

The necessity of extension of Tent Structures in Iran

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Abstract

Tent, is one of the oldest architectural forms that has been used from the past. The oldest known tents are from the ice age and they were made out of skins which were draped over a fram of branches. The black tents which where woven from goat hair, sheep,s wool or camel hair into very long strips has the closest form to the modern tensile textile architecture of the 20th and 21st century. The blacktents have a long precedence in Iran and were used by the immigrants and still are used by Iranian tribes.

Nowadays because of advancement of structure science and construction technology, architect,s tendency for using tent structures and creating architectural, beautiful and adapted with climate forms has been increased. Since a vast area of Iran has the hot climate, using these structures can provide a good shelter through shading and natural ventilation in this regions. This dissertation is based upon historical refrences, literal findings and the world wide web. We recommended the extension of modern tent structures which are the completed form of our black tents in Iran and encouraging architects toward our traditional architecture and inspiring of our architectural heritage.

Key words: black tent, tent, textile architecture, traditional

1. Introduction

Since the dawn of our time on this planet, human kind has made different shelters as a reaction to fluctuations in weather conditions and as a defensive barrier protecting him from predators or unwanted intruders. This instinctive need for creating shelter, lead to many building techniques and styles that varied from culture to culture. One of the oldest known shelters were nomads tents. Nomads tent was a transportable housing that was made of skins, fabric or similar materials and was raised on columns.

Although primary structures were tensional structures such as tent or compressive one like vaults and brick or stone archs, since the appearance of new building materials such as iron and concrete also new structural and computational systems in modern period, movement toward bending structures like beam and column began. But having a look to structure evolution in past hundred years, we see a slow motion toward shell structures. Meanwhile tent

structures which are the renewal form of ancient tents have been greatly in architect,s attention in these years.

This dissertation is based upon historical references, the world wide web and literal findings and case studies which look at 2 prominent tent structure. The case studies are chosen because of their importance as large scale tent structures and their concepts of connecting to surrounding landscape

2.Data and Material

There are many cultures around the world which include some aspect of nomadic life, and they have all developed vernacular solutions for the need for shelter. These all include appropriate responses to climate and customs of their inhabitants, including practicalities of simple construction, and if necessary, transport. One kind of these dwellings are black tents.

Black tents

The Black Tent is arguably most widely-documented of the vernacular types of traditional nomadic tents. It is the home of Arabs and many

other African and Asian peoples up to the present day, and therefore represents an entire culture of nomadic dwelling rather than a mere provisional form of shelter. The “black tent” (Fig. 1) in isolation does not represent a dwelling or “home”, but rather, must be seen as one element of a complete system of life – a mode of weaving a life pattern and dwelling “horizontally” in the landscape – a mode employed by hundreds of tent dwelling tribes of Asia and Africa.

The Black Tent is thought to have originated in Mesopotamia around 3000-4000 BC which makes it one of the most ancient and timeless architectural types still in use. As the vernacular form of the tent most similar in its structural principles to twentieth-century tensile structures, the Black Tent is thought of as a clearly-defined type. Actually, the Black Tent type comprises a diverse range of ethnic variants.

Variants of the Black Tent are geographically divisible into Eastern and Western major types. The Eastern types, the Oriental or Persian, are simpler, constructed of parallel cloth strips, and are considered as the earlier type. The Western types, also known as Occidental, or Arab types, make up a complex study. These are the types the Bedouin call the beytes shaar, the “House of Hair”. The Black Tent of the Middle East, though diverse in colour, is generally considered black, because it consists predominantly of a woven, black goats’ hair, which lightens after bleaching in the sun, and because of its strikingly dark appearance from a distance away, especially in desert contexts. Every surface – roof, floor and wall – as furnishings, carpet bags, spindle bags and so on, are made from black goats’ hair. The strong hair, shorn from herded goats, is spun on simple portable spindles and woven on handlooms into strips of about four cubits wide (up to 1.8m), which are later stitched together for tent construction. The activity of weaving in the tent by the inhabitants is part of its recurring maintenance. The tent awning is stretched over a minimal frame of wooden poles, tensioned with ropes. The materials relate to efficient use of available resources which are part of the nomads’ life patterns: domesticated animals carry the packed tent, as well as providing milk, meat, leather, and dung for the fire. Timber is used sparingly for poles, timber availability being heavily dependent upon the nature of the regions the nomads travel. (Cowan, 2002)

Vernacular architecture

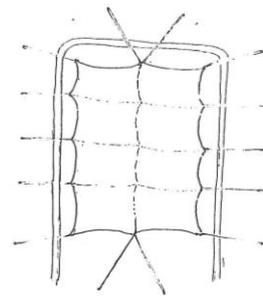
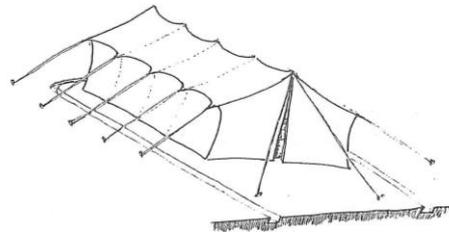


Fig 1: Black tent



Vernacular architecture is a term used to categorise methods of construction which use locally available resources and traditions to address local needs and circumstances. Vernacular architecture tends to evolve over time to reflect the environmental, cultural and historical context in which it exists. Many modern architects have studied vernacular buildings and claimed to draw inspiration from them, including aspects of the vernacular in their designs. In 1964 the exhibition *Architecture Without Architects* was put on at the Museum of Modern Art, New York by Bernard Rudofsky. Accompanied by a book of the same title, including black and white photography of vernacular buildings around the world, the exhibition was extremely popular. It was Rudofsky who first made use of the term vernacular in an architectural context, and brought the concept into the eye of the public and of mainstream architecture. Since the emergence of the term in the 1970s, vernacular considerations have played an increasing part in architectural designs, although individual architects had widely varying opinions of the merits of the vernacular. Vernacular architecture is influenced by a great range of different aspects of human behaviour and environment, leading to differing building forms for almost every different context; even neighbouring villages may have subtly different approaches to the construction and use of their dwellings, even if they at first appear the same. One of the most significant influences on vernacular architecture is the macro climate of the area in which the building is constructed. Buildings in cold climates invariably have high thermal mass or significant amounts of insulation. They are usually sealed in order to prevent heat loss, and openings such as windows tend to be small or non-existent. Buildings in warm climates, by contrast, tend to be constructed of lighter materials and to allow significant cross-ventilation through openings in the fabric of the building.

New interest in nomadism

After the first and second world wars in the twentieth century, a broader understanding of nomads and architectural nomadology emerged. (Cowan, 2002) To the destruction of homes and essential need to shelter for war victims, architectural strategies moved toward ephemeral architecture. Accompanying deeply altered views of the world, as evident in strategies and diagrams of architects work at the beginning of the twenty-first century, there has been a revived interest in the model of nomadism as it relates to architecture. In the beginnings of architectural modernism in Europe in the early Twentieth Century, nomadism assumed an ideological importance, symbolically associated with freedom and democracy. (Cowan, 2002) Also nomadism and nomadology was connected to the strong movements associated with ecology and environmental awareness. Finally nomadism was a protest against the complicity of architecture with industrialism and capitalism, the idea of liberating architecture from its role as a structure for reinforcing sedentary hierarchies was challenged. (Cowan, 2002) All of these issues inclined architects toward light, nonpermanent, portable and economical early tensile architecture. So they inspired from nomadic architecture that was the vernacular architectural form in Africa and Asia.

Pionners of tent structures

Frei Otto:

Frei Otto (b.1925) is recognized internationally as a master of innovative structures. He studied architecture at the Technical University of Berlin. He was drafted into the German army as a pilot and imprisoned in France, but completed his studies in 1948. His 1954 doctoral dissertation on suspended roofs led to his influential collaborations with Behnisch, Schlaich, and other designers on the Olympic Stadium in Munich (1972) and dozens of other permanent structures, temporary pavilions, and experimental designs. He founded the institute for LightWeight Structures at the University of Stuttgart, where he taught from 1964 to 1990. He notes that, "The whole natural world is built from a single constructional detail" a casing filled with fluid." (Allen, 2010)

Horst Berger:

Horst Berger is a prolific engineer and builder of tensile fabric structures. (Allen, 2010) Over the past four decades, he has been involved in the design of most of the major fabric structures in the world, from modest pavilions for Philadelphia's bicentennial celebration to

the Jeddah Haj Terminal in Saudi Arabia. Engineering News Record has rated Horst Berger as one of the top structural engineers of the last 100 years. He was born in Germany in 1928. He studied civil engineering at Stuttgart University and graduated in 1955. He began his career designing bridges and shell structures for Wayss and Freitag in Frankfurt. After a two year period in Iran, he moved to New York (1960) and started working for Severud Associates. It was there, he began working with lightweight tensile architecture on projects like Madison Square Garden. (Davies, 2009)

Tent Structures

Tent – which is in use for several years is a typical example of a membrane structure, in which the membrane (Fig.2) is prestressed through the application of an external force. A membrane is a thin flexible “stretched” surface structure that carries loads primarily through the development of tensile stresses (in- plane tension and membrane forces). Membrane structures are very sensitive to the aerodynamic effects of wind, which can cause fluttering to occur. Hence, most of the membranes that are used in buildings are stabilized in such a way that their basic shape is retained under a variety of loadings. Membranes are often used in conjunction with either single cable or cable nets that provide reinforcements. Membranes and cable nets are often grouped together for study since their behaviour is similar. To form a tensile surface structure a minimum



Fig2: Membrane prestressed by externally applied jacking forces

Of four support points are required, one more than needed for a rigid structural system.

(Narayanan, 2006) Most modern fabrics for architect agent that provides water proofing. A very durable and strong choice is Teflon- coated fiberglass. Fiberglass is extremely light and strong. The Teflon coating provides a water barrier, bonds the fibers together, protects the fibers from abrasion, and generally makes it difficult for dirt to stick to the surface of the fabric. (Place, 2007)

Case Studies Of Tent Structures

- Jeddah Haj Terminal (1982:Jeddah, Saudi Arabia, Architecture: Owings, Skidmore and Merrill, Structure engineer: Geiger Berger Associates)

The Haj Terminal (Fig.3) was designed to accommodate the highly diversified needs of 50 thousand people at any given time for up to 18 hours during arrival and 36 hours for departure. With a project of this grand of a scale, a tensile fabric structure proved to be the most practical option. This building had to be designed to provide comfort and protection against the intense heat of the desert sun. If an enclosed building with insulation along the walls and roofs were used, air condition and ventilation would be nearly impossible. This open-roof scheme would result in a fraction of the cost and a considerably shorter construction

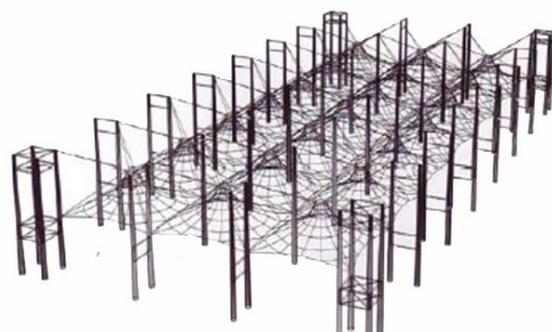


Fig 3: Roof isometric of

Jeddah Haj Terminal

an average daily temperature of 95 degrees in Jeddah, an enclosed concrete or metal roof, even heavily insulated, would heat up to 150 degrees, it would radiate this heat in and the required electric light would add even more to the heat load. The Teflon-coated fiberglass reflects the sun's rays while keeping a temperature within few degrees of that of the ambient air, and electric light is not required due the translucency of the fabric be able to provide adequate

daylighting. At night, the fabric acts as a reflective surface for uplighting. As for ventilation, mechanical fans placed intermittently between the pylons enhance air circulation and large exhaust fans are used to eliminate the exhaust fumes from the buses. (Bush-Brown, 1983)

- Denver International Airport (1995: Denver, Connecticut, Architecture: Fentress, Bradburn, and Associates, Structure engineer: Severud Associates)

Denver International Airport is a PTFE Teflon coated fabric membrane, roofing structure, which is primarily mast supported. The 275m long & 76m wide airport terminal is designed to evoke the majestic snow-capped peaks of the Rocky Mountain which nearly overshadow the airport. The undulating membrane roof (Fig. 4) is an international icon of Colorado, as one of America's favorite U.S. architecture landmarks. This graceful, lightweight roof incorporates two layers of PTFE Teflon coated fabric membrane set 0.6m apart this double skin ensure proper sound control and sufficient insulation against Denver's demanding climate conditions. To support this load-bearing structure, 34 interior columns and 10 miles of steel cable were used, completely enclosing the building's exterior and connecting to exterior anchorage points. This design, in turn, provides traveller with adequate shade and protection from inclement weather. (Davies, 2009)

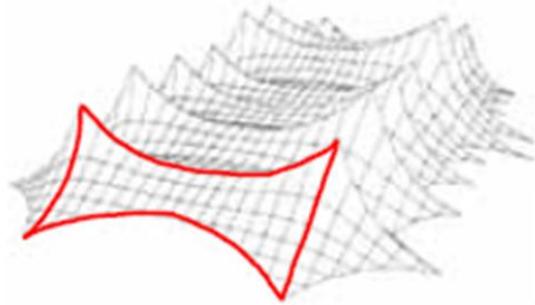


Fig4: Drawing of Denver Airport Roof

3. Research Methodology

This study was done through historical references, the world wide web and literal findings. As case studies we looked at 2 prominent tent structure. The case studies were chosen because of their importance as large scale tent structures and their concepts of connecting to surrounding landscape.

4. Results and Analysis

According to definitions stated in previous part, black tent is a vernacular architectural form. This form was used in Iran many years ago and is used in some regions yet. In vernacular architecture formation climate is one of the most effective factors. As a result; since the black tents have been adjusted with Iran climate, tent structures which are the renewal of black tents have the same vernacular characteristics and will be adaptive to its climate.

5. Conclusions

Since the origin of black tent is Asia, (Feilberg, 1944) it seems Western architects have taken the concept of modern tent structures from ancient Asian black tents. Tent structures have some of the ancient tent qualities such as: flexible, prefabricated, transportable, environmentally friendly material, use of nature light, connection to the surrounding landscape and low energy consumption which are the same themes that today's architects want to fulfill. Meanwhile they have found the most advantages of these structures for warm climates where they provide good conditions by shading and natural ventilation. Since the vast area of Iran has warm climate, using tent structures can provide comfort in regions where scorching sun makes it impossible to stay in and mechanical ventilation would be expensive. Also considering the precedence of black tents in Iran, using tent structures we will rehabilitate our vernacular architecture.

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