Allianz Riviera Stadium, Nice, France. Image © Milène Servelle and Serge Demailly, Wilmotte & Associés

Vinyl in European Stadiums

A journey from the splendid theatres of Ancient Greece to present-day sports complexes where the use of vinyl combines environmental responsibility and architectural greatness.

By Tobias Johnsen

vinyl plus®
COMMITTED TO SUSTAINABLE DEVELOPMENT

Velopark Cycling Centre, 2012 London Olympics.
Image © Hopkins Architects

Velopark Cycling Centre, 2012 London Olympics.
Image © Hopkins Architects

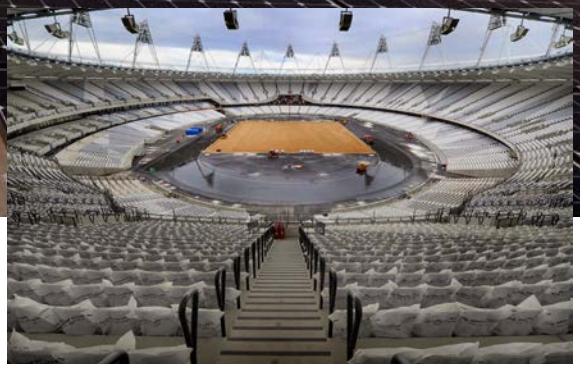
Sports stadiums have been called our modern-day cathedrals. While this may be a bold statement, it is true that stadiums draw together people of all ages, cultures and creeds. But today's stadiums are much more than the actual buildings. From simply being places where humans gather to watch events, most newly built stadiums are architectural icons representing the aspirations for cities, regions or even nations, all the while sustainability takes on increasing importance. This calls for building and construction materials that combine architectural freedom with environmental responsibility, preferably at the lowest possible cost.

Polyvinyl chloride, also known as PVC or vinyl, is such a material. One of the most versatile materials available, vinyl is used for everything from roofing and façade membranes over piping for freshwater to irrigation systems, profiles, cables, flooring and seating. Indeed, as the next pages will show, vinyl plays a prominent role in modern stadium development.

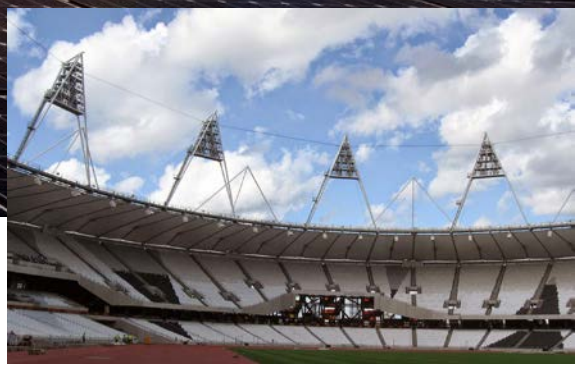
Vinyl and the Greenest Games in History

Our journey begins in London. After winning

Allianz Riviera Stadium, Nice, France. Image © Milène Servelle and Serge Demailly, Wilmotte & Associés



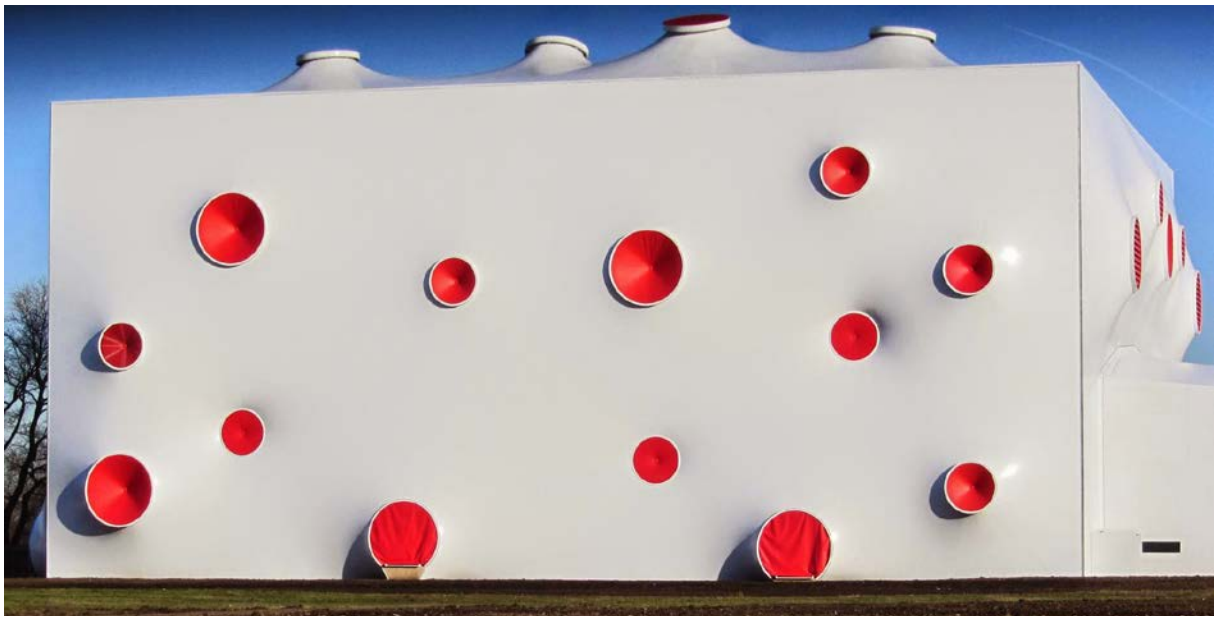
Olympic Stadium, 2012 London Olympics.
Image © Olympic Delivery Authority

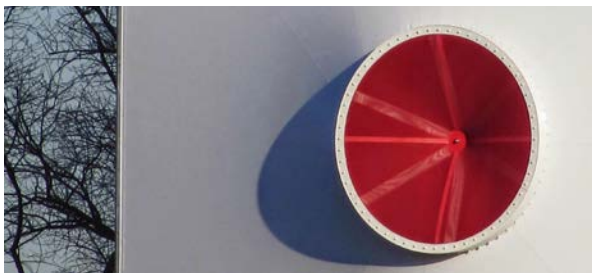


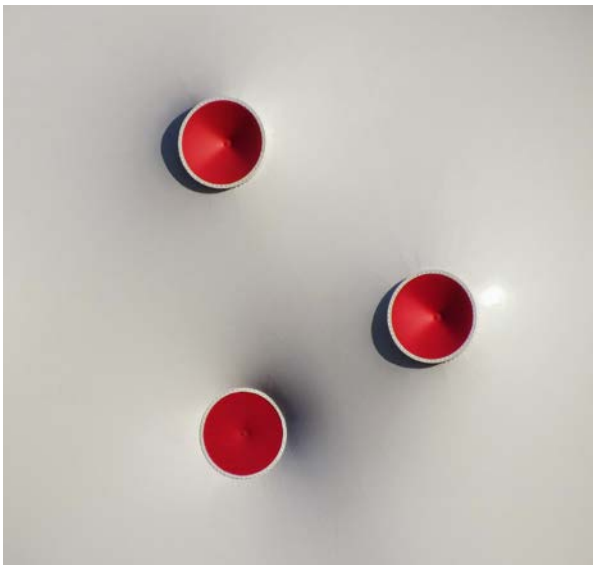
Olympic Stadium, 2012 London Olympics.
Image © Olympic Delivery Authority

the bid to host the 2012 Summer Olympics, the organisers announced an ambitious aim: The Games should be the greenest in history. In order for this vision to become reality, the Olympic Delivery Authority specified a number of strict sustainability requirements that suppliers of building and construction materials were expected to meet. For PVC specifically, criteria included compliance with the ECVM Industry Charter,[1] preference for at least 30% recycled content, and possibly a take back scheme for reuse or recycling. Indeed, the European vinyl industry was able to deliver products that met these requirements. Over 140,000 m^2 PVC tensile fabric were installed in the Olympic Stadium, Velopark Cycling Centre, Aquatic Centre, Water Polo Stadium, Shooting Venue, Basketball Arena, and Eton Manor. Just at the Olympic Stadium alone — awarded for its architectural qualities — a 25,500-m^2 canopy of PVC-coated polyester fabric covered spectators. PVC was also used for seating, critical infrastructure such as pipes and cables, and in some venues athletes competed on high-performance vinyl sports surfaces.

[1] European Council of Vinyl Manufacturers' 1995 Industry Charter to reduce the environmental impact of vinyl chloride monomer and PVC production, http://www.pvc.org/upload/documents/ECVM_Charter_VCM__PVC.pdf







Shooting Venue, 2012 London Olympics. Images © Magna Architecture

Design for Reuse

Importantly, many of the PVC applications manufactured for the Games were designed with reuse in mind. For instance, the PVC membrane from the Shooting Venue was reused in Glasgow for the 2014 Commonwealth Games. Another portion of the PVC was transported to Brazil and installed at 2014 FIFA World Cup stadiums, and at a school in Kent the school children now tread the same flooring as the athletes trod. For the non-reusable vinyl products, some were converted into gym mats for schools, while others were recycled through the so-called VinyLoop® process, which turns the plastic into raw material for new products.

The Path to Sustainable Development

That PVC played such a prominent role at the greenest Olympics in history is no coincidence. For the last two decades, the European PVC industry has worked tirelessly and invested large sums to make the PVC material more sustainable through its entire life-cycle. These efforts are encapsulated in VinylPlus®, the Voluntary Commitment to sustainable development by the European PVC industry value chain, which has been acknowledged by outside stakeholders such as the EU and UN. Recycling of 800,000 tons of PVC waste per year by 2020, lowering energy consumption in manufacturing, and

sustainable use of additives are just a few of the programme's many targets. VinylPlus builds on Vinyl 2010, a highly successful environmental initiative that ran from 2000 to 2010 and all of whose targets were either met or surpassed.

Clearly, the preference for PVC in London affirms the successful path to sustainable development the industry has taken. The official 'Learning Legacy' document by the London Olympic Delivery Authority on its PVC policy recognises the importance of PVC products made in accordance with Vinyl 2010 principles for certain applications. By raising the bar even higher with VinylPlus, there is no doubt the plastic will continue to play a prolific role at sporting events.

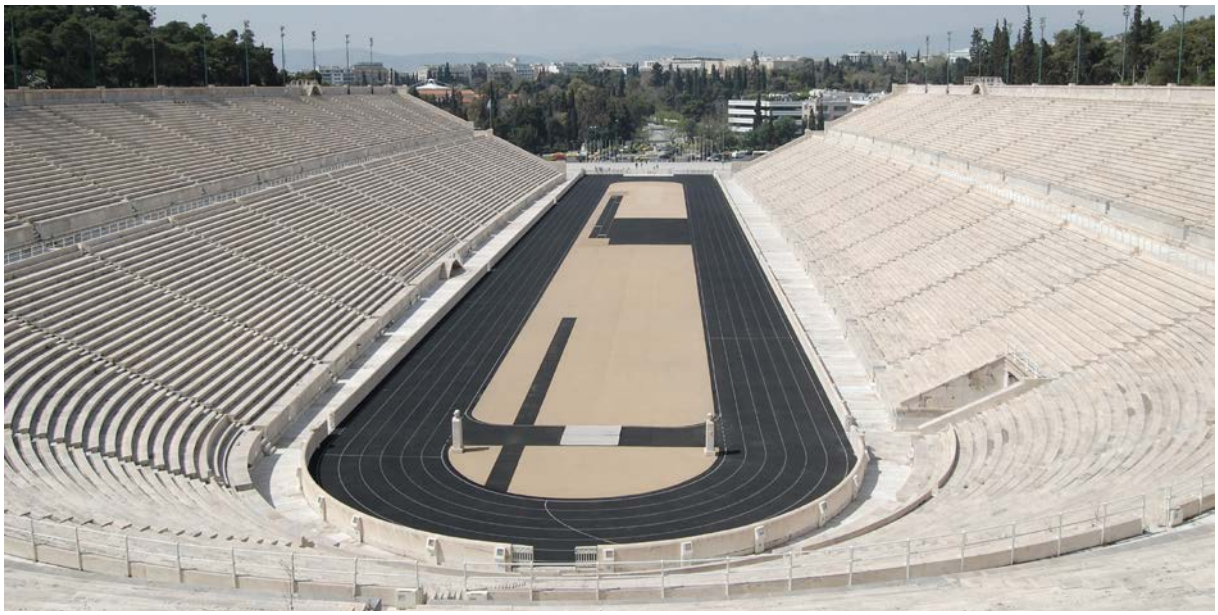
Yet before we continue our journey to other examples of vinyl in stadiums, let us have a brief look at the ancestors of our contemporary sports cathedrals with special attention given to the materials used.

Olympic Stadium, 2012 London Olympics. Image © Olympic Delivery Authority

Greek and Roman Ancestors

The word *stadium* traces its etymological roots to Ancient Greece, where it both denoted a U-shaped foot racecourse of 192 m and the place where spectators watched the event. The first stadiums were built around 800 BC. Some were cut out of hillsides like Greek theatres, while others lay on flat ground with slightly excavated performance area to provide for seating tiers. The most notable example is the Panathenaic Stadium in Athens, built in 330 BC and refurbished for the first modern Olympic games in 1896 and again for the 2004 Olympics. It is the only stadium made entirely of marble, hence the nickname Kallimármaro (meaning the "beautifully marbled" in Greek), and can currently accommodate 45,000 people. Despite the aesthetic qualities of marble, there are severe limitations to the material. Being a stone, it is of course heavy, difficult to work with and relatively expensive. Marble is susceptible to deterioration when exposed to the natural forces of wind, rain and temperature changes. On top of that, acidic agents have an especially degrading effect. Though acid rain does not pose the same problem it used to be, it has not been eliminated completely. Still, the fact that the stadium still stands after more than 2000 years is a testament to its construction quality.

Romans were also keen on stadium building, but the focus here was on death and glory, not friendly footraces. To this end, the Romans constructed *amphitheaters*: Large freestanding elliptical venues with high-rising tiers to display the bloody gladiator fights and public spectacles down on the arena floor. Unlike the Greek stadiums and theatres, artificial slopes for seating were built of timber, stone or a type of concrete to accommodate a maximum of spectators. Again, though these materials enabled the construction of splendid architecture, they are not without problems. Timber, for instance, is prone to fire, and in the Great Fire of Rome in 64 AD the wooden amphiteaters of Statilius Taurus and Neoronis both burned to the ground. The most famous Roman amphitheater is the impressive Colosseum, whose four stories could hold between 50,000 and 80,000 spectators. Though fallen into disrepair, stadium architects continue to mimic the Colosseum's genius design, which combines aesthetics with high capacity.



Panathenaic Stadium in Athens, Greece. Built in 330 BC and refurbished for the first modern Olympic games in 1896 AC, it is the only stadium made entirely of marble, hence the name Kallimármaro (meaning "beautifully marbled" in Greek). Like other early stadiums, the Kallimármaro was constructed between two hills to provide for natural seating tiers.

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The Colosseum in Rome is a predecessor to the modern high-rise stadium, built to accommodate the maximum number of spectators. In the Colosseum between 50,000 and 80,000 Romans could watch gladiator fights, mock sea battles and other events involving death and glory.

Image © Multichill, licensed under CC BY 2.0, via Wikimedia Commons

As Christianity swept across Europe the focus shifted from entertainment to churchgoing, and no new stadiums were built for 1500 years. While some stadiums were converted into living quarters, citadels and markets, others were simply demolished. Though sporting events took place in the Renaissance, these were held out in the open and no permanent buildings were erected.

The Second Wave of Stadium Development

When the industrial revolution and urbanisation took off in the 1800s, the demand for recreation and entertainment rose from its slumber. The UK was in the forefront with several large stadiums constructed for football, rugby and cricket; the most popular sports. Some of these, albeit with major changes, are still in use. For instance, Chelsea FC's home ground Stamford Bridge was built in 1877.

The revival of the Olympic tradition around 1900 took stadium development a step further. A precursor to the modern "all-seater" is the gigantic and now demolished White City Stadium, constructed for the 1908 London Olympics, which had a maximum capacity of 93,000 and was the largest of its time. With an athletic field and a swimming pool surrounded by a cycle track, White City hosted many of the events, unlike later Games where these are scattered around several venues. Infamous for its display of Nazi ideology, the stadium built for the 1936 Berlin Olympics is another prominent example. Shaped out of the earth and clad with stone, this architectural marvel had much in common with its Greek predecessors. Europe was not alone in its appetite for sports, of course. In the US, for instance, several large stadiums were built for the national game baseball in the 19th century, and after World War I the growing popularity of American football led to the construction of a new type of single-tier elliptical bowl of massive proportions.

With the advance of building techniques and availability of new materials, most importantly reinforced concrete and steel, these newer stadiums were more advanced structures than their ancient predecessors. White City, for instance, was built on a steel frame. Yet when thermoplastics, and in particular PVC, became common after World War II, architects were able to take stadium design to the next level.

Allianz Riviera in Nice, France. Resembling a flying bird, the stadium epitomises sustainable design practices and is one of the first to bear the EnergyPlus label. Naturally, vinyl plays an important role: The material is used for the tensile fabric covering the wood frame, and PVC profiles keep the many photovoltaic panels on the roof in place.

Image © Allianz Family of Stadiums Media Center

ALLIANZ RIVIERA
Nice, France

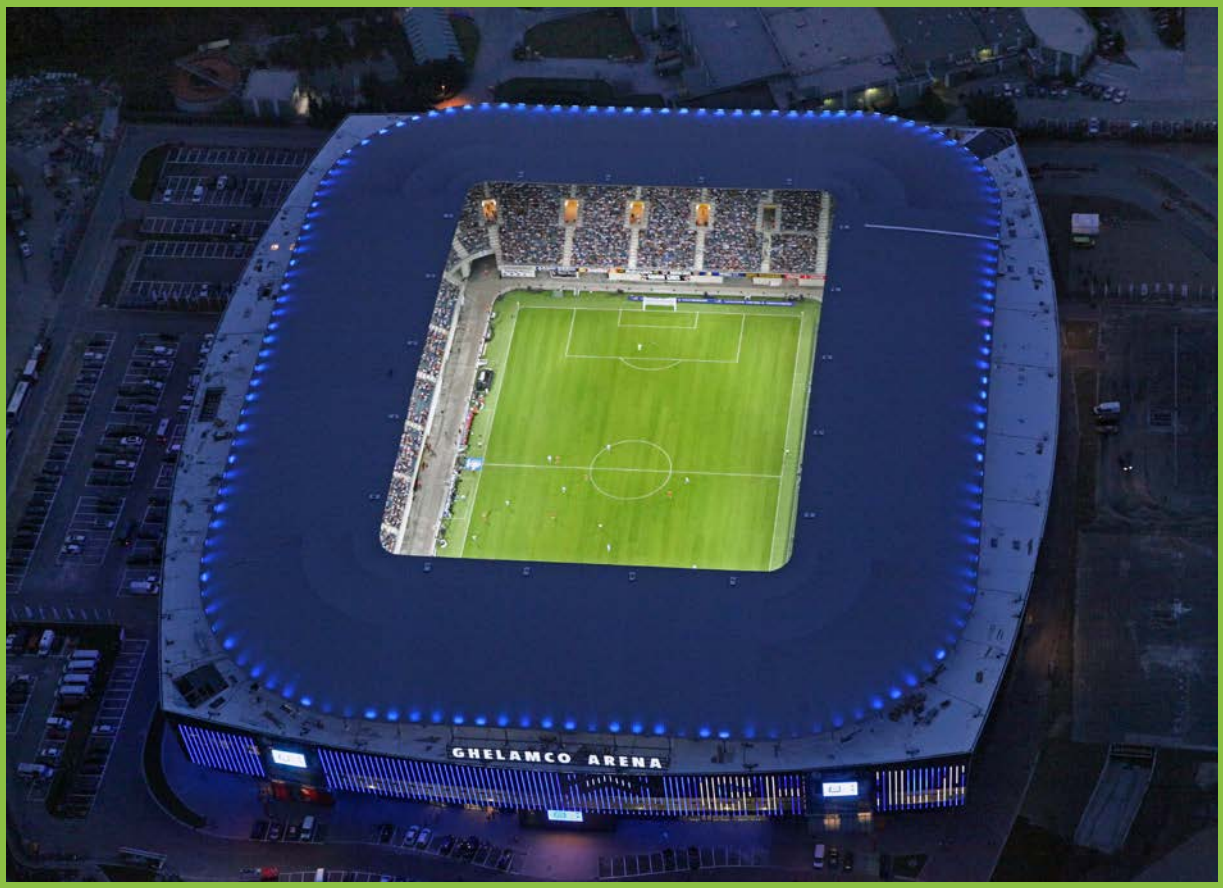
Completed in 2013, the Allianz Riviera stadium in Nice, France is a multi-functional venue home to local football club O.G.C. Nice, as well as rugby matches, lawn tennis and motorsports; concerts, shows and other large-scale events. The stadium seats 35,000 people and hosted several matches in the UEFA Euro 2016. Resembling a flying bird, Allianz Riviera is a magnificent piece of architecture that fits snugly with its surroundings in the middle of the Éco-Vallée, an ambitious long-term development plan for the Plaine du Var centered on sustainability. At the 2015 edition of the European PVC industry's Vinyl Sustainability Forum in nearby Cannes, the stadium's architect Marco Punzi from Wilmotte & Associés explained how extensive use of PVC enabled state-of-the-art design with environmental stewardship:

"For us, PVC was a natural choice. First of all because it allowed us to design a fifth-generation stadium that is well-functioning and hopefully aesthetically pleasing. For instance, we used a transparent PVC tensile fabric membrane for the façade, which lets daylight pass through and make the building appear open and inviting. And for the roof, we chose PVC for its acoustic qualities. Second, mitigation of greenhouse gas emissions must be integrated in modern stadium design as a lot of energy is consumed during events. It was actually one of the requirements in the bid for the contract. And we succeeded. In fact, Allianz Riviera is a positive energy building and one of the first European stadium to bear the EnergyPlus label. We achieved this by using a wooden structure for the building and installing 7,500 m^2 photovoltaic cells on the roof. Air conditioning is partly assured by natural ventilation, just as rainwater is recovered. And of course, PVC was used throughout the building, since it is long-lasting and can be recycled.

Indeed, by employing vinyl as the main building and construction material, the architect's grand visions have been fulfilled.

GHELAMCO ARENA
Gent, Belgium

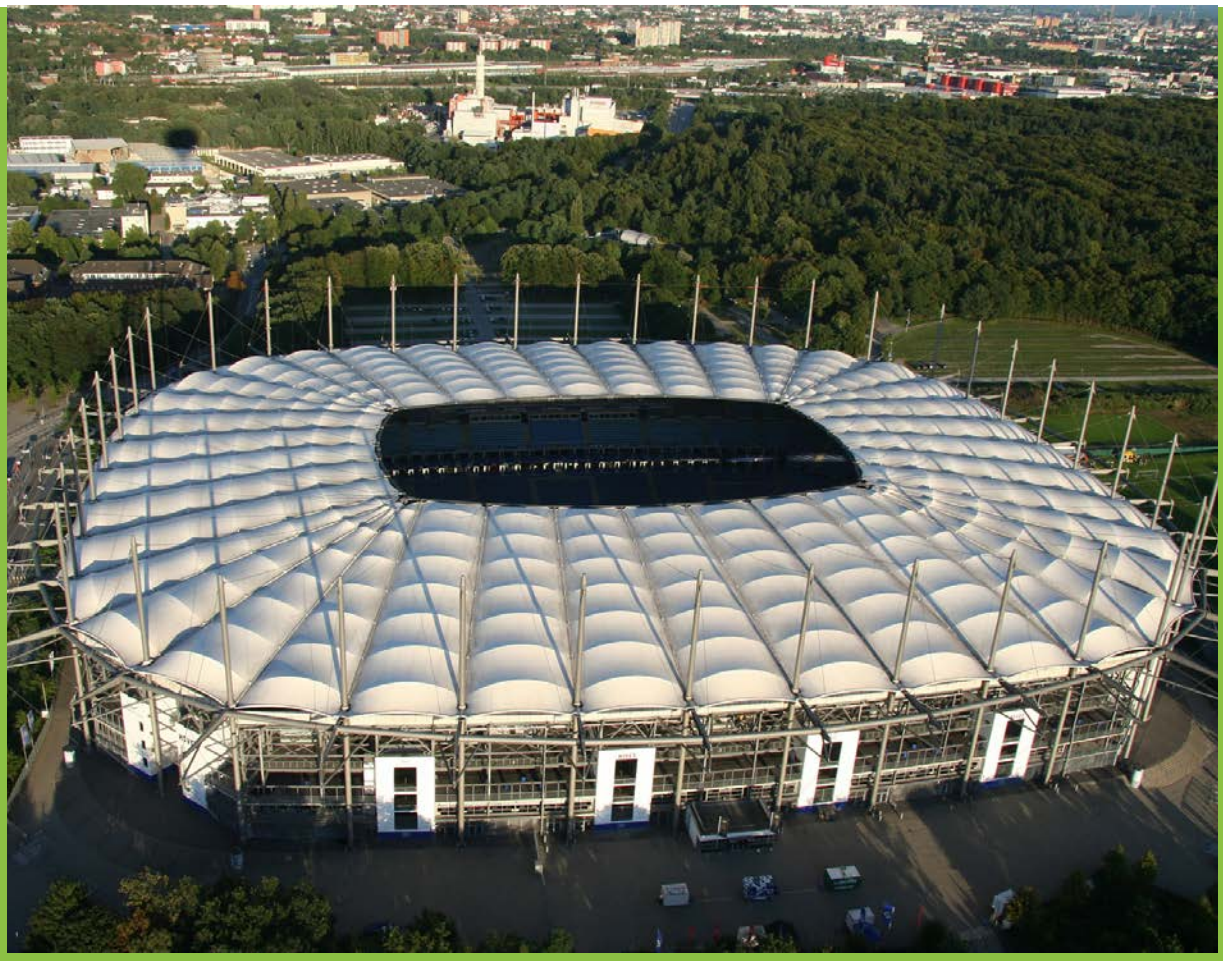
One of the top clubs in Belgian football, K.A.A. Gent certainly has a home turf that matches the sporting ambitions. As the first newly-built stadium in Belgium since 1974, the multi-use Ghelamco Arena opened its doors in 2013. The stadium seats 20,000 spectators and hosts — beside K.A.A. Gent matches — a multitude of events throughout the year, as well as a gym, supermarket, office facilities and a Guide Michelin restaurant. Keywords are safety, comfort and accessibility, and Ghelamco Arena, of course, meets the latest requirements of FIFA and UEFA. Equally important, the constructors managed to strike a balance between sustainable design and functionality. Crucial here is PVC. For the 13,000-m^2 roof, the architects chose a 1.5 mm thick vinyl membrane which has a positive influence on the climate inside the arena due to extremely high reflection of sunlight. Not only that, the membrane is future-proof: It is possible to install solar panels at a later date, and because of the high reflection the membrane will add 4 % to the power output once the panels are in place.



Ghelamco Arena in Gent is the first newly-built stadium in Belgium since 1974. Construction was completed in 2013. The 20,000-seat facility, home to football club K.A.A. Gent, is an example of a building where sustainable design meets functionality. A 1.5 mm thick PVC membrane covers the roof, which allows daylight to filter through and enables for future installation of photovoltaic panels.

Image © Renolit

VOLKSPARKSTADION
Hamburg, Germany



Volksparkstadion, Hamburg. Home of football club Hamburger SV, the stadium features a distinct PVC roof that covers the entire spectator area.

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Hamburger SV (HSV) is one of the oldest football clubs in Germany and the only team never to have been relegated from the Bundesliga since its foundation in 1963. On match day, over 50,000 fans from Hamburg and beyond come to watch "die Rothosen" (the Red Shorts) at Volksparkstadion. Built on the grounds of its predecessor bearing the same name, the remarkable stadium was inaugurated in 2000. With a capacity of 57,000 for league games and 51,500 for international matches, Volksparkstadion is also used for concerts and other sporting events. A distinct feature of the stadium is the roof, which is a light, cable-suspended 35,000-m^2 PVC membrane held up by huge pylons covering the entire seating and standing area. Together with closeness to the pitch, an oval layout and a vertical structure similar to the Colosseum, the loyal HSV fans have optimal conditions for watching their heroes in action.

Mercedes-Benz Arena, Stuttgart. Between 2009 and 2011, the already grand 28,000 m² PVC-coated polyester roofing membrane — suspended by an aesthetic steel frame that runs around the entire stadium — was expanded by 6,000 m² to cover the new grandstands. These were being built closer to the pitch as part of the conversion to make the stadium a football-only facility. The photo was taken during the 1-1 draw between VfB Stuttgart and Borussia Dortmund in October 2011, which was viewed by 60,000 spectators; the maximum capacity for Bundesliga matches.

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MERCEDEZ-BENZ ARENA
Stuttgart, Germany

Though Germany did not become another host-winner at the 2006 FIFA World Cup, "die Nationalelf" did end up in third place after a 2-0 victory over Portugal. Millions of viewers watched the match on television, but 52,000 lucky ticket-holders saw Bastian Schweinsteiger secure the bronze medals with two goals scored inside the magnificent Gottlieb Daimler Arena in Stuttgart. Now called Mercedes-Benz Arena, the original Neckarstadion was built in 1933 and renovated in 1993. One of the most important parts of the refurbishing was the addition of a 28,000 m² PVC-coated polyester roofing membrane suspended from an aesthetic steel frame that runs around the entire arena. This covers the grandstands completely and gives the stadium its significance. In 2009 conversion into a football-only facility begun, which was finished two years later. For the retrofit, the athletic field was removed, the lawn lowered by 1.3 m and two new grandstands were constructed and placed closer to the pitch. To cover the new seating area, the already impressive roof was expanded by 6,000 m². Now, 34,000 m² of vinyl roofing help make Mercedes-Benz Arena a world-class stadium for VfB Stuttgart Bundesliga and German national team matches.

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