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An over view of Membrane Structures & Conceptual Analysis

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Abstract: *Membrane structures are hugely popular in architectural design and are increasing in their abundance within buildings. There is an increasing trend concerning the use of membrane structures within architectural design. It is important to recognize the reasoning behind the growth in popularity: why are so many architects starting to use the design feature within their designs? The features of the membrane structure have been provided; an analysis of the strengths and weaknesses provides strength to the reasoning behind its use. This dissertation examines a variety of different factors concerning the membrane structures. It provides a detailed study of the use of membrane structures within building design; additionally, all of the different contributory factors have been referenced Membrane structures have been used in architecture for over 50 years; the dissertation follows a case study structure and uses some examples of membrane structures within architecture. Each case study provides a real-life example of how membrane structures have been successfully applied to modern day architecture. Additionally, it examines the complexity behind the construction of membrane structures and materials. It is important to understand the structural components that make it so appealing to architects. The associated advantages and disadvantages of membrane materials have been examined. Furthermore, the relationship between the construction components and the integrated design has been mentioned. All of these factors provide a strong understanding behind the use of membrane structures, explaining how they can be used and why they are becoming so popular. In our country Membrane structures never used before, so we are trying to introduce it.*
Keywords: *concrete, membrane*

I. Introduction

Membrane structures one form of architectural feature that are becoming hugely popular within modern day engineering, their used and aesthetic and economic feature is becoming more apparent. Our country is unaware of the detailed specification behind the membrane W The complexity of the construction pm involving all of its contributory materials. is unknown to many people within the industry.

This project has been based on much research surrounding the topic membrane structure end contributory membrane material within architectural design. These factor have been closely examined and toughly marched .to discover result that lead to a valid conclusion. Some different examples of membrane structures within architectural design lave been used in this piece of research. 11te dissertation follows a case study methodology; this allows for deep examination and understanding regarding few individual examples.

1hedesignofmisdim1adonhasbeensuucmmdmmdmmemmmchpommeach research point examines a variety of different features concerning different levels of membrane structure design, and also complete project of a structure which is created by us.

1.1 Characteristic of membrane design

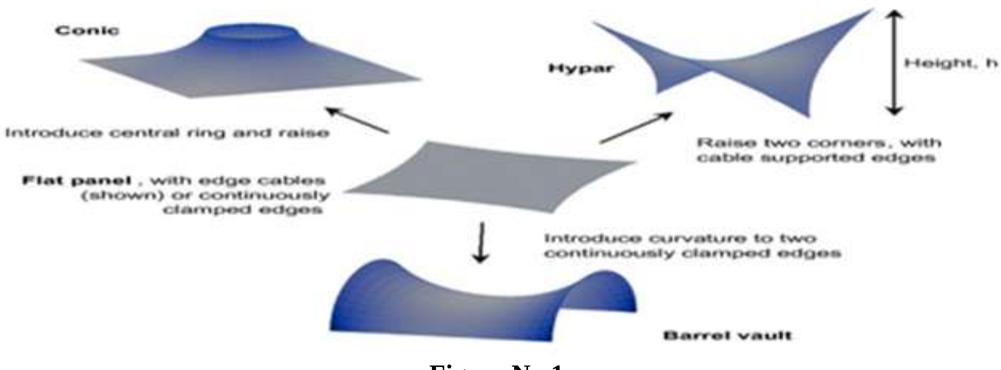


Figure No 1

Studies the different features of typical membrane structure design, including all of the factors that contribute towards its appeal to architects. Standard features of membrane structures include a large span across the building surface, giving it broad use of application. Use may include covering an exhibitions or music event venues. From an economic perspective, they are highly energy-efficient and save much money on transportation costs. The design can be easily deconstructed and transported to different am Furthermore, they are widely renowned as being highly safe and reliable. From an aesthetic perspective, they are considered to be very attractive and stylish, especially with modern day architecture

1.2Basic properties of membrane materials

Studies the elements behind the structural components of membrane materials. This section examines the composition of the materials used in the construction process. Furthermore, it studies the different properties that the construction process provides to the building; the benefits of the membrane structure and its contribution to the building specification will be referenced.

Study the mechanics behind the joint node within the membrane structure Studies the mechanical features of the joint node, specifically within the membrane structure design. The design principals of the joint node would be referenced, explaining the different methods of design. Additionally, the variety of membrane structure forms will be examined; this allows for a close examination of the relationship between the joint node and the membrane structure.

As previously discussed, this dissention follows a rigid structure. A detailed review of all the complimentary literature will be provided, which references the many other studies that examine this topic. Next, details about the some case studies shall be given, providing weight to the research paper. After, an analysis of the case studies shall be undertaken, closely examining the differences between each example. Finally, we create model of football

II. Methodology

In this work various tests carried out on materials. Also various test were performed on different ingredients of concrete as explain below.

2. 1. Structure, Construction Method and Membrane Material

A construction that directly utilizes the elements of membrane materials is known as a ‘membrane structure building. Either a cable frame or a skeleton frame can form the structure that sustains the membrane. It is possible for a structure on a small scale to consist of the membrane itself as the structural material. However, such a process is not possible on a larger scale structure because the membrane is not strong enough. If used on a large scale construction it is essential for the membrane to be strengthened somehow or used in conjunction with a frame(Smith, 200i).

Membrane materials have enough strength to be directly linked to the main frame unlike other roof materials. A membrane material has a natural tendency to curve, and although it can endure tension, it cannot withstand compression or bending. It is a complex task to make a curved surface using tension, and the process of designing the membrane structures is dependent on utilizing the tension in a precise fashion (Kaltenbach, 2004).

In the early days it was believed that membrane structures could only be design with mechanics in mind and that there was no room for creativity in the design. However, it was later discovered that although the curved surface is subject to specific mechanical requirements, there is much room for individualistic touches on the periphery of the surface area. Even so it is important to note that the periphery must still be supported either with cables or a frame.

An architect, who is used to working on traditional structures, may find it helpful to use a skeleton-frame membrane structure when constructing a membrane structure. This is because the membrane is able to be extended over steel, word or even a reinforced concrete frame in order to shape the space(Herzog, 1996).

Balloons actually provided the inspiration for air inflated membrane structures. Although F.W. Lancheser of England may have been first to put forward the idea for a field hospital, it was the Radar Dome built in the USA in the year of 1946 that was actually the first time that this structure had been created for a building on the ground. Following the success of this dome, similar structures were replicated across the private sector in the USA. As more of these structures were seen, international interest in these structures significantly increased. It is theorized that the uses of membranes as structures were used over 30,000 years ago for tents used by Nomadic tribes. Since these times, the technology involved with membrane structures has been ever increasing. These days, membrane structures are now as safe and durable as traditional buildings. This is due in part to the materials that form them. Synthetic fibers and glass fibers are now utilized and coating materials have enabled the structures to contain both water and fire resistant qualities Advancements have been made and there are many advantages to using membrane structures including their qualities of transparency, low weight and their ability to be applied to frames for large scale spaces For instance, it is now possible to cover a large space that would not be possible with traditional techniques with just one sheet of membrane material (Kaltenbach, 2004).

However, it must be recognized that membrane materials are not simply suited for all projects. If just one thin sheet is used then it will be difficult to adequately protect it from tearing as well as being difficult to provide insulation for heat and sound.

Advancements in the materials of the membrane structures have been continually been made.

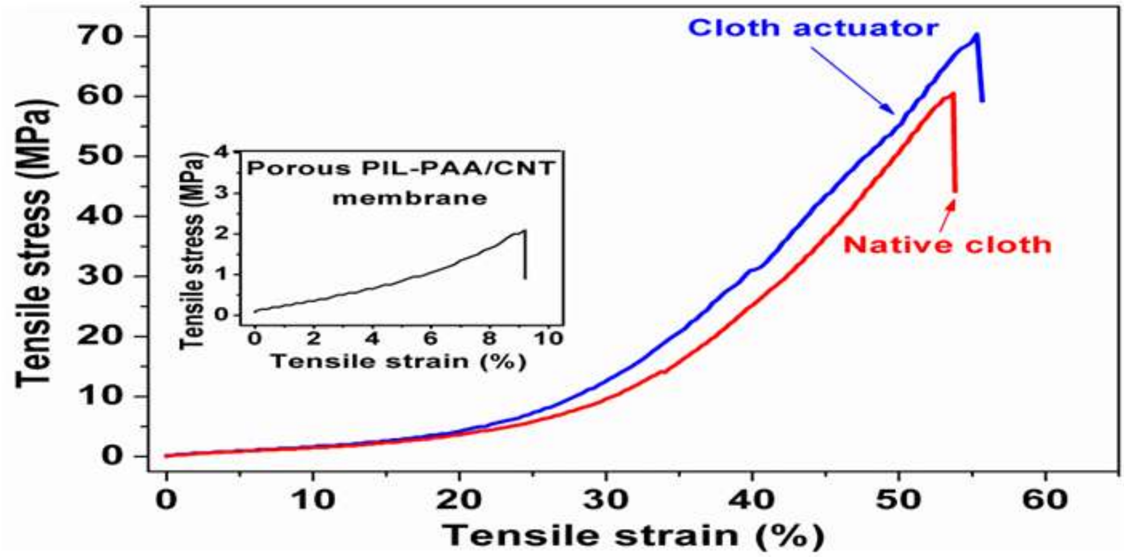
Significant advancements have included the industrialization of PVC in 1933, the development of PTFE in I938, the industrialization of Polyester liber in l947, and finally PTFE coated glass fiber fabric which was developed in 1972(Mewes,l993).

PTFE coated glass fiber fabric is considered a fixed long lasting building material. It is incombustible, strong and durable, as well as having the advantage of being self-leaning. In contrast to previous membrane materials, PTFE coated glass fiber fabric is not designed to fold or to detach lion: its support.

A critical advancement in the development of membrane structures has been a materiel known as pure coated glass fiber fabric which is very similar to stainless steel in terms of its durability. Its development as a material increased the potential of membrane structures to be applied in a many move circumstances. However. when this material was first introduced and used in the construction of permanent buildings in the I970s, then we doubts used in the construction of permanent buildings in the 19705, there were doubts in some quarters regarding the enduring features of the material. In fact some believed that over time the material would begin to crumble. However, as of yet there is no sign as of fragmentation in any of the buildings in which it was used. However, PTFE coated glass fiber fabric is not always favored. Despite problems with its durability and the tendency for the material to become easily dirty, there is a high demand for PVC coated fabric of synthetic fibers as a membrane material due to its cheap rate of production and the fact that it can be folded (Mewes, l993).Membrane structure design techniques are established on allowable unit stress where the figure of 4.0 as of fragmentation in any of the buildings in which it was used. However, PTFE coated glass fiber fabric is not always favored. Despite problems with its durability and the tendency for the material to become easily dirty, there is a high demand for PVC coated fabric of synthetic fibers as a membrane material due to its cheap rate of production and the fact that it can be folded (Mewes, l993).

Figure No2. Membrane structure

Membrane structure design techniques are established on allowable unit stress where the figure of 4.0 as a frequency is internally accepted as the safety factor for a membrane material (Clough, 1995). Although this figure is not as safe as it could be, it is considered adequate as it takes into consideration the potential decline in the strength of the membrane material. This safety factor is very low and is possibly only accepted due to the economical costs associated with this material. In the past damage has occurred due to tearing in the membrane material. Such tears begun in small specific areas of the material. In order to ensure adequate safety, the design of the membranes must consider every detail (Berge, 2001).



Fig, No3-Tensile-stress-strain-curves-of-the-cotton-free-PIL-PAA-CNT

Membrane Material	PVDF	PTFE
Support cloth	PES	EC 3/4
Greycloth-Weight	2758g/m2	450g/m2
Type of coating	Fungicidal PVC	PTFE
Total weight	1000 g/m2	1150g/m2
Tensile strength	4400/4000 N/5CM	7000/6000N/5CM
Tear strength	580/520N	500/500N
Adhesion	120 N/5CM	80N/5CM
Transmission	5%	12-14%
Reflexion	78%	73%
Shading-coefficient		0.21
Thickness	0.75mm	0.7mm
Width	250cm	470cm
Flame retardant	B1	B1
Termal conductivity(W/mK)	0.15	0.0865
Termal conductance(W/㎡ K)		110.9
Spec. heat capacity（Kj/kgK）		0.502
U-Value(W/㎡ K)	5.86	4.80

III. Conclusion

To conclude, the benefits of membrane structure architectures suggest that they are hugely superior to typical architectural designs. Many features make membrane structures widely appealing to architects. They have many ergonomic benefits, such as their large scale and simple construction requirements. Membrane structures can be easily deconstructed and transported, meaning they have many applications and possible uses. Additionally, they are renowned for being safe and reliable, giving them a high appeal for large scale structures. From an economic perspective, they are very energy-efficient and relatively cheap to construct. Furthermore, they have a positive aesthetic appeal and are considered to be visually appealing. All of the aforementioned features provide reasoning behind their use in architecture. Furthermore, this understanding allows for a greater breadth of applications. With the development of architectural technology, more designs will start to become integrated into modern day building design. Consequently, architects may find an even more Effective design structure to use in future constructions. Essentially, greater research needs to be conducted, especially with regards to new designs, in order to expand our understanding of architectural innovation.

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