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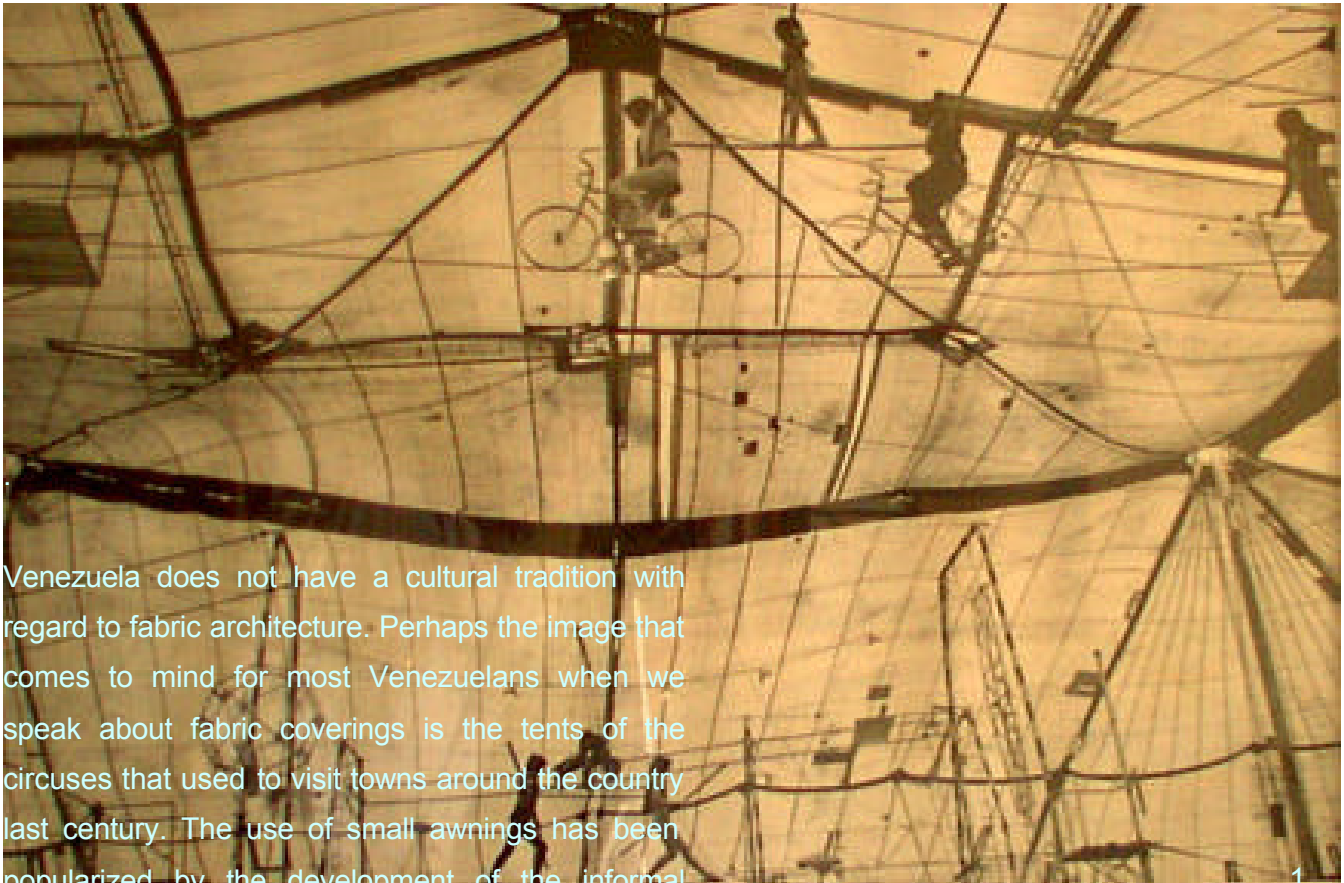
F A B R I C A R C H I T E C T U R E I N V E N E Z U E L A

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ABSTRACT

Venezuela, although it has good climatic conditions for the uses of Fabric structures, has starting to build fabric architecture only few years ago. In this article we briefly describe some of this projects.



Venezuela does not have a cultural tradition with regard to fabric architecture. Perhaps the image that comes to mind for most Venezuelans when we speak about fabric coverings is the tents of the circuses that used to visit towns around the country last century. The use of small awnings has been popularized by the development of the informal

economy in the last eight years which we can see in the streets of the main cities and fairs in towns in the interior. Some types have been industrialized but most of them are home-made or improvised.

Fabric architecture arrived in Venezuela relatively late despite the fact that, on the one hand, the country is located in the equatorial belt which gives it a moderate climate that allows the use of open spaces all the year round with winds that have a maximum speed of 7 m/s on the coast, ideal conditions for the use of fabric roofs. On the other hand, approximately 20 years some structures were imported, among which we must mention the Bolivarian Dome, located to date in the city of Barquisimeto (10000 M2 fiberglass with PTFE) and some inflatable structures to be used as deposits or itinerant roofs for the skating rinks that were popular at the time. Later, there was a proposal to cover the



bull ring in San Cristobal, Tachira State, made by the engineer Host berger, but which did not have much of a reception in the construction market, possibly because of a general ignorance, a lack of credibility in this technology or because of a lack of local supply of companies able to develop projects and the construction of this kind of structure.

In 1997, a group of professionals involved in the study and development of transformable structures at the Institute of Experimental Development of Construction (IDEC), attached to the Faculty of Architecture and Urban Development (FAU) at the Central University of Venezuela (UCV) began to give courses and talks on the design of fabric structures, with the collaboration of international professionals specializing in this area, which opened up the possibility of developing projects to use this type of structure in the country.

This opening led to projects for the Café at the Fine Arts Museum in Caracas, and the Fabric Awning for the Excavations area at the Taima-Taima Archeological Museum in Falcon State, both contracted by State institutions. In 1998, two awnings were designed and constructed for installation in the Divexity Amusement Park in the Sambil Shopping Mall in Caracas. These geometrically simple but attractive awnings installed in a very visible zone of the capital city generated a lot of interest in the market which led to an increase in demand that required the creation of the privately financed Estran Group company that specializes in the design and construction of fabric structures. Later the Conacero company which was involved in the Coliseum Project in Guanare, Portuguesa State, and specialized in the construction of metallic structures incorporated this technology in its

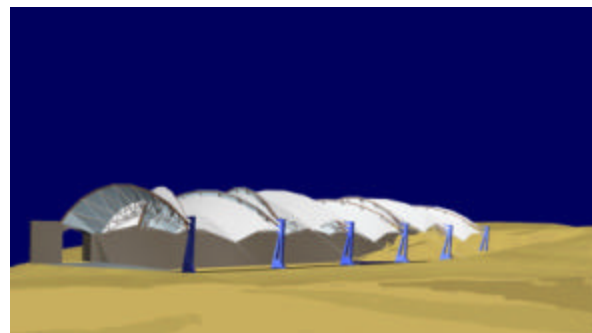
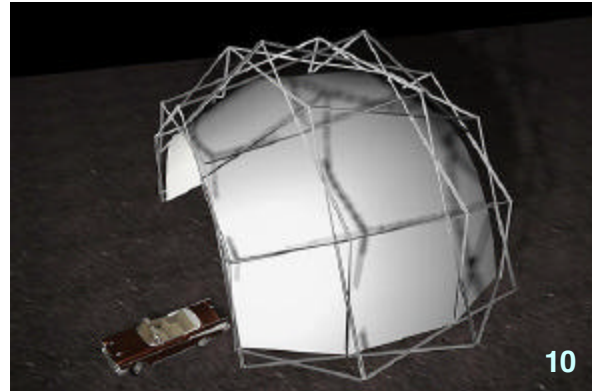


production line. In the last two years a considerable number of small and medium-sized awnings have been made by independent professionals for installation in cafés and shopping malls and produced in a wide variety of styles. We give some examples below of constructions carried out during the last two years by the Estran Group.

ESTRAN 1 DEPLOYABLE AWNING PROTOTYPE. 1987-2000, IDEC-FAU-UCV.

The ESTRAN 1 awning is a system that makes it possible, with minimum storage and transport, to raise in a few minutes awnings for use in exhibitions, fairs, temporary storage depots, or in any other situation that requires covered, protected areas. It consists of a foldable spatial mesh which when folded forms a packet measuring 4.20 x .80 x .80 m. weighing about 1,000 kilos; when unfolded, a process which can be carried out by as small crane, or by using burlins placed at strategic points in the structure itself, a cylindrical dome 14 x 8 m. at ground level with a 7 m. radius. This mesh is complemented with a Polyester/PVC membrane which is hung to the aluminum structure from below using a system of ropes and pulleys.

The structure design takes into account criteria of economy and construction simplicity, using elements existing on the national market or which can be easily manufactured. Aluminum was selected as the construction material to achieve the lowest weight possible and to facilitate its handling. The structural form selected was the cylindrical dome with a square base, consisting of three parallel arches joined by fourteen brackets. Each arch consists of six scissor-type assemblies formed by lineal elements of rectangular section aluminum.



The nodes are made of steel and insulated by means of nylon coils and washers to avoid friction between the mobile pieces. The awning is made of a PVC-coated polyester material. This prototype demonstrated the feasibility of producing instantaneous structures using compact packages that are easy to handle, transport and store.

TENSILE AWNING FOR THE EXCAVATIONS AREA AT THE TAIMA-TAIMA ARCHEOLOGICAL MUSEUM, FALCON STATE, VENEZUELA. 1998-1999. TECNIDEC-IDEC-FAU-UCV

The idea of erecting an awning over the Taima-Taima archeological excavation arose from the need to keep the archeological finds in a maximum state of authenticity and to avoid the deterioration that could be caused if the pieces were moved or left out in the open.

The project consisted of creating an on-site Exhibition Area within the limits demarcated by the edges of the excavation and protected by a fabric awning conformed by eleven modular elements covering a 20 m. space. These modules are tightened structures formed by two wooden arches joined transversally by metal frames, with cables and struts to stabilize the whole; the wooden arches support a fabric awning that, following the structure's curvature, produces an anticlastic surface. Each module forms at ground level a triangle that covers a 72 m² area. All these modules together conform a covered area of 794 m². When raised, the alternately installed modules look like a single element. The structure's double curvature and aerodynamic design allow it to support high wind speeds (max. 120 km/h) like the ones in the Falcon State's xerophilous landscape.



FABRIC AWNINGS FOR THE GAMES AREA IN THE "DIVERXITY" AMUSEMENT PARK IN THE SAMBIL SHOPPING MALL. Caracas, 1998-1999. TECNIDEC-IDEC-FAU-UCV.

This is a unit formed by two double curvature anticlastic fabric awnings that allow it to resist wind suction and pressure. The awnings are constructed with a polyester/PVC membrane (Ferrari Precontrain 702). The first one is attached to the mall's southern facade conforming an eave of five meters. The awning of 110 m² is supported by five steel uprights in turn are supported by cables anchored to the wall. The second awning has an area of 520 m² and is supported by eight pairs of 7m-tall metal columns in the form of an "A", articulated at their bases. The fabric is stabilized by cables with alternately opposed curves. The whole awning is taughtened from the fixed points located on one side on the story divider slab, and on the other side on the eastern facade of the building, outside the terrace area. The translucent fabric provides homogeneous lighting during the day, and at night it reflects the light shining on it, providing a very pleasant chiaroscuro effect. The pattern-making of the fabric, which is the most complex part of the process, the design and manufacture are done in the country. To assemble it, the same support structure was used as a crane.

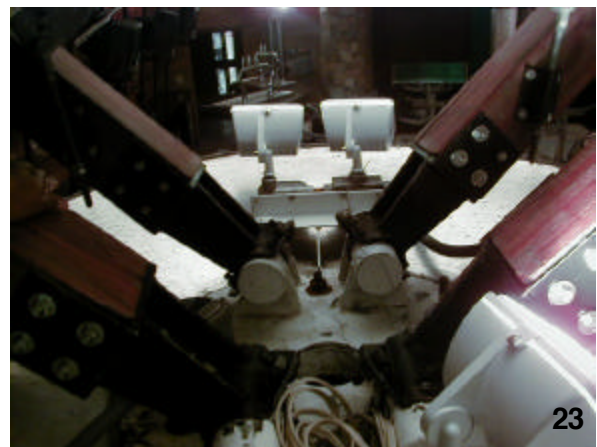


FABRIC AWNING FOR TOP'S RESTAURANT, SAMBIL SHOPPING MALL. Caracas 1999.

This awning is one of greatest constructive achievements both for its formal beauty and for the technique used to make and assemble it. It covers a total area of 430 m². The awning is made of four modules, defined by rigid borders conformed by eight arches of laminated wood, supported by concrete columns. The anticlastic membrane, similar in shape to a saddle, joins each pair of arches, providing them with lateral stability. The arches are made of "zapatero" (hard) wood, oven dried and cold-laminated with phenolic adhesive. The membrane is made of high tenacity polyester with PVC protection (Ferrari Precontrain 702) and is joined to the arch via an aluminum rail located along the length of the same. The structure was assemble at the site, first the central arches were place at the top of the column and hold together by transversal wood elements, the external arches were them assemble over the first group, the membrane was then introduced for each pair of arches in the aluminum rail and the arches separated, using a pivot system place at its base, until the desired pretension and geometry was obtain. Rainwater runs to the supports on the concrete columns where a stainless steel funnel collects it.

FABRIC AWNING FOR THE QUICKYLUB AUTOMOBILE LUBRICATION CENTER. Caracas. 1998-1999.

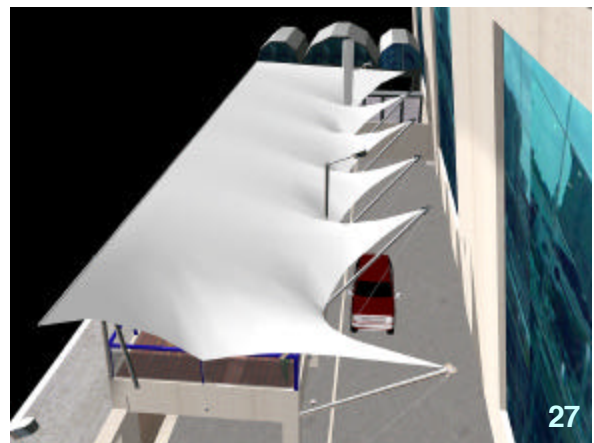
A 100 m² awning, shaped like a bird in flight, which was obtained via two 11 mts. metal poles supported on a single point on the building's structure, which provide the high support points for the awning. Two



low points are fixed to the building's structure and a third low point to one base. The contact with the building is free and it was made waterproof with a second fabric panel which is tautened over the poles. The double curvature in the shape allows a better distribution of the stresses caused by the wind, resisting wind speeds of up to 100 km/h. The process to tauten the awning takes place on the heads of the poles and at the points of connection with the existing structure. The membrane used is made of high tenacity PVC-coated polyester (Ferrari Precontrain 702).

FABRIC AWNING FOR THE MASSAI DISCOTHEQUE, NORTH SIDE OF THE SAN IGNACIO SHOPPING MALL. Caracas. 1999-2000.

The awning is located in the San Ignacio shopping mall. The structural arcades of the gallery that provides access to the shops define the awning's size, shape and location. The objective is to provide a refuge from the sun, wind and rain generated by the East-West orientation of the terrace. The area covered is approximately 60 m², the height is defined by the arcade, leaving free the views in all directions in order not to interfere with the shops' exhibition spaces and their signs. The views are framed by the borders of the awning and the visual continuity is not interrupted at all. The double curvature in the shape allows a better distribution of the stresses caused by the wind and contributes to a better distribution and collection of rain water. The awning is supported principally by a pair of composite metal poles which in turn are supported by cables attached to the facade of the Tower. The support points on the facade are located on the beams in the Tower's structure. The tautening



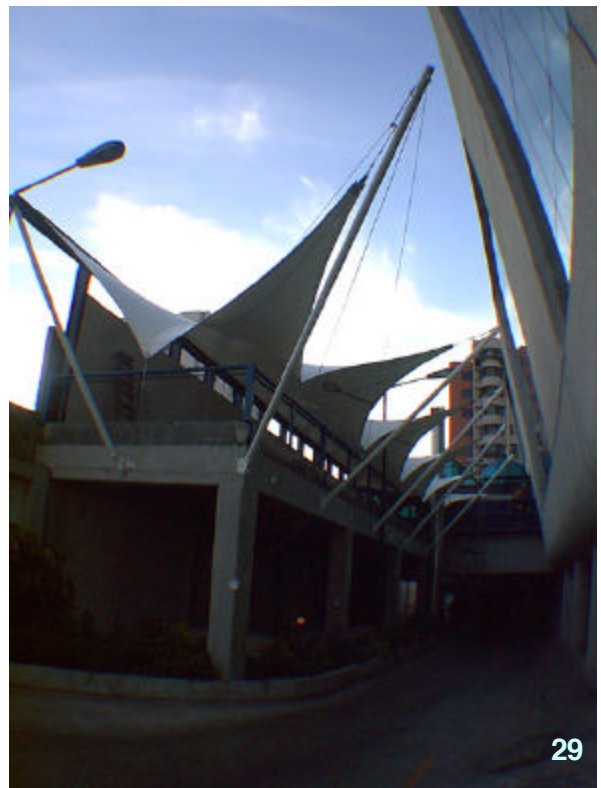
system is defined by the points where the fabric is fixed to the metal structure and the points on the ground.

FABRIC AWNING FOR THE TERRACE OF THE LA MANSION DE PARIS BAKERY AND PIZZERIA. PARIS SHOPPING MALL. Barquisimeto. Lara State. March 2001.

The proposed awning (120 m²) is a membrane with a double curvature, generated by low points (1m from the ground), high points (3m from the ground), a stiff edge to the backside wall reinforce to support the membrane loads (3.5m from the ground) and to the side of the existing building. The main elements in the structure that supports the awning are six pivoting steel poles that are supported on bases fixed in the beam that supports the terrace. The low points of the awning are tautened by wires attached to the same structure as the poles. A straight edge with aluminum sections will protect the terrace from rainwater on the side of the back wall and the building's facade. The rain water is channeled to the front over the planters.

FABRIC AWNING FOR THE SEATS AT THE RIO DANZA CARIBE THEATER. Caracas. March 2001.

The awning (120 M²) has been designed to take into account the image of the entrance as a whole, generating attractive shapes over the café area, without losing continuity with the rest of the awning. The combination of high and low anchorage points, distributed alternately, generates the organic shape of the awning, and guarantees its double curvature and correct structural stability. The awning has the double function of covering both the area of the seats in the theater and those in the café,



integrating them spatially. The membrane is supported by points located in the building and “pie de amigo” (friend’s foot) supported on the perimeter wall to create high points.

The location and height of the different points for fastening the awning give it an organic and free form, while creating gaps that guarantee the correct lighting and natural ventilation.

AWNING FOR THE “EL PARAGUITA” CAFÉ AT PETROLEOS DE VENEZUELA HEADQUARTERS, Los Chaguaramos, Caracas, November 2001.

This awning has an irregular shape because of the area available for the café, combining with the existing trees to create a shady space with protection against the rain. Part of the awning’s perimeter faces the building to which it is directly fixed, on the free perimeter it is supported by 7 poles that create the high points, the low points go directly to the bases. The 130 mm O steel tube poles are supported on independent bases and a containing wall along part of the awning’s perimeter. The pretensioning is made through the guys in the head of the poles and in the low points. The membrane is made of Ferrari Precontain 702 material.



SET OF FABRIC AWNINGS FOR THE HEADQUARTERS OF HIDROCAPITAL WATER COMPANY. Maripérez, Caracas. October 2000-2001.

The set is formed by three awnings; the first is located in the access area of the building and consists of a membrane formed by the combination of two paraboloids, supported at one end on three poles and at the other on fixed points in the



building's structure. On the side of contact with the building the boltropes are free therefore it is made waterproof by means of a stiff polycarbonate overlap fixed to the structure of the facade.

The second awning covers the staircase that joins the two wings of the building. It consists of a pair of conoids crowned with two transparent domes and supported by two floating poles fixed by wires from the existing metal structures. Rainwater is channeled towards the building's tiled roof and the gardens next to the staircase. The third awning is a paraboloid supported by a pole at one end that produces a high point and two low points that go direct to the bases, at the other end the membrane is mounted over a covered passage and fixed to the latter's beam through five bases.



SET OF FABRIC AWNINGS FOR THE TERRACE AREA OF THE MOVIE THEATERS AT THE EL RECREO SHOPPING MALL. Bello Monte, Caracas. January 2001.

To achieve integration from the spatial and functional point of view, for the architectural volumes of the new terrace of the El Recreo Shopping Mall Movie Theaters a set consisting of nine fixed fabric awnings is proposed. These awnings when overlapped generate a continuous pathway between the different theaters and the centers of vertical circulation that communicate the terrace with the rest of the shopping mall. An interesting spatial contrast is created by playing with different geometrical shapes. Conoids in the places where the different passageways meet and along the facades of the movie theaters generate shapes by the combination of paraboloids. The support structure consists mainly of a set of steel poles



supported directly on the existing structure. Three conoids hang from poles in a “V”, another pair of conoids are supported by the terrace slabs with central poles and the rest of the awnings are supported by poles hanging from the facade, the traction points are solved by means of wires, feters and guys of stainless steel anchored to the structures of the theaters or to the mall’s skylights, which serve to collect the water from the awnings in a perimeter gutter. The pretensioning points are in the head of the poles. The area to be covered overall is approximately 1,200 m2. All the awnings are made of Ferrari Precontrain 702 material.

PHOTOGRAPHS:

1. The Circus (photo Sigala).
2. Improvised parking cover (Tintorero, Lara).
3. Canopy in a town fair (lara).
4. Domo Bolivariano (Barquisimeto, Lara)
5. Domo de Guanare, Structure Conacero, fabric seaman Corp. Usa (Guanare, Portuguesa).
6. Deployable structures Estran 1 (Carlos Hernández, IDEC 1988).
7. Estran 1 structure before deployment.
8. Intermediate stage of deployment.
9. Structure fully deployed in 15 minutes.
10. Estran 1 view with covert.
11. Taima Taima structure, view of the whole project.
12. Lateral view of one of the modules. The module span 20 mts and it is supported by a metallic column in one side and a contention wall in the other (unfinished).

Front view, you can see the double curvature of the membrane, and the two lower cables



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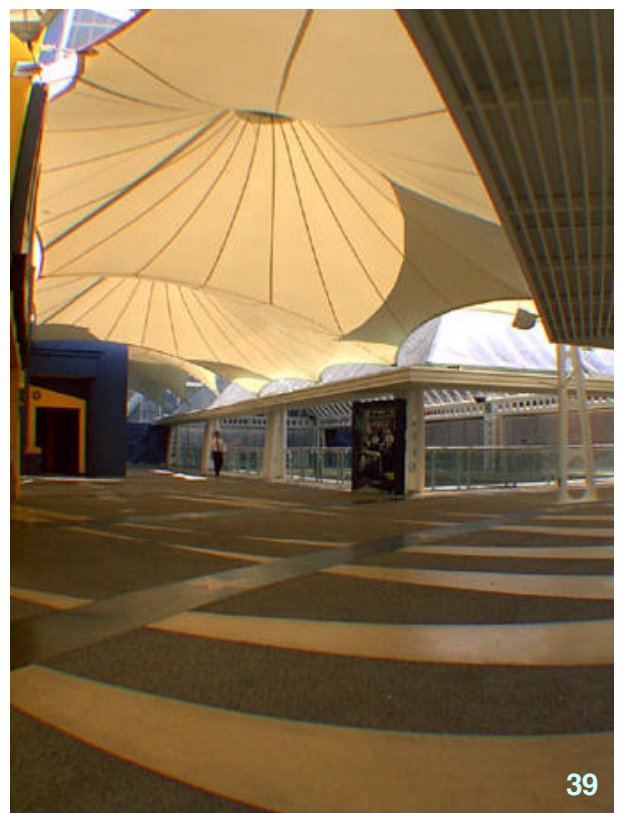


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13. which hold the structure connected to the ground when wind blow upward.
14. Seven metallic trusses and two wooden arches form the skeleton of each module.
15. detail showing the cables and tensors.
16. The two structures of Diverxity (Sambil, Caracas).
17. Lateral view of masts in A shape.
18. In the west side of the structure the loads are carried towards the facade.
19. The smaller cover is supported by mast from the facade of the building.
20. View of Top's structure from below.
21. View of Top's structure from the top.
22. The water is recollected on the column which support the wood arches.
23. The base of the arches allow the rotation movement during the erection process, in the way pretension is introduced to the membrane.
24. Quicklube membrane is supported by two 11 mts long masts which cantilever from the building façade.
25. Massai Front view, Two light weight mast hanging from the façade are the only rigid elements in this structure.
26. lateral view , , three cables connect the membrane toward the floor .
27. Mansion de Paris, general view of the structure.
28. Five masts connected to the beam support the membrane at one side at the other a reinforced wall.
29. Prension is introduced by tensor in the top of the masts an at the lowers points that goes to the concrete beam.



30. Internal view of danza caribe membrane, at the right the metallic structure are show.
31. North view of PDVSA café, The membrane was combined with the existing trees, two of them pass through the membrane.
32. South view. Mast and cables used a bearing wall as a base.
33. View from below, the membrane for the courtyard of Hidrocapital building is supported by two floating mast.
34. Lateral view of the same structure.
35. Hidrocapital front entrance membrane.
36. Small membrane at the back of the building .
37. Recreo shopping mall , view from below , this is one of the four different geometries uses in group of membranes.
38. General view of six of the structures at the Recreo shopping mall.
39. Internal view showing the ambient created by the membranes.
40. Internal View , below two conoid.
41. view from below of one of the corridors.

