TECHNICAL TRANSACTIONS | CZASOPISMO TECHNICZNE
ARCHITECTURE | ARCHITEKTURA
7-A/2014

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INNOVATION IN MODERN ARCHITECTURE ASTANA

INNOWACJE WE WSPÓŁCZESNEJ ARCHITEKTURZE ASTANY

Abstract

This paper analyzes the development and application of new modern eco-friendly building materials. Owing to innovative architects, engineers found an unusual material: ETFE. It is often called a miracle constructional material characterized by sufficient strength, a special surface, self-cleaning, the ability to withstand sun exposure as well as heat-insulating properties.

Keywords: architecture, new modern eco-friendly building materials, ETFE

Streszczenie

Artykuł zawiera analizę rozwoju i zastosowania nowych ekologicznych materiałów budowlanych. Dzięki innowacji architektów inżynierowie odnaleźli materiał niezwykły: ETFE. Jest on często nazywany cudownym materiałem budowlanym. Charakteryzuje go odpowiednia moc, specjalna powierzchnia, samooczyszczanie, odporność na promieniowanie słoneczne oraz właściwości izolacyjne.

Słowa kluczowe: architektura, nowoczesne ekologiczne materiały budowlane, ETFE

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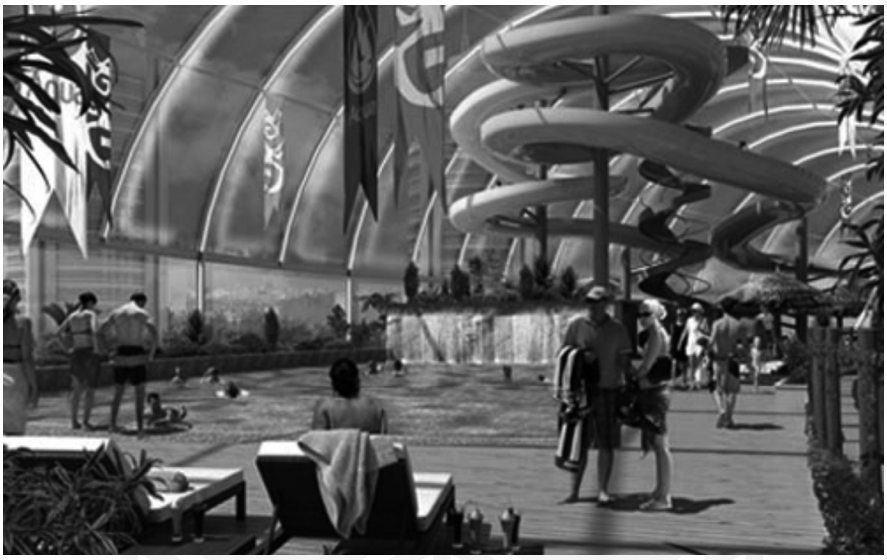
The project is the unique complex “Khan Shatyry” with a giant transparent tent. It has become a leisure center in Astana with a mini-golf course, a small lake, botanical gardens, indoor beaches, beauty centers and salons, concert halls, luxury condominiums, offices, a five-star hotel and a shopping center. “Khan Shatyry” is considered one of the biggest in the world at a height of about 200 m and a volume of 1.5 million kub.m.raspolozhen on 50 acres of land. This project is original in that the climate within the “city” is governed by internal modern automation .

Ill. 1. Botanical garden and an indoor beach
(source: Conceptual design of Khan Shatyr, Foster and Partners)

It was conceived by Norman Foster and thanks to a special coating and air conditioning system in x harsh climatic conditions, especially in the winter, the temperature at the mall throughout the year is optimal for family walks and shopping.

“Khan Shatyry” is two-thirds covered with a transparent coating of a special hollow plastic etilfluoretilenovoy film ETF, the material of the new generation, thanks to which the inside of the building will always have the same temperature and daylight. To heat a tent in 30 – degree weather is not difficult [1]. ETFE appeared in the 70s of the last century when the DuPont corporation invented a marvelous film for aviation (protection from sun exposure); however, it was a German student named Stefan Lehnert who studied engineering and business management that turned it into an architectural material. He worked on the topic of unclaimed commercial know-how.

Later, in 1982, Stefan founded the production company Vector Foiltec, which became a major manufacturer of architectural membrane in Europe (trade name Texlon). Of course, ETFE manufactures and American pioneer and Japanese glass company Asahi, which partly explains the particular fondness Kurokawa.



Ill. 2. Resting place in the winter time
(source: Conceptual design of Khan Shatyr, Foster and Partners)

Ill. 3. A general view of the “Khan Shatyry” during the construction period
(source: Conceptual design of Khan Shatyr, Foster and Partners)

Ill. 4. A general view of the “Khan Shatyry” during the night
(source: Conceptual design of Khan Shatyr, Foster and Partners)

ETFE is quite simply, etilfluoretilen. Production of etilfluoretilen films brings to mind the environment as it occurs in a closed cycle and furthermore, can be fully disposed. The obvious advantages of the membrane is light weight (weighing 100 times less than glass), high speed of installation, ease of transportation and a self-cleaning surface. It was originally founded for its ability to resist insolation x and its thermal insulation properties depend on the number of layers of air sealed within. The economic benefit has recently been called into question, but today it is already clear that the use of membranes in general is less expensive than glass, as the design becomes easier and the installation costs are reduced by at least 25 and at most by 70%. The service life today is 50 years (Kurokawa, among others, was forced to go to the cabling structure because of durability).

ETFE, a fluorocarbon-based polymer, opens new horizons for architects and designers in Kazakhstan and around the world. Imagine swimming in an arena made of bubbles or a stadium connected with steel beams like a bird’s nest, or even a huge tent proudly covering over a million square feet of space. Ten years ago, such a building may have existed only in the imagination. Today, they are constructed in Beijing: China’s new National Stadium and National Aquatics Center. All, thanks to x innovative architects, engineers and the unusual properties of a material called ETFE. ETFE is often called the miracle material of construction: sufficiently durable material to withstand 400 times its own weight, can be stretched to three times its own length without loss of elasticity, has a special surface that resists dirt, durability of about 50 years.

Weighing about 1% of the weight of glass, single-layer ETFE membrane is very light. This, in turn, gives a reduction in the weight of frames and imposes significantly less dead loads on the supporting structure. This reduction in the requirements for steel structures, provides many cost benefits to customers and is a key advantage when replacing glass in structures in order to meet current building regulations [2].

ETFE is an environmentally friendly building material. While being a 100% recycled product, the minimum consumption of energy for transport and installation means that it makes a significant contribution to the transition of a green building.

One of the major works of the architects of this century is the "Water Cube" in Beijing. You can start with the fact that this "pool" built of tetrafluoroetilena (ETFE), the durable, lightweight and transparent polymer that can withstand heavy loads, when a nearby fire does not smoke and does not light up – it just is formed hole. One could say that the polymer can be stretched over a frame of steel wire. The walls of this remarkable plastic look amazing: a pillow. Instead, they represent bubbles in water, as suggested by their numbers, but most of all they resemble lather. All the bubbles are of different sizes and shapes. Being in size from 1 to 70 m^2, they are independent of each other and if one bubble is damaged, the rest will be able to maintain the building in good working condition.

Ill. 5. The National Aquatics Center
(source: Conceptual design of The National Aquatics Center)

Ill. 6. The building of the Faculty of Law
(source: Conceptual design of Faculty of Law)

In the British city of Salford, the architectural firm Broadway Malyan designed and constructed the building of the legal department. It is interesting from many points of view, but it is most evident thanks to the lecture room, wrapped in ETFE and back-lit led- lights mounted in the gap between the walls and membranes.

These are not just simple decorative elements. Their interior space is filled with air, which is excellent thermal insulation as the space will not overheat and supercool. If for some reason the temperature in the building x falls below normal, the x electronically controlled pumps will make the adjustment by pumping warm air from inside the bubbles. At high temperature, the ventilation system will use the external air and not that from the membranes. Another remarkable feature of the "cube" is its seismic resistance.

Polymer coatings ("film") is constantly being improved in scientific laboratory programs: Dupont, Foster + Partners, Skidmore, Owings & Merrill (SOM) and Gehry Partners. By increasing the number of layers, including a special layer of «nanogels» gives the opportunity to increase the thermal properties of ETFE membranes. Along with its low weight , the main advantage is its high ETFE trasparency. Knowing its property to transfer up to 95% of the light, it is easy to see why it was chosen to build the Eden Project Biomes in 2000 and most recently the biopark tank in London (completed in 2011), where the full spectrum of natural light and UV is essential to plant health.

Independence from ultraviolet radiation, air pollution and other forms of environmental weathering makes ETFE membrane a very durable material . The structure of the plates has evolved for more than twenty-five years and extensive laboratory and field studies have shown that the material has a shelf life of more than 40 years.

A lot has happened very quickly in the development of ETFE. For thirty years, it worked its way from creation to one of the most popular building materials, but there is still much that needs to be done. The preference of ETFE, as a durable building material will lie in the development of various high-tech membranes and methods of coating which will alter not only the transparency but also the thermal and acoustic properties of the tissue itself [3].

Thus, the following conclusions can be drawn: the advantages of the membrane is its light weight (weighing 100 times less than glass), high speed of installation, ease of transportation, self-cleaning surface, the ability to resist insolation, thermal insulation, the use of membranes in general, less expensive, life of about 50 years. ETFE is also an environmentally friendly building material and the massive use of these polymer coatings must be developed for the construction of railway stations, sports facilities, large barns, shopping centers, etc.

References

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