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Hexagonal Structured Frame Design and Analysis

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Abstract: ***Hexagonal structures are the man made or natural structures. It has the geometry of a honeycomb to allow minimize the amount of material to reach the maximal weight and minimal material cost. Its objective is to design and analyze the new concept of hexagonal framed truss that is alternate to the normal Pratt type trusses. This concept explains the study of comparative and efficiency of the normal triangle trusses and hexagonal trusses. The project deals with the shape of the structure that takes more load than the normal structure and the amount of material use of this structure is lesser than the normal structures. Structural analysis is the determination of the effects of loads on physical structures. The results of such an analysis typically include deformation, stresses and displacements. This hexagonal framed steel structure may used in bridge frame, roof truss and more. The aim of our project is to construct a hexagonal framed steel bridge to reduce the usage of material, cost and to take the maximal load to the structure. Our main motive is to construct the economical bridge and to save the material used.***

Keywords: Hexagonal structure, Minimal Weight, Minimal Cost, Maximum load, Economical.

I. INTRODUCTION

Hexagonal structures are inspired from bee honeycombs, had found widespread applications in various fields, including architecture, mechanical engineering, nanofabrication, transportation, chemical engineering and recently biomedicine.

The geometry of hexagonal structures can differ, but common feature of all structures is an arrangement of hollow cells. These cells are circular and hexagonal in shape.

Hexagonal patterns are power full in nature due to their efficiency. These are the most efficient way to fill a space with the least amount of material. These shapes can be repeated without leaving gaps or overlapping.

II. METHODOLOGY

To prepare the model of hexagonal structure design to understand the behavior of the simply supported hexagonal framed structure under concentrated load.

Comparing the deflections, critical loads and stresses of hexagonal steel structure to study about the material and varying the thickness of trusses of hexagonal frames.

Understanding the unique properties of hexagonal structures, which depend on their structures, scales and the materials used.

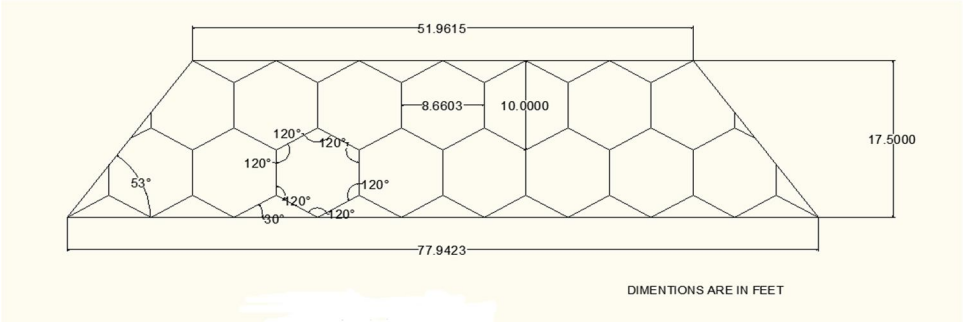

Fig 1: Hexagonal truss

The above 2D diagram represents the structure of the hexagonal frame that is used to analyze the data. In this frame, the load is given at the bottom of the frame. Due to the load the bottom of the frame is subjected to tensile force and top portion of the frame is subjected to compression force.

The reactions are given at the bottom of two ends of the frame. The simply supported frame is subjected to axial load. These are the fully constrained structures which are designed to support loads.

The joints of the hexagonal framed truss are made with frictionless pins and loads are applied at the joins of the structure.

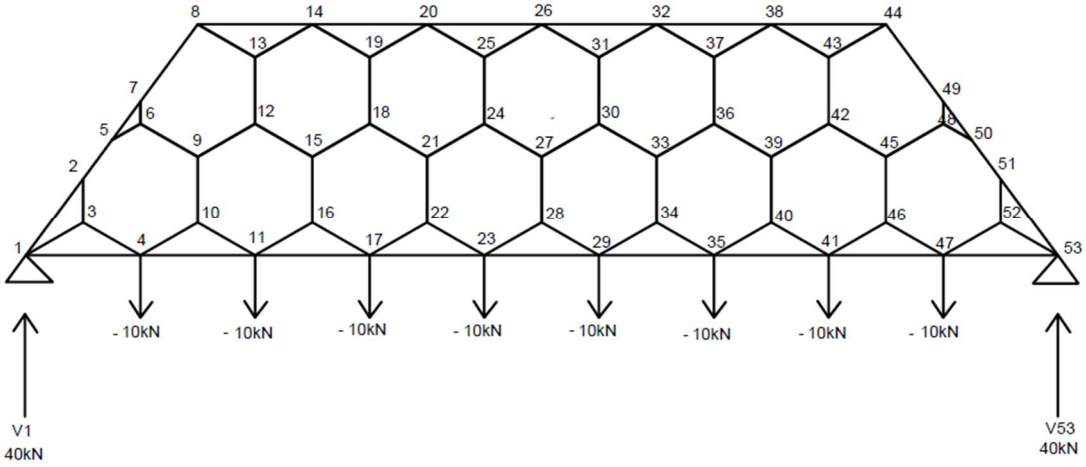

Fig 2: Truss members with load

Analyzing of perfect truss consists of finding the reactions at the support and finding the internal forces in the members of the truss.

A. Reactions of Supports

The reactions at the supports determine the load condition of the applied force and system of equilibrium by equilibrium equations. The equilibrium equations are a summation of horizontal and vertical forces are equal to zero.

$$\Sigma H = 0; \Sigma V = 0; \Sigma M = 0.$$

B. Internal Forces of Members

The internal forces in the members are determined by the joints of the truss is in equilibrium. The internal forces are found by the analytical or graphical method. In this project, the analytical method is used to find internal forces by the members.

By using the analytical method, the calculation of internal forces is found by method of joints and method of sections.

For this hexagonal structured steel frame, the method of joints is used to calculate internal forces of the members. The three dimensional hexagonal structured steel framed design is shown below.

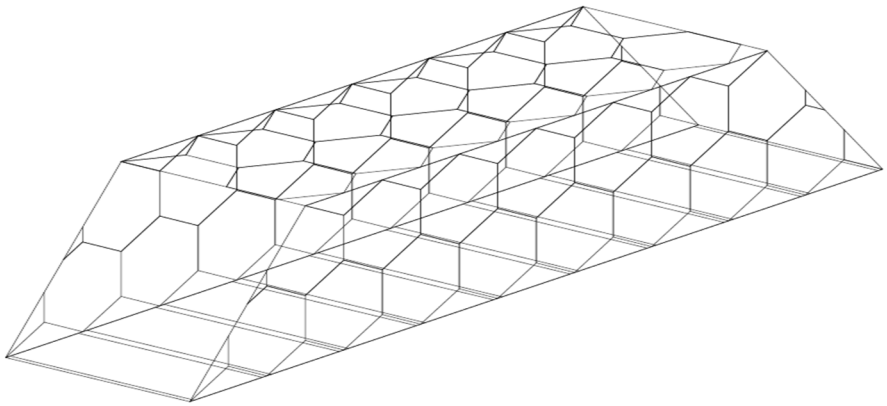

Fig 3: Three dimensional hexagonal structured frame.

III. CONCLUSION

The major purpose of this project is to understand the design principles underlying the creation of hexagonal structures for a wide range of practical applications. We can analyze and benefit through this highly efficient structural model in future. Collecting data, analyzing survey forms and tabulating data is used to apply statistical principles in calculating. An interesting future study might involve testing and analyzing the hexagonal structured design and stimulate the usage of ordinary designs.

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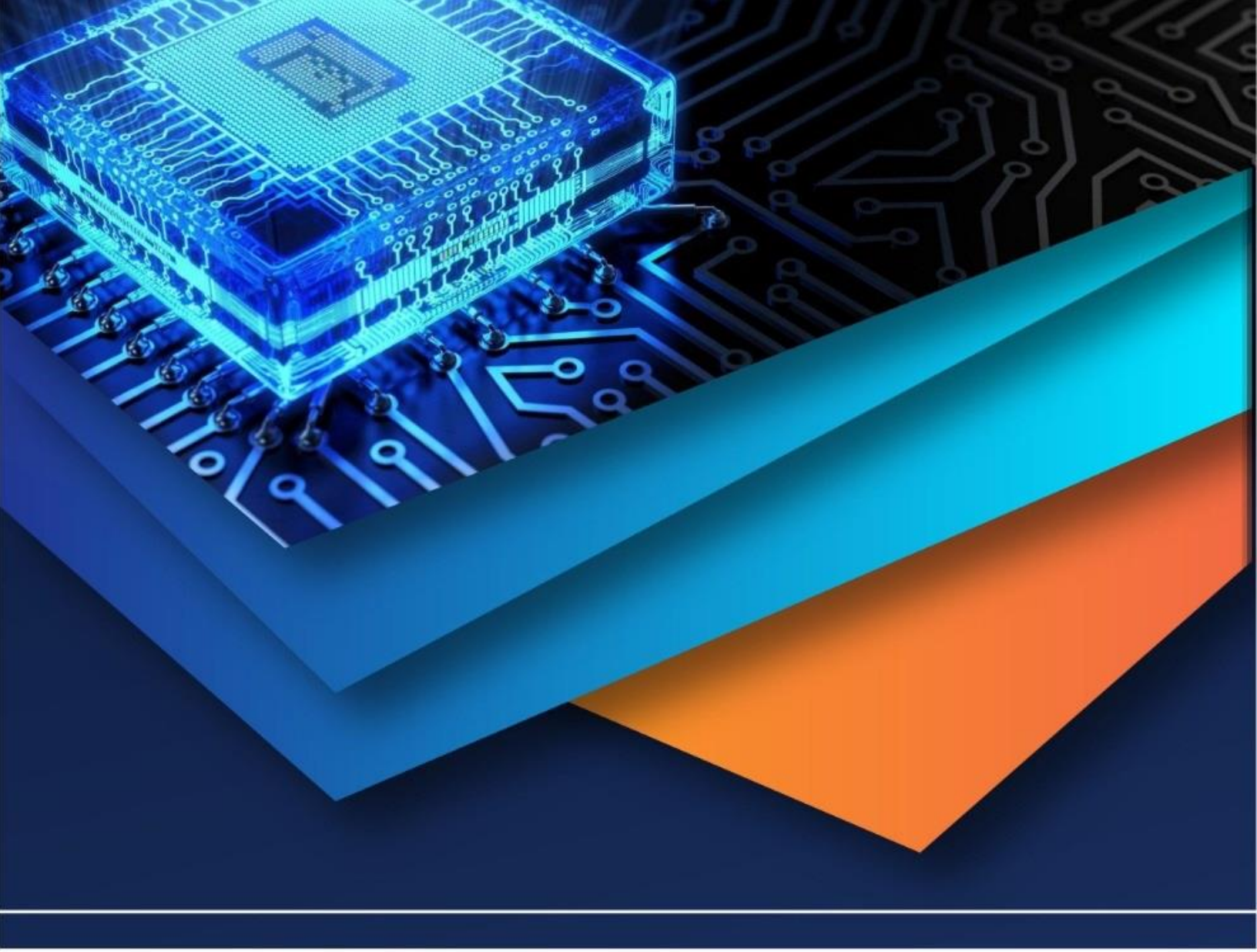

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