

**The "Magical" Lleida Technological Park:  
as an example of environmental building rehabilitation strategy  
VI International Conference on Textile Composites and Inflatable  
Structures – Structural Membranes 2013**

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**ABSTRACT**

**Keywords:**

**Textile roof, Structural membrane, Industrial, Flexible, Demountable, Sustainable, Rehabilitation**

In the present demand-driven market, when time plays a key role, the adopting of a flexible strategy easy to implement may be the answer to create an architecture that meets all requirements. The adaptation with membranes in a rehabilitation, in this case, is an economic way in which this complex was rethought for the new requirements. The membrane contributes towards the stability of the structure, that is composed out of frames, that bear the load of the membrane material, fixed between the buildings, thus creating new spaces and new possibilities. By introducing this new element with its properties, we do not only reshape the complex in a functional way, but we also make it sustainable in connection with the past and the present, creating a new way for the future, in this demanding ever changing market. Therefore the textile structure that covers the access area from the "Magical" Lleida Technological Park is driving this process forward with its persistent commitment to researching and developing new practical design concepts, functions and construction solutions methods. This new approach has a better environmental behavior based on its efficient use of resources, and its easy maintenance and renewal, thus moving it ahead from other standard solutions, making it a so-called pioneer of its generation.

The aim of this paper is: **a) to show that there are other methods apart from the traditional ones, for a construction and in some cases more suitable; b) to describe the main characteristics of the "Magical" Lleida Technological Park, with emphasis on the closing textile structure; c) to explain the closings capacity of sustaining itself by responding to the environmental conditions.**

The strengths of our proposal for this rehabilitation are related to the use of a textile structure, both in the creation of the facade and in the generation of the closing for the access. Key issues in this process are associated with:

**1. The superior quality of form:** It should be mentioned that for us the concept of "quality", can't be defined as just one attitude towards architecture, a style or an operating mode over the surroundings, but rather as a way of thinking and a correct approach towards the existing. **2. Adaptability, 3. Simplicity, 4. The quality of the space, generous for human activities, 5. Energy conservation and efficient use of resources, 6. Weight, 7. Durability**

## 1. SUSTAINABILITY CRITERIA AND ENERGY EFFICIENCY AS AN AIM

The strategy set out in the project design, includes a methodology for applying the sustainability aspect, within technical and economic limits, because buildings in general are the largest consumers of energy worldwide and reduce environmental pollution. Consequently, this strategy seeks to optimize the passive behavior of the building, by reducing the environmental impact and energy demand but also look for more efficient systems, supported by renewable energy sources to suit the remaining demand. Sustainable construction aspects proposed are not meant, only to reduce CO2 emissions, but also include other aspects such: the selection of materials and construction solutions which seek to reduce the environmental impact of materials used, incorporating its lifespan criteria, impact of its production, assembly and recycling. Membranes are a building material with a big potential as examples so far have shown, can be used as self-supporting structures which are more adaptable than glass solutions, in terms of both their price and flexibility.

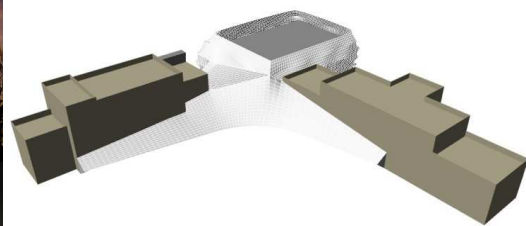
## 2. THE "MAGICAL" LLEIDA TECHNOLOGICAL PARK

The new test center for audiovisual production is located in the area occupied by the former infantry barracks and the current Science Technological Park Gardeny, in the city of Lleida. This infrastructure begins with the creation of the MAGICAL, a complex with facilities and services which follows the creation of audiovisual content, intended for various fields and market strategies (*Figure 1*).

The project, motions the rehabilitates of the existing buildings, comprising the adjacent main square. To complete the center's functions, we chose to construct, a third volume, as a large container, to house a film set in the southern corner of the square (*Figure 2*). A tensioned fabric, covers this container and spreads similar to a fog that embraces and connects the three buildings, defining a concavity towards the square, where there will be established the access to the complex. This material originates under, an open space for reception, waiting, cafeteria, poured into the plain landscape. Textile technology introduced into the building, opposed to the ponderosity of the historical buildings, allows us to see the great possibilities of this new building material.



*Figure 1- The "Magical" Lleida*



*Figure 2 - volumetry*

## 3. THE TECHNOLOGY IMPLEMENTED FOR ACHIEVING "OUR STRATEGY"

The areas on which we operate with textile material from this complex are: **the film set building**

because, the facade is exposed to pollution and to solar radiation and in the same time it represents a very important part, and **the main entrance space**, by enlarging it, and making it suitable for other activities. However, we mentioned before our aim was not only to reshape the complex for functional reasons, but also to make it sustainable and energy efficient.

### 3.1. The film set:

#### "A light-able TEXTILE FACADE' for Lleida"

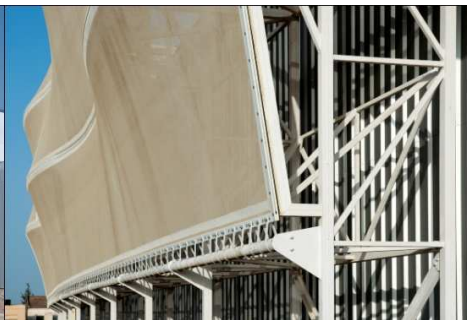
The buildings films set, was conceived as a large container of 600 sqm, 7m height and 8.70 m below the grill and a series volumes in which are installed controls, stores, services and general facilities of the complex.

This new building has been covered with a fabric envelope designed for the dual purpose of creating a space that works as a heating pad, protecting the set of solar radiation excess, and of achieving a new image able to illuminate or project images on the surface.

The textile facade, a single membrane out of Teflon coated fiberglass (PTFE), has been developed in collusion with the industry, by analyzing the pattern, making it resistant to mechanical and climatic actions, outside and inside having good behavior (*Figure 3*).



*Figure 3- textile facade*



*Figure 4- metal structure*



*Figure 5*

The textile facade allows images to be projected both on the outside and the inside, creating the possibility to advertise the Magical in special moments. Due to reasons of saving, the lighting projection time is kept to a minimal, but it does have the possibility to become a great "Firefly" on Gardeny Hill.

The film set, the largest set of the complex, is a structural box with closing, so it can work under specially controlled light and sound (*Figure 4*, *Figure 5*). At the basic insulation it was added envelopes: in the exterior, fabric taut skin that acts as a facade, while inwards, a sound absorbing lining that can maintain optimum reverberation time. In addition it is installed a cyclorama that helps achieve the desired visual effects.

### 3.2. The main entrance :

The entrance cover, a ports the maximum technological innovation in this project and is truly unique, due to its design and composition (*Figure 6*).

From the new building, the textile cover is "projected" towards the centers square and along the existing buildings facades, creating a textile canopy that connects and defines the whole lobby. In this access space the internal comfort conditions are improved, using natural air-conditioning systems with cross ventilation ascending, from north to south, with vents and openings used, during hot

weather, and efficient heating systems with radiant floors, for cold weather. The main aim was that this space operates most of the time with no energy support.

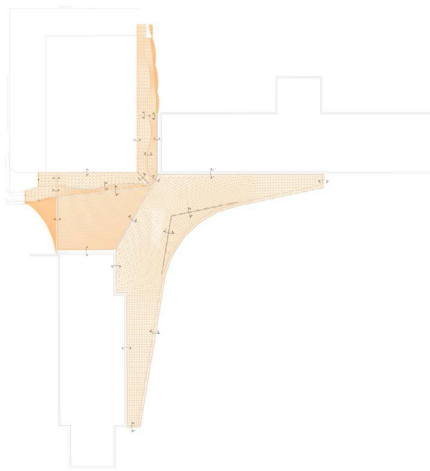
The multi-layer membrane consists of, Teflon coated fiberglass (PTFE-Poly Tetra Fluoride Ethylene) in the exterior and fiberglass with silicone in the interior: between the two layers, there is a translucent insulation, named MONIFLEX and a ventilated closed air chamber. MONIFLEX made out of layers of cellulose diacetate, folded and laminated transversely, is used mostly for thermal isolation but it is also lets light to pass through. Silicon is applied to enhance its fire resistance, durability, waterproofing and self cleansing.

The space that is generated under this envelope is used for the more public functions such as: reception, waiting areas and bar. The textile canopy is connected to the square and with the access, through a glazed surface that runs along the curve and defines it. On the south side is set the bar area with an outside terrace from which it can be admired the landscape of Lleida.

### **Multi-layer translucent membrane advantages**

Various documented studies have shown the benefits of bright spaces, benefits which include improved learning environments for schools, improved productivity for offices and manufacturing facilities.

- By isolating the cover we can increase the original cover's thermal insulation performance by 4+ times
- Energy efficient layers and promotes free natural day lighting.
- Sound and acoustical insulation properties.
- Stain and fade resistant.
- Extreme flexibility.
- Reduces energy consumption, requirements and costs.
- Does not deteriorate over time or resists natural compression.
- A1 fire-resistance level



*Figure 6 - cover plan*



*Figure 7 - main entrance*

## 4. ENERGY SAVING

### 4.1. The protection of the heat acquired and its management through suitable materials

We paid a great deal of attention to the interactions between the physically determined energy requirements of our textile membrane and the energy installed building services, in order to find the most advantageous combination of passive and active technologies (Figure 7). This cover is an energy efficient design because it balances all aspects regarding the achievement and the saving of resources, due to its multi-layers composition. Functionally, the system provides significantly reduced costs at lighting systems, reduced energy consumption in air-conditioning, by this providing an optimized mix of passive solar strategies and energy-efficient materials.

By using a multi-layered membrane with an air chamber, we create a better controlled inner climate with efficient use of resources, easy maintenance and renewal character. Textile fabric is perhaps the most lightweight and simple construction material to create habitable spaces, linked to constant changing spaces, but it emerged in a permanent space where all the necessary comfort conditions were achieved. The textile cover, translucent with an closed air insulation that moderates the outer conditions, thus becoming an isolate translucent enclosure, has resulted in an efficient solution (Figure 8, Figure 9).

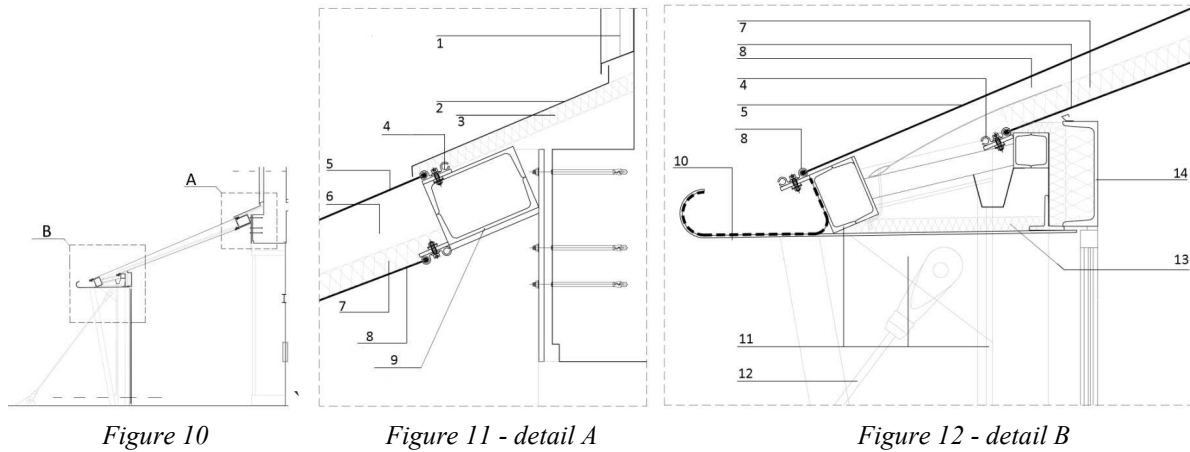


*Figure 8 - main access perspective textile envelope*



*Figure 9 - supporting structure*

As we know an efficient solution must be implemented well in a given tissue to have a favorable behavior. Therefore, we thought thoroughly the details regarding the connection of the membrane with the existing structure. Thermal bridging appears when materials have low thermal insulation capacity, allowing heat to flow through them, thus generating a problem that we tried to prevent. The bridges have to be eliminated, rebuilt with a reduced section or with materials that have better insulating properties (Figure 11, Figure 12, Figure 13).



1-exterior insulation Gutex 80mm; 2-aluminum plate; 3- insulation 40mm; 4- electro-fused metal framework; 5-Teflon coated fiberglass; 6-air chamber; 7-translucent insulation MONIFEX 60 mm; 8-fiberglass with silicone textile; 9-steel support structure; 10-aluminum channel;11-supporting metal structure of the cover; 12-tirant; 13-extruded polystyrene insulation 40 mm; 14-profile IPE300.

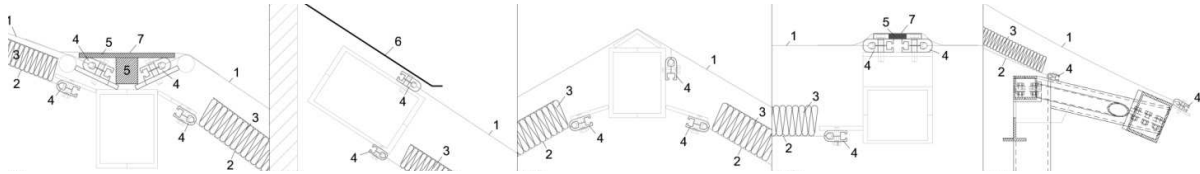


Figure 13

1-Teflon coated fiberglass PTFE; 2-fiberglass with silicone textile; 3-insulation 70mm; 4-aluminum profile; 5-fireproof metal piece ; 6,7-aluminum protection against water infiltration.

In general all textiles have easy maintenance, under tension or in the tensile state, these fabric membranes offer durability and fire resistance to meet building codes. PTFE fabric membrane provides exceptional strength and durability. waterproof, resists UV rays and is chemically inert. As a result, it is exceptionally stain resistant and easy to clean. PTFE fabric can reflect as much as 60 percent of visible light to make it a cost-effective, low-maintenance option for building owners and developers who demand a material that stays looking great for many years of service. These features allow the ability to push the design further on.

#### 4.3. Natural ventilation

As we already established, the main goal was the provision of a good environmental behavior in accordance with the changing seasons. The double textile cover acts as a regulator between the interior and the exterior. Fresh air that enters in the lobby trough the openings of the envelope is channeled causing an air stream that allows natural air conditioning. The envelope of the lobby has practicable openings at the highest point. Together with the openings in the north square and the south cornice, it allows the natural ventilation of this space. In addition, this space is be provided with vegetation, so that during the warmer months the atmosphere can cool, by evapotranspiration from plants.

#### 4.3. Day lighting

We studied the compositions of the sun protection elements in order to prevent direct access of solar

radiation and allow adequate light for indoor use. In this sense we have thoroughly explored the possibilities of textile walls, beyond its shading properties. In this way, we obtain a waterproof and berating spaces simultaneously, a thermally insulating and translucent multilayer ventilated enclosures. We always took into account that a textile structure that has one single layer has poor acoustic and thermal insulation properties, but a double or multilayer system is much better.

## **5. BUILDING REFERENCES**

Authors: Felipe Pich-Aguilera Baurier, Architect, Teresa Batlle Pagés, Architect, Josep M<sup>a</sup> Puigdemasa, Architect. Responsible for the group: Xavier Milanes, Angel Sendarrubias, Pau Casaldàliga. Responsible for the project: Ivan Acevedo, Bernat Ros. project collaborators: Pamias-Puigdemasa architects. Specialists: Pamias Engineering, Tensile Structures: IASO. Executive Leadership: Felip Bernadó Solsona. Photographs: Pich-Aguilera Architects. built-up area: 7,448 m<sup>2</sup> Cost : € 5,232,415 Year: 2012.

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