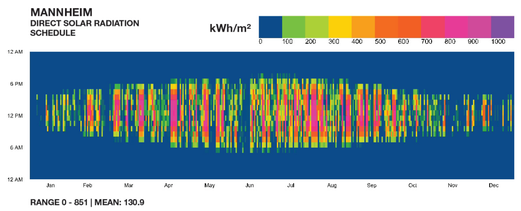
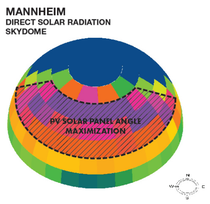
Artee- BUGA23 Pavilion

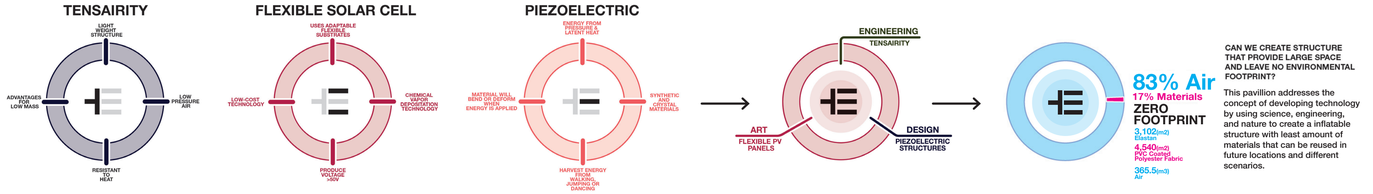
Understanding each technology's advantages led to the main pavilion's design process. The key driver to the design of the central element was to discover a form that enables the integration of multiple technologies to improve energy performance. Integrating these technologies fell into the concept of Artee, a mix of design, art and engineering that incorporates flexible solar thin-films, Tensairity & Piezoelectric installations.

The installation's centrepiece is an adaptive kinetic solar pavilion that can change shape to maximise the surface area facing the sun during the day and the seasons for optimum efficiency and power output. With a span of 58m and a height of 10m, the covered area of solar thin-film is 2,143m².
Due to an energetic and structural optimisation, the solar thin-films are placed on the eastern, southern, and western areas, whereas the steep northern part of the pavilion is uncovered. The building structure of the adaptive kinetic pavilion consists of inflatable tensairity beams defined as ribs connected with an inner and outer ring. This ultra-light and flexible structure of the pavilion allows changing its shape by adjusting the air pressure inside the tensairity ribs.
In order to achieve geometrical stiffness, high and low points are generated with the wavy outer ring, as illustrated in the renderings. The solar pavilion is co-beneficially opened for access by the outer ring. All the structural elements of the inflatable tensairity beams are made out of PVC-coated polyester fabric reinforced by a thin steel wire mesh, and the envelope consists of an Elastan membrane on which the solar thin-films are mounted. An in-depth study on pneumatic and adaptive systems and structural analysis were used to analyse the constructability.





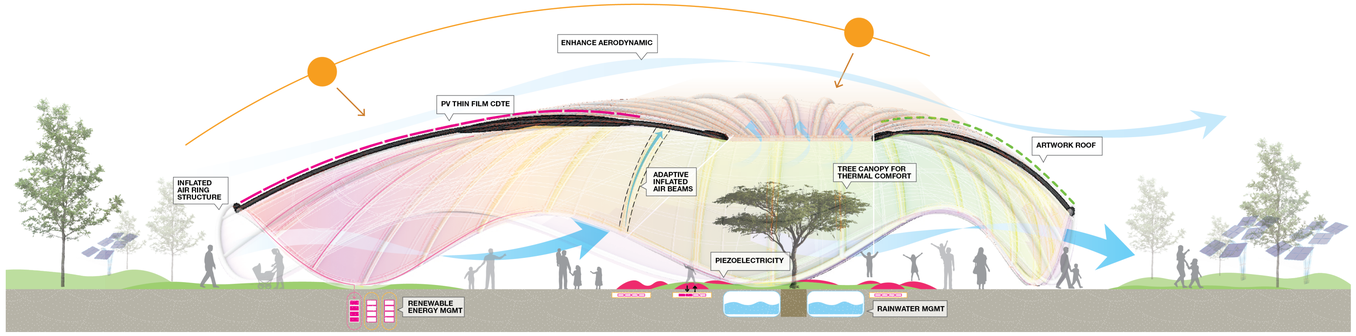
The direct solar radiation in Manheim ranges in between 200 and1000 kWh/m² during the year, while summer is the period with high solar irradiation. The solar pavilion optimises its surface faced to the sun during the day and the seasons resulting in a high-energy performance canopy due to its kinetic system. The roof collects solar radiation most efficiently when the sun's rays are perpendicular to the panel's surface. Precisely, the pavilion adjusts the inclination of the surface not only at 12:00 but also at 9:00 and 16:30 (highest temperature) in summer.



Sustainable Technologies Strategy

CAN WE CREATE STRUCTURE THAT PROVIDE LARGE SPACE AND LEAVE NO ENVIRONMENTAL FOOTPRINT?

This pavillion addresses the concept of developing technology by using science, engineering, and nature to create a inflatable structure with least amount of materials that can be reused in future locations and different scenarios.

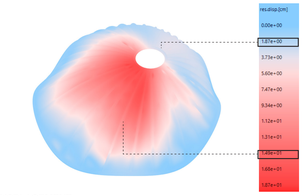


Section - Sustainable Technologies Strategies

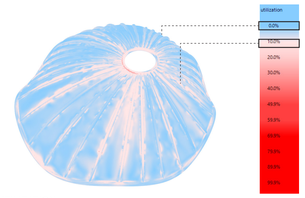
Exterior Perspective Adaptive Kinetic Pavilion

Exterior Perspective Adaptive Kinetic Pavilion

STRUCTURAL ANALYSIS



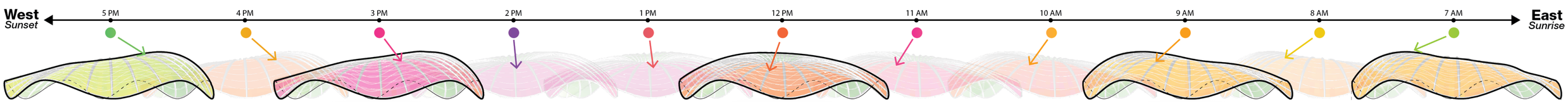
DISPLACEMENT



UTILIZATION

The low dead weight in combination with the geometrical efficiency of the inflated structure allows for ultra-wide spans, which was investigated by structural analysis. In the upper picture, the maximum deformation under loading of wind and snow is shown (max. 18.7 mm), while in the lower picture the high utilization of the stiffening airbeams can be seen.

PAVILLION // TRANFORMABLE ENERGY



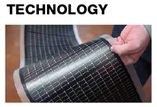
PAVILION
TOTAL RENEWABLE ENERGY GENERATOR PER YEAR

245 MWh

Incident Solar Radiation	635 kWh/m²
Photovoltaic film sheet area	2,180 m²
Photovoltaic film efficiency	0.25
Coefficiency	0.9

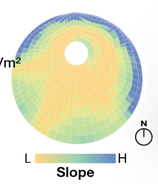
*based on EPW 1997-2021

TECHNOLOGY

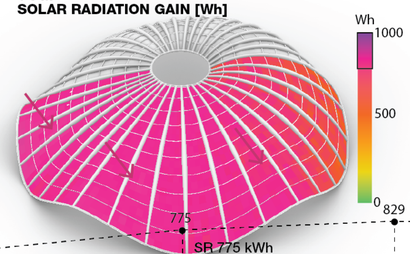


Thin-film Cadmium Telluride (CdTe) photovoltaic solar cells. Efficiency 18 - 30%

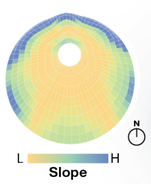
3 PM PLAN HEIGHT ANALYSIS



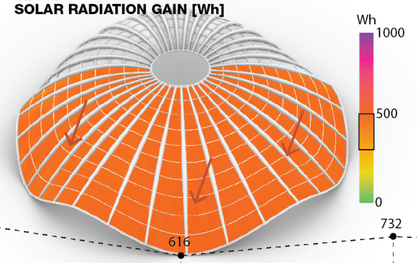
3 PM SOLAR RADIATION GAIN [Wh]



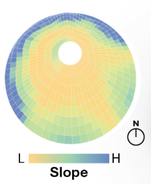
12 PM PLAN HEIGHT ANALYSIS



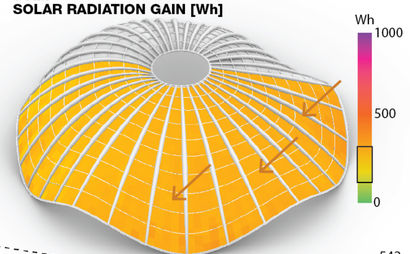
12 PM SOLAR RADIATION GAIN [Wh]

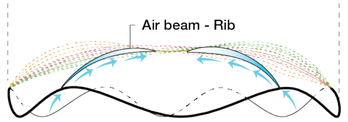


9 AM PLAN HEIGHT ANALYSIS

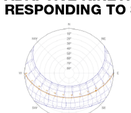


9 AM SOLAR RADIATION GAIN [Wh]





ADAPTIVE KINETIC INFLATED STRUCTURE RESPONDING TO SUN DIRECTION



MANNHEIM SUNPATH