TensiNews

Newsletter Nr. 18
april 2010
published twice a year
price 15€ (post incl)
www.tensinet.com

Newsletter of the European based Network for the Design and Realisation of Tensile Structures

Case study

'TENSILE SURFACES STRUCTURES'
DESIGN PROCESS

RESEARCH

A SIMPLE NON-LINEAR MATERIAL MODEL FOR PVC-COATED POLYESTER FABRICS

"Batsail"

IMS RESEARCH PROJECT

PROJECTS

STADIA South Africa

USA-SHADE

Lone Butte Casino Lights Up the Desert Sky

Chandler, Arizona, USA

The newly constructed Lone Butte Casino is located south of Phoenix in Chandler, Arizona and is owned and operated by the Gila River Indian Community. Visitors to the casino are greeted by a spectacular fabric structure at the main entrance built by FabriTec Structures. FabriTec, in conjunction with Group West Architects and General Contractor JE Dunn, have created a custom framed tensile structure made of Teflon-coated Fiberglass (PTFE) fabric. The 5-tiered, wrapped panels form the canopy for the main entrance and peak at a height of 13,7m. The panels range in sizes from as much as 21,3m long to widths of up to 9m. The casino also features two smaller side-entry structures as well as an interior fabric structure for the central court of the building. The 3 entrances to the building were given equal importance and were designed with matching features both outside and in the immediate indoor entry areas.

The design of the fabric structure is unique in that the fabric cladding is on the underside of the structural steel elements thus concealing the steel from view below (Fig. 1). The cumulative effect of this design is that the structure looks like layers of clouds floating above the entryway. To add to the dramatic appearance, the structure has been built with colorful custom up-lighting which automatically changes and can be controlled for various degrees of evening light and for time of year. FabriTec Structures won at the 2009 International Achievement Award (IAA) with this project the Outstanding Achievement award.

Jay Jensen
jjensen@usa-shade.com
www.usa-shade.com

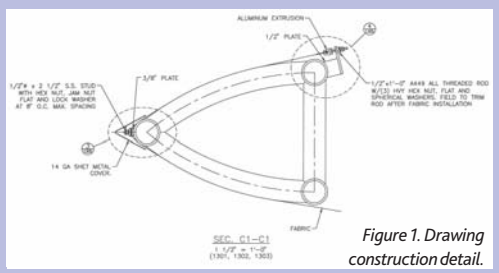


Figure 1. Drawing construction detail.

Location address:	Chandler, Arizona, USA
Client:	Gila River Indian Community
Function of building:	main entrance Casino
Type of application of the membrane:	canopy
Year of Construction:	2009
Architects:	Paul Hamel (Group West Architects)
Engineering:	FabriTec Structures
Contractor:	JE Dunn Construction
Supplier of the membrane material:	Saint-Gobain & MultiKnit
Manufacture and Installation:	FabriTec Structures

ARQUITEXTIL FHECOR

ETFE single skin

Architectural concept

Aranda de Duero is a town in Castille (Spain). A new Arena was constructed in this town. The building consists of a circular grandstand and a global roof. The roof is partially retractable in order to adapt the configuration of the building to different events. The Arena has a circular shape in plan with a diameter of 80,14m. The roof was designed as a shell structure. Half of the central part of the roof is retractable and has a shape of spherical sector of 32,90m of diameter in plan. *(Fig 1)*

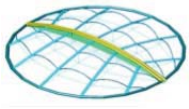
Steel structure – fixed roof

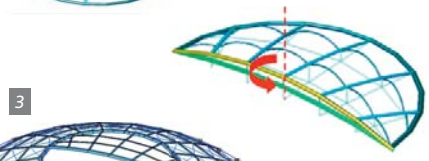
The main structure has a Schwelder configuration. A spherical shape supported only in the perimeter by

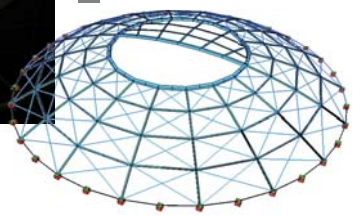
1

1

Name of the project:	ETFE SINGLE SKIN ARANDA DE DUERO ROOF
Location:	Aranda de Duero, Spain
Client:	Victoriano del Río
Function of the building:	Concerts, sports and bullfighting Arena
Type of application of the membrane:	Protection against environmental hazards and light transmission
Year of construction:	2006
Architectural Design:	José Romo (FHECOR Ingenieros Consultores) José María Lastra (Comercial Marítima L&Z)
Structural Engineers:	José Romo (FHECOR Ingenieros Consultores)
Consulting engineer for the membrane:	José Romo (FHECOR Ingenieros Consultores) & José María Lastra (Comercial Marítima L&Z)
Tensile membrane contractor:	Comercial Marítima L&Z
Supplier:	Nowofol GmbH
Manufacture and installation:	Comercial Marítima L&Z
Material:	Nowoflon ET 6235 300 µm ETFE
Cover surface:	1.400m²







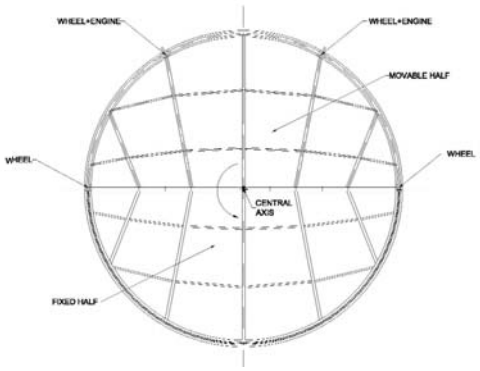


Figure 1. Air views of the roof.
Figure 2. Fixed roof during construction.
Figure 3. Model view of the fixed elements.
Figure 4. Retractable roof in opened and closed positions schemes.
Figure 5. Top view of the closed oculus.
Figure 6. Movable upper half bearing on fixed bottom half.
Figure 7. Membrane bottom view.
Figure 8. Interior view and light going through the oculus.

Spain

Aranda de Duero Roof

neoprene bearings of 300x400x 121mm located over 36 concrete pillars. The maximum relative level of the fixed roof is 9,64m. This gives a ratio height/span of 1/8,3. The structure conformed by HEB280 profiles as meridian and parallel beams. The diagonals of steel bars 32mm give the shell behavior of the structure. Diagonals were prestressed to ensure efficiency of the system.

The structure has an outer beam. This element of 0,60m depth and 0,90m width was made in reinforced concrete working in tension. The central oculus has in the perimeter a steel hollow beam of 745mm width, 700mm depth and 12mm of thickness. This beam is working mainly in compression. The structure is considerably light. Its slenderness ratio (depth/span) is 1/285 meanwhile the egg shell is 1/100. *(Fig 2)*

Steel structure – retractable roof

Half of the oculus follows the geometry of the main roof and it is also fixed while the other half is movable. *(Fig 3 - 4)*

In order to unify the global design of the roof, the retractable part has the same radius of curvature as the fixed roof. To have a more clean view, the structure of the oculus does not follow the structural system of the fixed roof. The movable half spins around the central vertical axis. *(Fig 5)*

The movable part is supported in the central axis and in four wheels. Two of them are in both edges of the beam, and the other two at 60 and 120 degrees. Two engines move the central wheels. The movable structure is composed by HEB steel profiles. Both circular beam and the one in the diameter have steel hollow section. *(Fig 6)* Movable upper half bearing on fixed bottom half.

ETFE membrane

ETFE has been used as the oculus roof material to obtain maximum transparency. Even though Aranda has snow winter conditions, the membrane was design as a single layer. ETFE has a thickness of 300µm. The membrane has a negative Gaussian curvature, to resist snow loads as well as wind suction. Steel arches give shape to the membrane. Twelve radial sectors configure the ETFE membrane.

Each of them was fixed to the meridian beams, and stressed by elevating the steel arches. Longitudinal inox 8mm cables were used to help the membrane resist snow loads. *(Fig 7)*

Conclusions

Light ETFE has allowed to build a slender movable roof which could not be possible with heavier materials such as glass. Single skin gives a high level of transparency which was one of the client's requirements. One of the main goals of this design was the successful combination of ETFE with a movable structure. *(Fig 8)*

José Romo Martin, FHECOR Ingenieros Consultores
jrm@fhecor.es
www.fhecor.es

José María Lastra, Comercial Marítima L&Z
jmlastra@arrakis.es
www.arquitextil.net