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The Idea of Designing an Amphitheater in the Besh Qardash of Bojnord (Tourist Destination and Recreational Region) with Stretch Fabric Structures

Mojgan Ghorbanzadeh [a*]

[a] *Department of Architecture, Faculty of Art, University of Bojnord, Bojnord, Iran.*

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Abstract

One of the criteria for sustainable design is "the principle of adaptation to local regions". In this case, the native, historical, cultural and specific characteristics of the region are considered. This study tried to use an idea of designing an amphitheatre in the Besh Qardash of Bojnord (tourist destination and recreational region) with stretch fabric structures as the contemporary structural systems that have a certain similarity to nomadic tents which along with being in line with the historical and cultural elements of the region, including the historical tomb next to the spring, present a combination of modern and local architecture. This can be a great help to hold ceremonies and cultural events in this location, such as holding traditional wrestling competitions (Ba Chukhe) and horse racing (Turkman horse) in special time of the year. In the following parts, along with introducing the geographical and climatic conditions of the region by examining the technical and executive characteristics of stretch fabric structures, the results will be presented.

Keywords: Sustainable Design; Fabric Structures; Amphitheatre; Modern Architecture; Stretching; Contemporary Structures.

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1. Introduction

In a modern human view, city is place that we should feel peace and safety and help humanity and culture to grow. The better the place is, we have more security and can develop more. In addition to responding to the environmental, economic, and industrial problems, it also responds to the physical and mental needs, peace, security and the pleasure of the citizens. The purpose of social efficiency is to provide a place for spending leisure time, recreation, and educational and scientific gatherings.

Architectural fabric structures are a form of building that can almost be considered a contradiction in terms. Fabrics represent some of the lightest artefacts made by humanity, and yet, buildings represent some of the heaviest. Because of their lightweight nature, fabrics are also flexible and mobile, whilst buildings, at least in their traditional sense, are solid and permanent. However, fabric architecture does exist and has for millennia as one of the earliest forms of building to be manufactured on a regular and widespread basis. It is also one of our most advanced and innovative forms of building, which continues to develop rapidly today, and almost certainly into the foreseeable future. The use of fabric structures for famous historical and artistic buildings can be broken down into three main goals. In some cases the aim is replacement, seeking to re-create a missing section of the building that has been passed down to us over time. At other times, adding functions to a building requires additional space (integration), resulting in a review of the entire structure and a desire to, in a sense, link old and new. Finally, project designers sometimes want to highlight as much as possible the temporal difference between what previous centuries have bequeathed us and what is being added. This ensures a

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* Corresponding author: m.ghorbanzadeh@ub.ac.ir

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clear distinction between the volumes and allows the viewer to interpret the dynamics or contrasts between such structures.

From long ago, Besh Qardash Park is considered as a place with pleasant weather to take rest. The park has approximately 330,000 visitors in summer, which is the high season and it needs recreational spaces, campsites and resting areas and temporary accommodation which is suitable for this number of tourists and their needs. The citizens of Bojnord along with having peaceful and suitable place next to the nature of BESH QARDASH expect the new design to respect the historical and cultural values of this region and the new design should strengthen and emphasize them. The important part of the BESH QARDASH site is the main and historical part that is located in western part and include the spring, the pond, the old trees and the tomb. The place has significant historical, cultural and natural background in the eyes of local people. In fact, an amphitheater with a tent structure on the campus could be designed and big monitors can be used to show movies and contests to attract more visitors and improve the friendliness and social relations. Therefore some spaces are designed for seasonal and permanent exhibitions for a variety of art crafts and local arts, a space for reviving the cultural and historical traditions of the region, such as Ba Chukhe wresting and Turkmen horse race, that were hold here in the past, along with proper places for holding celebrations and ceremonies. Considering the location of the park that is next to national and international road it can have transcendental performance.

2. Brief Introduction of Bojnord

2.1. The Importance of Bojnord

Bojnord is a vast plain, which is surrounded by mountains. It is located in the northeast of Iran and northwest of Khorasan Province, and the closest city to Golestan and Mazandaran Provinces, as well as Caspian Sea. It is a fertile land with unique characteristics. The high mountains are covered with snow, fertile plains, lush meadows, scattered forests of oak, and wild pistachios, ornamental flowers and plants and medicinal herbals, many springs in valleys and lands, a pleasant and diverse climate that make this region the focus of attention of different ethnic groups. The ancient civilizations is the unique characteristic of this vast and historic land. It can be said: Khorasan silo is a city of beautiful sites and a summer resort in the North Khorasan province.

2.2. Geographic Location and Topography

From north it has 200 km shared border with Turkmenistan. From south it leads to Esfarayen and Garmeh and Jajarm cities, from west it is close to Maneh and Semelghan city and from east it leads to Shirvan. The population of Bojnord is 328489 people and the area is 11461 square kilometers. The altitude is 1070 above sea level and in terms of geographical location, in the north latitude of 37.27 and east longitude 57.17. The topography of Bojnord plain with an altitude of 1100 meters is the lowest and, at the same time, the widest flat area of the Bojnord plain. This plain with an area of 100 square kilometers between the altitudes of 1050-1200 meters has provided the largest and most important population region with horizontal extension. Bojnord is a mountainous city with Aladagh mountain range which is continued East Alborz range and it has two peaks of 3000 meter (Salouk and Aladagh) (Figure 1).

Figure 1. The paths of Besh Qardash park

2.3. Brief Introduction of Besh Qardash Site

Besh Qardash is name of a natural-historical complex which is located six kilometers south-east of Bojnord – Esfarayen road. Besh Qardash is a beautiful set of a spring, old trees, running water and a tomb with turquoise dome that catches the eyes even among the branches of trees. It is surrounded by rocky and soil hills (Figure 2). The place is always favored by the residents of nearby people due to its fresh and mineral water and pleasant weather. It has swimming pools for men and children. There are historical sites of Qajarieh Dynasty in the east part. Its architecture consists of seven colors tiles of turquoise and a combination of bricks and tiles. The tomb has inscriptions that are embellished with verses from Sura of Noor with Sols Calligraphy on turquoise ground, which today, the remains can be seen on the main porch. The tomb was first built in Qajarieh and later become the personal graveyard of Sardar Mofakham (the governor of Bojnord and Gorgan at that time). Besh Qardash has a long history, with its springs and old Plane trees (Figure 3). There is a theory that the origins of the Besh Qardash goes back to Part era and before Islam it was the temple of Zoroastrians [1].

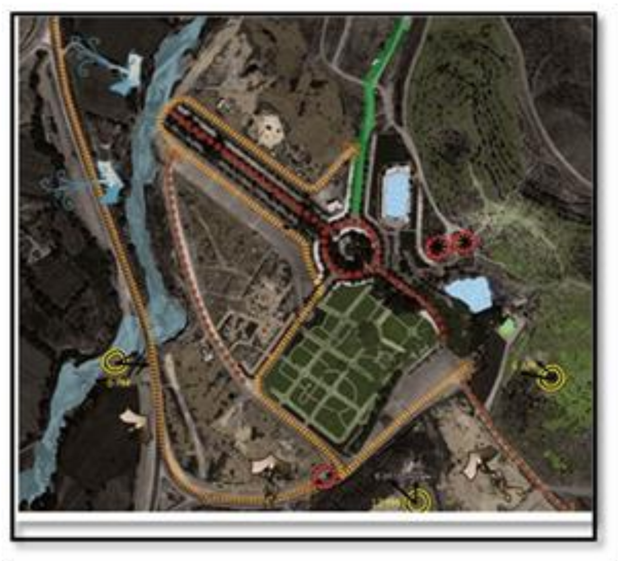

Figure 2. Aerial Photo of Besh Qardash site

Figure 3. The access roads to the site

3. The Positioning of the Amphitheater

Considering the proper conditions of morphology and topography of the site space in terms of the low slope of the earth in this area and the distance to historical site that includes spring and the ponds, it is place for big gathering. The wrestling competitions are hold here due to its proper location and it is the best evaluated place for the amphitheater (Figure 4). Designing this modern structure helps to attract more people for the cultural and traditional events [1].

Figure 4. The location plan of the amphitheater [1]

4. History of Stretch Fabric Structures

4.1. Prehistoric and Traditional Fabric Structures

The earliest human-made structures were both functional and transient. The pattern of existence for early hominids was as a hunter-gatherer, and their developing skills with tools helped gain access to both an improved diet of animal flesh and the ability to use animal by-products to make weapons, tools, clothing and, of course, shelters. The remains of tent-like structures that utilized animal hides have been identified from as early as 150,000 years ago. Timber-framed buildings clad in Mastodon skins (pieces of which remain attached to the poles) from 13,000 years ago have been found preserved in peat bogs on the banks of the Chinchihuapi Creek in Southern Chile (Dillehey, 1984). Archaeologists have discovered seasonally occupied sites in Pincevent, Northern France that had 4.5-m-wide tents with wooden poles supporting animal skins, built by nomadic people who probably took their buildings with them as they moved between sites (Scarre, 1988). These prehistoric building forms are the ancestors of traditional portable building patterns that are still familiar today such as the Lapp keti, Inuit Tupiq or the North American tipi. The keti is usually a conical structure (though it can sometimes take a dome-like form) clad in reindeer skins or softened bark, and it was once used extensively across Siberia by nomadic hunting and herding peoples. The Tupiq is the summer tent of the North Canadian or Alaskan Inuit, whose temporary winter dwelling, the igloo, is far better known [2].

4.2. Fabric Structures or "Tent" in Iran

Čādor "tent," is a portable dwelling characteristic of certain nomad groups. It consists of a canopy of cloth or skin supported by upright posts and anchored to the ground by means of pegs and ropes. The word čādor refers to both the canopy and to the entire tent. The most common type of tent in Iran and Afghanistan is the "black tent" (constructed of bands of woven goat hair stitched together), which is known from Mauritania to India (Feilberg, 1944, passim). White tents of cotton canvas imported from Europe are rarer and are generally found at opposite ends of the social scale: depending on their size, the richness of their decoration, and their interior arrangements, they can be the dwellings of either powerful nomad chiefs (formerly even of kings and their courts during the summer) or of certain categories of migrant service workers (kowlī, ḡorbatī, etc.) who are more or less looked down upon.Both of the basic tent types used by nomads elsewhere in the Middle East are present in Iran and Afghanistan: the black, goat-hair tent and the felt tent [3] (Figure 5 and 6).

Figure 5. Turkman tent

Figure 6. Nomadic tent

4.3. Twentieth-Century Event Architecture; New techniques and Materials

At the beginning of the century, circus tent manufacturer Stormier began to construct temporary fabric buildings for other purposes, such as the performance tent for the 1912 S€angerbundfest (choral singing festival) in Nuremberg, Germany, which could shelter 20,000 people. This company, with its historic expertise, was an important link with the development of contemporary fabric structures for architecture through its collaboration with the great innovator in fabric architecture design, Frei Otto. From the early 1950s, Otto combined engineering practice, research into innovative structures, and sensitivity to both the beauty and potential sustainability attributes of lightweight building systems. His personal experiences with aviation and economic hardship in pre- and post-war Germany informed his approach to design, leading him to search for more economic, yet also innovative, building solutions. Influenced by sail and tent makers, his early designs for shelters and exhibition tents at the Federal Garden Exhibitions in 1955e1957 were nevertheless exciting contemporary expressions of the potential of fabric architecture to do more than current heavyweight buildings could do (Figure 7). Elegant and ephemeral, they appeared to be images of the future, though rooted in the technology of the past. Through dedicated research, Otto developed new methods of designing these structures based on weighted cables and soap bubbles to produce naturally formed physical models that produced a resolved structural form. Models incorporating calibrated springs and carefully measured weights led to new fabric patterns that were consequently constructed in full-size examples. The new fabric architecture of this period was well suited to exhibition and event architecture, which is often temporary (and, therefore, often subject to short lead-in times and meagre budgets) and requires a strong image. Otto's German Pavilion at Expo '67 in Montreal, Canada, instigated a long and continuing use of fabric architecture for this purpose. However, this early example of a large building used a steel cable-net mesh from which polyester fabric was hung, contemporary fabric technology that was inadequate for a building of this scale at the time. Enhanced versions of vinyl coated polyesters (PVCs) are, nevertheless, the main material now used for fabric architecture due to their relative low cost and 15e20-year lifespan. The need for stronger, more durable fabrics was met in the 1960s when Du Pont invented a polytetrafluoroethylene (PTFE)-coated fiberglass cloth membrane, with an initial predicted lifespan of 20 years, although many early buildings have now exceeded this, and the life of current buildings is expected to reach to 50 years or beyond [2].

Figure 7. Music Pavilion at the Federal Garden Exhibition, 1955, Kassel, Germany

5. Case Studies

At the end of the 1990s the Cuban touristic sector underwent an important development phase, which required solutions that created shaded areas over existing structures. The company Copextel then created a division that built approximately 80structures in its first 10 years of existence, many of which have not survived because of bad material quality and building mistakes common to an emerging industry with limited technological resources. In the last few years, as a result of the knowledge gained earlier and the acquisition of technology, design and building capabilities have improved, resulting in around 1600 m2 of membrane installations each year. Dr. Angel Martinez introduced the subject of fabric architecture in the master's program at the Instituto Superior Politécnico.

José Antonio Echeverría, and in 2011 a line of research as well as an optional subject on the topic were opened in the Faculty of Architecture. As an example of these works we highlight the cover of the National Aquarium in Miramar, City of Havana, where two structures were built: a 400 m2 structure for the sea lions show and a 620 m2 structure for the dolphinarium (Figure 8). Both membranes cover the area of the bleachers and are generated by the association of paraboloids, whose low points go straight to foundations in the surrounding gardens or on the concrete structure of the building, and the high points to metal lattice masts (Figure 9) [2].

Figure 8. Cover of the Dolphinarium. Sergei Manuel Joa Dubitskaya [2]

Figure 9. Perimeter masts. Sergei Manuel Joa Dubitskaya [2]

An examples of current Mexican fabric architecture has been mentioned as bellow:

Vasconcelos Stadium

Area: 1890 m^2.

Year: 2008.

Owner: Equipo De Beisbol Guerreros de Oaxaca.

Design: Broissin Arquitectos Y Carpas Y Lonas El Carrusel, S.A. de C.V.

Calculations: Ing. Salvador Mandujano.

Construction: Carpas y Lonas el Carrusel S.A. de C.V.

Location: Oaxaca, México.

Material: PVC/polyester Ferrari 1002S.This structure was manufactured to cover the bleachers of a stadium built in the 1960s that was being remodeled. The proposed structure solution was governed by the integration of the new structure with the existing concrete one (Figure 10).

Figure 10. Vasconcelos Stadium. Héctor Mendoza [2]

Figure 11. Structure view. Héctor Mendoza

The solution consisted of three modules, two lateral ones at the same level and a higher central one. Metallic columns are attached to concrete ones using special staples. From there, trusses are placed 13.75 m toward the field and 4.30 m toward the back of the stadium, and are stabilized by means of cables and tubular arms. Tubular arches are placed among the trusses, and the membrane lies on these arches. The membrane is stressed toward the side trusses with auxiliary hoists and is stapled to a frame made for that purpose. The front and back edges of the membrane are stressed using turnbuckles (Figure 11) [2].

6. Design Rules

The unique features of membrane structures are mainly ascribable to the structural behavior of flexible elements, such as cables and membranes, and their differences compared with the components of more conventional roofs (Chilton 2010). Elements in pure tension provide the most efficient way to resist external loads. Compared to beams and columns, where part of the material is underutilized or the buckling instability compromises the final residence of the components, cables and membranes can be stressed at the material's ultimate strength. However, due to the similarities with a catenary, the (large) deflection of the structure is directly related with the magnitude and the distribution of the applied loads with several drawbacks in term of structural design. Only an adequate geometry, designed with a correct level of double curvature (anticlastic for pre-stressed surfaces, synclastic for inflated components) can support the downward and upward wind and snow loads without ponding and fluttering problems [4].

Despite the overall complete difference aspect, cable nets share the basic physical principles which regulate their equilibrium and shape with the boundary tensioned membranes described above. According to Lewis (2003), from the point of view of an analyst it can be said that they represent a discrete-type of membrane with no considerable differences, therefore they can both be called a tensioned structure. This argument is reinforced by the historical evolution of this type of structure which, at the early stage when technical fabrics did not provide the necessary resistance, were realized by means of a load bearing cable net structure under pre-tension, with a further layer made by one of the first examples of coated fabric. One common configuration is based on rigid edges made by steel or concrete under compression, on which the cables are anchored and tensioned obtaining double curved anticlastic surfaces in which each node is stabilized by force in opposite directions in equilibrium. If the surface assumes a synclastic configuration the equilibrium is achieved by means of heavy roof cladding, which prevents the surface lifting in the presence of wind. The second alternative is the use of flexible edge cables supported by masts and tie backs. Cable domes are based on a slightly different structural scheme which is generally circular in plan and based on radial trusses made of cables with the only exception of vertical compression struts. Cable trusses mostly present a planar structure, with a top cable and a bottom cable with a considerable cross-sectional area due to their load bearing function. They are separated by means of hangers which contribute to the stress distribution of the two main cables. The structural equilibrium is obtained with geometries and a pre-tension which prevents compression stress states in each cable or hanger, in the case of suspended geometries the stability is achieved with heavy suspended loads.

Cable trusses often incorporate struts under compression in order to reduce the level of flexibility. The load bearing capacity of pre-stressed cable nets, domes and beams depends on the geometry chosen, the level of pre-stress and the allowable deformation and fatigue strength of each member, the higher the pre-tension the lower the deflection under external loads, but with a consequent increase in costs and material stress [4].

7. Materials Used

Synthetic polymers such as polyester, glass, and aramid are commonly used as fabric materials, in which the yarns/fibres are interlaced in two mutually perpendicular directions (0° and 90º) in order to achieve the desired degree of strength, translucency and impermeability [4]. As coatings, polymers such as polyvinylchloride (PVC), polytetrafluoroethylene (PTFE), polyvinylidene difluoride (PVDF) and silicone have been applied. These have been reported to impart shielding properties to the fabrics' fibres by protecting them against UV radiation, abrasion, adverse atmospheric conditions (humidity, rain, snow, etc.) and to provide geometrical stability to the fabric. Therefore, this type of structures has been commonly applied as a sustainable solution to replace steel and concrete [5] (Figure 12 and 13).

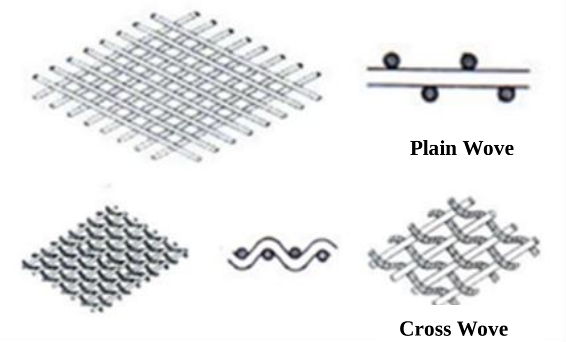

Figure 12. Details of PVC fabrics

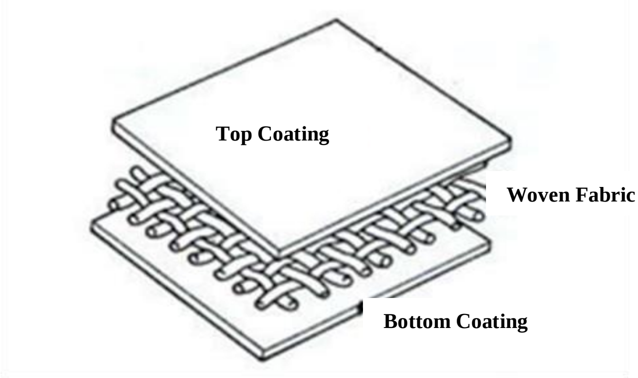

Figure 13. How to combine PVC Fabrics

7.1. Performance Indicators of Polyester Fabric

7.1.1. Mechanical Properties

Coated fabric consists of different layers combined with the matrix, coating, and a surface treatment for sealing or printing. The matrix, which can be woven or nonwoven, can be made with yarns of natural fibers such as wool, cotton, hemp, or silk, or man-made fibers such as fiberglass, polyester, nylon, or Kevlar. The coatings are usually vinyl, neoprene, silicone, or Teflon.1 The coating and the surface layer can protect the yarns against different sources of damage (UV, abrasion, atmosphere, rainwater and moisture) and provide material to permit heat-sealed seams. PVC (polyvinylchloride) **-** coated polyester fabric is one of two most commonly used materials. Its thickness is always larger than 0.5 mm and its surface weight is 420–1500 g/m^2. It is more popular mainly due to its favourable price, good toughness, various colors, and soft texture. Besides, it can easily be folded and unfolded with good tolerance of cutting error. However, it is always with poor durability, fire-resistance and self-cleaning. In order to improve its durability and self-cleaning polymeric materials such as acrylic, polyvinylidene fluoride (PVDF) and polyvinyl fluoride (PVF), are used as the top coats of PVC-coated polyester fabrics. PVC-coated fabric has virtually no bending stiffness and therefore can only resist tension. It must be in tension to sustain a shape and the tension also provides stiffness, which prevents excessive deflection and flutter. As a polymer composite, the building PVC-coated fabric is always manufactured by plain woven, and it is highly nonlinear and viscoelastic [6].

7.1.2. The Durability

The durability of textile membranes in outdoor architectural applications is a key factor to be considered in a specific project design. The degradation of the polymers within the coating and its propagation to the fibers contributes to the loss of functional performance, mainly in terms of mechanical properties. PVC-based membranes on the other hand are considered less durable with a lifespan of 10-15 years if exposed to high levels of UV. Nevertheless, previous studies have proven the improved mechanical strength of PVC-based membranes, in which the yarns that are aligned straight inside the composite, are capable of being oriented in different directions and to respond in a successful way to the applied efforts [5].

7.1.3. Light Transmission

Membrane structures can be seen as flexible and adaptive systems that adjust to different environments according to the necessities, e.g. responding to climate variations. They are meant to protect the building against environmental actions, at the same time allowing the natural light to enter into the space. The use of membrane structures in public facilities such as outdoor coverage passages, stations and stadiums have increased in recent years, since it allows for creating larger built spaces. Being thin membrane materials they are very light and transparent, possessing highly solar-reflective properties, which allows for absorbing little solar heat, keeping their surface temperatures low when irradiated by solar radiation. As a result, a space with both daylighting and natural ventilation can be provided. Apart from that, the architectural membranes are able withstand environmental factors and structural loads, presenting a greater lightness when compared to conventional materials with similar mechanical characteristics. Moreover, it allows saving energy through natural light control and internal temperature. Polyester fabrics of white structures can achieve 22 percent light transmittance, however, soil accumulation and dirty or jumping color in the long run may reduce their transparency [5].

7.1.4. Resistance to Fire

The protection from chemical and biological influences, fire-retardant behavior, weld ability, waterproof qualities and UV ray resistance depend on the coating layer. For applications which do not require weather tightness, the use of open mesh fabrics is recently becoming quite popular. The weaving pattern can be designed in order to achieve the required level of solar protection and the design can take advantage of the reduced wind loads and of the substantial absence of ponding and wrinkles due to the permeable structure. The most used fibre for architectural fabrics since the early 1960s due to the reduced price, good mechanical performance and the expected lifespan. The progressive degradation due to UV rays and the behavior in case of fire can be easily improved with an adequate coating. The fibres are quite flexible and are very common for temporary and seasonal structures. Thanks to new technologies, coated fabrics, based on polyester fibres, are now recyclable

The final properties of a coated fabric, with the only exception of the mechanical performance, are mainly related to the materials used for the top coatings. They are usually placed on both sides of the fabric and can be combined with several additives in order to achieve the requirements in terms of weather and UV resistance chemical and biological attacks, fire behavior and color stability. Therefore, the quality of the coating is fundamental for the service life of the material Polyvinylchloride (PVC) is generally used in combination with polyester fabrics Additional additives and top-coatings are generally used to improve the fire behavior, the expected lifespan, the self-cleaning properties and the color stability [4].

7.1.5. Cost

Due to its low cost effectiveness, it was ranked the second largest commodity after polyethylene (PE). (Mechanical and Structural Changes of PVC when Subjected to Heat) PVC has advantages such as low cost, lightweight and is easy to handle and install. It isn't affected by corrosion or other forms of degradation; therefore, it is used as an alternative to the metal in many applications where corrosion can compromise functionality and increase maintenance cost [7].

8. Fixing of Skins (Fabric) and Bone (Structure)

8.1. Skin to Skin

Because of the limitation of size, fabrics have to be connected together in order to cover a large roof. There are basically three connecting methods:

Stitching Connection

Stitching is a firm connecting method, but it could also be easily damaged. It is commonly used together with Hot Melt Connection for PVC-coated polyester, in order to gain better strength. If it is used in outdoor, it has to be on top protected by another PVC layer from UV radiation. However, stitching is not applicable for PTFE-coated fibre glass and any other rigid fabrics (Figure 14) [8].

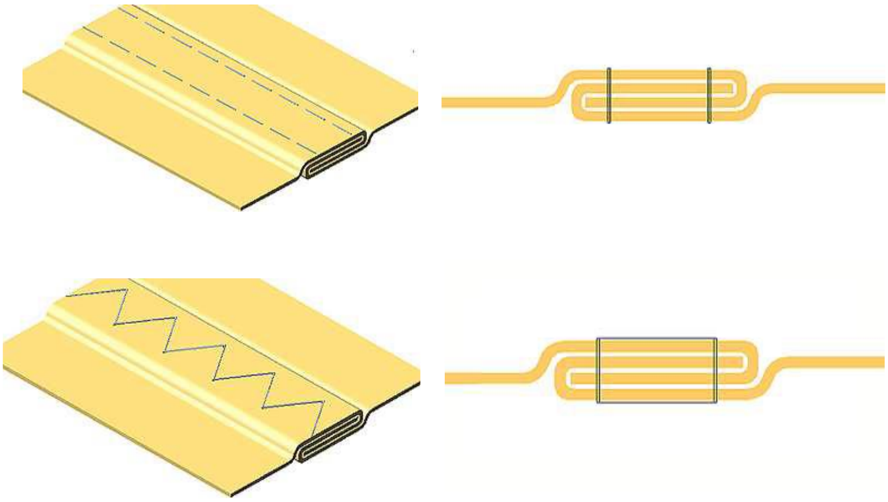

Figure 14. Sample of fabric connection with sewing [8]

Mechanical Connection

Mechanical connection is by using mechanical joints to connect fabrics together. Fabrics are either connected by clamp plate where fabrics are overlapped or with clamp plate holding the side cable of the fabrics. Usage of mechanical connection has the problem of water leakage, which needs special design to seal the water from entering in between fabrics (Figure 15) [8].

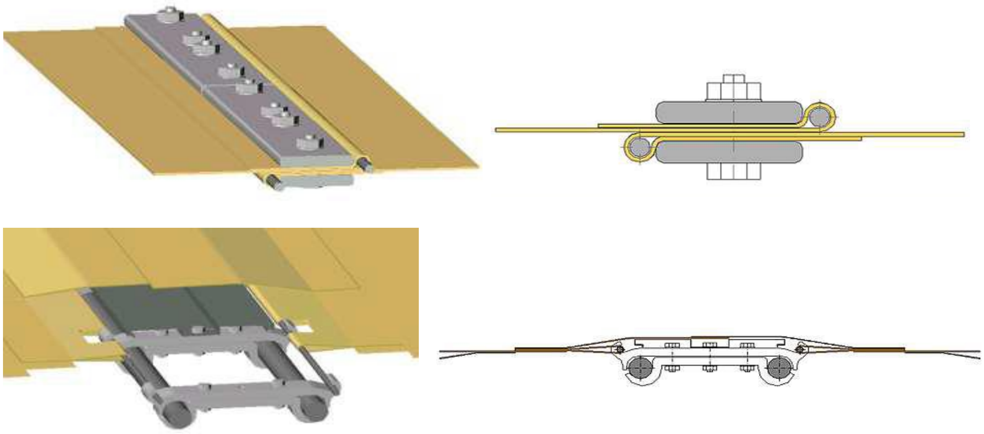

Figure 15. Two samples of mechanical connection proposed in designing the roof of the amphitheatre [8]

8.2. Skin to Bone

After the fabric is attached to the steel frame, a fabric structure is completed. Two methods are commonly used to connect the fabric to the frame.

Clamp Plate

Clamp plate is used to firmly hold the side cables of fabric by steel plate (fig 16) [8].

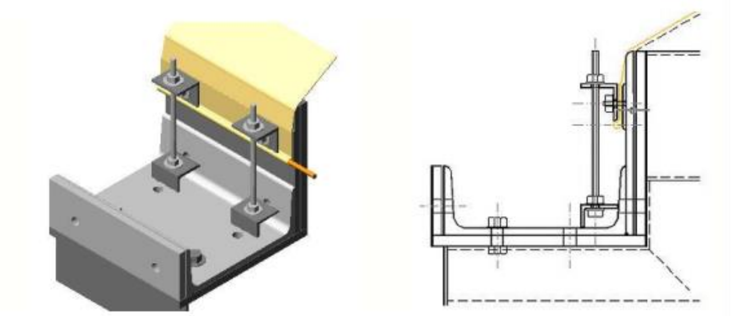

Figure 16. How to connect the fabric to the support [8]

Cable Connection

This method is by using cable to tight up the supporting. Because the materials for cable and fabric are not the same, space for tolerance should be allowed in between, in case of abrasion (Figure 17) [8].

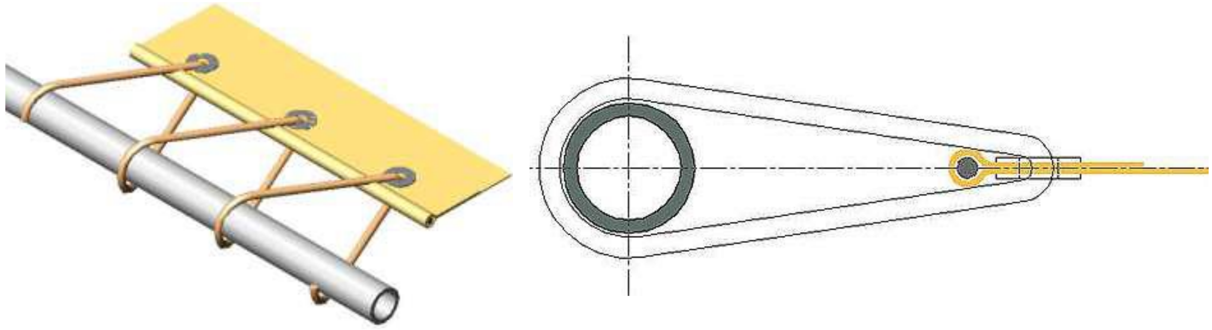

Figure 17. How to connect the fabric to the cable [8]

9. Analysis

The tiled canopy of this amphitheater is a 700-square-meter structure that shadows a gradient. The capacity of this gradient is 750 people. In the amphitheater, the combination of the structure and the architecture of the project form the basis of the plan. The concrete position of its spectator's acts as a foundation for dorsal truss structures and the gradient of the ground allows the use of a stepped back foundation. So that, on the two sides of the gradient there is an indoor space to sit. The cloth with joints on the back is connected to these metal trusses in the form of summits and valleys, and from the front to the cable trusses leading to the front pillar. Each of these two columns is also drawn from the back with 4 cables. Cable ties are embedded in the edges of the fabric, as well as underneath and on it that create the pre-stress force into fabric and make it stable against wind and snow loads.

The first thing is to make a model with a cloth tape as a cable that has a hard pivotal equilibrium and a good approximation of the proper shape and stress under fabric membrane loading. Then by generalizing the results of the analysis of forces in different members, we calculate the structure with the lowest mistake. After analyzing and providing software output, we often provide a list of membrane tensile stresses in the direction of the warp in all areas of the membrane and the desired loads, then we compare these tensions with the allowed values for the selected fabric in the design, which is often tensile strength of the fabric strip is divided into a safety factor. The safety factor of the project for stretched tensile strength for short loads, including wind force is 4 and for common present loads is 5 and the considered forces are calculated by working stress. The effects of the pre-stress and dead load of the structure is tried to be considered in the calculations. Considering that in most early analysis, excessive stresses in one or more membrane regions are detected due to one or more loading cases, it was tried to observe the ASCE standards to reduce excessive tensions. For loading procedures, by adding cables along fabric that are under extra stress, part of the load initially endured with the fabric is to be transmitted to the cables. Due to high hardness of steel cables, the extra stress is mostly be controlled (Figure 14). Finally the specifications and also the pre-stress level of used cables are obtained after repetitive analysis of the software.

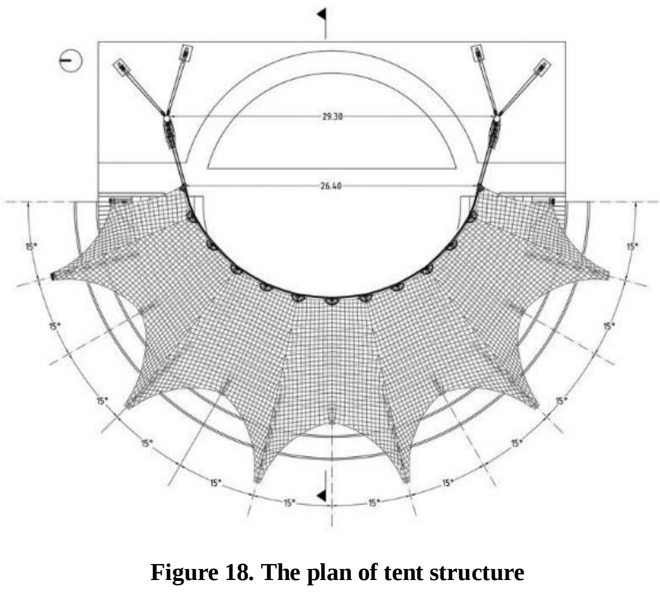

Figure 18. The plan of tent structure

10. Proposed

After designing process and considering the amphitheater location in Besh Qardash site, the final design (Figure 19, 20 and 21) are recommended to be implemented in the site.

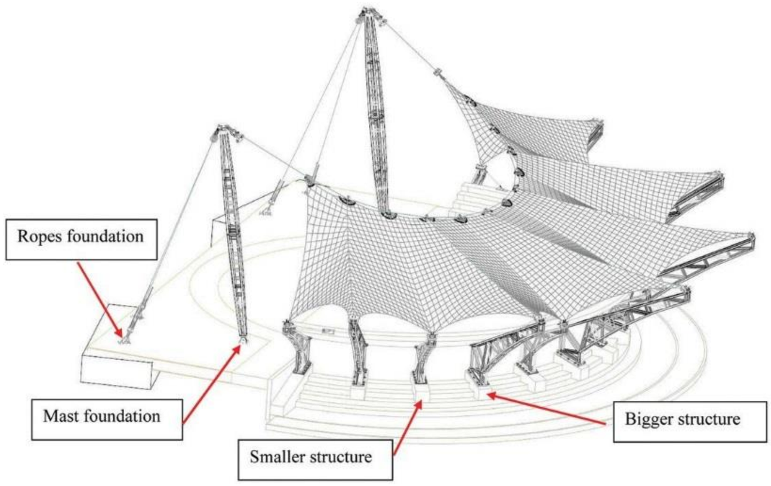

Figure 19. The details of proposed fabric structure

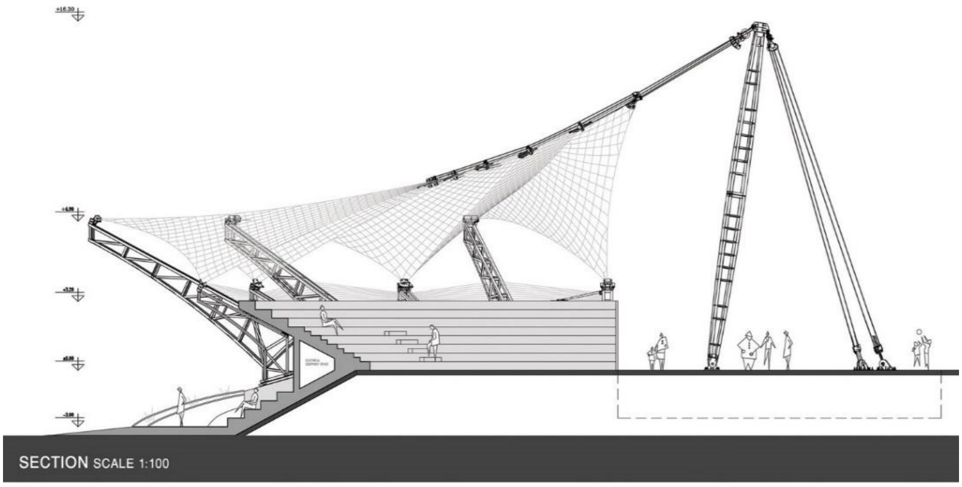

Figure 20. Cross section of the proposed scheme

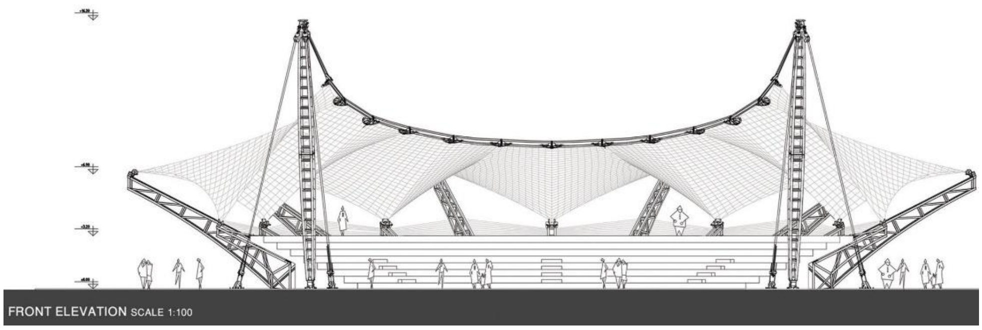

Figure 21. Elevation of the proposed scheme

11. Conclusion

Currently, people have unique cultural behaviors in Besh Qardash site. The future plan of developing Besh Qardash, should organize the behavior, along with respecting previous behavior. The plan should realize this behavior and organize it properly and provide the required facility for people. The potential of its natural environment like fresh water, proper morphology, natural cover and diverse artifacts, the short distance from the city and its accessibility make it suitable for attracting tourists. The proposition of tent structure mixes the modern and traditional architecture and it has sudden and huge impact on tourists. The tourist and visitor will be excited by seeing a combination of nomadic tent. It excitement of fabric roof and its daring technology and fulfilling the space coverage will be expressed frankly. This quality surprises all the tourists from seeing a fabric with a big gate and it gives an indescribable emotion to visitors along with other characteristics of Besh Qardash.

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