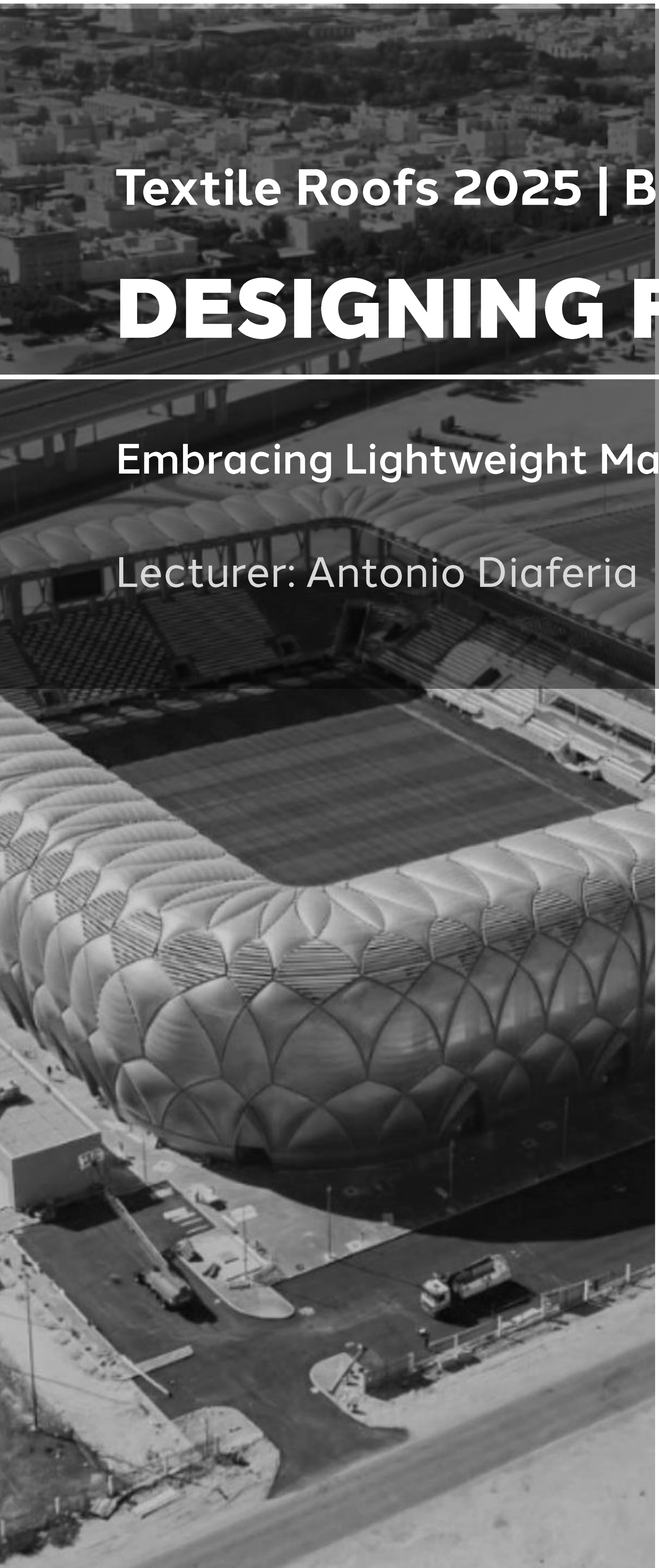
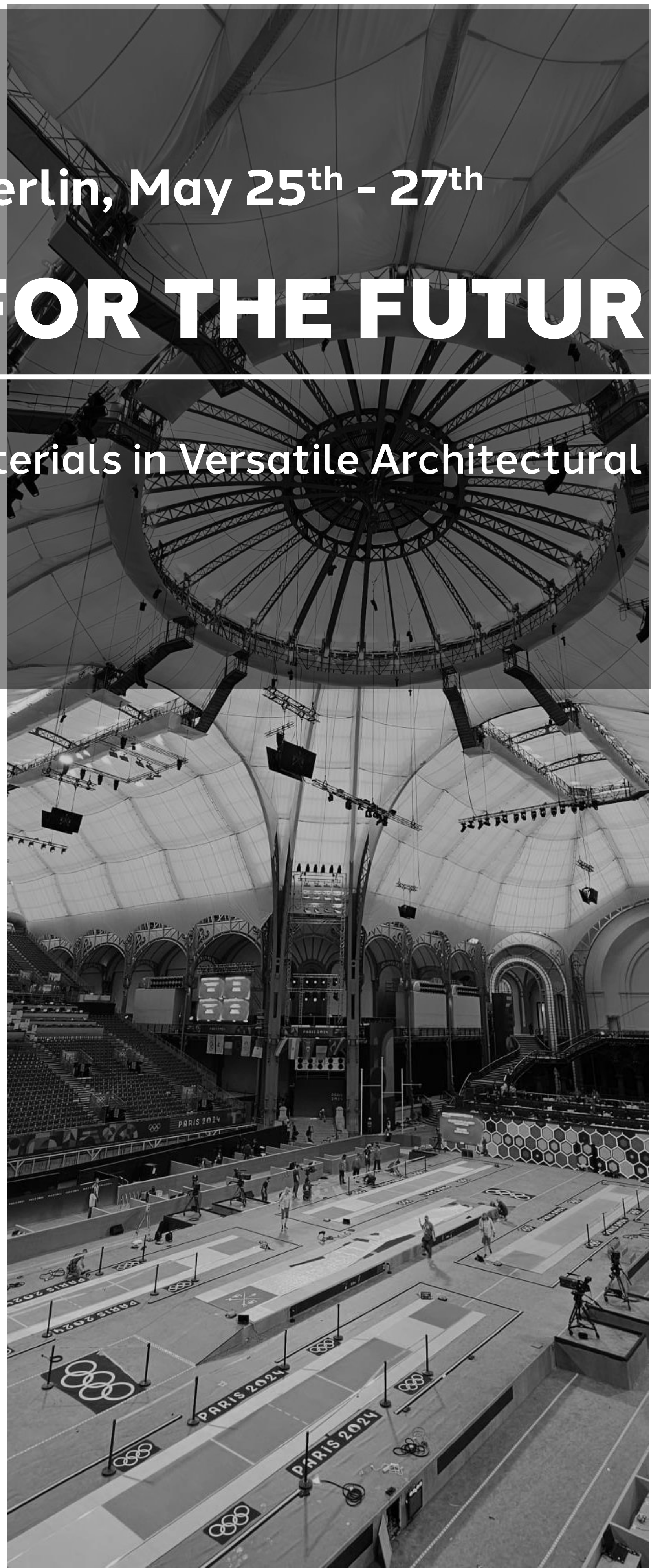




Textile Roofs 2025 | Berlin, May 25th - 27th

DESIGNING FOR THE FUTURE

MAFFEIS engineering

Embracing Lightweight Materials in Versatile Architectural Solutions

Lecturer: Antonio Diaferia

01 Sulaibikhat Stadium

02 Under Armour HQ

03 Grand Palais

SULAIBIKHAT STADIUM - KUWAIT

LOCATION	Kuwait City | Kuwait
YEAR	2021 - 2023
STATUS	Completed
TYPE OF BUILDING	Stadium
SERVICE	Tensile Structures | Special Structures
FINAL CLIENT	Kuwait Football Association
CLIENT	Taiyo Europe GmbH
ENGINEER	Maffeis Engineering SpA
MATERIALS	ETFE | Aluminium
SEATS	15.000

Jaber Al-Mubarak Al-Hamad Stadium, formerly known as Sulaibikhat Stadium, is a football stadium located in Sulaibikhat, Kuwait. It serves as the home stadium of Sulaibikhat SC. Covering an area of **102,000 square meters**, it has a seating capacity of **15,000 spectators**. The stadium is part of a major sports venue renovation project aimed at improving Kuwait's sports infrastructure. It was named after Jaber Al-Mubarak Al-Hamad Al-Sabah, the 7th Prime Minister of Kuwait.

Maffeis Engineering carried out the Full Design of the ETFE cladding system, including clamping and the air distribution layout.

BUILDING TYPOLOGY

The project involves a multifunctional stadium located in Kuwait City, designed to host sporting events in a climate marked by high temperatures and intense solar exposure.

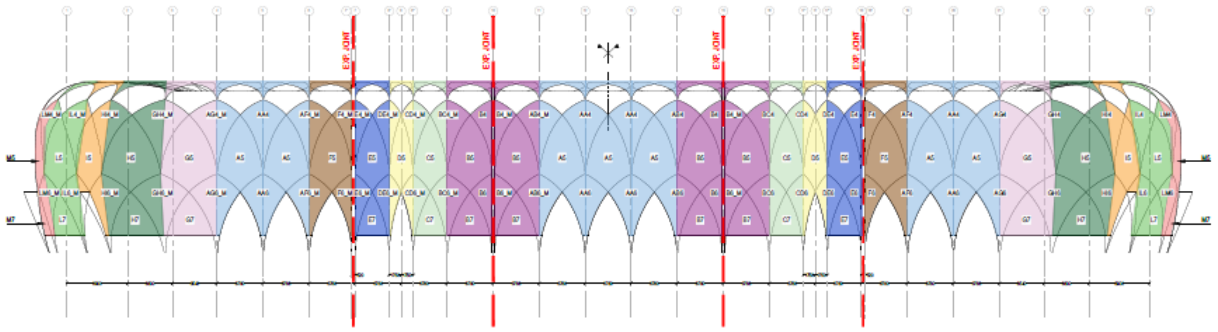
The use of a lightweight material such as ETFE for the cladding was driven by the desire to visually reduce the mass of the structure while ensuring a protected and comfortable Environment for spectators.

The envelope is not merely functional—it becomes an integral part of the stadium's architectural language: a **technological "skin"** that redefines the traditional concept of a sports roof into an iconic, translucent, and forward-looking element.

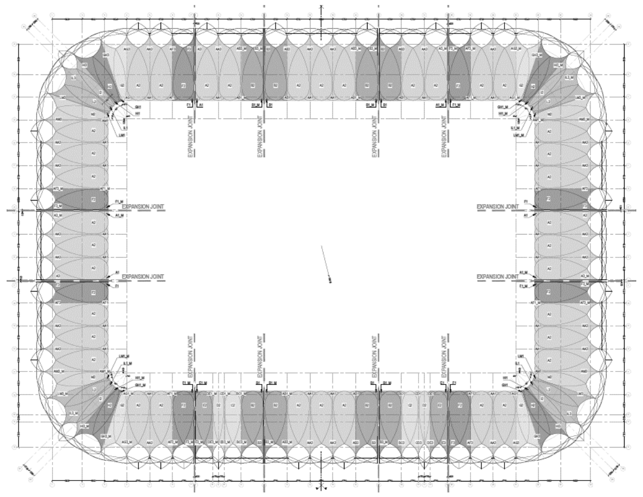
FUNCTIONALITY

A lightweight envelope for weather protection and architectural identity

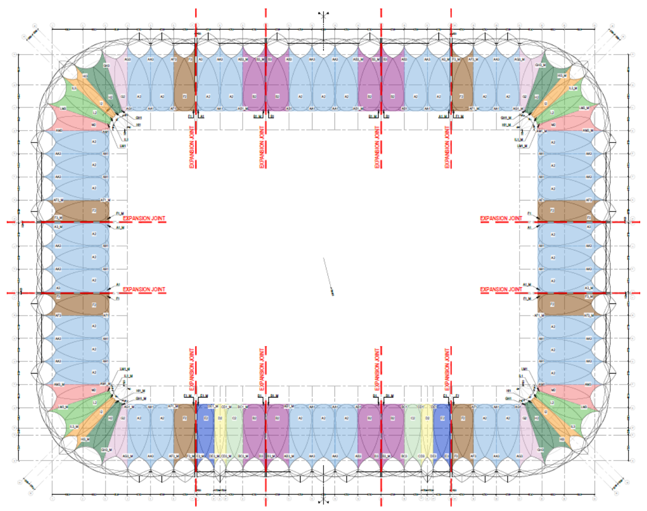
The membrane system designed for the Sulaibikhat Stadium **serves both functional and aesthetic purposes.**
Primarily, the ETFE cushion cladding provides protection from harsh solar radiation while ensuring a high level of natural light transmission inside the stadium concourses.
Thanks to the air-filled cushions, the system offers thermal insulation and rain protection, ensuring user comfort in a challenging climatic environment like Kuwait.
Beyond performance, the translucent skin creates a distinctive visual identity, turning the structural.



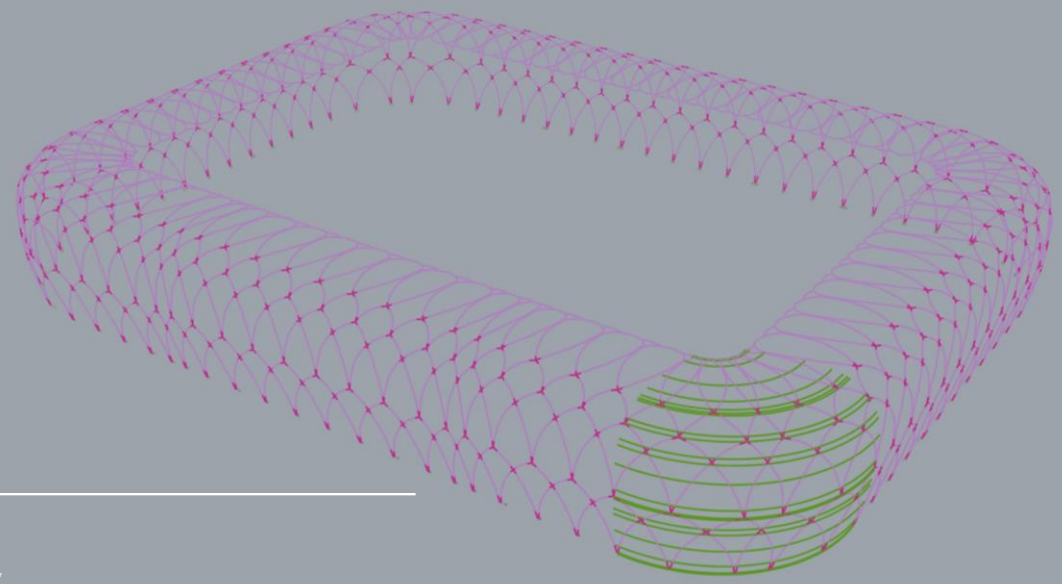
Module Identification - South Elevation



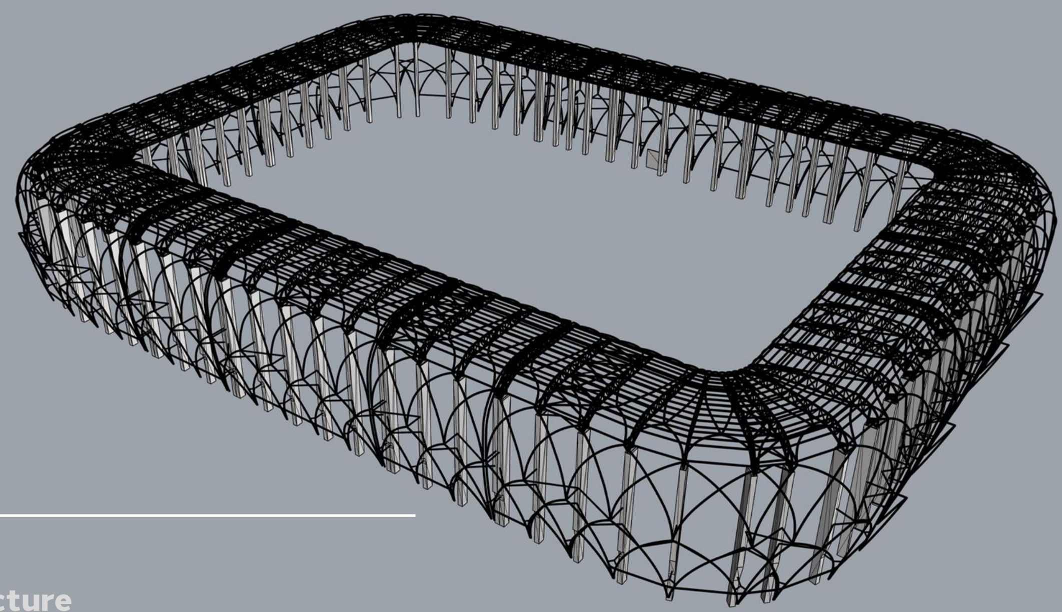
Plan view of the stadium (all the elements without pattern are ETFE cushion)



Module Identification - Plan View



3D MODEL
First Study



3D MODEL
Steel Structure

TECHNICAL CONSTRUCTION SYSTEM

Lightweight envelope integrating structure and form

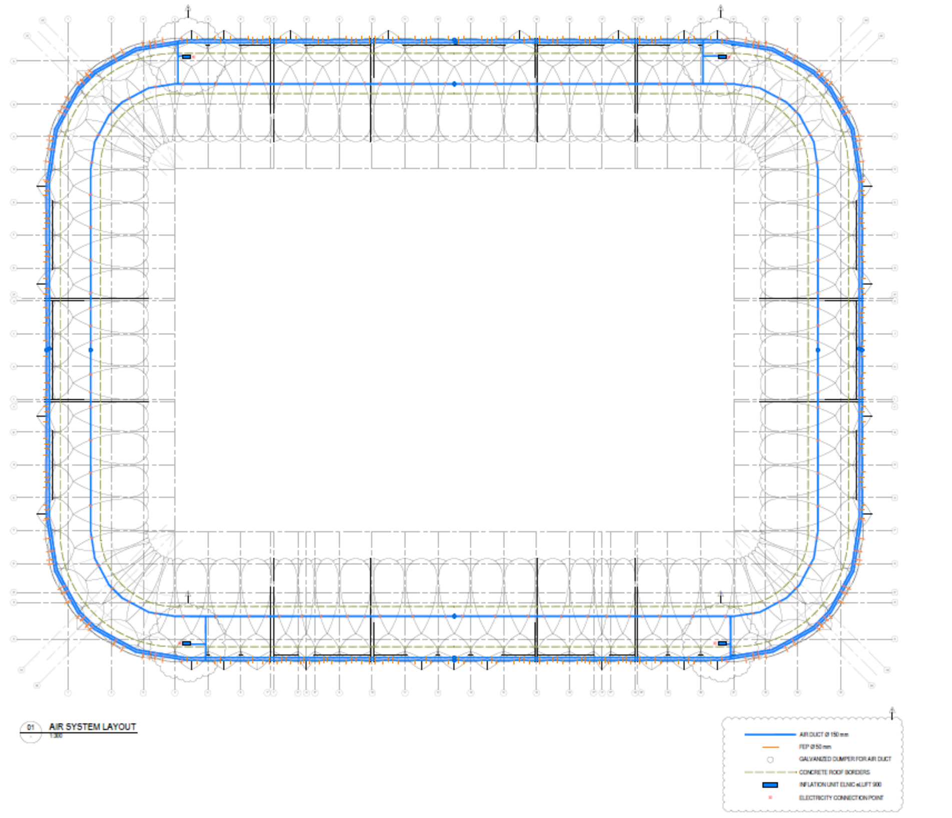
The roofing and façade of the Sulaibikhat Stadium are entirely clad with ETFE cushions, used in a double-layer system inflated with low-pressure air to maintain shape and performance.

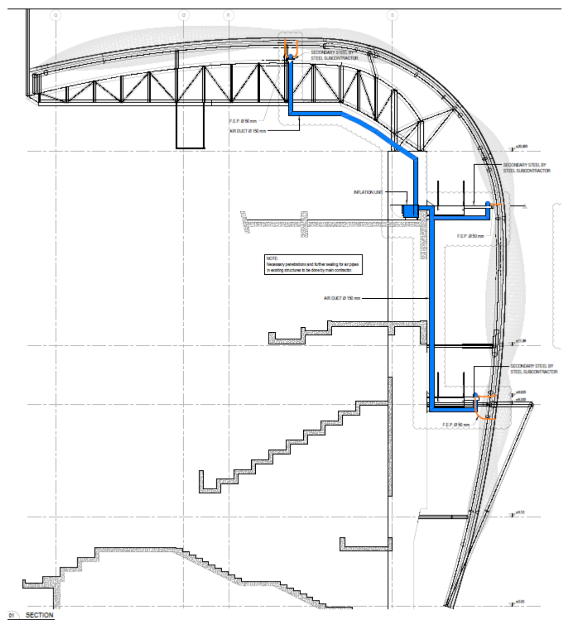
What distinguishes this application is the integration between the ETFE system and the main structural skeleton, composed of a spatial steel frame that not only supports the building but also defines the edge of the ETFE skin itself.

The design eliminates the need for a traditional subframe: the cushions are anchored directly to the steel structure, which has been engineered to absorb the minimal loads transferred from the membrane system, including wind and internal air pressure.

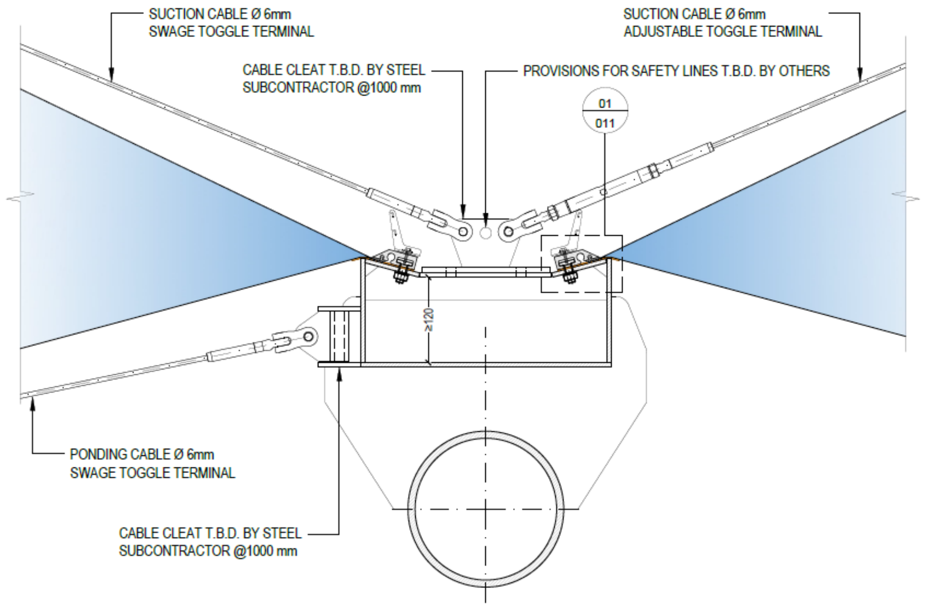
This solution results in a clean, expressive architecture, where the transparency and curvature of the ETFE emphasize the lightness of the material in contrast to the robust frame.

Custom-designed aluminium extrusion profiles are used along the cushion perimeters to house the pneumatic system, ensure airtight seals, and allow for periodic maintenance access. The use of ETFE significantly reduces the dead load compared to glass or polycarbonate, enabling the structure to span large distances with optimized steel sections.



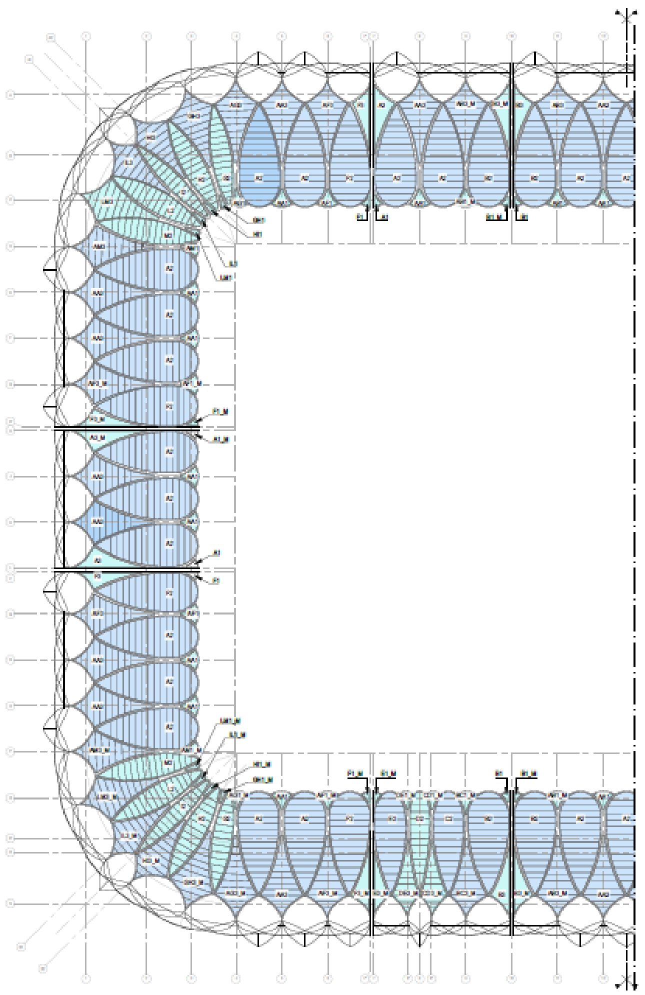


MATERIAL SPECIFICATIONS				
PART	DESCRIPTION	SIZE / TYPE	MATERIAL	FINISH
ETFE CUSHIONS	OUTER LAYER	THICKNESS 200 µm	ETFE	PRINTED - PATTERN DM 4:65 LIGHT (BY HUECK)
	INNER LAYER		ETFE	CLEAR
	OUTER LAYER	THICKNESS 250 µm	ETFE	PRINTED - PATTERN DM 4:65 LIGHT (BY HUECK)
	INNER LAYER		ETFE	CLEAR
EXTRUSION	ALUMINUM EXTRUSION	TENSO-SKY TDE-41	ALLOY 6060T66	ANODIZED - MIN. 25 µm
FASTENERS	HAMMER HEAD SCREW DIN 188	M10 x 30mm	SS A4-70	
	NUT DIN 934	FOR M10 BOLT	SS A4-70	
	WASHER DIN 125A	FOR M10 BOLT	SS A4-70	
	SPRING WASHER DIN 7980	FOR M10 BOLT	SS A4-70	
	SELF TAPPING SCREW DIN 7504 K	4.2 mm	SS A4-70	
EPDM GASKET	EPDM GASKET		EPDM	SHORE 60/80 - BLACK
EPDM LAYER	BASE EPDM LAYER	THICKNESS 2 mm	EPDM	SHORE 60/80 - BLACK
BIRD WIRE BRACKET	BIRD WIRE BRACKET		SS GRADE T.B.D.	
CABLES	CABLES	Ø 6 mm	SS GRADE T.B.D.	
	END 1 - SWAGE TOGGLE TERMINAL		SS GRADE T.B.D.	
	END 2 - SWAGE TOGGLE TERMINAL		SS GRADE T.B.D.	
AIR PIPES	METAL SHEET BY LINDAP	Ø 200 mm T.B.D.	STEEL	GALVANIZED
	FLEXIBLE PIPE	Ø 50 mm T.B.D.		

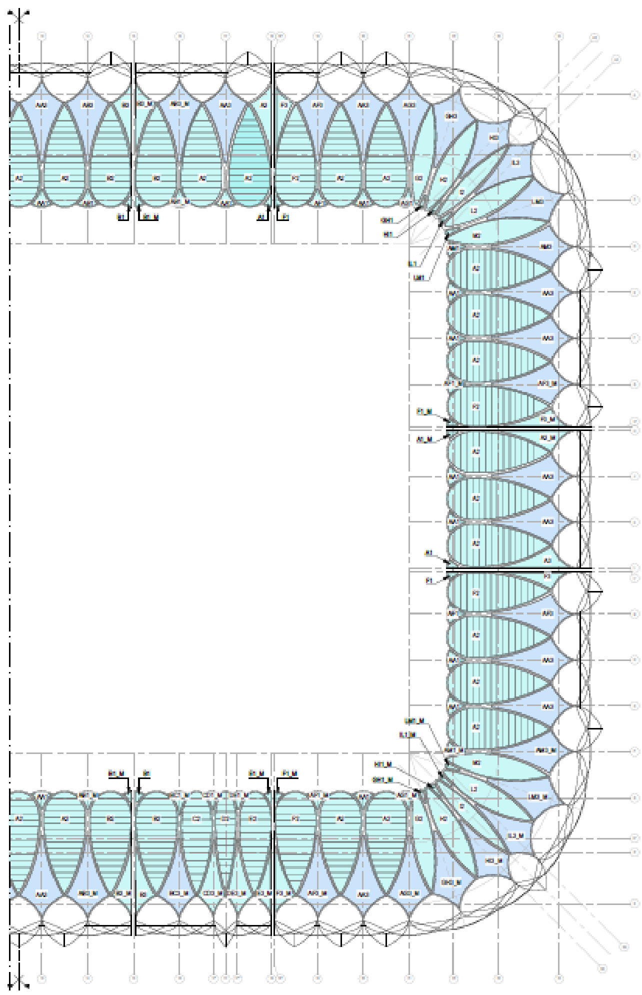


MAFFEIS engineering

TECHNICAL CONSTRUCTION SYSTEM



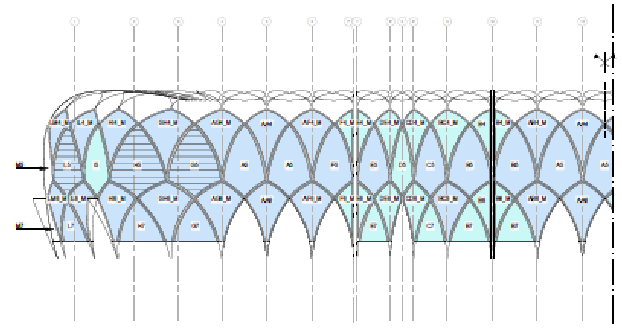
01 CABLE LAYOUT PLAN - ETFE UPPER LAYER



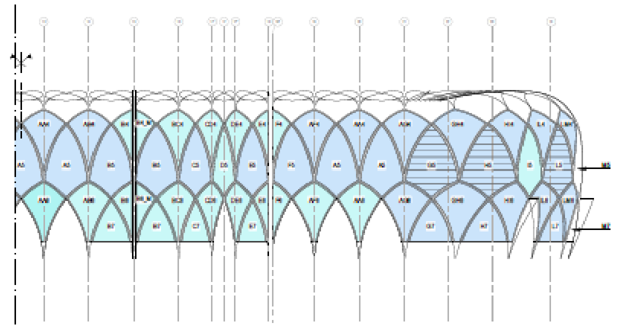
01 CABLE LAYOUT PLAN - ETFE LOWER LAYER

ETFE THICKNESS 200 µm

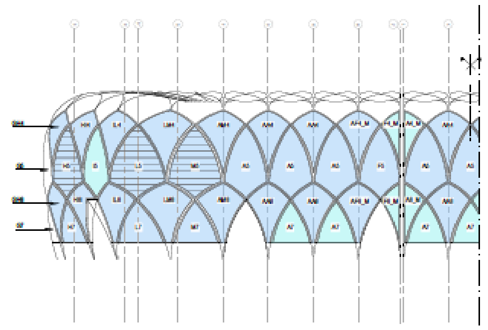
ETFE THICKNESS 250 µm



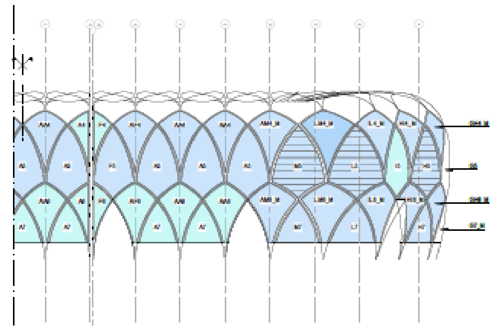
01 CABLES LAYOUT SOUTH ELEVATION - OUTER LAYER



02 CABLES LAYOUT SOUTH ELEVATION - INNER LAYER



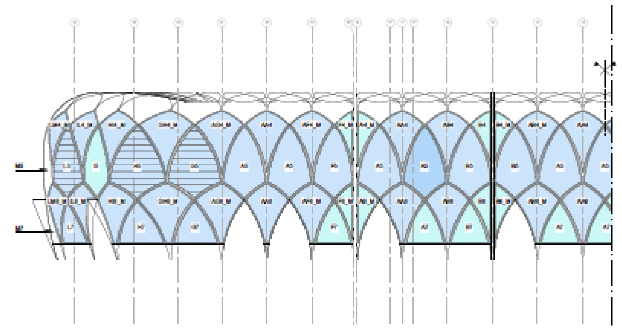
03 CABLES LAYOUT EAST/WEST ELEVATION - OUTER LAYER



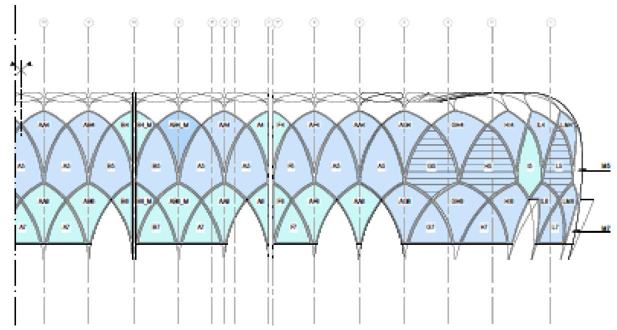
04 CABLES LAYOUT EAST/WEST ELEVATION - INNER LAYER

ETFE THICKNESS 200 µm

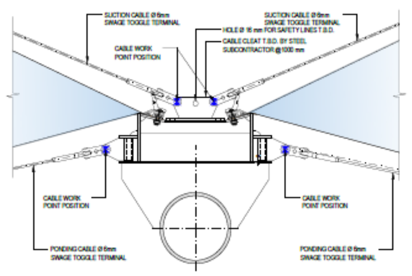
ETFE THICKNESS 250 µm



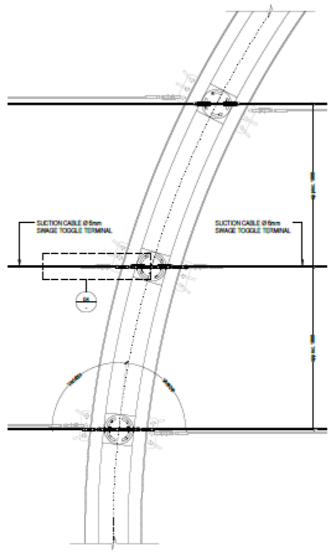
05 CABLES LAYOUT NORTH ELEVATION - OUTER LAYER



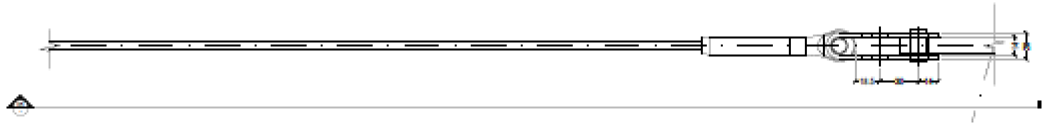
06 CABLES LAYOUT NORTH ELEVATION - INNER LAYER



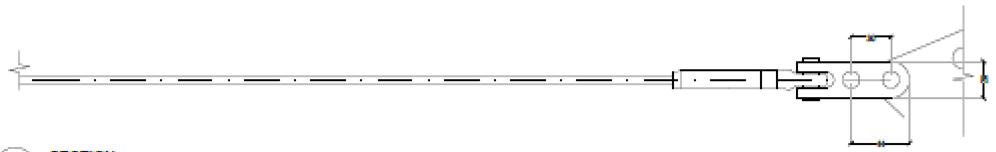
01 GUTTER TYPICAL SECTION



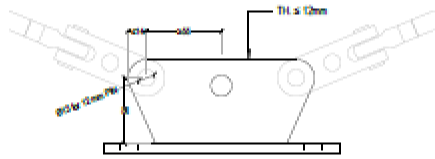
02 TYPICAL GUTTER PLAN VIEW ON STRAIGHT ZONES



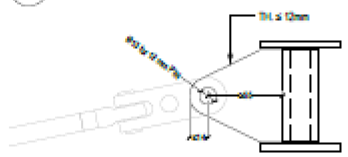
04 SWAGE TOGGLE TERMINAL TYPICAL DETAIL



05 SECTION



06 TYPICAL CLEAT



07 TYPICAL CLEAT

MAFFEIS engineering

LOCATION	Baltimore | U.S.A.
YEAR	2022 - 2024
STATUS	Completed
TYPE OF BUILDING	Commercial Building
SERVICE	Façade Engineering
FINAL CLIENT	Under Armour
CLIENT	Taiyo Europe GmbH
ENGINEER	Maffeis Engineering SpA
MATERIALS	ETFE | Cables | Steel | Aluminium

The new HQ, constructed almost entirely of mass timber, aims to achieve LEED v4 Platinum Certification, net zero energy operations, and the WELL Building Standard. The façade system helps enhance the building's striking glass envelope while delivering cutting-edge design and aesthetic appeal.
Maffeis Engineering is responsible for the ETFE Façade engineering and primary steel substructure.

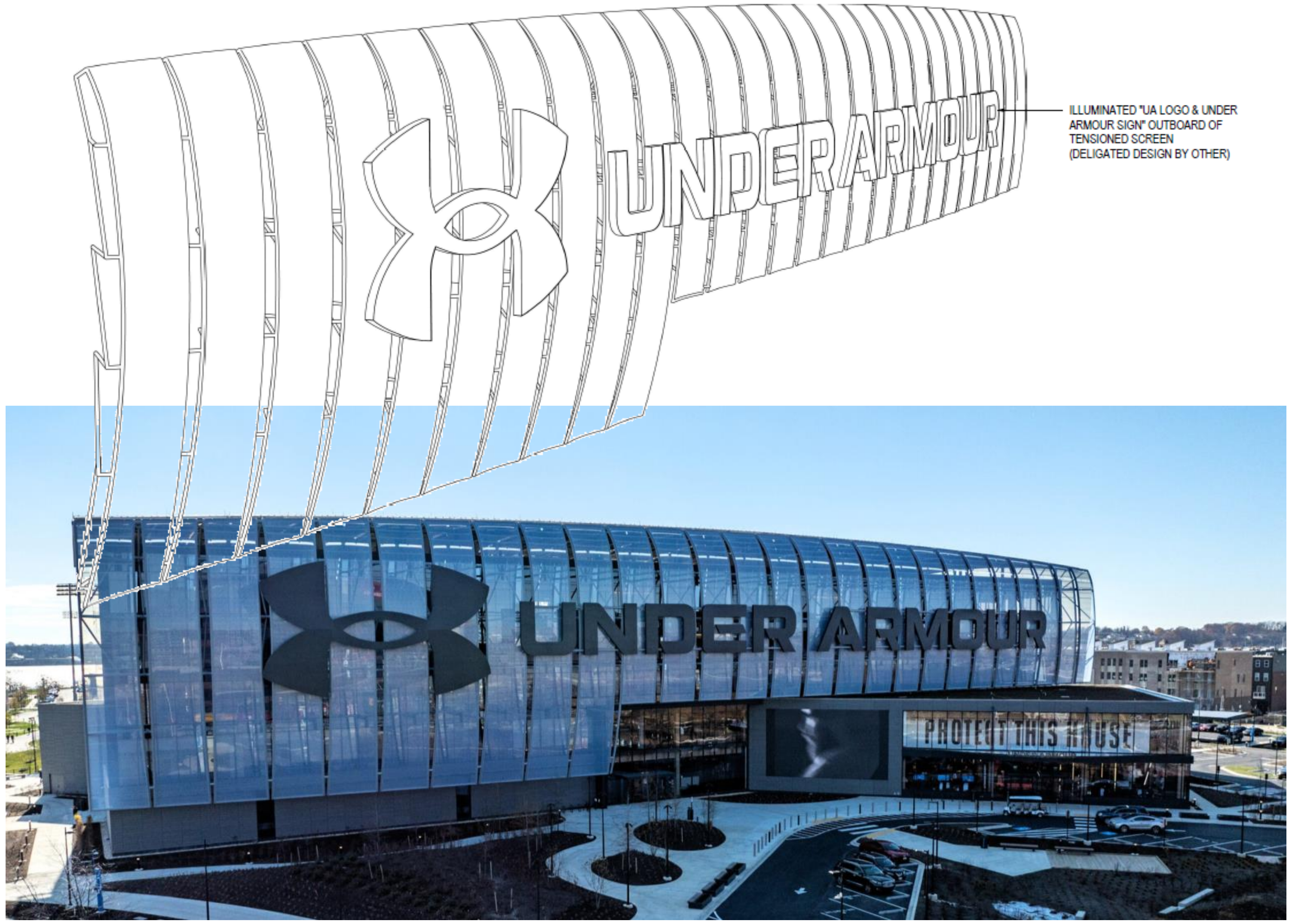
BUILDING TYPOLOGY

Under Armour Global Headquarters - A flagship building with a distinctive, lightweight identity

The project concerns the new global headquarters of Under Armour, an internationally recognized brand in sportswear and innovation.

Located in Baltimore's redeveloped port area, the building aims to reflect the values of performance, transparency, and sustainability.

The choice of an ETFE façade underscores the dynamic character of the brand, offering a fluid, continuous surface that envelops the building without adding excessive structural weight. **This is not a traditional curtain wall**, but a lightweight membrane system that **acts as a second skin**, enhancing the relationship between the interior and exterior while supporting the architectural ambition of **creating a visually impactful and technically advanced envelope**.



MAFFEIS engineering

FUNCTIONALITY

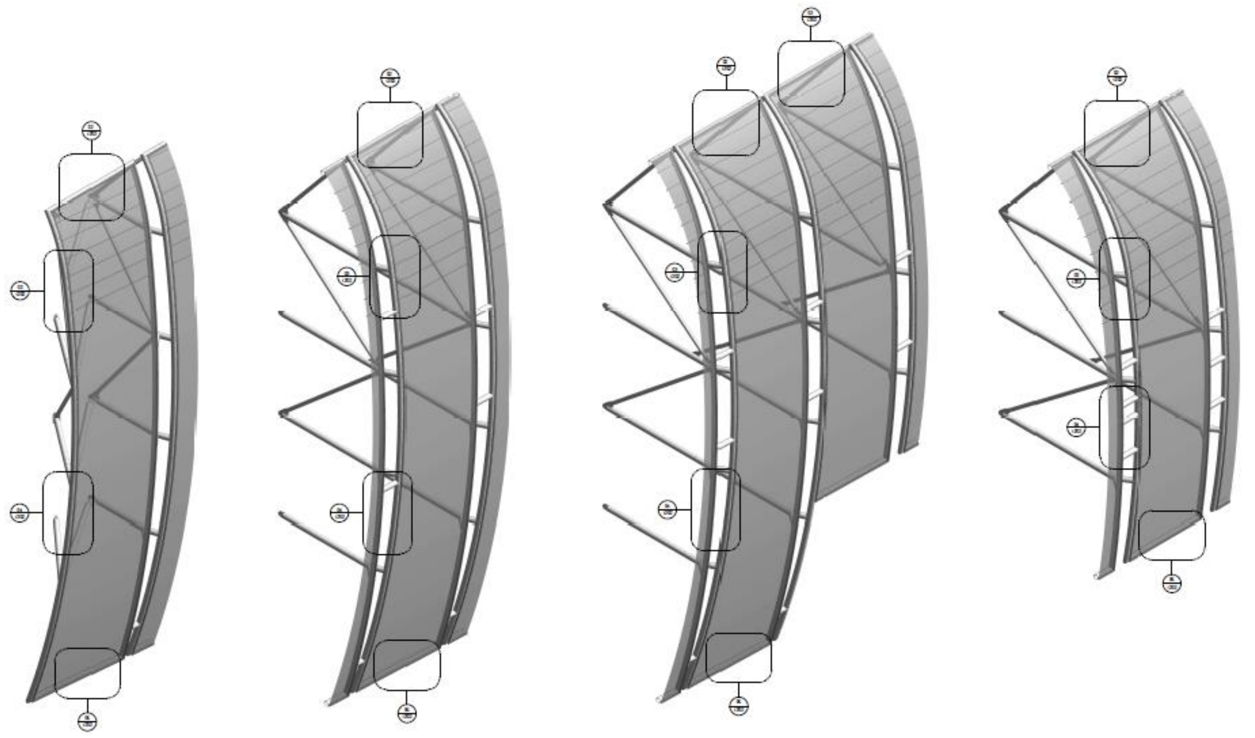
A breathable second skin for solar control and architectural expression

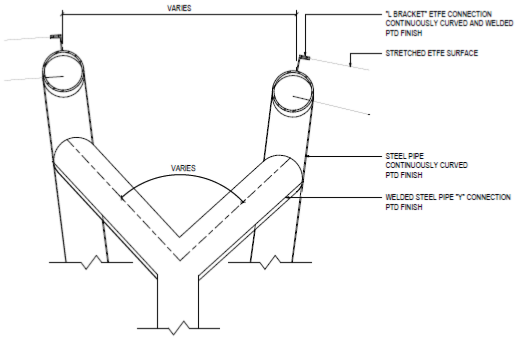
The ETFE facade at the Under Armour Headquarters was developed as a lightweight, high-performance shading layer applied directly over the building envelope.

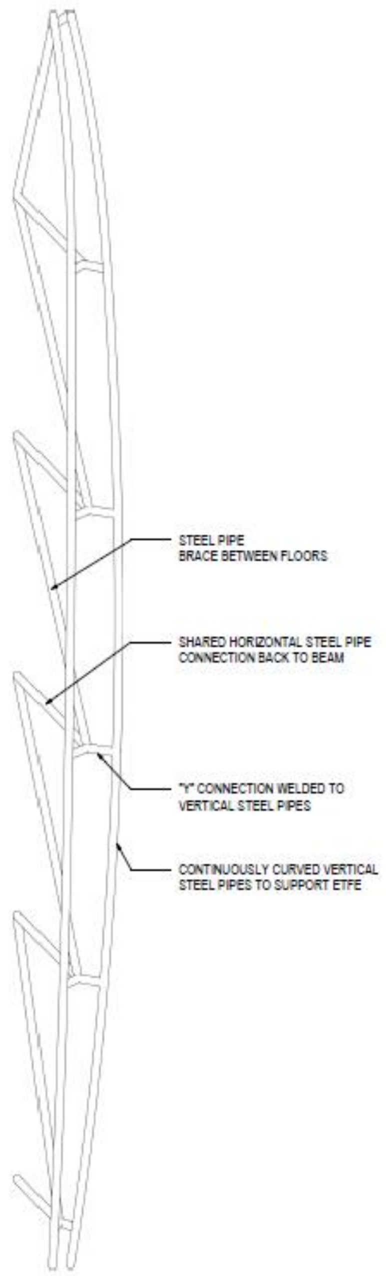
Its primary **function is to reduce solar gain and optimize interior comfort by achieving a carefully calibrated shading coefficient**, tailored through custom printing patterns on the ETFE film.

Installed as a single-layer membrane, the system acts as a passive solar screen while allowing diffused daylight to penetrate the facade, minimizing glare and reducing energy loads.

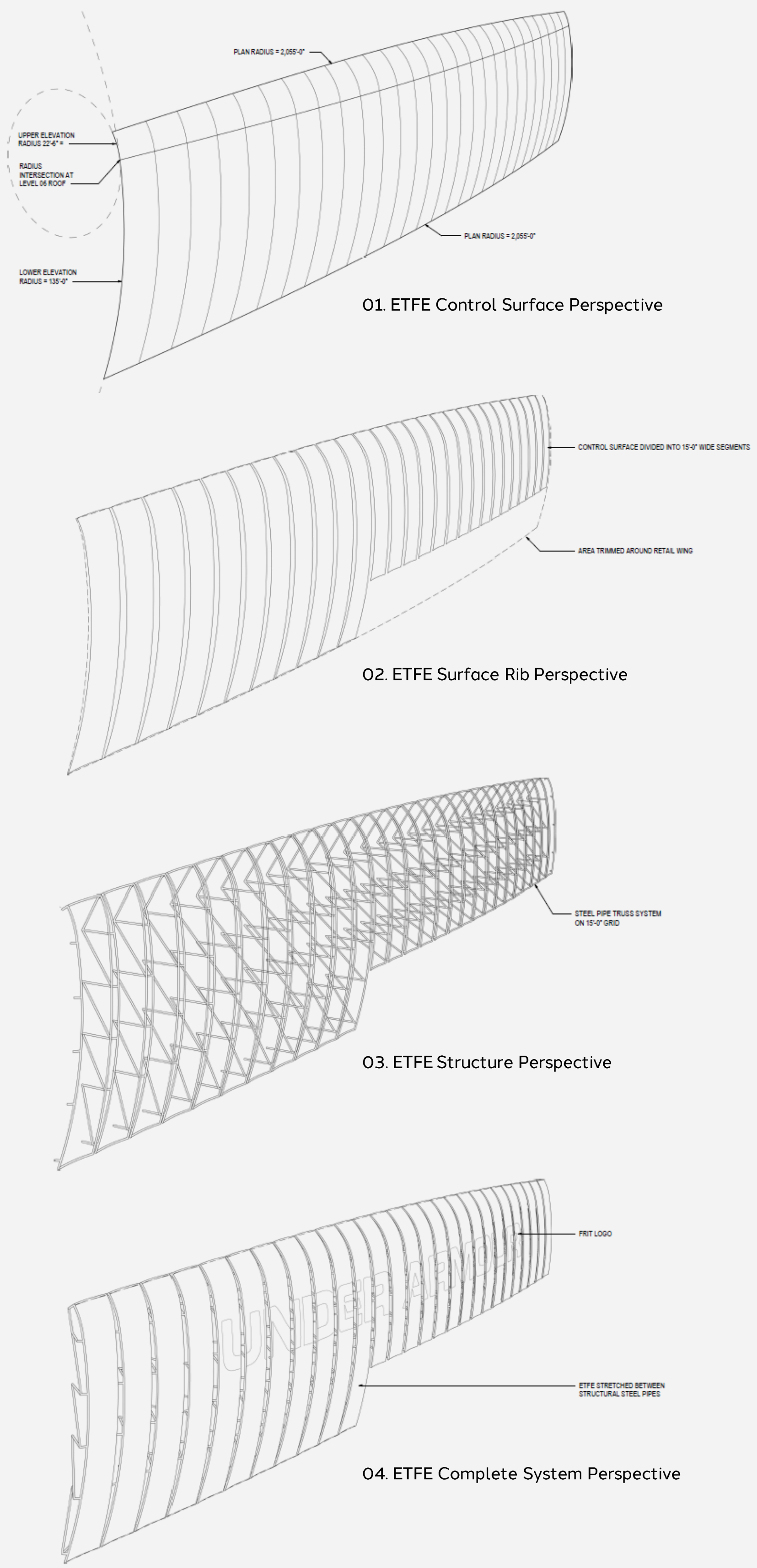
At the same time, it enhances the building's architectural identity, creating a sleek, tech-inspired outer layer that reflects the brand's innovative spirit.







ETFE Truss Axon



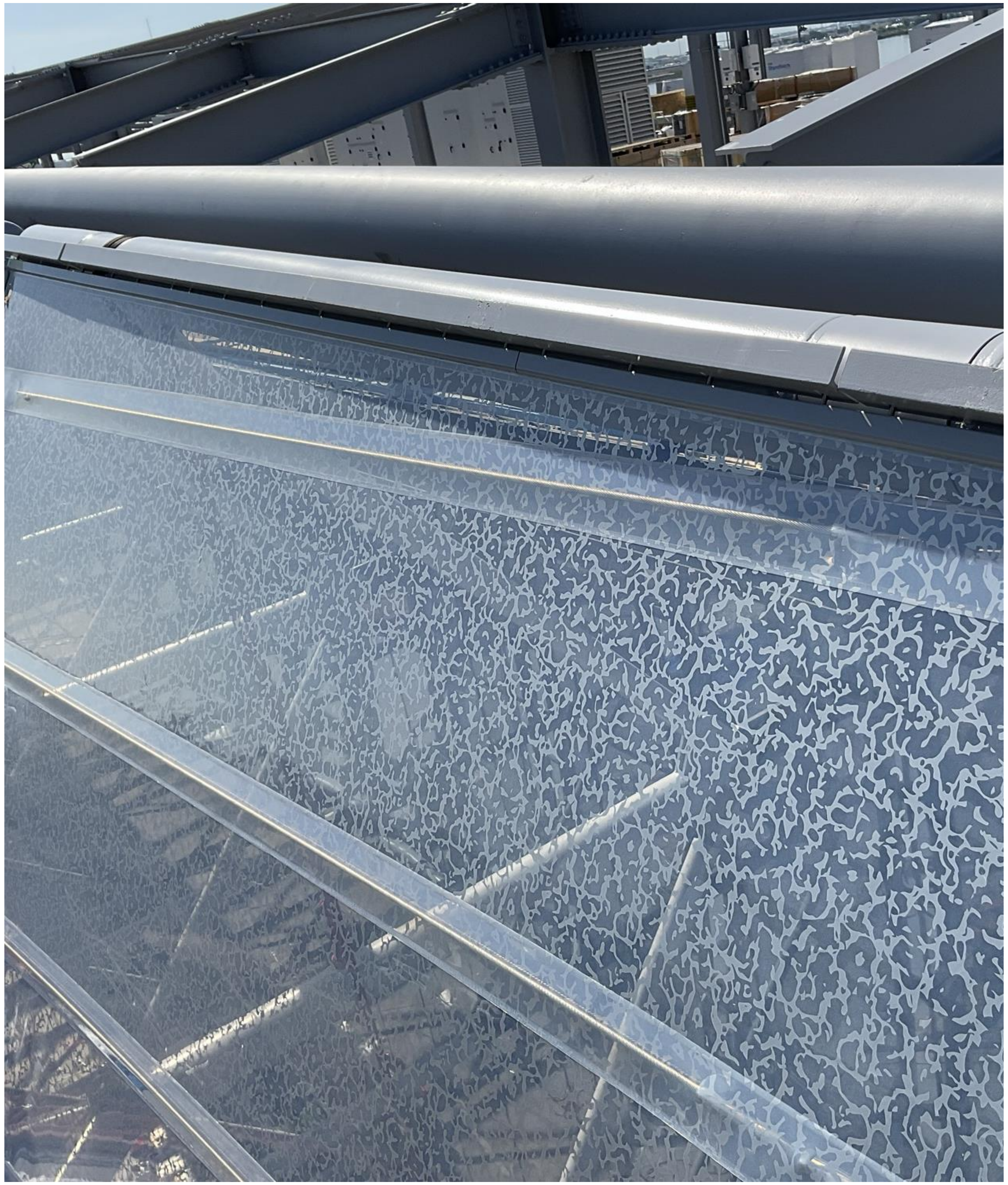
01. ETFE Control Surface Perspective

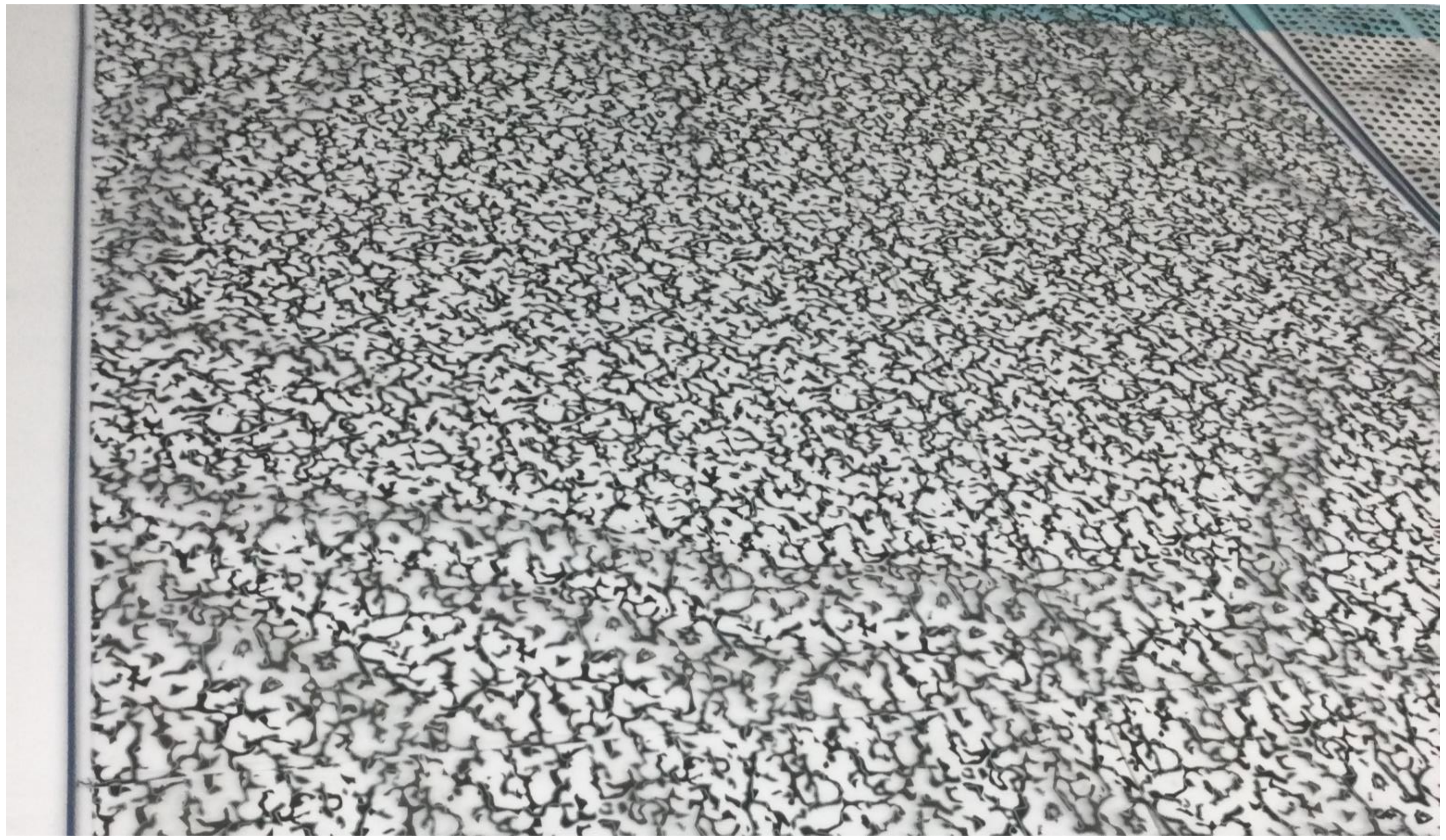
02. ETFE Surface Rib Perspective

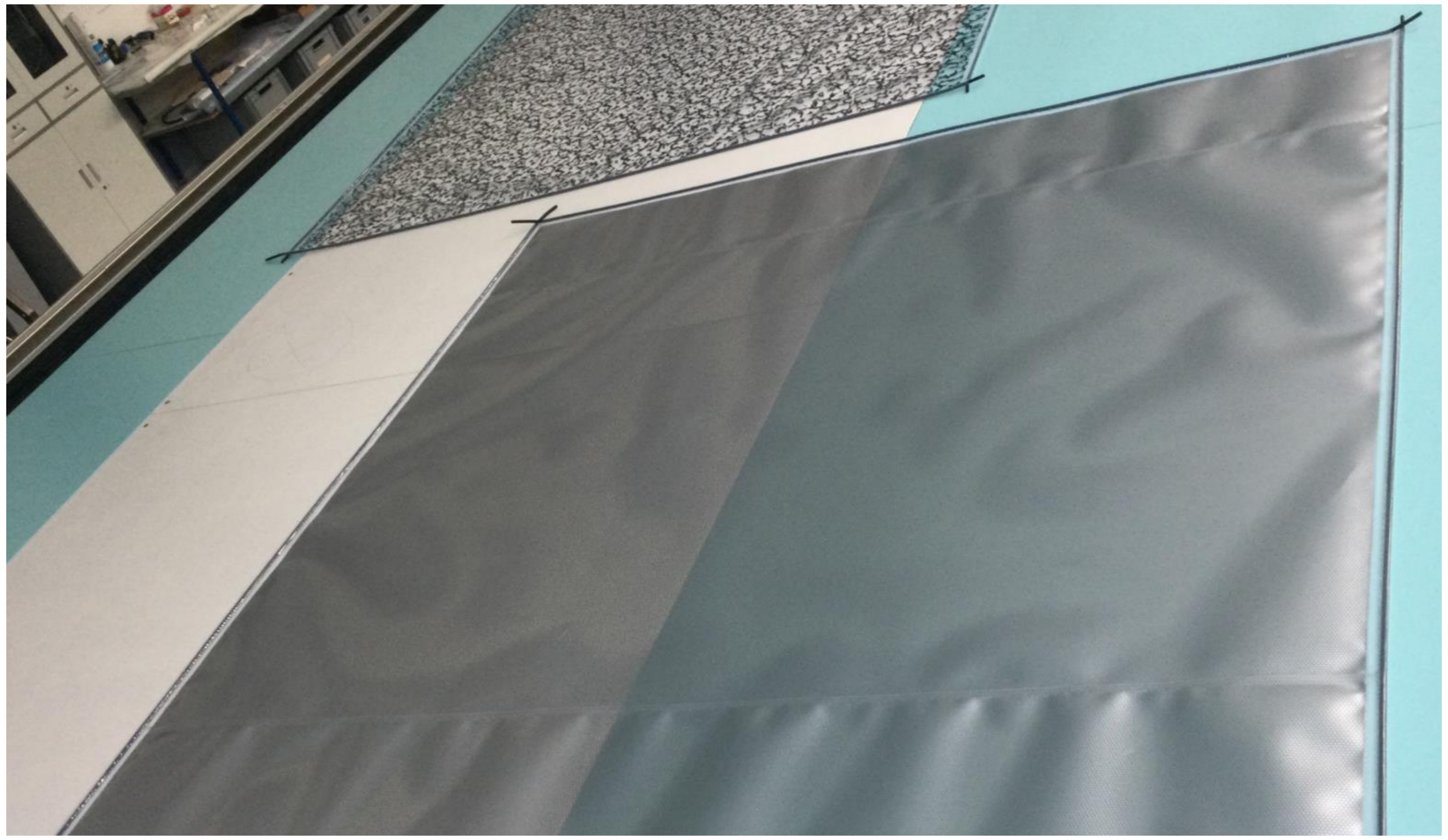
03. ETFE Structure Perspective

04. ETFE Complete System Perspective

MAFFEIS engineering







TECHNICAL CONSTRUCTION SYSTEM

Single-layer ETFE facade with minimal structure and printed shading

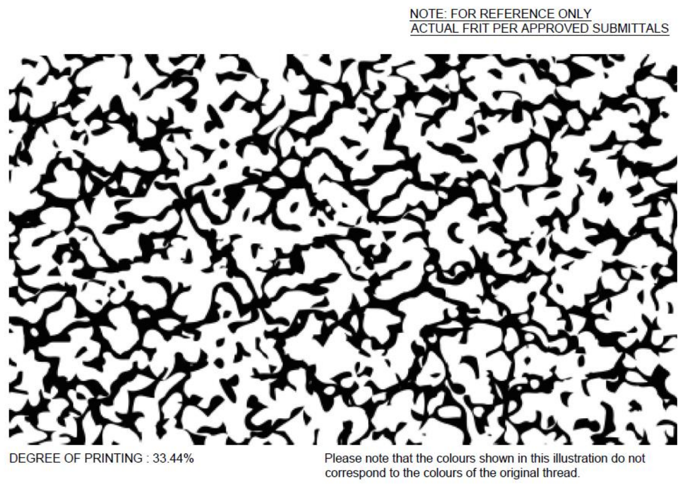
In this project, the ETFE membrane is used in a single-layer configuration stretched across a series of vertical steel trusses that form the primary support system. Unlike traditional ETFE cushion systems, this solution minimizes the need for air inflation or cavity management, opting instead for simplicity, lightness, and visual clarity.

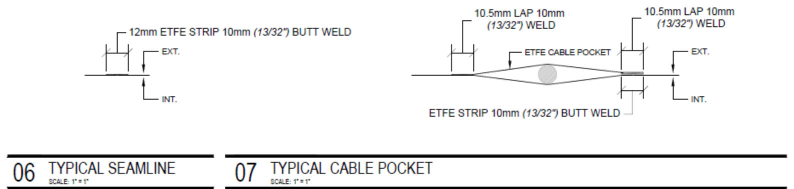
The membrane is printed with a custom-designed dot matrix pattern, tailored to deliver the desired solar shading coefficient, in line with the project's environmental and visual comfort goals.

The ETFE foil, with a thickness of 500 microns, is secured at its edges using aluminium clamping profiles, while a limited number of horizontal stainless-steel cables provide additional tension control and wind resistance where needed (primarily at the upper part of the system).

The trusses are fixed directly to the timber slabs of the building, allowing the ETFE to be deployed as a continuous second skin, independent of the primary façade. This approach results in a lightweight envelope that spans long horizontal distances with minimal anchoring points and no need for substructural framing behind the membrane.

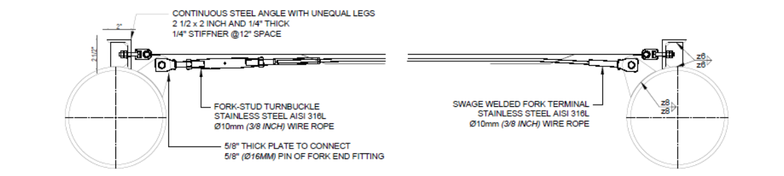
The exposed detailing of the system - cables, clamps, and profiles - is intentionally left visible, emphasizing the raw elegance and technical honesty of the construction, in line with the aesthetic language of the brand.





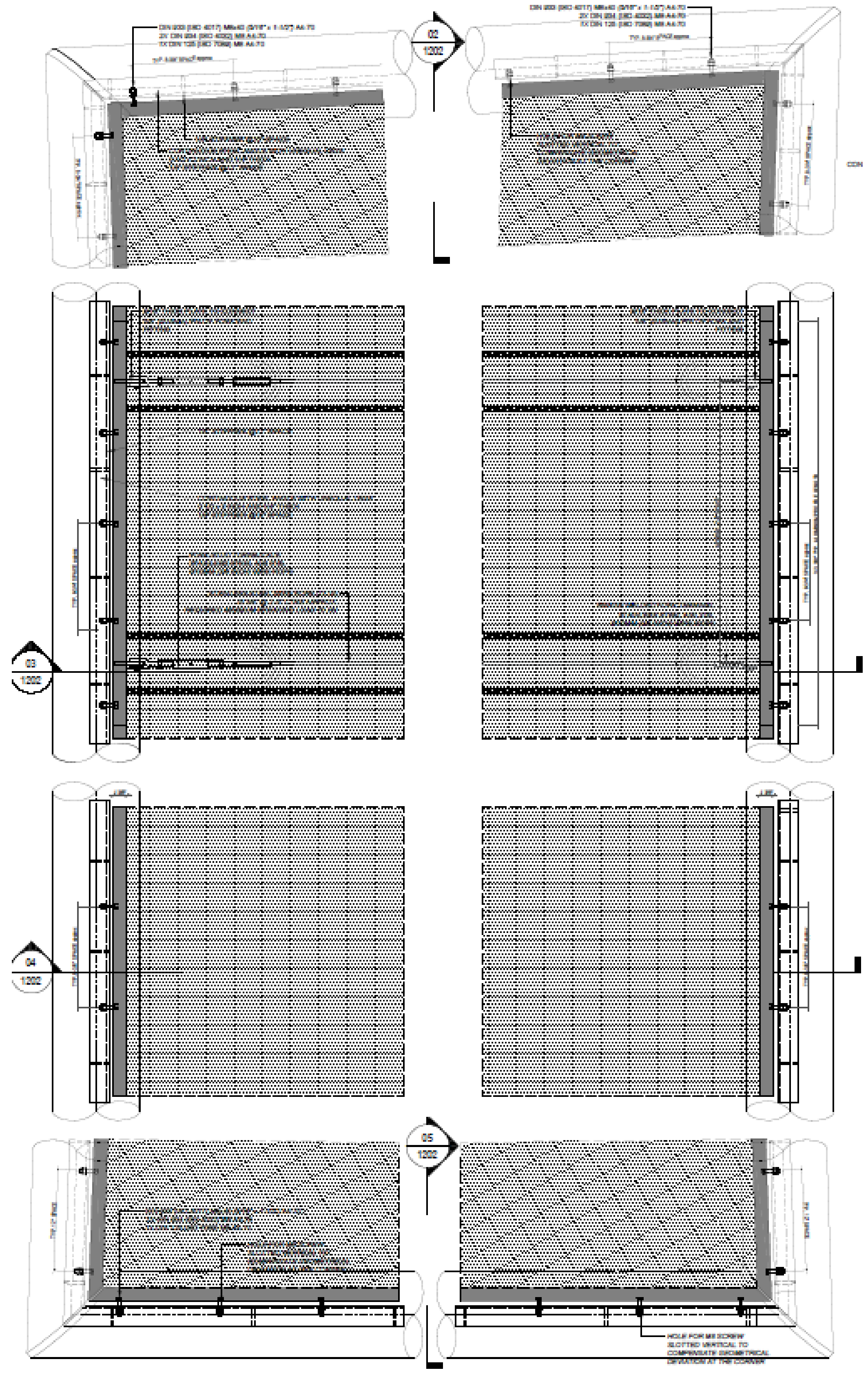
06 TYPICAL SEAMLINE

07 TYPICAL CABLE POCKET



03 SECTION 03

04 SECTION 04



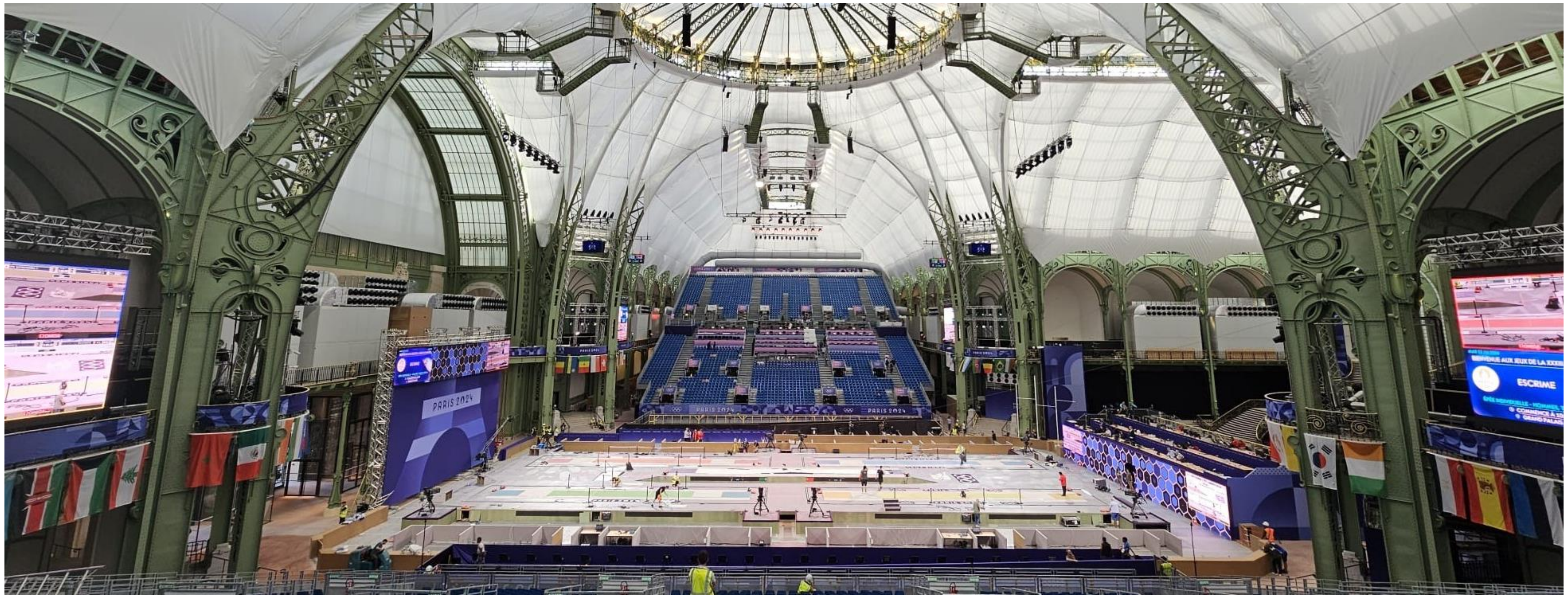
1 ETFE FACADE - TYPICAL PANEL

MAFFEIS engineering

LOCATION	Paris | France
YEAR	2022 - 2023
STATUS	Completed
TYPE OF BUILDING	Cultural Building
SERVICE	Tensile Structure
FINAL CLIENT	Ministere de l'Economie et des Finances
CLIENT	Taiyo Europe GmbH
ENGINEER	Maffeis Engineering SpA
MATERIALS	PTFE
SURFACE	15.000 m²

The Grand Palais, an iconic building in Paris built for the Universal Exhibition of 1900, was recently covered on the inside with Serge Ferrari's Tenseo 902 S2 membrane. As the largest glass roof in Europe, almost 15.000 m² of technical fabric had to be installed to darken the interior of the building, which hosted the Paris 2024 Olympic Fencing Games.

Maffeis Engineering was responsible for engineering, design and fabrication drawings for the roof membrane, fixation details and closures.

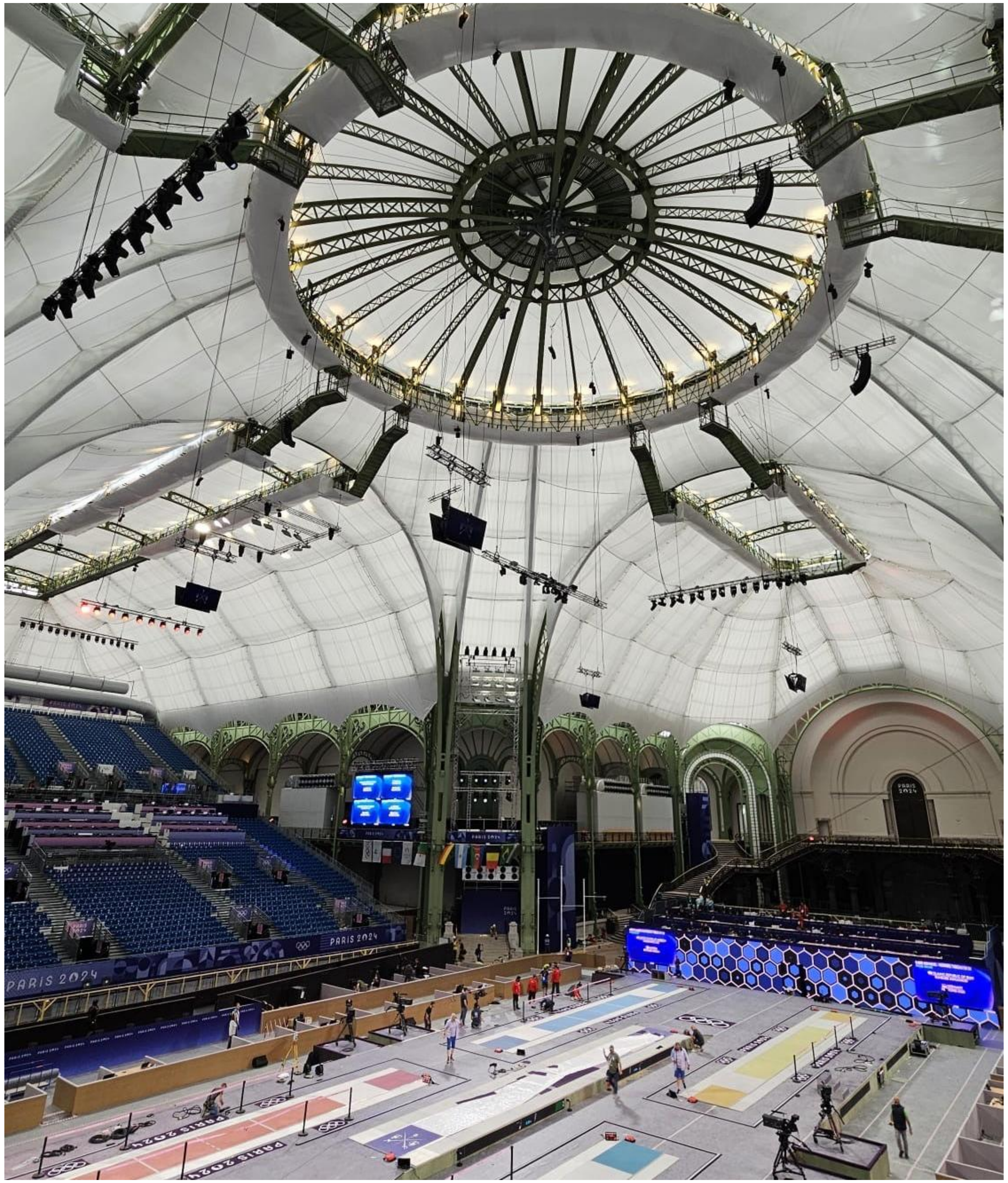


BUILDING TYPOLOGY

Grand Palais - A historical landmark temporarily transformed for a global event

The Grand Palais is one of the most iconic buildings in Paris, renowned for its monumental glass vault and its historical and artistic significance.
In preparation for the Paris 2024 Olympic Games, the building was repurposed to host various events, requiring a temporary yet effective shading solution to protect the interior from direct sunlight.

The use of a lightweight textile membrane allowed for full coverage of the vast glazed surfaces without invasive anchoring, preserving the integrity of the historic structure. This project highlights how technical textiles can be discreetly integrated into highly sensitive architectural contexts, where reversibility, elegance, and respect for heritage are paramount.



MAFFEIS engineering

FUNCTIONALITY

Temporary solar protection through adaptive textile design

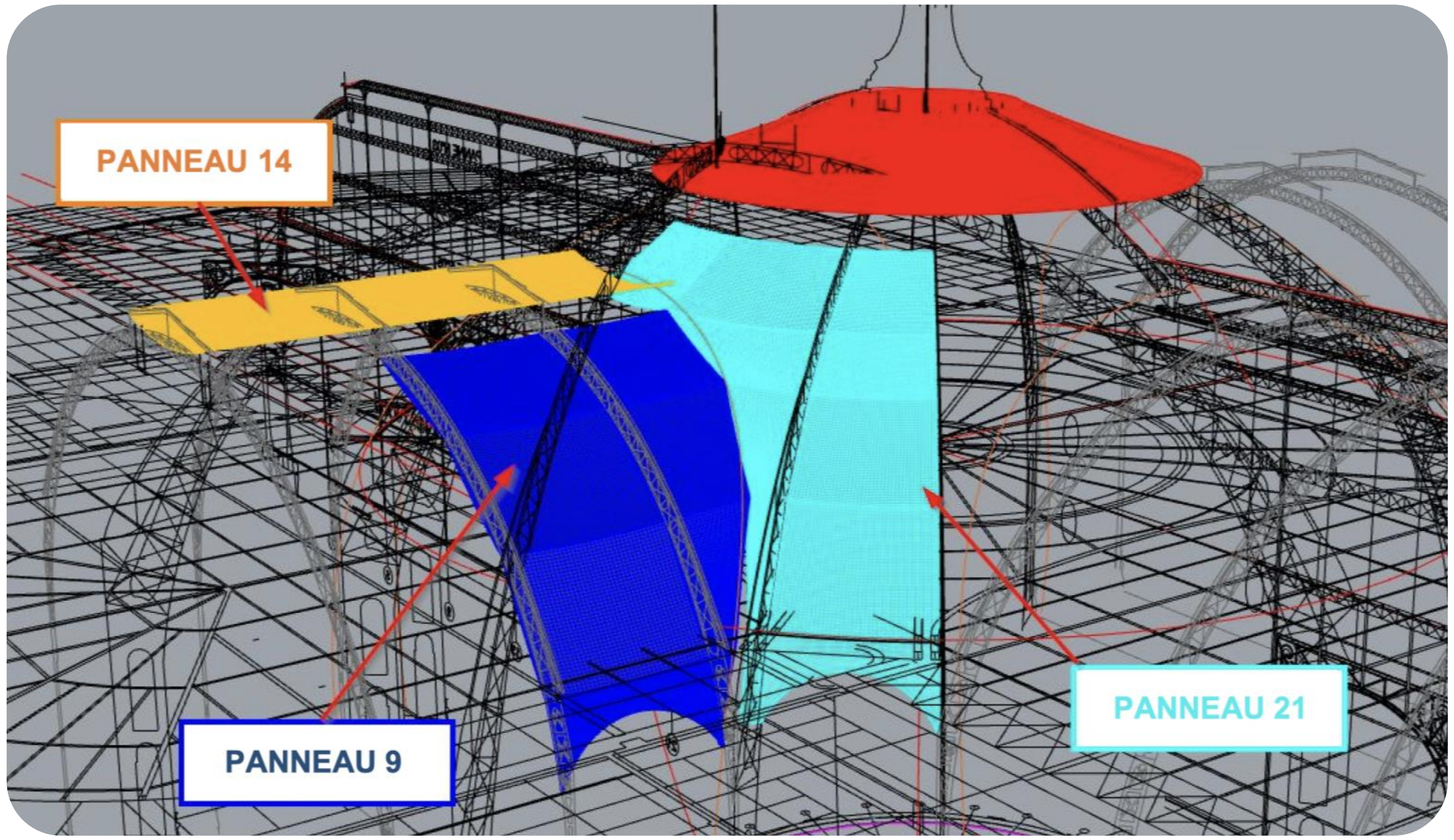
The textile membrane installed inside the Grand Palais served a temporary yet essential function: to block and diffuse direct sunlight entering the vast interior through the original glass vaults during the Paris 2024 Olympic Games.

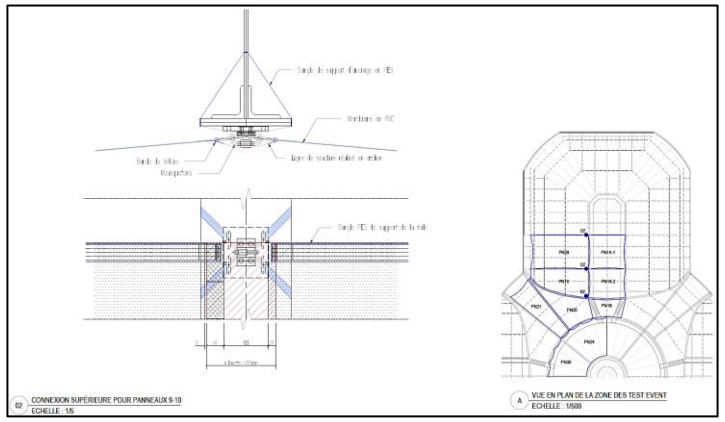
The objective was to ensure visual comfort and thermal moderation for both spectators and athletes, without permanently altering the historic structure.

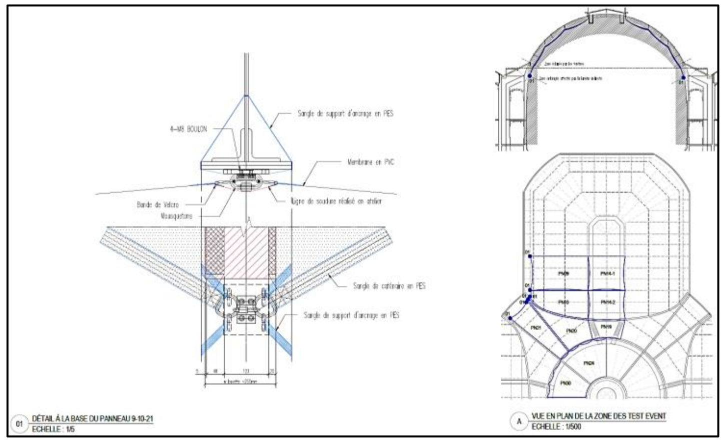
Designed as a non-invasive, removable shading system, the PVC/PES textile panels were suspended delicately across the vast spans of the nave, shaped to evoke classical drapery and respect the elegance of the architectural space.

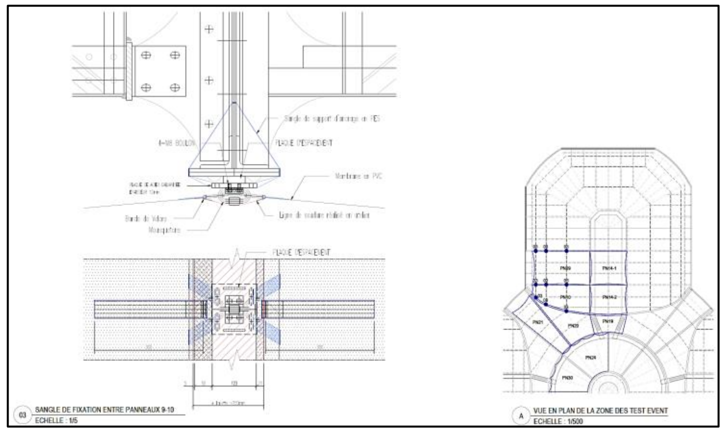
The fabric's optical and thermal properties were specifically selected to balance light filtration with minimal heat transmission.

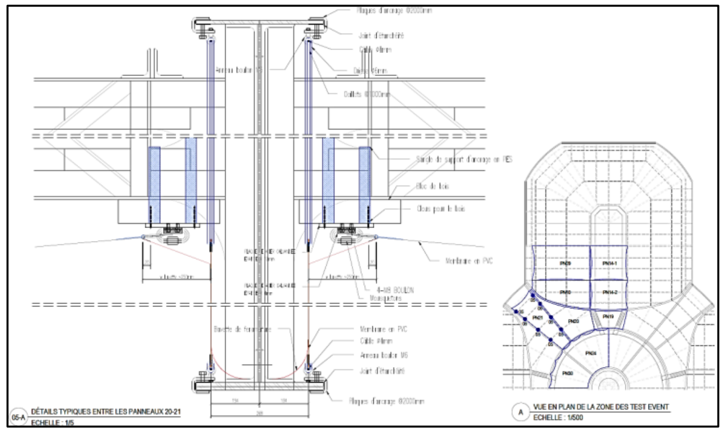
Every attachment point was engineered to avoid structural overloading, while the overall layout ensured rapid assembly and disassembly - a key requirement for a venue returning to its original state post-event.

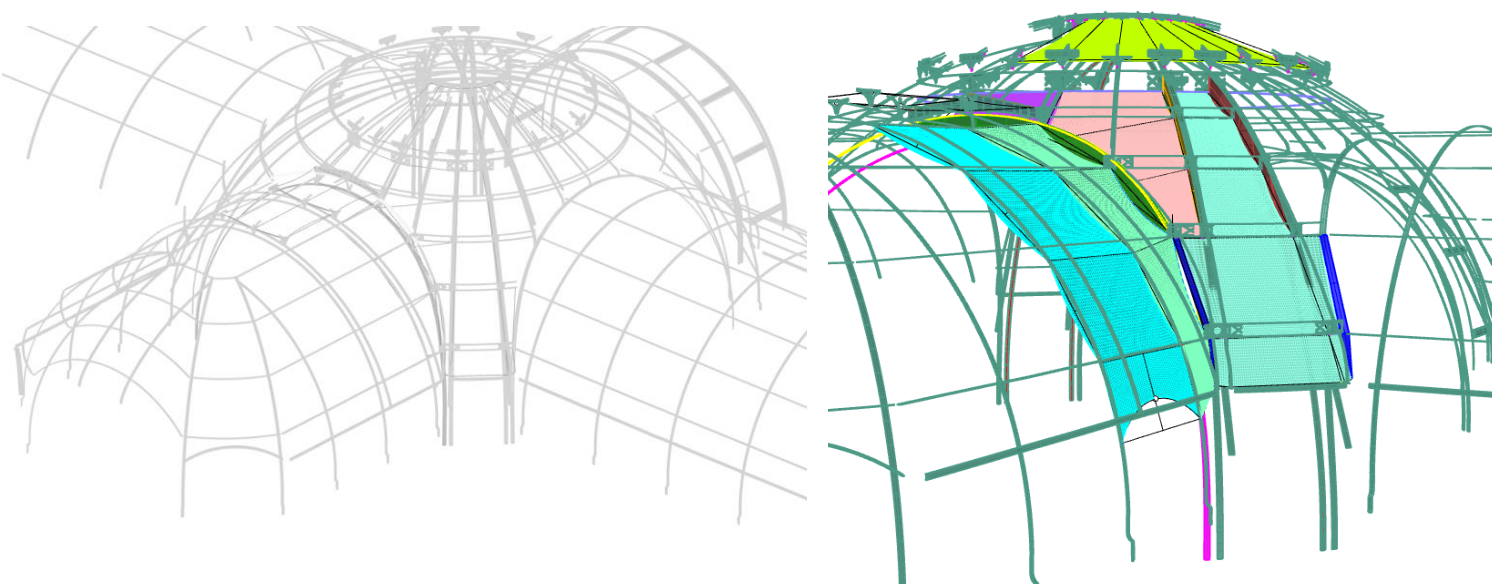












Form-finding with Linear Projection

MAFFEIS engineering

TECHNICAL CONSTRUCTION SYSTEM

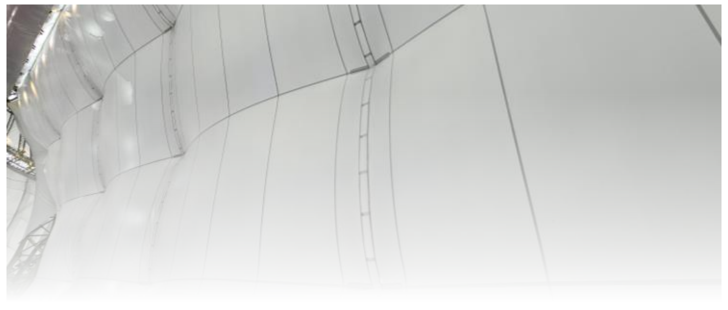
Reversible PVC/PES inner shading system with non-invasive fixing strategy

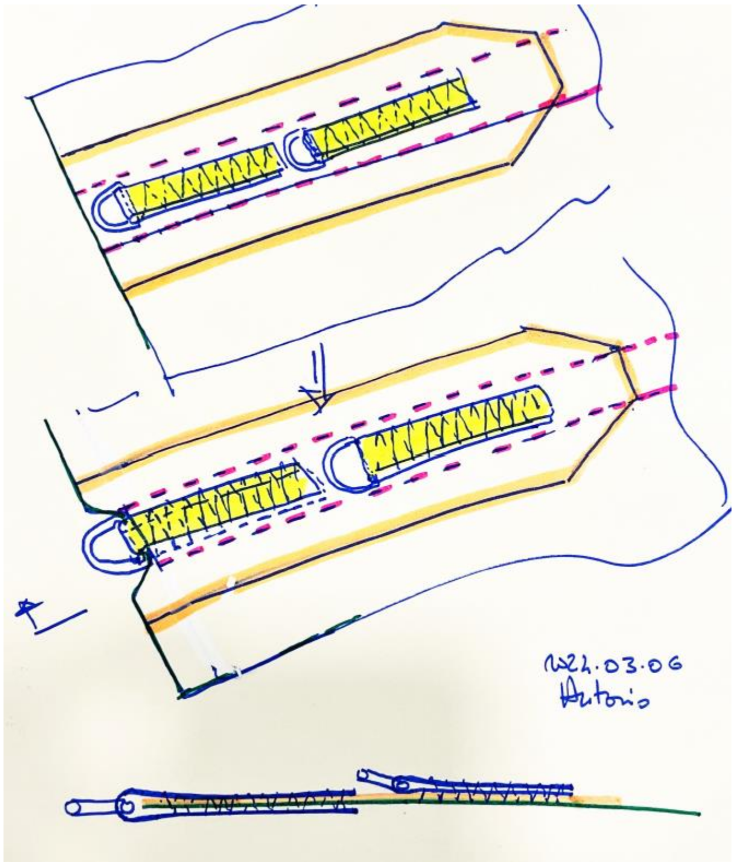
The shading membrane installed inside the Grand Palais is made of PVC-coated polyester fabric, selected for its excellent solar shading capabilities, fire resistance, and light diffusion properties. The fabric is arranged in large-scale panels that follow the curvatures and rhythm of the historical steel-and-glass structure without touching or altering it permanently.

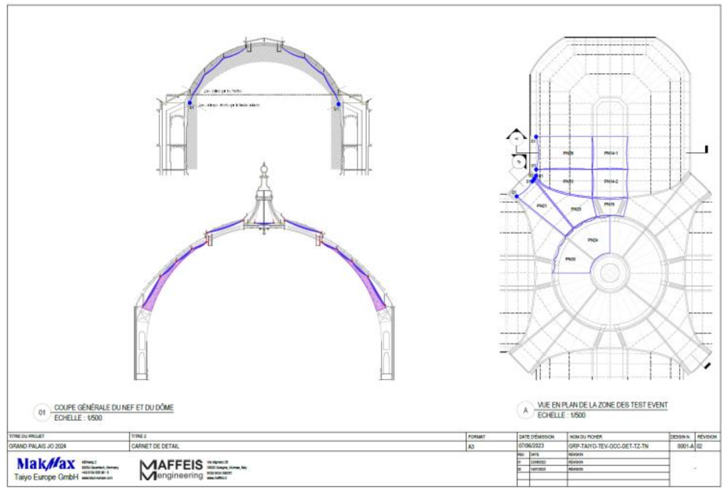
The system is entirely non-invasive, complying with strict heritage preservation constraints. Fixings are clamped to existing structural elements using reversible brackets and custom-designed aluminium components that allow for a friction-based grip, avoiding any perforation or permanent connection.

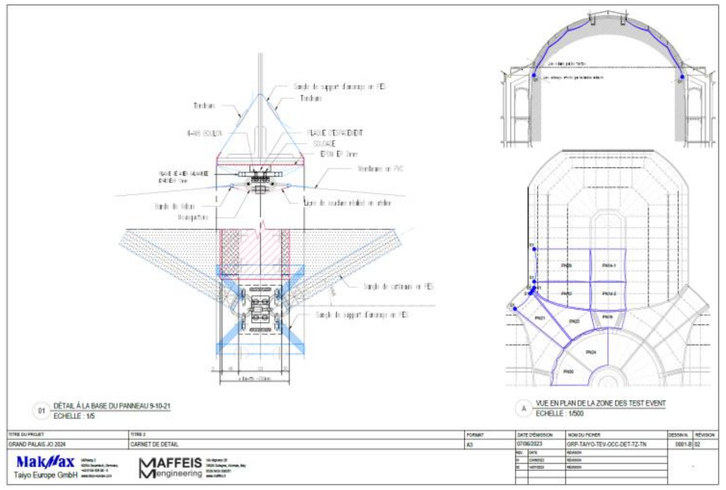
Particular attention was given to installation logistics, with lifting and tensioning sequences carefully engineered to minimize time on-site and avoid disruption to the protected interiors.

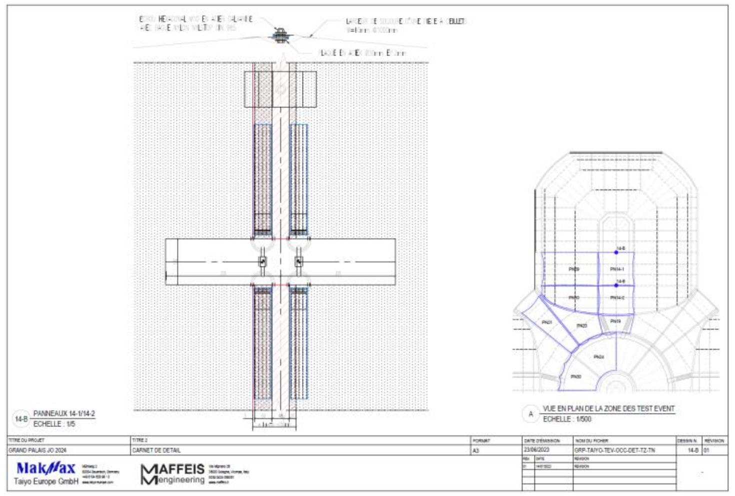
This construction solution demonstrates how technical textiles can solve complex constraints - in this case, offering temporary, lightweight shading while fully respecting and preserving a world-class architectural heritage.

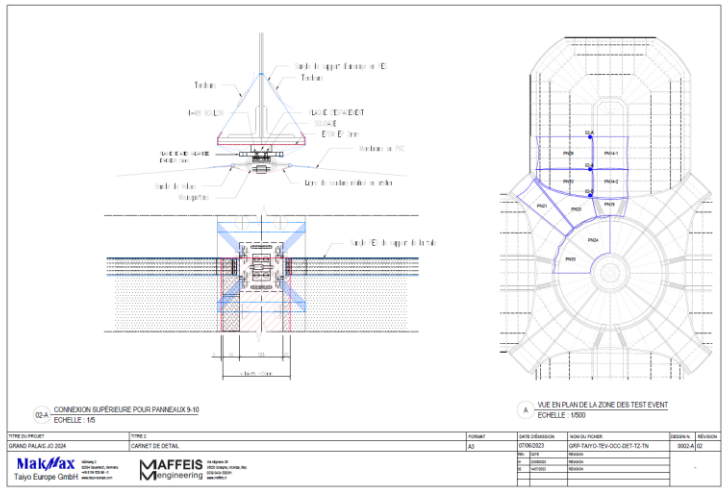




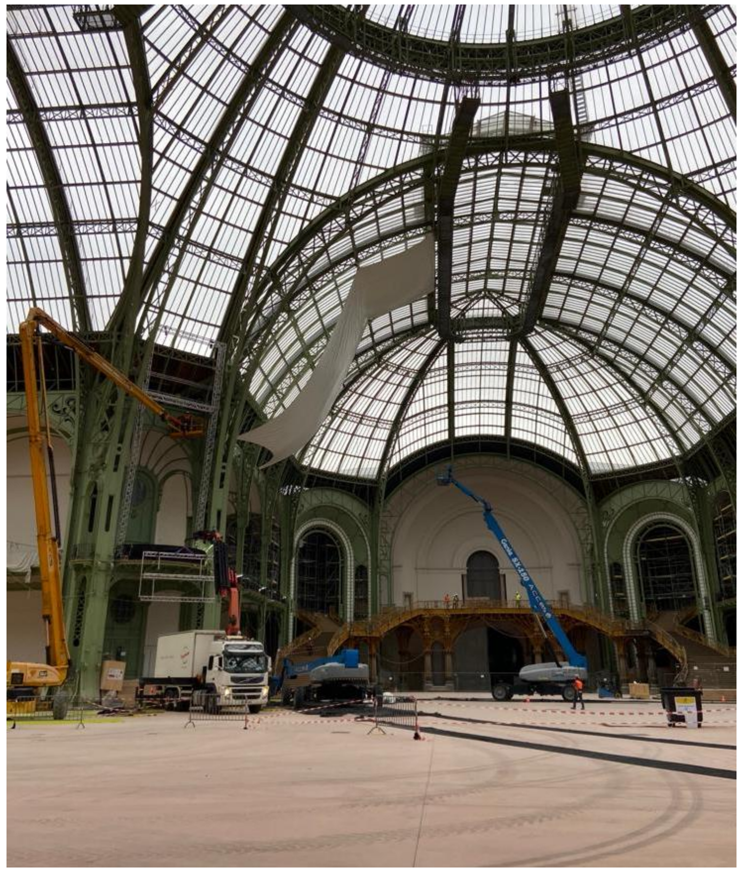


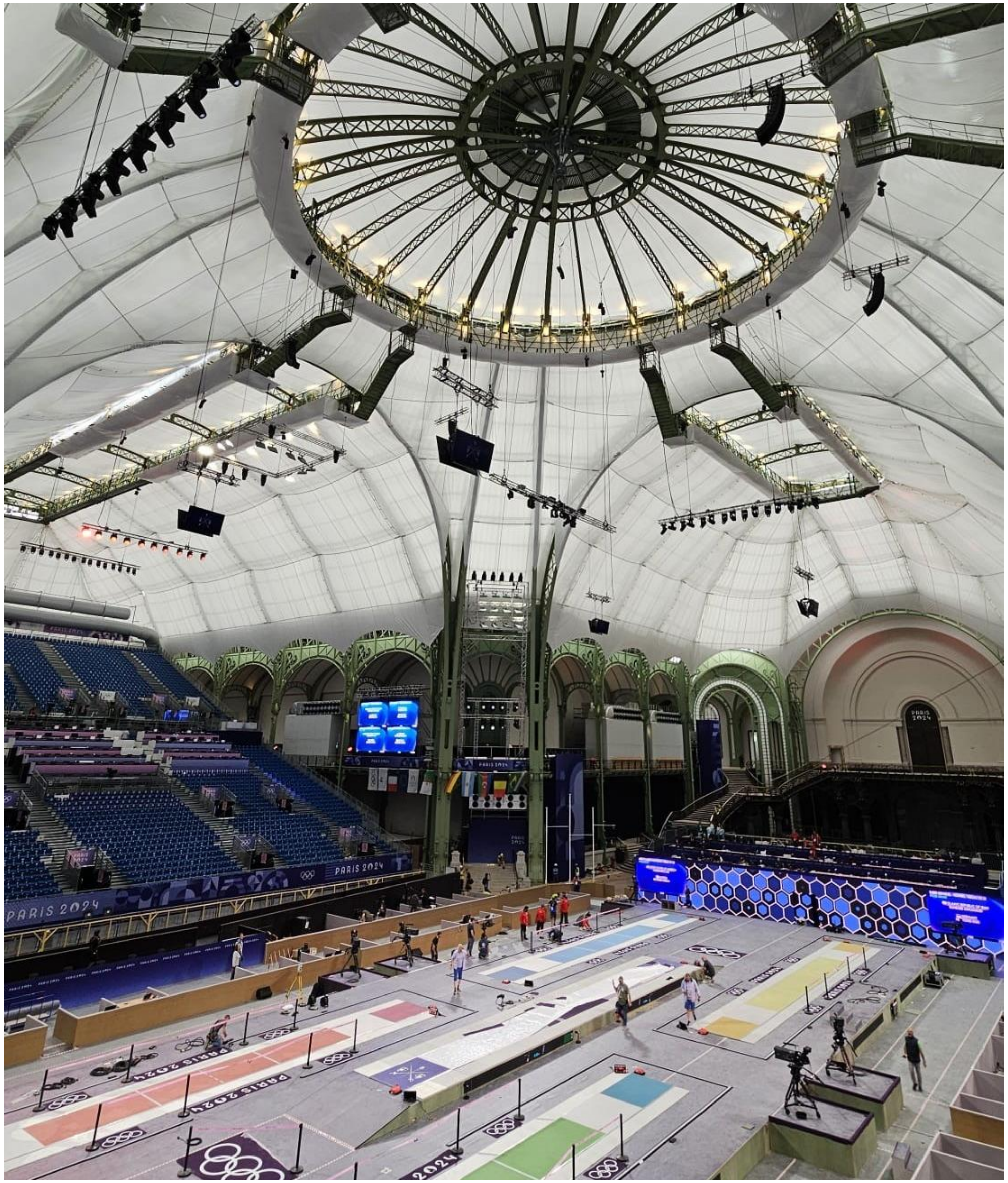


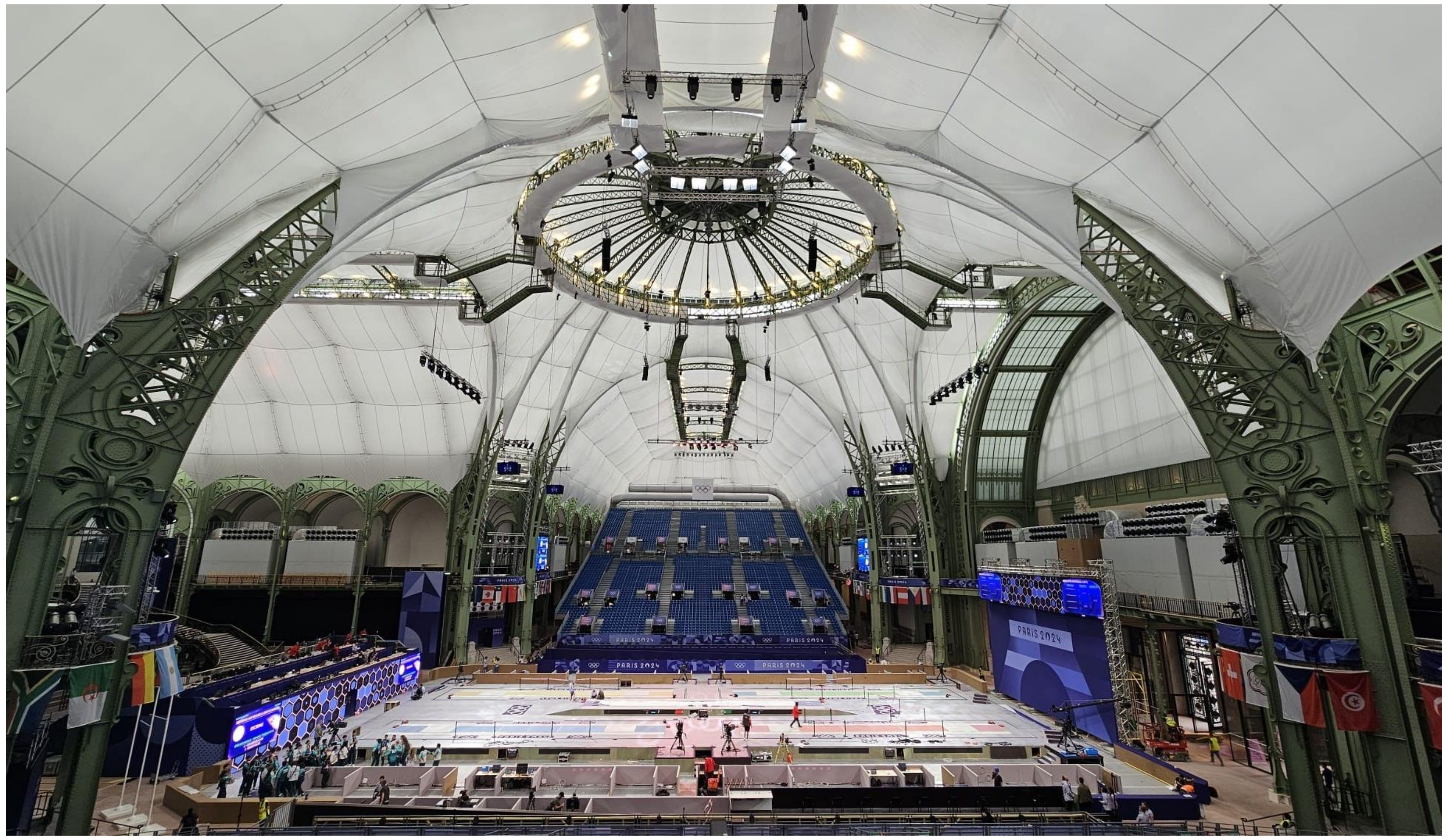




MAFFEIS engineering







FROM PROJECTS TO EXPERIENCE

These three projects demonstrate how the use of lightweight materials is no longer merely a technical or economic choice, but a conscious architectural decision capable of addressing very different contexts—enhancing efficiency, reducing structural impact, and offering refined aesthetic solutions. Lightweight architecture does not simply mean 'less weight,' but greater design freedom, increased sustainability, and enhanced versatility.

MAFFEIS ENGINEERING

ABOUT THE FIRM

Maffeis Engineering is a leading multi-disciplinary engineering firm with a team of over 312 professionals, including Architects, Civil, Mechanical, Façade, and Structural Engineers.

Our comprehensive services span from initial project conception to final handover, encompassing a diverse range of engineering disciplines such as Stadia & Arenae, Facade Engineering, Bridges & Viaducts, Civil Works, Special Steel, Tensile & ETFE Structures, and Geotechnical Engineering. Additionally, we have established specialized expert teams focused on highly specific engineering domains.

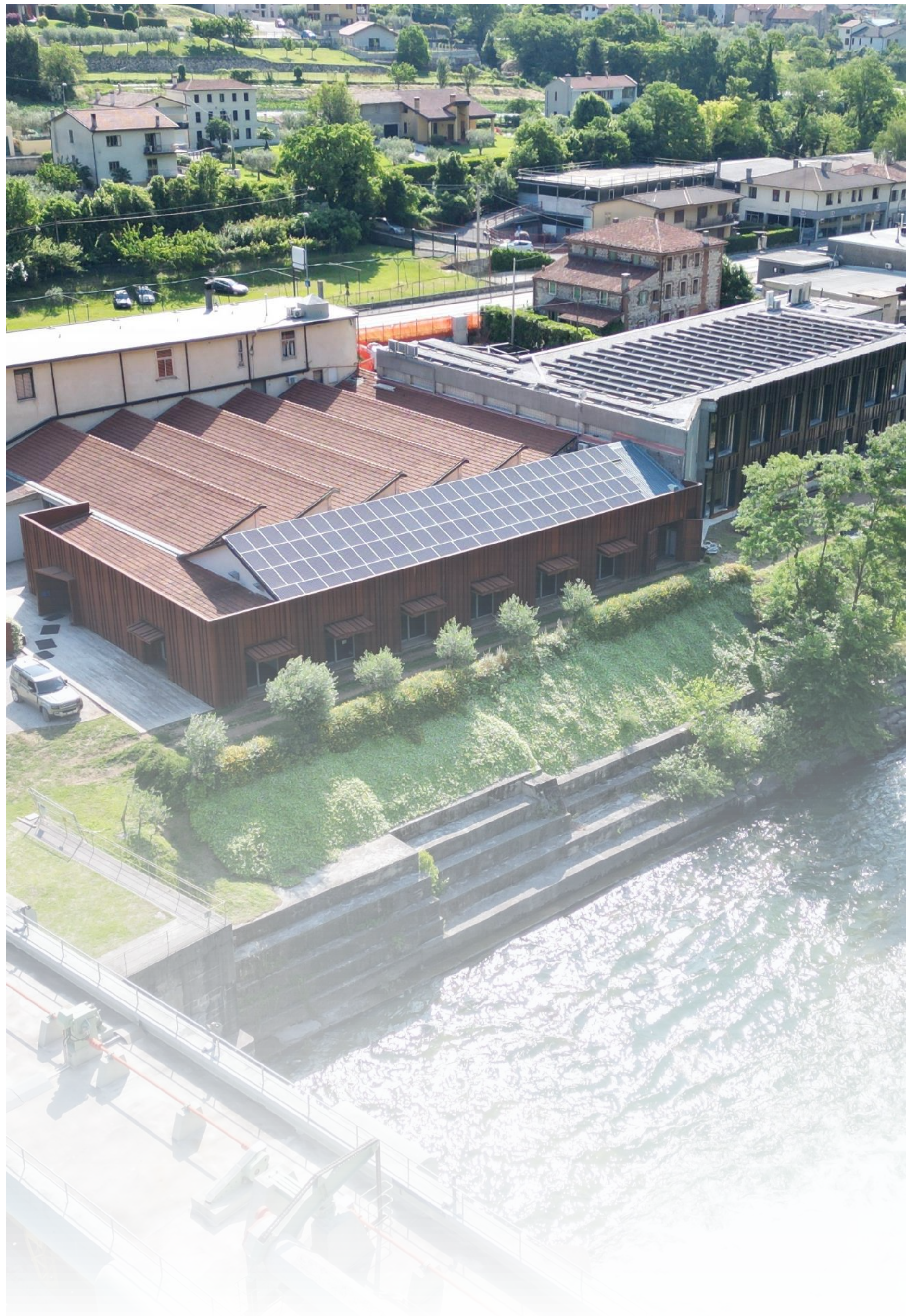
Our core mission at Maffeis Engineering is to deliver unparalleled engineering solutions to our clients. We achieve this through streamlined workflows, standardized processes, and continuous improvement efforts, with a strong emphasis on environmental sustainability and workplace health and safety. Our UNI ISO certifications underscore our unwavering dedication to these principles.

Headquartered in Solagna, Italy, Maffeis Engineering also maintains offices across the globe, including locations in the United Kingdom, Romania, Switzerland, France, United States, South Africa, Germany, Norway, Canada, United Arab Emirates, Australia, and Hong Kong.

Within our Structural Engineering division, we boast a team of highly skilled professionals specializing in the design of large-scale covers and roofs, particularly for stadia, stations, airports, special steel structures, and long-span constructions. We are industry leaders in providing comprehensive engineering solutions for civil buildings and stadia, with expertise in retractable roofs and movable mechanical systems for sports facilities.

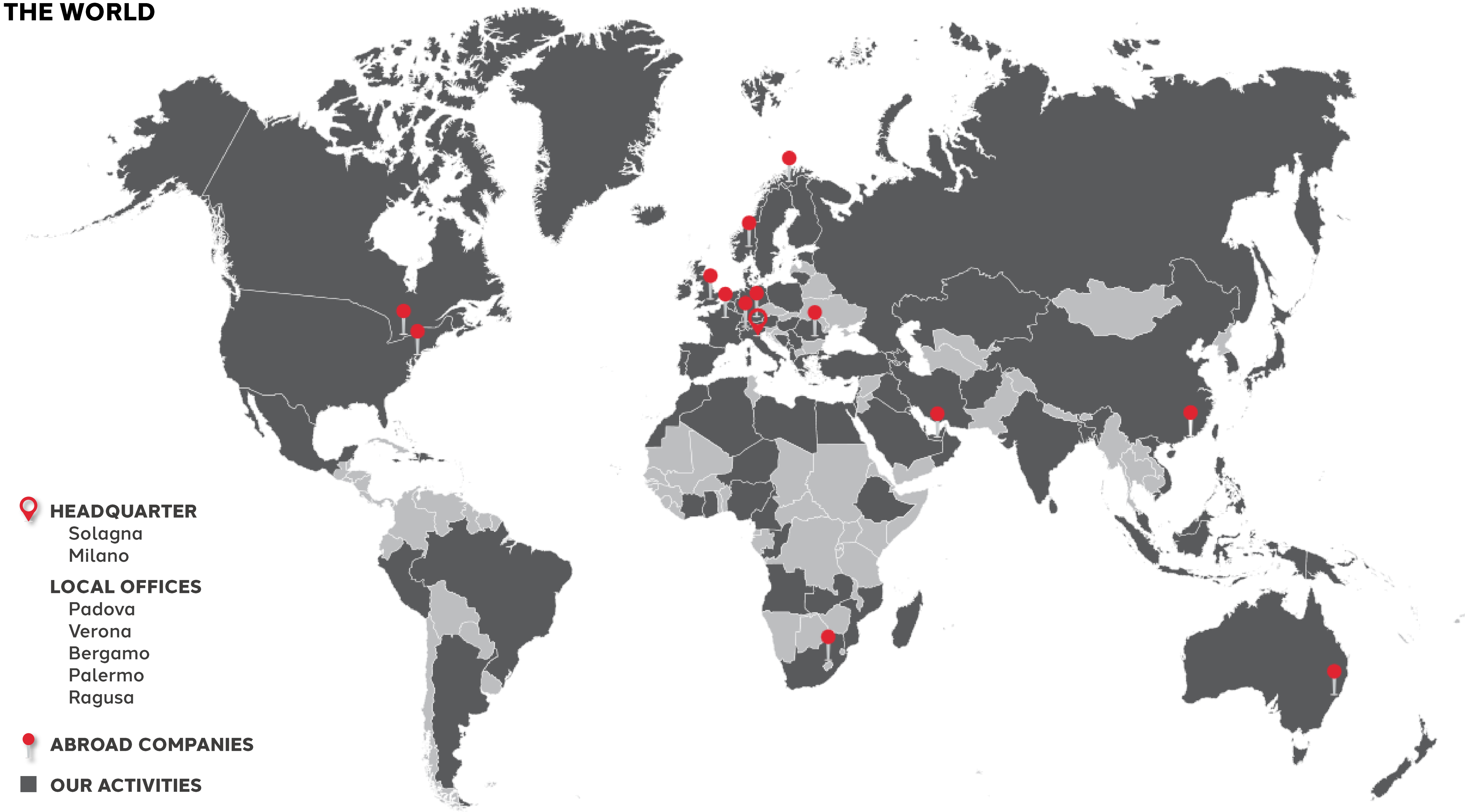
Furthermore, Maffeis Engineering possesses extensive experience in the conceptualization, preliminary design, and finalization of steel bridges of various types. Our team comprises Structural Engineers, Architects, Facade Designers, Mechanical Engineering consultants, and technical specialists, offering a wide spectrum of professional design and engineering services. Supported by in-house software developers, draftsmen, and a well-organized back-office staff, our highly motivated team thrives on excellence and innovation.

At Maffeis Engineering, we recognize that our people are our greatest asset. Through a robust training program that includes both in-house initiatives and external courses, we continuously invest in cultivating new talent and complementing the expertise of our seasoned professionals



(*) UNI ISO 9001:2015 - Quality Management System
UNI ISO 14001:2015 - Environmental Management System
UNI ISO 45001:2018 - Health and Safety Management System

AROUND THE WORLD



+ 4,500	+ 60	13	312	224	51
projects worldwide	countries with projects worldwide	international offices	employees	engineers	architects

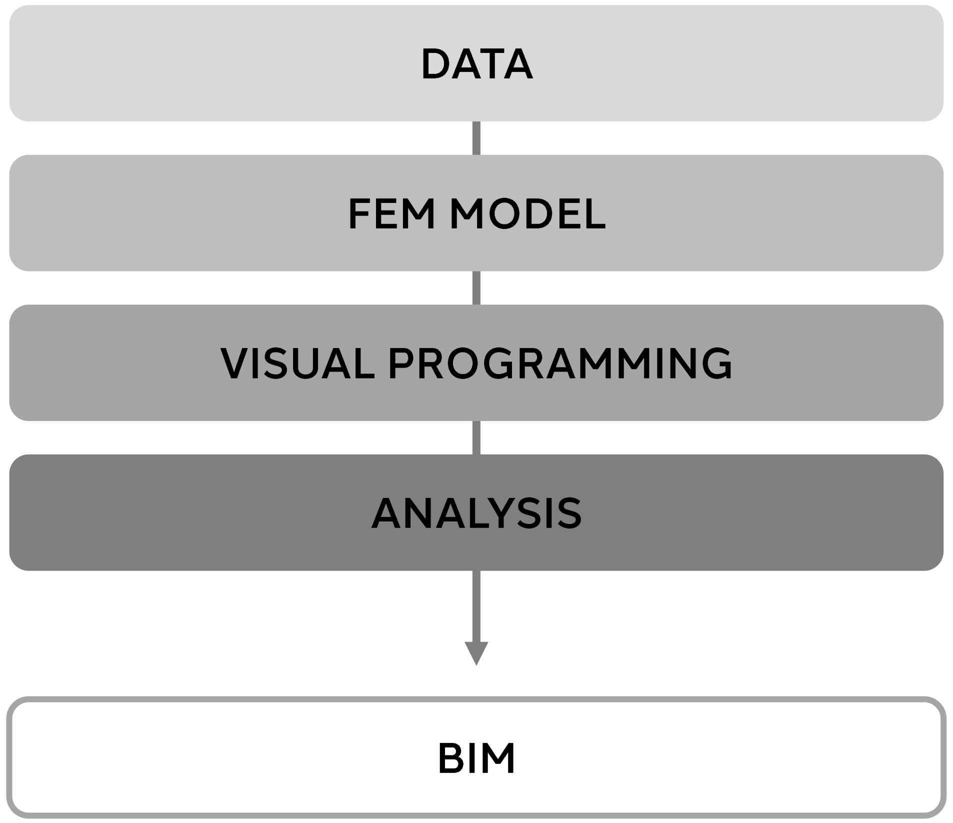
OUR APPROACH

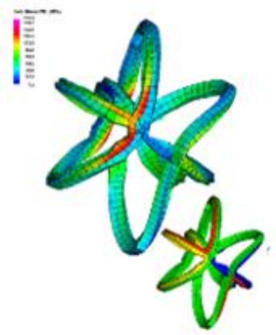
PARAMETRIC DESIGN

The “One Single Model” (OSM) approach rises, in our experience, as the best tool to manage complex buildings through the different engineering branches. This approach aims at creating a single parametric 3D model containing every building information and capable of being associated with all the different design phases.
An innovative and powerful engineering tool, where we have one model linked to BIM/Parametric Models (grasshopper) /FEA (Strand7/ SAP2000) and, in real time, adjust the architectural geometry and carry out the structural analysis/design in a fully integrated looping process.

OSM BENEFITS

Ensure design performed with innovative procedures and software to reduce the overall cost and project duration.
Allow multiple changes to the design to ensure successful incorporation and reduce risks.
Allow innovative workflow for the design of unique and complex connection details and reducing the overall cost and project duration.
Ensure successful coordination and checking among international design consultants to reduce the design duration.
Allow installation 4D animation, control engineering and geometry to improve safety and reduce hazards.



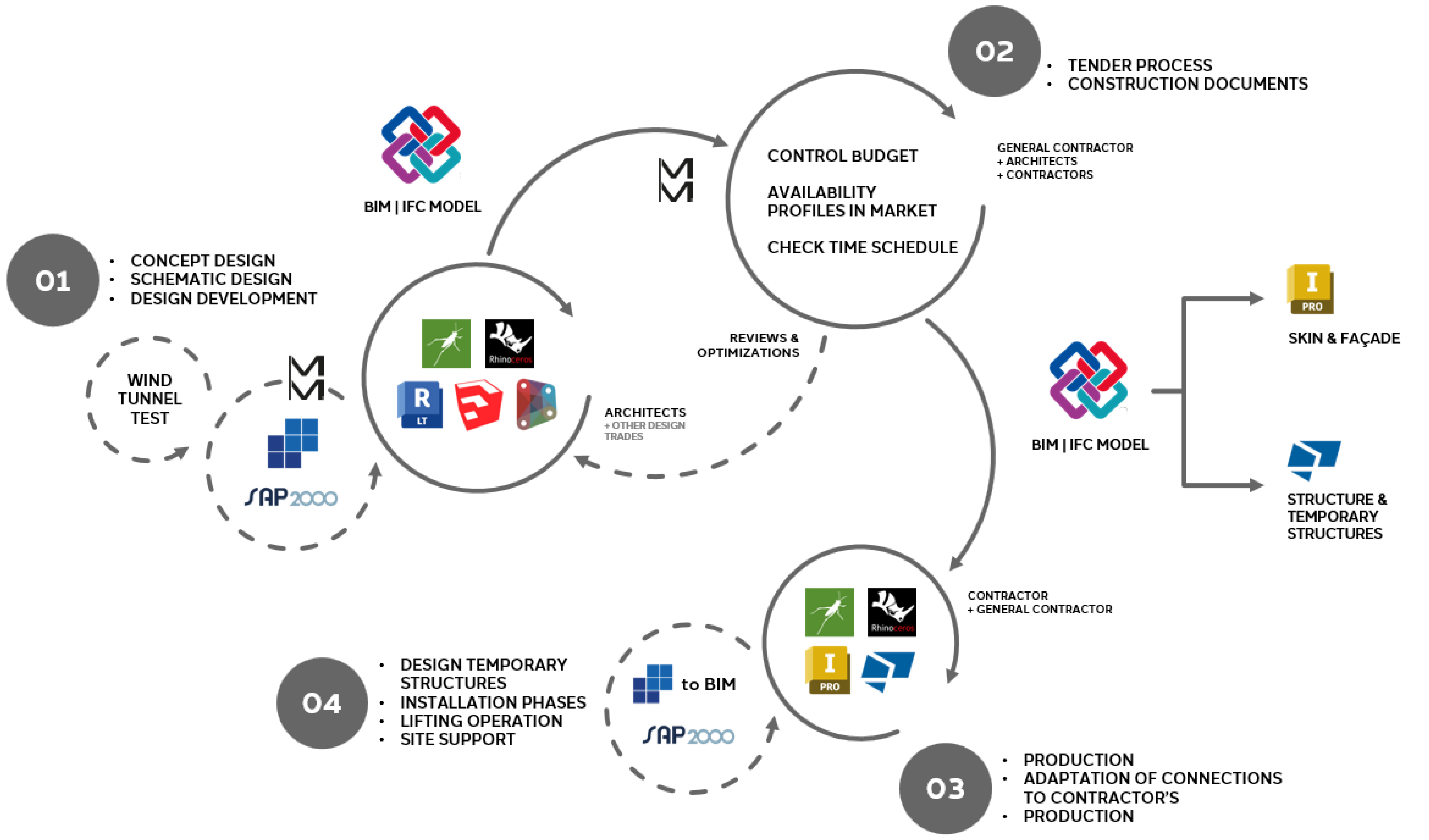


- Help to reduce time
- To ensure successful coordination
- To create innovation solution

MAFFEIS engineering

DESIGN FLOW

Typical design flow for steel, cable and special structures.



MAFFEIS engineering

LCA & SUSTAINABILITY

At Maffeis Engineering we embrace digital in-house parametric tools to conduct Life Cycle Assessment (LCA) studies right from the outset of our projects. Through the utilization of evolutionary algorithms, we don't just evaluate the embodied carbon in our structures and facades; we unveil novel structural designs achieved through iterative optimization and automated processes aimed at reducing embodied carbon. The outcome is the most finely tuned scheme, perfectly aligned with the architectural vision. By integrating LCA into the early stages of our design process, we make well-informed choices regarding material selection and construction methods, reducing our environmental footprint and optimizing resource usage, laying the foundation for a more sustainable built environment. Our commitment to remaining at the forefront of cutting-edge sustainable materials and technologies ensures that our projects consistently exceed the most current sustainability standards. At Maffeis Engineering, we take pride in integrating a comprehensive, data-driven approach to sustainability.

Life Cycle assessment and sustainability approach to the design.
LEED, BREEAM certificated projects Green facades design.

Our services:

- Climate change adaptation and resilience
- Net zero carbon buildings
- Sustainable buildings design
- Embodied carbon lifecycle assessments
- Renewable energy
- Building retrofit

150 HOLBORN
London | UK

New DAR Headquarter in London

- LEED Platinum Certified
- BREEAM Outstanding
- SKA Gold

THE FORGE
London | UK

UK's first NET Zero. Commercial Development

- BREEAM Excellent

SKYCITY MALL
Hong Kong

BEAM Plus NB v1.2 PA Certification
- Platinum rating for Office Certificate
- Gold rating for Retail Certificate

LEED v4 Pre-certification
- Platinum rating for Office Certificate
- Gold rating for Retail Certificate

WELL v1 Pre-certification
- Platinum rating for Office Certificate
- Gold rating for Retail Certificates

KÖ-BOGEN II
Düsseldorf | GERMANY

Europe largest green Facade
30,000 plants

- DGNB Platinum

Europe's largest green facade built with 8 kilometers of steel planters protected from corrosion with TRIPLEX® SYSTEM.

MAFFEIS engineering

THANK YOU

Q&A

MAFFEIS ENGINEERING SPA
Via Mignano 26
36020 Solagna (VI) - Italy
www.maffeis.it