

## Architectural skin for a stadium: an eco-sustainable alternative

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**Abstract.** The concern for improving environmental conditions makes current architecture focus on eco-sustainable designs that, hand in hand with technology applied in sustainable materials and innovative designs, mitigate the pollution that affects Santa Catarina, Nuevo León, Mexico. The baseball stadium construction project would be located in this place that suffers from serious pollution since it is affected by the surrounding industries, which leave as a result damage to its water and air (due to metals, garbage dumps in the river and that affect the air), another factor that affects is the climate whose average is 23 degrees per year with variations ranging from 7 to 43 degrees Celsius, making it a place that requires intervention by architects where design and construction are applied. eco-sustainable construction at low costs, through a project in which the customs of the stadium users make them aware of the use of resources.

**Keywords:** Architectural skin, eco-sustainable development, stadium project, materiality, pollution.

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## **1. The need for a change that contributes to the environment**

Generate the use of architectural skins that go beyond expectations and that architects have used worldwide; indicate that we are halfway to what the world requires to be sustainable and eco-sustainable, without neglecting important elements such as respect for the inspiration of the memory that opus caementicium means to us [3]. Likewise, it is observed that the architectural wall or skin known as façade architecture is part of the innovation that seeks to meet needs that arise from the moment in which contemporary art generates rejection of the historical styles of the 19th century and that, after this with the breakdown of the revivals, they appear as a consequence of the international exhibition of modern architecture in 1932. [4]

Then, the architectural envelopes must meet the needs of use of the activities of the interior and keeping in mind the conditions offered by the exterior to solve by constructively and materially construction with technology that makes it possible. But this is not without first taking into account the importance and role that eco-sustainable construction plays today, considering that, in Santa Catarina, NL Mexico. It is going through a critical moment so it is vital to supply materials that pollute a large percentage, not only the city but also part of the country. This is why following the coherence with which sustainability is developed, being reflective of the commitments acquired as they have not only countries like Mexico but many more in Latin America and the world have done; where the field of construction is involved, which generates an impact on the exaggerated use of water, for which it is necessary to apply strategic procedures and previously analyzed so that this precious resource is not wasted, which is already needed in the points close to where not many years ago you could enjoy it. Nor can the proper use of the light resource be underestimated. The management of waste and implementation of materials that at the time a remodeling is required become products that return to the cycle without mistreating the ecosystem, absolutely all the implementation of technology and furniture that are used within the structure of the stadium. [5]

Therefore, it should be considered that from the same work processes are executed in which the optimization in the use and care of natural resources are revalued as one of the main objectives when developing the project through the implementation of materials that are supported under the standards and developed for the care of the environment, both for the project structures, the envelope together with the covers which for this case are developed with a series of benefits, optimizing time and resources in their installation and with characteristics They are clearly recycled that do not damage or impact their environment with their use, but on the contrary, they offer possibilities of providing benefits to their natural environment from various points of view, as can be analyzed in the baseball stadium project. [5]

## **2. Technological approach: contribution to smart cities in Mexico**

This revolution comes with the need for the use of high technology resources that help with the research and its implementation, where concern for the environment and the contribution that information technology and technology can provide in favor of minimization prevail. of problems faced today in terms of the lack of control in the statistics of the amount of energy waste, measurement and control of pollution levels. Projects like the one carried out in San Pedro Garza García, NL, Mexico; with the construction of Plaza Nativa with a honeycomb

structure, the first one covered in ETFE (ethylene tetrafluoroethylene) [6], characterized like the I-Tensing for its long durability. [7]

The use of the characteristics used by the stadium skin, a project located in Santa Catarina, NL, Mexico, contributes in a forceful way in the transition that frames the cities of the future with a sustainable approach, by complying with the regulatory requirements for the care of the environment. environment and that in addition to this is an icon in the use of state-of-the-art technology, that i-tensing micro textile fiber [7], provides versatility and evolves in terms of solar and light resistance properties. It reports a high overall energy performance in different climates. By providing thermal insulation, it contributes by protecting the climatic variations, achieving savings in heating and air conditioning of 35% to 70%, being able to count on the benefits of its luminous solar protection, and its versatility by contrasting and complementing the incorporation of different technologies that, like the green skin of lichen [8], when the application of solar panels is desired, it accepts it without the need to make any type of modification. [7]

### 3. Mind map: ideas breakdown for the baseball stadium project with eco-sustainable envelopes

Figure 1 shows the ideas that will be developed in the semi-professional baseball stadium project.

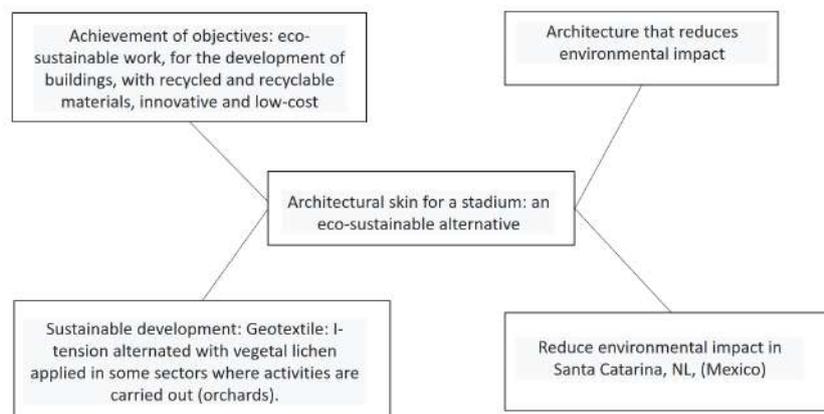


Fig. 1. Mind map.

## **4. Architectural skins**

The façade is the first agent that intervenes in energy management, as it is the element that determines the protection factor for the user and detects the consumption that can be saved, optimizing on elements that prioritize its importance. The textile architecture for a few years started a focus on what a whole teamwork means when developing textile membranes and fibers, which must pass several tests so that they can really be used by applying fibers, membranes, technology, installation of solar panels, incorporation of lights to recreate scenarios evoking different feelings and emotions, taking advantage of the ease of interpretation of the work being performed and its use in the stadium. [9]

### **4.1 Sustainable materials**

The semi-professional baseball stadium project challenges the use of technology using two materials with which it is sought to positively and innovatively impact the use of materials that fulfill the function of the envelope in the project: the i-tensing geotextile alternated with the design in segments of green envelope (vegetal lichen). The first developed with recycled materials and in order to be included in the recovery chain of sustainable materials with properties that benefit maintenance costs among others, followed by the vegetal lichen that is part of the plants. However, the treatment that is applied to it, it becomes a material that potentiates cost reduction both in its production, installation and maintenance since they do not generate costs that are generated when the natural lichen is implemented, allowing to take visual and ecological benefits, including low cost of installation, light weight, among others. [10]

This must be subjected to stabilization by means of an ecological vegetable procedure in which the sap is replaced by glycerin compounds which ensures its conservation, appearance and texture for an approximate time of 15 to 20 years, as it does not require any type of maintenance. We are facing a solution that provides great advantages, the color can be chosen since it is possible to request that this membrane be dyed by food coloring, obtaining the appropriate color range compared to the desired aesthetic part including low installation cost, light weight, among others. [11]

### **4.2 Envelopes: characteristics and contributions**

In the design, the creative potential will be used to take advantage of the flexibility with which the material is lent and achieve a unique and attractive design that is the first view of the benefits that this material hides that working transversally with the characteristics with those that are counted in the environment, take advantage of the good ones and counteract those that must be treated, such as climatic peaks and pollution. [10]

The transparency will provide the possibility to play and take the benefits of sunlight reducing consumption in lighting, the work is complemented by carried out a technology with solar panels that will be used during night events. A thermal insulator will be used in a large proportion due to the sun and rainfall conditions on the different days in which this area is subjected, it is achieved thanks to the placement and implementation of technology and design that benefits with lighting, heat, and mediating cold peaks are reached. [10]

Sun protection and light since despite counteracting by providing shelter and the entry of light that is optimal not only for athletes and their maximum performance in different sports. Likewise, in the stands and areas for use by spectators, lights are provided that vary their tones combining with nature, providing the natural and dynamic shelter necessary for their enjoyment. [10]

Optimization in construction will be on time since it can be installed quickly, its placement should not be assembled in plants or directly from the factory, but on the contrary, it has to be handled at the same point in which it is carried out the work. Resistance to the elements will be one of its greatest virtues since it must be sustainable, providing adequate resistance to its use. It is characterized by not generating low quality control compared to the benefits it provides ecologically and sustainably. [10]

The parts of the roofs will be exposing their beauty and will attract attention identifying this work, as integration of the eco-sustainable wave with technology and environmental responsibility, which receives as a response to this experience the use of the orchards that make up the project that comes from the family of natural materials of plant origin ideal for application in the field of construction and in other fields such as consumer goods, this moss is listed in the industry by the company that provides it Materfad, from Mexico, within the category of foams given its characteristics; the weight is quite light which means that in the assembly of ceilings and covers it is not going to mean a disadvantage. light and non-toxic that evokes the natural, due to its conditions since it is not necessary to water it and it does not grow. contributes a greater reduction in investment expenses by placing it in the sectors of the panels with the greatest impact of light and in those that are directly affected by the acoustic waves of the games and competitions of the activities that take place inside the stadium, for the maximum use of its properties that benefits you. [10]

The foams give us the benefit of having the same volume at a lower mass, which means that there is the same volume for less energy, characterized by being low energy since it complies with being low cost, insulates thermally and acoustically, being the ideal material to generate the comprehensiveness. [10]

Lichen is a plant that grows in northern Europe in cold areas and can be pruned freeze-dried [10], or replaced by glycerin to preserve the plant which contributes being a material with durability of 10 to 15 years, it will be used in strategic sectors of the stadium in which a greater amount of hearing protection and thermal climatic is required. A quality that generates well-being and tranquility for all those who will be enjoying the facilities is not infected. It does not produce bugs or pests, it leads to caring for the environment, attracting the attention of nature lovers and those interested in enjoying its benefits without the need to cause an operating expense in fumigation of the enclosure. [11]

### **4.3 Morphological approximation**

The geotextile material offers a versatile use both on its facade and on the roof in the open / closed aspect, it can be used in a retractable way incorporating technology that benefits the air conditioning and condensation of heat waves. It is related to the environment playing with its visual aspect, generating images that give a feeling of well-being and activities that are very in tune with the natural by the textile material, it provides soft textures but not simple or completely smooth. Provides some transparency since natural lighting enters. [12]

The envelope should be the configuration that differentiates the space and the place that we are covering in the project, taking into account that the spatial substance remains perceptually continuous from one space to another. Generating a quite versatile volumetry leaving aside the mass and the thickness since it is intended to generate a visual impact completely opposite to what the configuration of the space really is inside. It takes advantage of playing with the envelope and the light as has been indicated since the idea of use and optimization of natural resources. At this point we find the opportunity to build without limitations seen before, in order to show the possibility of integrating not only the protagonists who usually use the stadium. [12]

#### **4.4 Architectural skin modulation**

The I-Tensin developed by the IASO R&D department, which is based on prestressed fabric panels, manufactured in the workshop and placed on site through a secondary structure formed by battens or supports, is adaptable to any type of construction and the perimeter frame built with extruded aluminum profiles on which the textile membrane is fixed. [13]

Modulation in irregular triangular geometric shapes. Fixed to the perimeter anchoring system, they allow the anchoring of the I-tensing textile fiber and the anchoring of the natural lichen, a perfect combination for mounting the lichen. [13]

### **5 Case study: Semiprofessional baseball stadium in Monterrey**

The only one in Mexico with 3 levels, technological use in the use of one of the largest screens in the entire country and location of online television in all the corridors of restaurants and shops that are located outside the stands, in figure 2 is shows a photo of the BBVA stadium. [14]



**Fig. 2.** BBVA Stadium

Monterey Stadium is the stadium that has state-of-the-art technology from its facilities. Going through the planning of audiovisual systems and the implementation of 2,874 ETFE cushions, which contribute to the sustainability of energy and atmosphere by having the characteristic of cleaning themselves; of square geometry with lights that are programmed according to the colors of the respective equipment. [14]

The importance of the responsibility that construction entails make this the incursion of advanced technology in terms of what encompasses the Monterey stadium in which respect and harmony with nature is promoted, two points that should be taken as a reference for the construction of the baseball stadium project in Santa Catarina because less than this could not be contemplated since through the use of low-impact materials and the responsible use of water and energy, the impact of these precious resources is achieved, the landscaping for the stadium is the protagonist because of its inspiration, it makes the environment relate more than maintaining the relationship with nature, rescuing it, by connecting the mountain and the river and the alignment of the trees which function as a windbreak barrier. [15]

Given this, it is taken as a clear reference for the use of high technology which, being at the forefront and systematized towards the wave of caring for the environment, exemplary information is obtained for the adequacy of the project in which, in conjunction with the implementation of the design and the envelope is generated by the creation of the stadium with the implementation of technology and resources that, when recovered, return to the cycle to form part of a great construction that will inspire others. [15]

## 5.1 Reference analysis



**Fig. 3.** iGuzzini Company

Design awarded on several occasions, deserving of awards recognized in 2013 Architizer A + and in 2011 as Archdaily's building of the year [16], in addition to its excellent design which inspires the sky and the balloons, it manages the lighting concept that is properly a of the great geotextile strengths. Which, as already mentioned before, based on its benefits in terms of the handling and condensation of light, also allows the handling of its design and maneuverability to be generated, which although we can take it to the handling of geometric or oval figures according to want to give the handling that makes a good complement to the winds and light. [17]

The I-voltage is presented as a great alternative both for the environment, the design and the comfort of the user and the spectator. The light that this material allows to enter the interior of the enclosure and the sustainable management support that favors the conditioning of the facilities not only benefits from the management of the shade to protect from the intense light without obstructing the good natural light for the enjoyment inside. of the enclosure. It also mitigates the harmful rays of light and high temperatures. Geotextile fibers can be conditioned in such a way that according to the requirement of the characteristics that are needed, their preparation is formulated and the amount of fibers plus the proportions is allowed to handle the adjustment to the needs that are required to be supplied. As is the case of the use of geotextile material in the iGuzzini. [17]

Therefore, it is taken as a reference given to the technological implementation and the complement that it exercises, being an excellent response to the environmental crisis that not only Santa Catarina is facing, being the most important business center in Latin America but also one of the most affected by pollution generated by industrialization. [18]

## 6. Conclusions

Based on this research we were able to realize the importance of collaborating in favor of the environment and how we can do it through architecture, we found materials that do not harm the environment and we realized the importance of morphology in the skins' architecture, since they help to manage wind and sunlight. [13]

The eco-sustainable constructions are the result of the acclaimed call for the evolution of man, the technological revolution and its advances in relation to a planet that urges care for its permanence.

The solutions are presented year after year and it only depends on the rising designer architects for their implementation who are not afraid to get out of the easy way, often dragging faulty adaptations. That is why we recommend projects that invite you to carry out a joint work that, thanks to the application of the latest technology, sustainable and eco-sustainable materiality, it is possible to improve the planet, giving it life instead of death through construction.

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