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Analysis and Design of Tensegrity Structure

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ABSTRACT

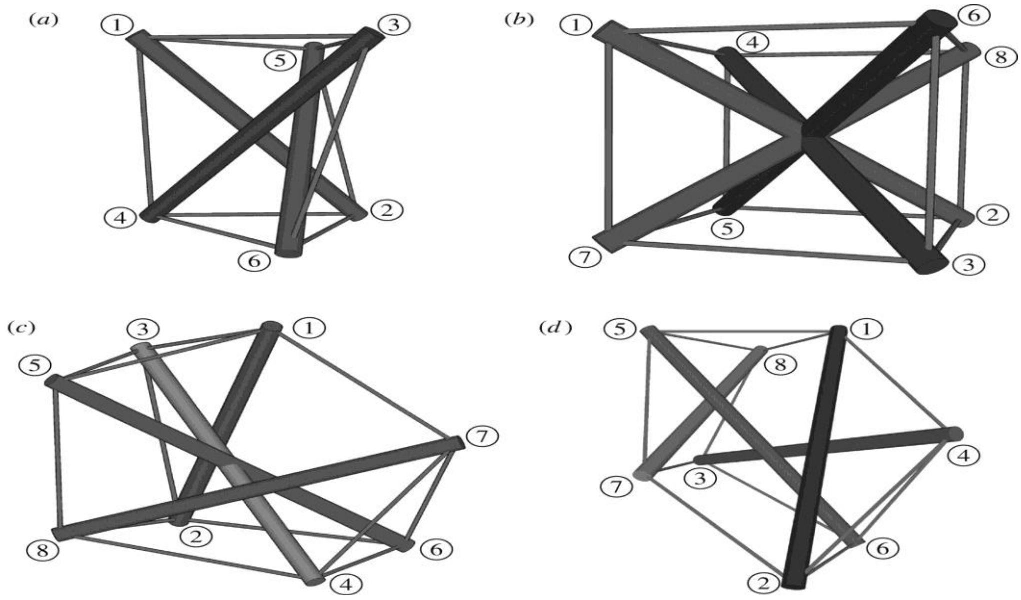
The characteristics of the tensegrity structures, which make the world attractive for human use, are their flexibility and using of material in way of economical. That's why structure which is constructed using tensegrity principle will make them highly flexible and economical at the same time. Though many research are concentrate on the theoretical aspect like from finding, only a few practical works have been done on how to use these structures.

Keywords : Plan, Survey, Design, Analysis, Construction, Staad pro.

I. INTRODUCTION

Tensegrity structure are 3-D trusses where members are assigned specific functions. Some members remain in tension while others are always in compression .usually for compression members, solid section or bars are used , and string or cable type element can be used as the tensile members. The bars are rigid bodies and the strings are one dimensional elastic bodies. Hence, a material system is in equilibrium if the nodal point of the bars in the system re in equilibrium. Most bar-string configuration will not be in equilibrium. Hence, if constructed they will collapse to a different shape. Only bar-string configuration which collapse to a different shape. Only bar-string configuration which is pre-stressed and in a stable equilibrium will be called Tensegrity structure. The word "Tensegrity" is a contraction of the phase "tensional integrity". The word was proposed by Richard Buckminster Fuller in 1962. The construction of the first tensegrity structure is however attributed to the artist Kenneth Snelson who created his X-piece sculpture in 1948.

Snelson describes tensegrity as a "class of structure possessing, what may be termed discontinuous compression, continue tension characteristics". Which means the structure will have continuous tension through tout and the compression element will remain as small islands in a sea of tension. A widely accepted definition was given by Moto, "A tensegrity is a system in stable – equilibrium state comprising a discontinuous set of compressed components inside a continuum of tensional component."



II. 2. APPLICATION OF TENSEGRITY STRUCTURES

Kenneth Snelson, made an observation concerning the practical application of Tensegrity structures in relation to the load handing capacity of Tensegrity structures, and thus their limited practical relevance. There have been few actual implementations of the Tensegrity principle in engineering application, which is mainly ascribed to the lack of knowledge concerning actual construction methods rather than any knowledge concerning actual contraction methods rather than any deficiencies in the Tensegrity concept. Tensegrity structures are certainly relevant in various areas of engineering as emphasized by the benefits mentioned in the preceding sections.

Smart Structures:

Most Civil Engineering structures are static. A more challenging functionality fir Civil Engineering structures is active adaptation to changing requirements, such as load modifications, temperature variations, support settlements and possible damage occurrence.

The concept of active structures involves structures that include both static and active structures elements. Adaptive structures are defined as structures whose performance is www.studymafia.org controlled by a system composed of sensors, actuators and a computer that provides the ability to learn and improve response to changing environments.

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III. Strut Tensegrity Structure

Description of the model:

This type of proto-type is called half cub octahedron. It consists of 12 cables (4 top cables, 4 bottom cables and 4 side cables) and 4 strut in all. The detail of the model is shown below:-

Length of the strut:- 3.0ft ,Length of the cables:- 4.5m, Height of the structure:- 2.5ft

Weight of the structure:- 3.5kg

All length are measured from centre to centre distance.The model prepared by us is as shown below:-

Materials used :-

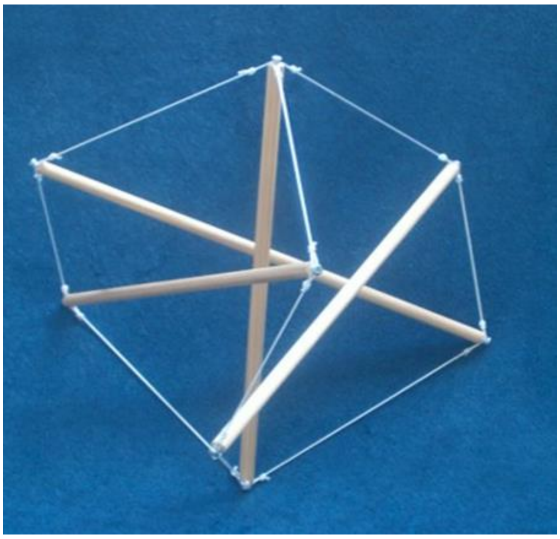
Strut:- Mild steel

Cables:- High tensile strength steel cable of mm diameter.

Type of connection provided:-

Welded connection is provided between strut and cables.

Tensegrity 4 strut model



IV. Analysis

The generated existing structure was then analyzedby subjecting to the following loading conditions, using STAAD pro V8i.

- Dead load
  - Self weight of the tower
  - Self weight of antenna
  - Wind load

The response of the structure to the above mentioned loading conditions were observed and the net deflection of the structure was noted for comparison. Design Wind Speed (Vz)

The basic wind speed for any site shall be obtained from the code or from the weather department and shall be modified to include the following effects to get design wind speed,

Vz at any height, Z for the chosen structure:

(a) Risk level,

(b) Terrain roughness and height of structure,

(c) Local topography, and

(d) Importance factor for the cyclonic region.

It can be mathematically expressed as follows:
Vz= Vbk1k2k3k4

Where,

Vb= design wind speed at any height z in m/s,
k1= probability factor (risk coefficient),
k2= terrain roughness and height factor,
k3= topography factor, and
k4= importance factor for the cyclonic region.

V. Conclusion

On having a comparative analysis between the experimental and theoretical result, it was found that the trend of variation is almost similar but the difference in the theoretical and the experimental value. The possible reasons for observed disparities in the theoretical and experimental result are:-

- Inaccuracies of the experimental equipment
- Joint are not completely flexible
- Pre-tension effect in cables
- Fabrication errors

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