

Feasibility Of Tensile Membrane Structure In Ahmednagar City.

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Abstract—Membrane structures are hugely popular in the rapidly developing world of civil engineering and their use is increasing in different aspects of buildings. There is an increasing trend concerning the use of membrane structures within architectural design for better aesthetical view and better alternative for traditional roofing materials. It is important to recognize the reasoning behind the growth in popularity. The implementation of these new technique needs to be boosted in Ahmednagar city as there are very few practical applications at present. This paper contains the survey of the city for the locations where these structures can be assembled. Market survey is also mentioned to ultimately check that is a tensile membrane structure really feasible in current scenario of Ahmednagar district.

Keywords—Tensile membrane structure(TMS), PTFE, ETFE, Feseability.

I. INTRODUCTION

Tensile Membrane structures are one form of architectural feature that are becoming hugely popular within modern day civil engineering. Today society is unaware of the detailed specifications and their advantages. These structures are part of a unique technology which gives engineers the ability to experiment with Shape and create appealing structures. They are not only visually exciting, but are environmental friendly and economically competitive as well.



Figure 1- Tensile membrane structure.

Membrane structures closely resemble to tent like structures that were initially found in Germany. These were stable and reliable structures which can be quickly erected at the proposed site thus resulting in becoming a vital aspect of

modern day architecture so these structures are still regarded as very reliable and suited to specific types of structures.

The materials which are used are lightweight and are very efficient in long span applications. As an additional benefit, they transmit forces to the ground and also much of the building cover. Main objective of this study is to introduce this new technique of roofing to Ahmednagar city. The field survey reports suggest that applications of membrane structure is negligible and enchaining the concept in to the society. After thorough study of the city few locations where undertaken for designing roofing along with checking their feasibility.

II. MATERIALS

The term 'fabric' is used to indicate the wide class of fabrics which are the vital components of this concept also their technical aspects are more significant than the aesthetic ones. Material of these fibers is one of the most important factors which contribute to the final performance of the structure, especially from the design point of view. The fibers can be natural or artificial in which natural fibers have the advantage of a reduced environmental impact. It is found that the properties of natural fibers cannot be significantly changed in order to meet particular requirements and results in reduction of their application. Whereas artificial fibers can be obtained by using a wide range of bulk materials and processes which satisfy a wide range of requirements such as the mechanical and chemical properties. Here are some of the commonly used fabrics for erecting tensile membrane structure:

A. PTFE (Polytetrafluoroethylene)

It is synthetic fluoropolymer of tetrafluoroethelene with chemical formula $(C_2F_4)_n$ with numerous applications. It is a particularly versatile ivory-white and opaque plastic fluoropolymer, made by free-radical polymerization of many tetrafluoroethene molecules. This material is used for roofing of structure like food and drink industries, pharmaceuticals and telecoms.

Versatile properties of PTFE are –

- High flexural strength even in low temperatures.

- High electrical resistance and di-electric strengths.
- Water resistant.
- It has low coefficient of friction.
- Weather resistant.
- High durability.
- Fire resistant.
- Thermal stability.

But color availability is only white which restricts its appearance.

B. ETFE (ethylene-tetrafluoroethylene copolymer)

ETFE (ethylene-tetrafluoroethylene copolymer) is a plastic derivative that is frequently used as a building material in the form of ETFE membranes. The material is characterized by high light and UV transmittance, temperature resistance and very low weight. ETFE film is a hundred times lighter than glass and allows more sunlight to pass through. As a result, it is often used for the construction of light-transmission roofs.

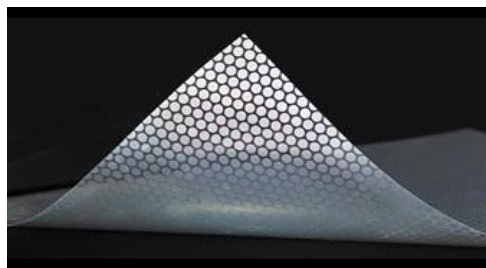


Figure 2- ETFE Sheet.

The material has a self-cleaning function which is provided by the lotus effect. This special surface ensures that wind and rain are sufficient to remove dirt from the surface of the material. Also it is fully recyclable and available in more than 40 colors.

The main features of ETFE are-

- Highly translucent
- Extremely light weight
- Extraordinary tear resistant
- Fire resistant
- Low cost
- Recyclable
- Highly durable
- Low maintenance

III. METHODOLOGY

The procedure for the design of the membrane structure consists of following three main stages-

- Field Survey
- Market Survey
- Software Design of the structures

The above mentioned points are useful for overall understanding of the requirements along with appropriate applications.

A. Field survey.

Field survey is the method by which engineers search for sites and collect information about location, distribution and organization of human settlement. The collected information was further used to prepare sketch of the structure which can be provided on the site according to the necessity.

The Field survey was carried out in the important parts of the Ahmednagar City. The locations which are in the need of these structures such that the purpose is served without disturbing the present parameters of the location are finalized they are:

- Military area, Bhingar
- Tofkhana police station, Savedi
- Tarakpur bus stand

1. Military Area, Bhingar:

The city has widely spread military area and spacious land is under the control of the authorities. Recently renovation work of the area was undertaken in which sitting arrangements were provided besides the road. The arrangements are located in an open area and are of less use during the rainy season or unfavorable weather conditions. Therefore, to make the optimum use of the facilities, the sitting arrangement can be covered with TMS which will also improve the aesthetical view.



Figure 3- Sitting arrangement at military area.

Some of the benches are covered with traditional materials such as galvanized iron sheets which are not that appealing to eyes. The traditional material will be degraded and lose its stability after few years. So to provide better quality and stable structures this location was selected.

2. Topkhana police station, Savedi:

This is one of the most important location of the city which has a large parking space for vehicles. During summer and rainy season the automobiles are subjected to the effects of the weather. Thus to provide a better roofing for vehicles, the location was approved.



Figure 4- Parking area of topkhana police station.

3. Tarakpur bus stand:

Tarakpur bus stand is one of the main stations of the transportation facilities of the city. Numerous bikes and cars are parked every day on this site. It was observed that the parking space for bikes was crowded and was not properly bifurcated. The main motto behind electing this area for the design of tensile membrane structure is to provide spacious parking for vehicles which is properly designed as well as maintained. By doing this, the place can be used to its optimum capacity and more vehicles can be parked.



Figure 5- Parking area of Tarakpur stand.

B. Market Survey.

Investigation into the state of market for the materials to be used for the construction, including their need and demand among the consumers was carried out after finalizing the locations. The market survey gives a detailed idea about the availability of the materials and their cost in market. It is therefore beneficial in planning and designing the structures.

The main function of market survey is also to calculate the overall cost of the construction. This included the cost of material, transportation charges and labor charges. The cost may vary from material to material and also the location. Here is the basic data obtained from field survey:

Use	Household, shops.
Height	Upto 60 meters
Membrane Material	PVC/PTFE/ETFE
Minimum order Quantity	1 Sq.ft
Cost	380/Sq.ft

C. Software Design.

Main elements of software design are as follows-

1. Form Finding:

Through the form-finding process the initial, equilibrated shape of the structure is determined. Initial shape of membrane structure is a function of stress ratio in which external loads are not considered. This aspect is mainly based on topographical characteristics of the area considering static equilibrium. Present architectural features like surrounding buildings play a key role in determining the shape.

2. Static analysis:

Through the static analysis it is possible to predict the stress and the displacements which will appear in the tensioned surface due to design and the external loads such as snow or wind. The European design code is necessary to obtain loading combinations and the safety factors due to uncertainty of assumed magnitudes.

3. Dynamic analysis:

This analysis is the interaction study of relation between varying external load and structure. Main fluctuating force that a membrane structure undergoes is the wind load which causes deflection. In this case small deflection can lead to total collapse. For the better stability the prototype of the proposed idea is tested in wind tunnel test, this gives better idea about effect of the wind force and the behavior of the prototype accordingly. Objective of analysis is to study wind distribution on the boundary of the material.

4. Patterning:

The material is processed in two dimensional cutting pattern obtained from, form finding. This operation is generally based on mathematical studies carried out for

several applications, such as the determination of the surface area of solids or the topographic issues of Ahmednagar city. Physical models are widely used for increasing the accuracy of the computer software and its results.

IV. CONCLUSION

As we can see that the tensile membrane structure are really developing in a rapid way. By taking into consideration the above, this research paper will provide basic data which will be required for implementation of tensile membrane structures in Ahmednagar city in the near future. Ahmednagar is a developing city, and introduction of such new technique will boost the infrastructural development of the city. Feasibility of the structures in Ahmednagar city can be concluded by this paper which will boost the construction of tensile membrane structure in the city.

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