



**Architectural Idea Book:
Buildings and Structures
Made With ETFE Film**





EFTE PROJECTS

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NürnbergMesse Expo Center



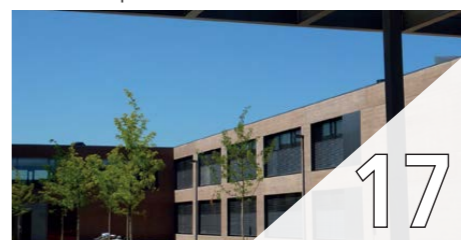
Vitam Liesure Center



Afrykarium Oceanarium



L'ecole Europeenne



Tottenham Training Centre



Canary Wharf Station

Project Name: **Canary Wharf Station**
Location: **London, UK**
Fabricator: **seele cover GmbH**
Architects: **Foster + Partners**

The Canary Wharf Station is located in the waters of London's North Dock. Foster + Partners designed the station to be an accessible, welcoming bridge to the commercial district. The wooden structure sits above a roof garden and Canary Wharf Group's four-story retail and leisure development. The building was designed to evoke the ships that once occupied the docklands, contrasting with the region's ubiquitous steel and glass towers.

The station's 310-meter-long roof rises 30 meters into the air, enclosing the shops and entrances below. The station is insulated with Fluon® ETFE film, which provides the required sunlight transmittance for the garden terrace's distinctive microclimate. Because of the climate, they are able to grow exotic plant species in the garden that are not usually associated with British flora.



Project Name: Allianz Arena
Location: Munich, Germany
Fabricator: seele cover GmbH
Capacity: 75,024 seats
Architects: Herzog & de Meuron

Allianz  Arena

Allianz Arena

The Allianz Arena in Munich is an innovative football stadium that hosted the 2006 FIFA World Cup. It is the flagship stadium for ETFE film, the material used for the inflated cushions that make up the arena's outer facade. The film protects spectators from wind and rain while allowing light to shine onto the natural grass. ETFE film has a solar transmission rate of over 90%, is much lighter and more dirt-resistant than glass, and is easy to maintain.

Allianz Arena was the first stadium in the world with a fully color-changeable exterior. It can be illuminated red and white when FC Bayern München are playing or blue and white if TSV 1860 München are at home. All-white or other color combination lighting are also possible. This is a good example of how facades of ETFE film cushions can use lighting for branding or advertising.



Khan Shatyr Center

Project Name:
Location:
Engineering, Fabrication
& Installation of
ETFE Cushions:
Architects:

Khan Shatyr Entertainment Center
Astana, Kazakhstan
Vector Foiltec
Foster + Partners

Khan Shatyr is a 150-meter-high transparent tent in Astana, Kazakhstan. Built in a distinctively neofuturist style, the entertainment center has a 200-square-meter elliptical base that covers 140,000 square meters. The center provides a major civic, cultural and social venue for the people of Astana, bringing together a wide range of activities within a sheltered climate that remains comfortable all year round. Underneath the tent, an area larger than ten football stadiums is used as an urban-scale park, shopping and entertainment venue with squares and cobbled streets, boating river, shopping center, mini-golf and indoor beach resort.

The roof is constructed from ETFE film cushions suspended on a network of cables strung from a central spire. The transparent film allows sunlight through, enabling tropical plants to thrive inside the center. The film also helps the building's heating and cooling systems regulate inside temperatures, despite extreme outside temperatures that range from -35 °C and +35 °C. ETFE film provides long-term durability and weather resistance, even in extreme conditions.



Forsyth Barr Stadium

Project Name: **Forsyth Barr Stadium**
Location: **Dunedin, New Zealand**
Engineering, Fabrication
& Installation of
ETFE Cushions: **Vector Foiltec**
Capacity: **30,748 seats (sports events) / 36,000 seats (concerts)**
Architects: **Jasmax & Populous**

Forsyth Barr is the only stadium in the world with natural turf covered permanently with ETFE film. This venue hosted matches during the 2011 Rugby World Cup and is now a multipurpose stadium used for large-scale events including sports, concerts and trade fairs.

The 25,000-square-meter clear ETFE roof provides excellent light transmittance, which is ideal for growing natural turf. In bad weather, attendees stay completely protected. In good weather, they can enjoy the sunlight by day or the stars at night.



Baku National Stadium

Project Name: **Baku National Stadium**
Location: **Baku, Azerbaijan**
Engineering, Fabrication
& Installation of
ETFE Cushions: **Vector Foiltec**
Capacity: **68,700 seats**
Architects: **Heerim Architects & Planners Co., Ltd.**

This impressive six-story stadium covers 225,000 square meters and is home to the Azerbaijan national football team. It has hosted a number of major sports events, including the 2015 European Games, and was selected to host the quarter-finals of Euro 2020. It was designed to meet the Union of European Football Association's (UEFA) highest international standards for stadiums.

The stadium's 51-meter-high ETFE film facade and roof system provide a lightweight structure. The diamond-shaped panels enabled substantial savings in steel tonnage. For these reasons, the stadium achieves environmental benefits and cost savings. ETFE film also adds to the aesthetics of this iconic building.



Resorts World Sentosa

Project Name: Resorts World Sentosa (RWS)
Location: Sentosa Island, Singapore
Engineering, Fabrication & Installation of ETFE Cushions: Vector Foiltec
Architects: DP Architects

This 49-hectare complex, located on the island of Sentosa, is Asia's ultimate destination resort. RWS offers many attractions including the region's first and only Universal Studios theme park, S.E.A. Aquarium, Adventure Cove Waterpark, Dolphin Island, Maritime Experiential Museum, an award-winning destination spa, a casino, six unique hotels, the Resorts World Convention Centre, celebrity chef restaurants and specialty retail outlets. The resort also offers world-class entertainment, concerts and public shows.

Meinhardt Singapore, part of the Meinhardt Group, a leader in sustainable design and engineering, designed all the facades and roofs. Fluon ETFE film provides natural lighting and shade while protecting visitors from Singapore's tropical rainforest climate. The resort has more than 25,000 square meters of ETFE and PTFE roof canopies. The cooling systems integrated within these canopies contribute to energy savings of 2.9 million kWh per year.



Singapore Stadium

Project Name: Singapore National Stadium
Location: Kallang, Singapore
Engineering, Fabrication & Installation of ETFE Cushions: Vector Foiltec
Capacity: 55,000 seats
Architects: Arup Sport

The National Stadium in Singapore is a multipurpose arena used mostly for football matches. It is the only stadium in the world custom designed to host football, rugby, cricket and athletics events. The stadium is the centerpiece of the new multipurpose Singapore Sports Hub complex, which includes an aquatic center, arena, museum, library, shopping mall and watersports center.

White ETFE film was selected for the stadium's retractable, dome-shaped roof because of its excellent reflective properties. The film also resists heat, chemicals and extreme weather. The roof has a sophisticated LED system installed beneath it, enabling it to be used as a giant screen.



Fisht Olympic Stadium

Project Name: **Fisht Olympic Stadium**
Location: **Sochi, Russia**
Engineering, Fabrication
& Installation of
ETFE Cushions: **Vector Foiltec**
Capacity: **40,000 seats**
Architects: **Populous & BuroHappold**

Located in Sochi Olympic Park and named after Mount Fisht, this stadium was designed for the 2014 Winter Olympics & Paralympics and the 2018 FIFA World Cup. The open aspect at either end affords views of the Caucasus Mountains to the north and the Black Sea to the south.

The roof was designed to look like the snowy peaks of the surrounding area. The pneumatic cushions are held in aluminum extrusions that are supported by a lightweight structure. The cushions are made from multiple layers of Fluon ETFE film that are kept inflated at low pressure to provide insulation and wind resistance. The roof consists of double-layered and triple-layered cushions manufactured from different types of ETFE film. Opaque film was used to reflect direct sunlight, and a translucent grade was used to provide the feeling of natural daylight inside the stadium.

The ETFE roof allows maximum daylight in winter and solar shading in summer. The grass surrounding the stadium is not affected by shade because of the roof's translucency, height, latitude, size and orientation. It has a lens opening to allow more light to enter during the daytime, and it can be illuminated at night. Rainfall keeps the ETFE film clean.

Rotterdam Floating Pavilion

Project Name:
Location:
Engineering, Fabrication
& Installation of
ETFE Cushions:
Architects:

Rotterdam Floating Pavilion
Rotterdam, Netherlands

Vector Foiltec
Deltasync & Public Domain Architects

This eye-catching complex in the Rijnhaven in Rotterdam has three floating hemispheres. The structure is 12 meters tall, with a fully relocatable floor area the size of four tennis courts. The floating structure is flexible, innovative and sustainable. Its heating and air conditioning systems rely on solar energy and surface water. Multiple climate zones make it possible to use energy only where it is required at each moment. The pavilion is largely self-sufficient for power and even purifies its own toilet water.

ETFE film was used for the complex's roof structure. The film is approximately 100 times lighter than glass. It is also low maintenance and fully recyclable. The pavilion is a good example of how ETFE film can be used for sustainable buildings.



Itaipava Arena Pernambuco

Project Name: Itaipava Arena Pernambuco
Location: Recife, Brazil
Engineering, Fabrication & Installation of ETFE Cushions: Vector Foiltec
Capacity: 46,160 seats
Architects: Fernandes Arquitetos Associados

Located in Recife, the Itaipava Arena Pernambuco hosted FIFA Confederations Cup fixtures and was one of the venues for the 2014 FIFA World Cup Brazil. The 46,160-seat arena was built by Brazil's largest engineering and construction firm, Odebrecht. It has six levels, with 102 corporate boxes, 42 food kiosks and two restaurants.

The stadium enjoys a strategic location in a protected area measuring 27 hectares. It is part of an urban center featuring business, residential, educational and entertainment areas that contribute to the development and expansion of the Recife metropolitan region.

High-performance Fluon ETFE film was used across the arena's facade. The film gives the stadium a futuristic, rounded look and allows natural light into the building, reducing its dependence on electricity. Backlighting was installed to provide nighttime illumination and dramatic visual effects.



© Inês Campelo/Itaipava Arena Pernambuco

Project Name: **La Confluence**
Location: **Lyon, France**
Fabricator: **seele cover GmbH**
Architects: **Jean-Paul Viguier et Associés**

La Confluence

At the meeting point of the city of Lyon's two rivers, the Rhone and the Saone, La Confluence is Europe's largest urban development. Inside the leisure center there is a rollerdome, bowling alley, adventure park, karting track, climbing wall and multiscreen cinema.

The shopping and leisure center's large roof consists of canopies of ETFE cushions. The inflated ETFE film cushions, fabricated by seele cover GmbH, are set in an arched design. ETFE cushions were the ideal solution for achieving a naturally lit space.



Manchester Victoria Station

Project Name:
Location:
Engineering, Fabrication
& Installation of
ETFE Cushions:
Architects:

Manchester Victoria Station
Manchester, UK
Vector Foiltec
BDP (Building Design Partnership)

Manchester Victoria railway station underwent a \$63 million transformation, becoming a transportation interchange. The station concourse now has a fully accessible bridge linking to the Manchester Arena, and the footbridge spanning three platforms allows for growing numbers of passengers. A modern retail space and new units complement the passengers' experience. Refurbishment of the original ticket hall and modern glazed entrances lifts the overall look, feel and usability of the station.

Thanks to a new \$23 million roof made of Fluon ETFE film, it is now a safer, brighter and more spacious gateway to the city that can meet growing passenger demand. The new roof is a contemporary structure with self-cleaning properties. It is lighter than glass and allows abundant natural light into the station. Manchester Victoria station is now an iconic building as well as a vital transportation hub.



Photo © Network Rail

Project Name: NürnbergMesse Exhibition Center
Location: Nürnberg, Germany
Fabricator: seele cover GmbH
Architects: Kadawittfeldarchitektur

NürnbergMesse Center

NürnbergMesse Exhibition Center was recently renovated to extend the exhibition fairgrounds. There are now 15 halls covering an indoor expo space of 170,000 square meters and an additional outdoor area of 50,000 square meters.

A new 20-meter-high steel slatted roof redefined the central entrance of the complex. The new roof spans the front of the building and forms the Fluon ETFE roof of the building's new entrance. Only 12 columns support the entire roof, with each column supporting approximately 1,000 square meters of roof. The small number of columns made it possible to span the prominent entrance area without interfering with visitor flow or the view at the main entrance.

The fundamental elements of the roof construction are the 2.5-meter-high slats. The roof was designed so that the transparent, air-filled ETFE cushions allow a lot of natural light. The vertical orientation of the slats combined with partially printed ETFE film also provides heat insulation.



Vitam Leisure Center

Project Name: Vitam Leisure Center
Location: Neydens, France
Fabricator: seele cover GmbH
Architects: L35 Arquitectos

Vitam Leisure Center is an environmentally responsible tourist destination covering 50,000 square meters. It is located between Annecy and Geneva in Neydens, France. It was designed by L35 Arquitectos of Barcelona to provide relaxation for adults and fun activities for children. The center features a sports center, a water park with both indoor and outdoor swimming pools, a well-being center, a hotel, a restaurant and a shopping center. Ecologically constructed and managed, the structure blends into the natural landscape and has underground car parking.

The use of transparent, lightweight ETFE film was essential to minimize the visual impact on the surrounding landscape. It also ensures that a maximum amount of natural light enters the aquatic areas. Fabricator seele cover GmbH designed and constructed the ETFE film roof covering the aquatic center as well as the ETFE skylight set in the green roof of the main building. At the aquatic center, a wave-shaped wooden frame supports 53 ETFE cushions with a total surface area of 4,300 square meters.



PROJECT 15

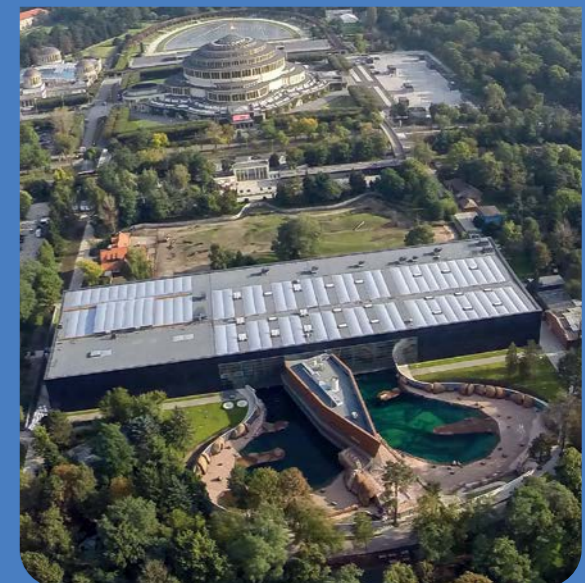
Afrykarium Oceanarium

Project Name:
Location:
Engineering, Fabrication
& Installation of
ETFE Cushions:
Architects:

ZOO Wrocław Afrykarium Oceanarium,
Wrocław, Poland
Vector Foiltec
ArC2 Fabryka Projektowa Sp. z o.o.

The Afrykarium Oceanarium is a 160-meter-long black building located inside ZOO Wrocław. When exiting the building, visitors can see the zoo's main entrance and Centennial Hall located on the axis of the building. Along the entrance elevation, a shallow body of water reflects the black and slightly wavy north facade, which represents the beauty of Africa's inhabitants. Five halls are grouped around an attractive, multifunctional lobby. Each hall houses different African biotopes and animal expositions.

The roof over Afrykarium Oceanarium is covered with both sheet metal and Fluon ETFE film cushions. The cushions provide sufficient natural light to ensure a healthy microclimate inside the building.



L'école Europeene

Project Name: L'école Européene Luxembourg II
Location: Bertrange-Mamer, Luxembourg
Fabricator: Ceno Membrane Technology
Architects: Michel Petit Architecte & Schilling Planung GmbH

The educational sector is also using lightweight, flexible ETFE for roofs and facades. In 2012, the second European School opened for pupils whose parents are employees working at European institutions in Luxembourg. The school campus is located in the village of Tossen-berg on the border between Bertrange and Mamer. The campus consists of six buildings, all of which meet the highest standard of energy efficiency. The quality of the insulation, the use of wood for the heating system and natural ventilation all contribute to minimizing the buildings' energy consumption.

The campus has five roofing structures made from double-layer ETFE cushions. The top layer of each cushion is made from matte film to reduce the intensity level of direct sunlight that can pass through. This also ensures pleasant, glare-free lighting in the recreational areas inside.



Tottenham Training Center

Project Name: Tottenham Hotspur Training Center
Location: Enfield, UK
Fabricator: seele cover GmbH
Architects: KSS Group

The Spurs' 77-acre training center is a state-of-the-art facility with 15 grass pitches, world-class player preparation areas, a pool and hydrotherapy complex, an altitude room, a large-scale gymnasium and specialist sports rehabilitation suites. The training center was designed by the architects KSS to be extremely energy efficient by maximizing natural daylight and limiting solar heat gain.

The center reinstated hedgerows and field boundaries, and planted an orchard and an organic kitchen garden to make the facility sustainable. They planted more than 150 trees, plus thousands of new plants, hedges and flowers, and installed an attenuation pond to enhance the ecological habitat.

Fluon ETFE film was the material of choice for a transparent roof over the artificial pitch.



Photographs by Gareth Gardener

Project Name: **The SSE Hydro**
Location: **Glasgow, Scotland (UK)**
Fabricator: **Novum Structures**
Capacity: **12,000 seats**
Architects: **Foster + Partners and Arup Scotland**

The SSE Hydro

Designed by Foster + Partners and Arup Scotland, the spectacular SSE Hydro is a state-of-the-art venue with a wide range of technical features. It opened in September 2013 and is now one of the most prominent concert and entertainment venues in the UK, hosting more than 140 events every year.

The arena hosts international artists, global entertainment and sporting events, attracting more than a million visitors each year. With a seating capacity of 12,000, the arena has staged the MTV Europe Awards, the Ryder Cup Opening Ceremony, the BBC Sports Personality of the Year and the 2014 Commonwealth Games.

The unique facade of the SSE Hydro is made up of pneumatic translucent cushions made from ETFE film. The film allows natural light to illuminate the inside during the day and the arena to glow at night. The SSE Hydro has a 125-meter-wide roof with the diagonally latticed steelwork forming a shallow silver dome standing 45 meters at its highest point.





Fluon® ETFE Film is a revolutionary architectural material that is used around the world because it is safer and lighter than glass. Light weight means that ETFE film requires less structural support, which in turn reduces building time and costs. The material is heat resistant, chemical resistant and fire resistant with excellent thermal insulation properties, high light transmission and long-term weatherability. Its high level of heat retention, combined with its ability to allow in more natural light than glass, can reduce energy costs by up to 30% compared to glass.

Despite being lighter than glass, Fluon ETFE Film will not easily rip or scratch over time, even in the harshest environments. The film has a high tensile elongation (200 – 510) and tear strength, as well as a thermal melting point of 260°C and a linear thermal expansion coefficient of 9.4. Fluon ETFE Film is available in various thicknesses and finishes ranging from 12µm to 250µm and with light transmission options of over 90%.



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