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WONDERS OF THE WORLD

World-Class Sports Stadiums

Modern arenas are true architectural works, using the latest materials and technology. Take a look at 10 of the most impressive structures

By Stacy Perman

Sports architecture can be traced back thousands of years. The first known stadium was built in Olympia, in western Peloponnesus, Greece, where the Olympic Games began in 776 B.C. While stadiums were built to host competition, they were also seen as a reflection of a society's strength, glory, and wealth. Today's Olympic stadiums, World Cup soccer arenas, and other sports facilities are built with those same intentions -- though they're obviously more complex affairs, leveraging 21st-century building technology and materials to push the bounds of architecture. Take a tour of the 10 of the most intriguing examples.

ARCHITECTS GMP – VON GERKAN, MARG UND PARTNER ARCHITECTS

Allianz Arena

Munich

Allianz Arena, Munich
Herzog & de Meuron
Completed April, 2005

TIMM SCHAMBERGER/AFP/GETTY IMAGES

Pritzker-winning Jacques Herzog and Pierre de Meuron, the Swiss team behind London's Tate Modern and the 2008 Beijing Olympic Stadium, created a dazzling high-tech venue to kick off the FIFA World Cup this summer.

The stadium features a quilted translucent shell made of ETFE foil, a lightweight, translucent plastic. The shell is the largest structure of its kind in the world as well as the most dramatic: A lighting system embedded in the foil "pillows" allows the color of the facade to change from blue to red to white, depending on which home team is playing.

Siemens equipped the arena with such state-of-the-art systems as smart-ticketing technology that allows visitors entry to the stadium and can be used as an electronic wallet to buy snacks and souvenirs. It also has a powerful closed-circuit monitoring system that's said to be able to read a program in a fan's hand.

The 66,000-seat arena was built at an estimated cost of 280 million euros ($343.7 million) and covers an area of more than 179,000 square yards. Some 80 architects and engineers worked on the structure, which will host the opening match of the World Cup on June 9.

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Werner March Stadium

Berlin

Berlin Olympic Stadium
Von Gerkan, Marg + Partners
Completed 2004

ARCHITECTS GMP – VON GERKAN, MARG UND PARTNER ARCHITECTS

The landmark Werner March stadium -- where Jesse Owens won Olympic gold in 1936 in front of Hitler's VIP box -- is one of the most durable examples of the imposing Nazi architecture that Hitler saw as a tangible symbol of the new world order. But in preparation for this year's World Cup in July, the stadium has undergone a four-year, $283 million renovation.

The main challenge for the Hamburg-based Von Gerkan and Marg, who also designed Berlin's new central train station, was to transform the crumbling open-air arena into a modern, multifunction facility while preserving the stadium's original structure. Their solution: a glass roof supported by cantilevered steel columns that extends over the 76,000 seats but leaves the field under an open sky.

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National Stadium

Beijing

Olympic Stadium, Beijing
Herzog & de Meuron
Under construction, to be completed in 2008

IMAGE © HERZOG AND DE MEURON

Sports stadiums have long followed the enduring design of one of the original wonders of the world, Rome's Coliseum. Herzog & de Meuron's National Stadium in Beijing is an attempt to rethink the classic sports-arena layout for more ecologically correct times.

The Swiss architects (of Tate Modern fame) wanted to provide natural ventilation for the 91,000-seat structure -- perhaps the largest "eco-friendly" sports stadium designed to date. To achieve this, they set out to create a building that could function without a strictly enclosed shell, yet also provide constant shelter for the audience and athletes alike.

To solve these design problems, they looked to nature for inspiration. The stadium's outer grid resembles a bird's nest constructed of delicately placed branches and twigs. Each discrete space within the facility, from restrooms to restaurants, is constructed as an independent unit within the outer lattice -- making it possible to encase the entire complex with an open grid that allows for natural air circulation. The architects also incorporated a layer of translucent membrane to fill any gaps in the lacy exterior.

National Swimming Center

Beijing

National Swimming Center, Beijing
PTW and Ove Arup
Under construction, completion scheduled for 2008

The striking exterior of the National Swimming Center, being constructed for the 2008 Olympic Games and nicknamed the "Water Cube," is made from panels of a lightweight form of Teflon that transforms the building into an energy-efficient greenhouse-like environment. Solar energy will also be used to heat the swimming pools, which are designed to reuse double-filtered, backwashed pool water that's usually dumped as waste.

Excess rainwater will also be collected and stored in subterranean tanks and used to fill the pools. The complex engineering system of curvy steel frames that form the structure of the bubble-like skin is based on research into the structural properties of soap bubbles by two physicists at Dublin's Trinity College. The unique structure is designed to help the building withstand nearly any seismic disruptions.

Ski Dubai

United Arab Emirates

Ski Dubai, United Arab Emirates
F+A Architects
Completed December, 2005

CHRIS JACKSON/GETTY IMAGES

Ski Dubai is a winter wonderland in the desert. Located in the sun-baked desert emirate of Dubai, the cavernous 32,290-square-foot indoor ski resort counts five downhill ski runs varying in difficulty (the longest is 1,312 feet with a 196.85 foot fall), a cross-country trail, a 295.2-foot quarter-pipe for snowboarders, and, of course, a chairlift.

Located next to the Mall of the Emirates, the $275 million winter wonderland also boasts the world's largest indoor snow park. At 9,842 square feet, it offers tobogganing hills, a twin track bobsled ride, a snowball throwing gallery, and a snow cavern.

While the exterior temperature in Dubai ranges from 60 to 135 degrees Fahrenheit, the ski area remains a constant 28 degrees. The entire structure is designed as a capacious cold box. The walls have several layers of insulation and 23 blast coolers. Two feet of snow pack lies underneath a layer of fresh powder that is replenished every night by mimicking mother nature: Chemical-free water is put into a specially designed chiller, sent through pipes into snow guns, and blown out into the freezing cold environment which crystallizes into snow.

Port Hawkesbury Arena

Cape Breton, Nova Scotia

OJOLICK ASSOCIATES ARCHITECTS / PLANNERS

Port Hawkesbury Arena, Cape Breton, Nova Scotia
Bob Ojolick
November, 2004

As a general rule, indoor hockey rinks don't have windows. The sun's heat would create soft patches in the ice, and its glare would create be a problem for the athletes. So Port Hawkesbury's plan to makes its new rink and civic center green and bright posed a challenge.

Lead architect Bob Ojolick's solution included a band of glass between the walls and the roof and a transparent glaze, engineered by Advanced Glazings. The material, also used at Cirque du Soleil's National Circus School in Montreal, creates the effect of natural daylight indoors by evenly distributing direct sunlight at any time of the day from an angle without producing glare or shadows. The solution is estimated to shave 40% to 50% from electricity costs.

The eco-friendly complex also employs a geothermal heating and cooling system that uses waste heat from the ice-making process to provide radiant heating inside of the arena through ethanol-filled loops located on the floors and bleachers.

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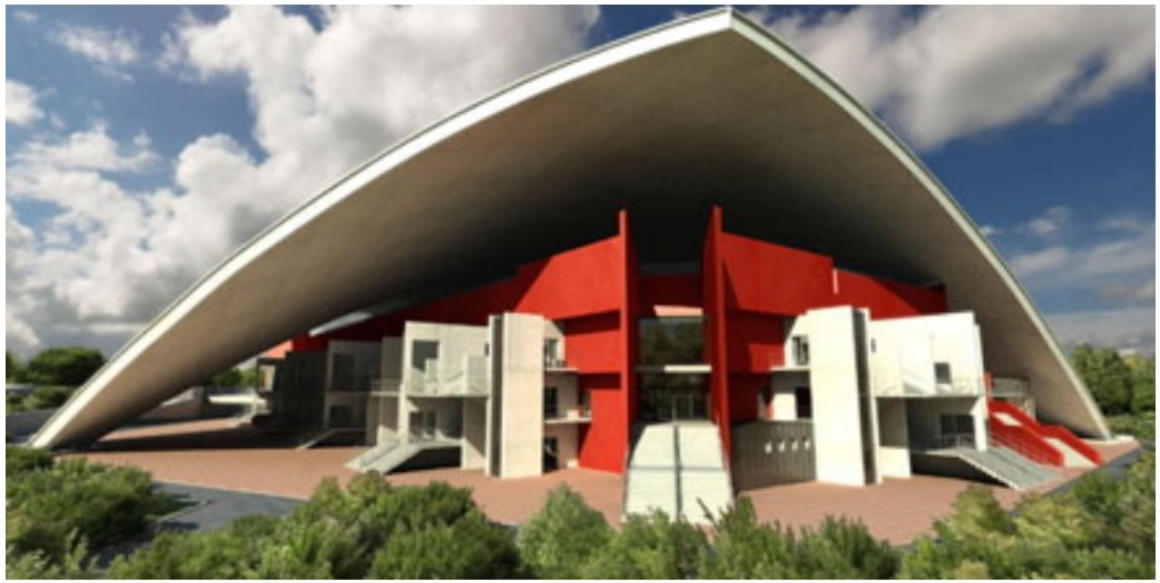
Palazzo a vela

Turin, Italy

Palazzo a vela, Turin, Italy
Gae Aulenti, Cesare Roluti, Matteo Filippi, and Francesca Quadri
Completed December, 2004

The Palazzo a vela is the centerpiece of the upcoming Winter Olympics in Turin. The wonder of this building is the recent renovation, undertaken to bring the original 1961 structure up to today's Olympic standards. The architectural team, headed by Aulenti, essentially created a building within a building.



L'AGENZIA TORINO 2006

Maintaining the original exterior -- a sail-shaped structure that is suspended between three reinforced concrete arches set at 60 degrees and fastened to the ground at three points on a hexagonal base -- the Palazzo's internal pavilion now has a 10,000 seat capacity and versatile functionality to extend the life of the complex beyond the Olympics. The structure can house sports, cultural, and leisure activities once the games are over, which the City of Turin hopes will help economically rejuvenate the entire area.

Cardinals Stadium

Glendale, Arizona

Cardinals Stadium, Glendale, Ariz.
Peter Eisenmann and HOK Sport
To be completed by fall 2006

HOK SPORT

When Cardinals Stadium is completed next fall, it will be the first sports facility in North America to feature a removable grass field and a retractable roof. Contained in a 12-million pound, 234-foot-wide by 400-foot-long tray, the roll-out field takes about 45 minutes to move in and or out of the stadium. Leaving it outside of the stadium, the designers estimate, will eliminate humidity problems inside and save $50 million in costs associated with maintaining the grass indoors.

Designed by world-renowned architect Peter Eisenman in association with HOK Sport (a leader in sports architecture), the $355 million, 160-acre stadium is designed with the arid climate and the environment in mind. Its insulated metal skin is composed of panels separated by vertical open-air gaps that allow natural light to enter. The retractable fabric roof will give the 63,000-seat stadium an open-air feel even when it is closed.

New Wembley Stadium

London

New Wembley Stadium, London
World Stadium Team, Foster and Partners, and HOK Sport
Expected to be completed 2006

With 90,000 seats, the new Wembley Stadium will be the largest soccer arena in the world. The signature 98.3-foot high twin towers of the original Wembley, built for the British Empire Exhibition in 1924, are being replaced with a dramatic 436-foot arch that will support 5,000 tons of the 7,000-ton movable roof. This structural solution eliminates the need for pillars that could obscure visitor's views. (With a span of 315 meters, the arch will be the longest single span roof structure in the world and will be visible from all parts of London.)

HOK SPORT

Built to incorporate the latest digital technology, the stadium includes two giant video screens, each roughly the size of 600 TV sets.

Al Khalifa Sports Complex

Doha, Qatar

Al Khalifa Sports Complex, Doha, Qatar
Various
Expected to be completed December, 2006

KARIM JAAFAR/AFP/GETTY IMAGES

The tiny independent emirate on the Arabian Peninsula is building one of the biggest sports complexes in the world. As it prepares to host this year's Asian Games, to be held in December, the petro-rich nation has invested a reported $2.8 billion in renovating existing sites and building some 30 state-of-the-art facilities for the 20,000 athletes who will compete in 35 different events.

The centerpiece of the games is the Al Khalifa Sports Complex, which will house the 50,000-seat Al Khalifa International Sports Stadium and the athletics, aquatics, gymnastics, hockey, and martial arts events. North and west of Doha, a number of venues for shooting, football, basketball, biking, badminton, and equestrian events are being constructed. By the end of 2006, Qatar will boast a new aquatics center and nine multi-sports clubs.

The development is impressive for more than the number of projects. In November, the Aspire Academy for Sports Excellence, a sports-training facility, completed construction of what is the world's largest indoor sports dome. The 290,000-square-meter roof encompasses a full-size football field, Olympic-size swimming and diving pools, a gymnastics hall, a 200-meter athletics track, a sports games hall, 13 table-tennis courts, three contact sports mats, eight fencing strips and two squash courts.