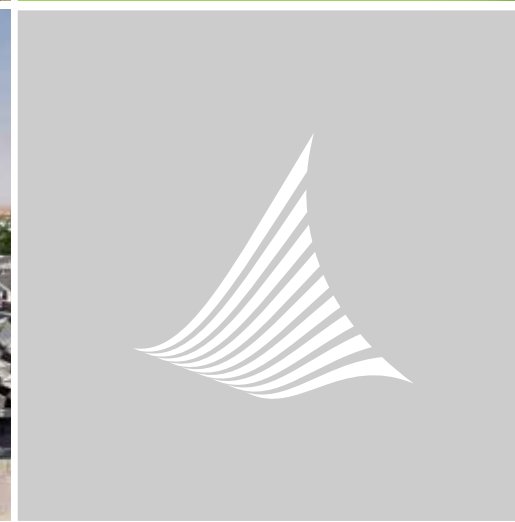


POLYCARBONATE VS TEXTILE

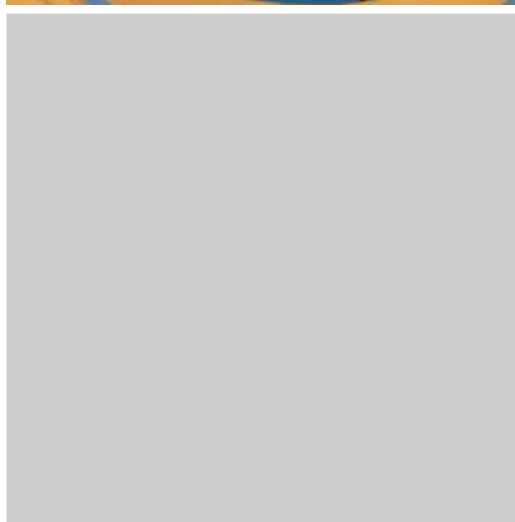
STADIUM ROOFING FOR THE 2018 WORLD CUP



Text: Vladimir KOLOSOV



TEXTILE ARCHITECTURE – PVC, PTFE AND ETFE STRUCTURES ARE SUCCESSFULLY USED GLOBALLY IN THE CONSTRUCTION OF FACADES AND ROOFS OF LARGE SPORTS FACILITIES. NONETHELESS, THERE ARE NOT SO MANY EXAMPLES OF THESE «NEW GENERATION» TECHNOLOGIES IN RUSSIA, AS MANY STATE OFFICIALS AND DECISION-MAKERS IN THE SPORTS CONSTRUCTION MARKET ACTIVELY OPPOSE THEM. DO WE HAVE CHANCES TO SEE AT LEAST SOME OF OUR STADIUMS BUILT FOR THE 2018 FIFA WORLD CUP WITH MEMBRANE ROOFS AND FACADES?





In the last issues of Sport Build, we discussed in detail the history of membrane architecture in Russia and in the rest of the world. Despite a number of success stories in American, Asian, and European construction markets, the textile architecture (that is often called the XXI century architecture) still faces criticism in Russia. The aesthetic side of the new technology, as well as design and outlook of the new facilities proved to be attractive for everyone, but there are problems with functionality and practical use, as many conservative-thinking officials refuse to accept the facts. Analyzing the whole Russian construction and real estate market, the sports facility segment seems

to be the last in line to proceed with the new way of thinking.

Because of the «textile revolution» many architects, designers, customers, and contractors are now divided into two opposing camps when deciding on this or that construction project. Given that Russia has become a global leader in the field of sports venues and global events organization, the country should be more progressive in terms of new construction materials and techniques.

THE OTHER SIDE OF THE ROOF: WHO LEADS 7:4?

When analyzing modern facade and roofing construction methods globally,



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we can see that in the last 10-15 years a new trend emerged to use more textile and membrane structures to cover facilities. Light, strong and feasible membrane structures are not only ideal for roofing, but also make a whole sport facility look more attractive. Unlike thermoplastics, textile structures can undergo large plastic deformations without cracking or breaking.

Tent materials can be used in any climate zone – this is especially critical in the Northern regions, where membrane structures are able to withstand heavy snow loads. A reasonable question arises: why only 4 of the total 11 football stadiums built or reconstructed for the 2018 World Cup in Russia have chances to apply the modern architecture trends – namely textile and membrane solutions? As for the remaining 7 stadiums, their roofs will be covered with typical steel or polycarbonate sheets, and their facades – with heavy steel perforated sheets with thickness up to 1.5 mm.

Do we talk about stadiums located in areas where low winter temperatures can destroy the textile? Not at all! Modern cold-resistant membrane materials can stand frosts of -50-60 °C even under dynamic loads. The cold-resistant ratio is the highest possible, given the almost zero hygroscopic rate of the tested material.

Maybe the membrane textile structures are not strong enough to stand severe snow and wind loads? The answer is the same: the strength of modern membranes (given that 1 sq. m weighs 1,300 grams) with a 50-mm wide strip is 815 kgs, while

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At least, 5 of the total 12 stadiums built for the 2018 World Cup will use membrane roofing or facade structures this or that way. However, these technologies are not generally popular in the Russian market, while the clients are very cautious towards using them. In most cases, this happens because of the underdeveloped legal base concerning the use of membrane structures. That is because many clients prefer to avoid them and use standard materials instead. Another reason is a higher cost of membrane structures vs other construction materials. However, each particular case is individual, because using light textile structures can often lead to big savings on optimization of basic metal structures. More over, installation of membrane structures is a less complicated process that takes less time, which can positively influence the whole facility cost structure.

the same 500-mm steel strip can withstand only 320 kgs. Thus, the pre-tension membrane state before its destruction does not exceed 1%!

Perhaps, polycarbonate is a better stuff to react on hail and freezing rain? There are many cases when builders had to change the sheets of polycarbonate after the hail of a moderate strength in

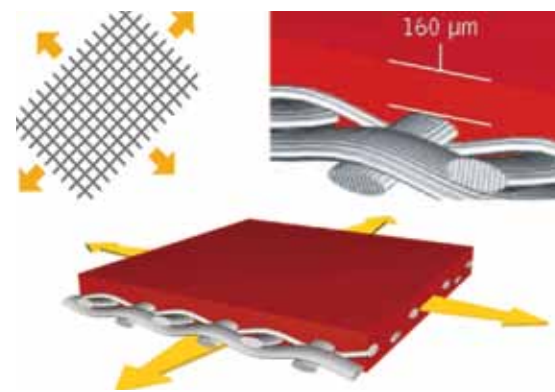


different regions of Russia. However, there is no record of a broken roofing membrane because of a very strong hail in the sports industry so far. The same about UV resistance. Polycarbonate can withstand ultraviolet radiation of the sun only with a special thin layer of protective lacquer. When it is damaged, the spot becomes a hole within 1-2 years under ultraviolet light. Through this cavity, polycarbonate sheets are gradually filled with water, whose freezing and thawing accelerates destruction of roof sheets. As for modern membrane materials – PVC, PTFE, and ETFE – they do not have drawbacks of that kind. A typical example: the name of TX-30 membrane indicates a 30-year warranty provided by its manufacturer.

The same way it happens in traditional construction, the design of membrane structures requires interaction between the client, architect, engineer, and



A REASONABLE QUESTION arises: why only 4 of the total 11 football stadiums built or reconstructed for the 2018 World Cup in Russia have chances to apply the modern architecture trends – namely textile and membrane solutions? As for the remaining 7 stadiums, their roofs will be covered with typical steel or polycarbonate sheets, and their facades – with heavy steel perforated sheets with thickness up to 1.5 mm





contractor. It is important to determine in advance all required technical features and capabilities of a membrane structure. Individual elements of textile roofs are manufactured in a factory and assembled on site.

A MATTER OF PRICE

The final cost of roofs and facades is the most important criterion for a customer to make decision concerning the choice of a particular technology. With textiles, one can easily cover huge vertical spaces from one column to another without additional steel structures that are heavy, expensive, and time-consuming during installation.

Replacing steel plates with textile parts in any of the Russian stadiums for the 2018 World Cup can save up to 100 million rubles just because in this case you do not need to install heavy half-timbered metal structures. You can save even more on textile materials that do not require any replacement, unlike the mentioned steel plates. The total weight of a facade can also be reduced by at least 60%. With different calculation approaches, the use of textile materials and membrane technologies leads to a 20% cost reduction of stadia facades and roofs.

The key advantages of soft textile structures are lightness, portability, and affordability. Installation of architectural textile is relatively simple, economical, and does not require heavy machinery. Modern architects and designers use textile as a material that changes sports facilities towards a better quality of life, comfort, and cultural communications. Performance attributes of textiles especially refer to the 3rd generation polyester fibers that the industry leader – Serge Ferrari Group – supplies to the market.

Another factor that significantly limits popularity of membrane technologies in Russia relates to a “common knowledge” that the membrane architecture means a 100% foreign product, which is not in line with Russia’s latest government policy that requires domestically made products to dominate the local market. However, there are well founded doubts concerning the given figure of the 100% imported technology.

“In fact, a number of local companies now produce membrane structures in Russia according to the world’s leading technologies, – says Andrey Moroz, CEO of LOMMETA Group of Companies and Chairman of the Tex-Style Association for Textile Architecture and Membrane Structures. – Our company was quick to realize bright perspectives of textile



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ANDREY MOROZ,
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In the light of economic decisions made by the country leaders, especially concerning imported parts and materials for the construction of sports facilities, I would like to emphasize the following: Russia does not produce membrane and textile materials of the desired quality, as of today. On the other hand, we have managed to limit a share of imported materials to 15-20% of the total project costs, which seems quite acceptable in the current situation. As far as I can understand, many top officials and key decision-makers in the country do not possess necessary information about local businesses that are able to design, produce, and install modern membrane structures at sports facilities. This is certainly in line with the President’s concept of import substitution.

architecture. We started producing facade and roof structures after we have trained the local staff, purchased all necessary hardware and software in order to limit the share of imported components to 15% of the total project costs. Thus, we have managed to substitute for 85% of imported parts and components, and this is exactly what Russia’s President wants (as well a number of state officials in charge of stadia construction). All we need is to draw their attention, so we could wake them up to listen to what domestic producers have to say about textile architecture.”

In plainer words, there are domestic producers in the Russian membrane technology market niche, but there is a shortage of high-quality raw materials produced locally. A similar situation exists in many economy sectors today, so there is nothing wrong with that. Technically, the process of production of textile structures in Russia looks as follows: a local company purchases raw materials from the world’s leader – i.e. Serge Ferrari (the average price is 5 euros per 1 sq. m). Then the company brings the stuff to Russia, goes through customs clearance procedures (normally paying 7% of the cost), and then uses its hard- and software to cut and weld it to become a finished product ready for transportation and installation on site.

An alternative option is to contract a European company to install a textile roof. In this case, the final cost will be quite different, even if a company buys

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The main advantages are that a PVC-polyester membrane needs less secondary support structure than a polycarbonate roof, and that the installation of large prefabricated panels can be much quicker than that of small PC plates. Furthermore the fire behavior cannot be achieved with thick massif (and really transparent) PC plates, therefore typically hollow chamber plates are used, and they can accumulate dirt in the chambers. The disadvantage of the PVC is that almost no UV light is passing through the membrane. However, typically this can be improved with a transparent part along the inner edge only. For TV transmission, the reduced light with membranes is typically better.



TABLE 1
POLYCARBONATE VS TEXTILE

Cost	Even if membranes and PC plates are of the same quality and technical capabilities, the total construction costs of the stadium roof will be 15-20% lower (including the substructure cost).
Installation speed and quality	Membrane structures can be assembled much quicker than polycarbonate plates. This happens because installation of polycarbonate is normally done by using relatively small sheets with many fastening and sealing elements. Membrane installation is based on larger sheets with not so many welding junctions and sealing points. In turn, the reduction of sealing points reduces the risk of leaks.
Operating expenses	Inspection and maintenance of polycarbonate structures require more time and manpower as compared to the membrane roofing. The cost of cleaning and repair works of polycarbonate plates is significantly higher because much more connection and hardening points are required.
Weight	Textile membranes help achieve unique architectural forms, avoiding excessive loads on the frame and foundation. Weight of material is 650 to 1,500 g / 1 sq. m. Textile roofs and facades require columns, trusses, and beams to be located more remotely from each other if compared with polycarbonate plates. This produces the apparent ease of construction.
Curvature	Membrane technologies facilitate the manufacturing of complex volumetric shapes and structures with double curvature, while polycarbonate plates suppose curvature in one direction only.
Hygroscopicity	Capillary water absorption in polycarbonate cavities causes repeated freezing and thawing of water inside the cells, which leads to destruction of structures. The membrane is free from those disadvantages due to the absolute lack of hygroscopic properties and moisture absorption.
Environment	Membranes are more resistant to chemical and aggressive environmental influences (including resistance to hail). The textile structures are resistant to the dirt and grease, and are self-cleaning. Coatings made of polycarbonate often attract birds that pick compactors out of spaces in polycarbonate sheets, where the water flows in. The membrane coating typically scares birds away, while the oily sliding panel surface does not allow them to cling to the tent and sit on the membrane.
Maintainability	Any membrane structure installed on site needs repairing only in case of a significant damage, while polycarbonate plates require repairing in most cases. Thus, a hole in the membrane can be repaired right on the construction site without prejudice to the quality of coating, while polycarbonate sheet requires complete replacement in case of damage.
Catastrophic consequences	When exposed to fire or collapse, membranes having a similar degree of flammability with polycarbonate plates cause less disastrous consequences for people.
Confectioning	When confectioning membrane coatings by welding tent panels with RF current, the weld joints have 150% of strength vs the base material and are protected from water seepage. The joints remain feasible and work well under the wind, providing the membrane coating with flexibility and wind resistance. When installing polycarbonate, connecting joints are the weakest points of the coating. They often break under the strong wind.
Ultraviolet	Membranes made of PVC, PTFE, and ETFE normally operate 30-50 years. It becomes possible due to their high resistance to UV light. The lifetime of polycarbonate plates is 15-20 years, depending on a special security layer that prevents it from ultraviolet inside the structure. If this fragile layer is broken, the whole polycarbonate plate can disintegrate within 1-2 years.

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THE SAME WAY it happens in traditional construction, the design of membrane structures requires interaction between the client, architect, engineer, and contractor. It is important to determine in advance all required technical features and capabilities of a membrane structure. Individual elements of textile roofs are manufactured in a factory and assembled on site. The final cost of roofs and facades is the most important criterion for a customer to make decision concerning the choice of a particular technology. With textiles, one can easily cover huge vertical spaces from one column to another without additional steel structures that are heavy, expensive, and time-consuming during installation

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Why new technologies are unlikely to make their way through bureaucracy in Russia so far? It happens because more attempts and efforts should be undertaken in order to win! Those interested in the new technology promotion in the market should learn how to conduct the right policy to make the customer understand every strong point of it. The state official level is exactly the point where many progressive decisions are blocked (especially, concerning the construction of new stadiums to host the 2018 FIFA World Cup). I personally have nothing against the new construction methods and membrane architecture ideas, as I believe in their future prospects. In the end, even the most conservative customers will have to accept them. PVC-polyester membranes show better technical characteristics compared with polycarbonate plates.

the same raw materials from the same manufacturer at the same price. The change can be easily explained: a foreign company will use its hard- and software to cut and weld the textile structures to ship it to Russia. In this case, the final cost reaches 25 euros per 1 sq. m plus 14-15% to pay for the customs clearance. The same about the price of installation works that European specialists should conduct locally.

DEALS AND FORGERY

As it often happens, new technology products in the market are protected against counterfeiting for a short period only. In other words, until the market demand for those products reaches a certain point, fake producers simply do not pay attention to them. Nowadays, this disease affects the membrane construction market as well, but to a much lesser extent if compared to polycarbonate plates.

The world's largest membrane product manufacturers pay special attention to this issue. For example, Serge Ferrari Group typically sells its dual-labeled rolls with the Precontraint® stamp printed every 10 meters, also containing the production shift number and date. This helps control not only manufacturing teams at the factory, but also the product quality in each roll, even after its installation at the stadium roof. Certified companies and reliable partners are responsible for raw material processing to secure Serge Ferrari brand's uniqueness and a 30-year guaranty on purchase and installation of its products.

Unlike textile or membrane structures, polycarbonate products are easy targets for fake manufacturers in the market. The so-called «pirate indicator» tells that the current market prices of laminated polycarbonate mats can vary 3 times depending on manufacturer (China, Taiwan, South Korea, Israel, South Africa, Turkey, Czech Republic, Italy, or Germany). It is nearly impossible to tell a real manufacturer from a fake one, especially if a product has already been installed on site – only highly qualified specialists are capable of doing that.

A typical example is a deal, according to which polycarbonate plates of the German Bayer were supplied to Russia as Israeli Boyer-branded ones. In reality, the products were made in China and then delivered

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Serge Ferrari issues a 20-year guarantee on standard and 30-year guarantee on special durable tent materials for roof coating, although in reality they remain operational during 40-60 years. Surprisingly, but even shades of PVC material's color never change by more than +/- 1.5% compared with the initial state. This can be achieved by using special additions in outer PVC layers. If we talk about polycarbonate structures, even the best of them become yellow in just 3-5 years of maintenance, and lose 15% to 35% of their translucency in the following 5-7 years.

to Russia via the Israeli port of Haifa (swindlers simply replaced Chinese documents and stamps with Israeli ones). 🇮🇱

