10mm, 8mm, 6 mm.

The von mises stress varies from 97.797 Pa to 3.85MPa for the 12mm thick shell where as for a10mm thick shell, the Von Mises stress varies from 130.546Pa to 4.01 MPa, the same for a 8mm and 6mm thick shell is from 747.361Pa to 4.54MPa and 130.488Pa to 5.01MPa respectively.[2]

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The optimized version of a steel structure used in civil engineering obtained through a process of structural optimization using Finite Element Method. The main advantage of this optimized structure is the cost which is 50% smaller then the cost of a standard version of this steel structure. The optimization process was made using Finite Element Method and ANSYSprogram. The paper presents the results of structural analysis of this optimized steel structure in two load cases: the snow weight and the seismic simulation.
The results of static analysis for the optimized structure show that the second type of structure with the opening of 30 m had bigger Von Mises stresses in both load cases. Both optimized types of steel structures have good behavior for both load cases (snow and seism) and they can replace the standard steel structures which use heavy beams with large dimensions I sections. The main advantage of these lighter optimized versions is: 50% smaller costs because the weight of the steel structure is 3 times smaller than the standard structure, so we use 3 times less steel.[3]

The Transmission-line tower is highly indeterminate structure. In present study, a typical 132-KV double circuit transmission-line tower is considered, for optimizing the structure with respect to configuration and different materials as variable parameters. The tower is modeled and analyzed using STAAD-PRO and ANSYS software's. The basic model of the tower considered is analyzed in STAAD-PRO and the results with respect to the member axial forces are validated in ANSYS. A number of experimental configurations of the tower are obtained by increasing the base width of the tower and also by decreasing the bracing patterns below the waist of the tower.[4]
This paper includes advantages & disadvantages of steel structures, Load & Load Combination, Limit state method of design, failure criteria for steel, codes, specifications& section classification.

In this author explain complete procedure & criteria to be considered while designing steel structure. Author explained about Bolted & riveted & welded joints with examples.[5]
Long span column free structures are the most essential in any type of industrial structures & pre engineered buildings(PEB) fulfill this requirement along with reduced time & cost as compared to conventional structures. Design of structure is being done in STAAD PRO software & conventional steel frames, in terms of weight which in turn reduces the cost. Conclusion of this literature is that pre engineered steel structures building offers low cost , strength, durability, design flexibility, adaptability & recyclability. It is seen from present work that weight of steel can be reduced to 27% for hostel building, providing lesser dead load which in turn offers high resistance to seismic forces. Comparison in second example showed that even though PEB structures provides clear span , it weighs 10% lesser than conventional structures. For longer PRE engineered buildings are more suitable than conventional structures.[6]
The study represents simultaneous cost, topology & standard cross section optimization of single storey building structures. The considered structures are consisted from main portal frames, which are mutually connected with purlins. The optimization is performed by the Genetic Algorithm (GA). The proposed Algorithm minimizes the structures material &labor cost, determines the optimal topology with the optimal number of portal frames & purlins as well as the optimal standard cross sections of the steel.
This paper concluded that Genetic Algorithm method is most suitable for solving the encountered problem in civil engineering. The mathematical problem such as derivatives, Integration are not included in this method which makes the method easy to use. The main aim of paper is to obtain the simultaneous cost, topology & standard cross section optimization of single storey industrial building structures.[7]

## 3.PROBLEM DEFINITION

Most of the Solar panel manufacturer uses heavy base structure for installation of control panel. Base structure is manufactured in a traditional way. Because of that structures are overdesigned & over weighted structures. Requirement of the design is light weight, low cost & high strength structures as per requirement of the control panel. Due to over weighted structure, material consumption is more which leads to higher cost.

By analyzing their manufacturing process there is no FEA methods or theoretical calculations were used to get the better & economical design( Optimum results).

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To get better design with light weight & low cost there must be a requirement of analyzing structure carefully , for that ANSYS will be the better option to get optimum design as per requirement of control panel & manufacturer point of view.

To determine effective section a structure for panel is considered Analysis & design of structure for various section is to be done. Also cost comparison is to be done for all available sections.

## 4. METHODOLOGY

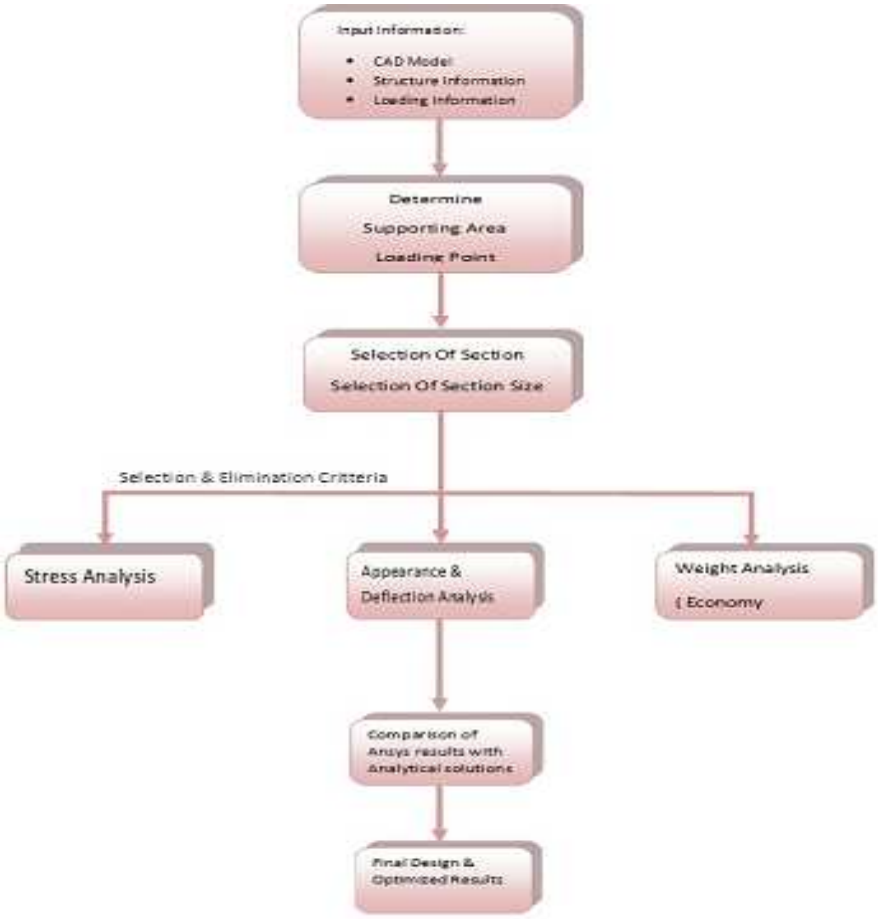


Figure 1 General Methodology

### *4.1 Input information*

By analyzing current structural requirement for the base of control panel the software base proto model will be design on PRO-E.

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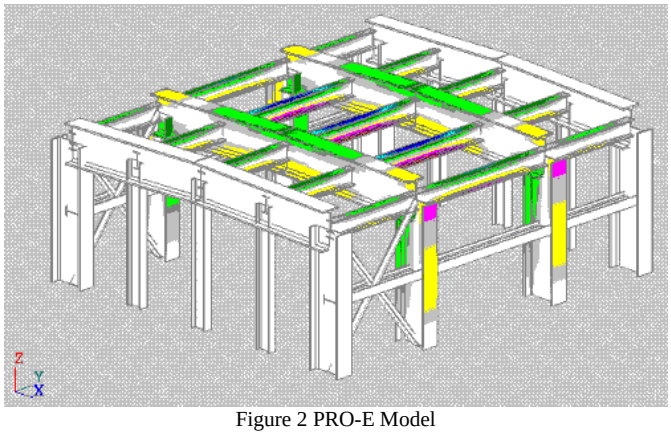

Figure 2 PRO-E Model

***4.2 Determine supporting and loading points.***

Preliminary information for the boundary condition in terms of area of constrains, loads etc will be taken as per requirement of design.

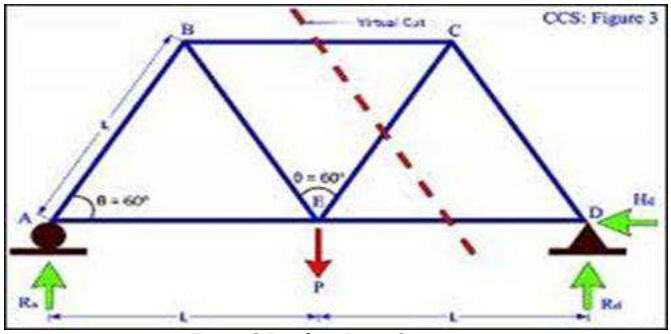


Figure 3 Loading Point & support

***4.3 Selection of sections***

During of loading of steel structure , majority of steel structure are subjected to compound loading & their resultant deformation consists of torsion, bending, tension or compression. Under simple tensile & compressive loading, the strength &stiffness of an element depend only the area of cross section.

Based on Various standards for structural steels , we will consider different section like L , I , C etc with various sizes and thickness to find out the most suitable section that can be used.

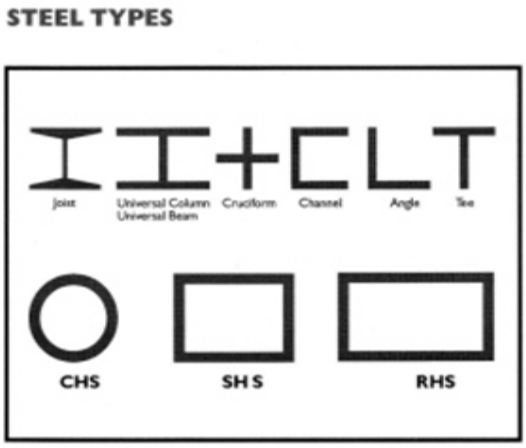


Figure 4 Steel Section Type

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***4.4 Deflection analysis-***

Using FEA methodology we will find out the possible deflections in the structure and further compare this deflection with different cross section .

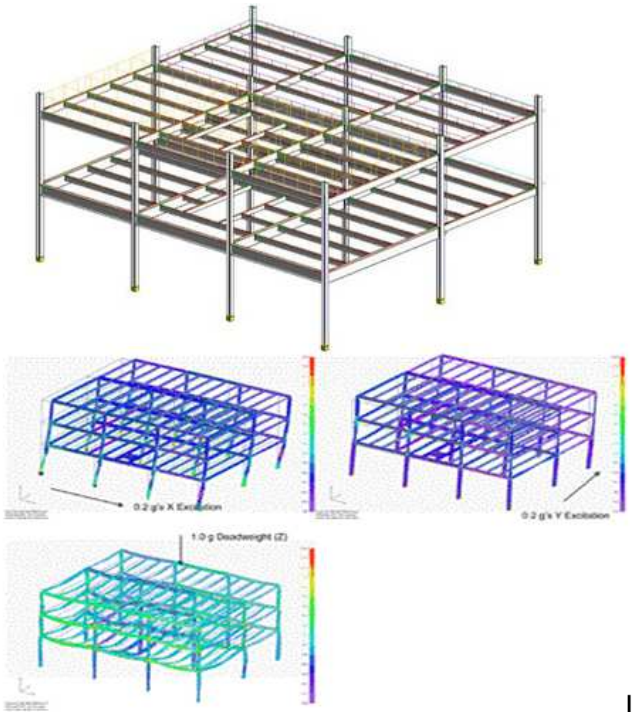

Figure 5 Deflection with different cross section

***4.5 Weight cost and availability analysis***

Perfected optimization of the structure with reference to different sections, length , width etc to ensure least possible weight for structure this in turn will reduces the overall cost.

## 5. CONCLUDING REMARKS

By this Analysis we expect that the best structural design for electrical control panel with--

- To Get optimum design
- Cheaper and less material
- Overall cost reduction
- Better structural stiffness.
- Lighter structure
- Better manufacturability (Flexibility)

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