Soaring 150m into the Astana skyline, the Khan Shatyr Entertainment Centre is the world’s largest tensile structure. Its 21st Century design is inspired by the rich nomadic history of the Kazakh people who roamed the unforgiving steppes of Eurasia. The 150m mast secures a cable net tent, weighing over 2 tonnes, to a height of 90m, from an elliptical base of 200m. The translucent Ethylene Tetra Fluoro Ethylene (ETFE) cladding ensures visitors can enjoy the wide variety of shopping and entertainment options under filtered natural light, while remaining sheltered from the -35°C to +35°C extremes of Astana.

BuroHappold Engineering was presented with a tri-fold challenge. How to raise a secure 2 tonne tent, in the dead of bitter winter, and still make sure the end result would be a well-aerated, comfortable space for people to thoroughly enjoy throughout the year?

Our team designed a tripod around the central mast to bring the tent to its final standing point. To offer structural stability in face of both the heavy tent load, and threats of harsh weather conditions, the supporting head on which the cables were secured, remained the tripod’s only movable feature. The tubular steel tripod was welded together onsite and wrapped in temporary covers, making it possible to continue to work on the cabling and ETFE cladding, despite the bone chilling -35°C (-22°F) weather outside.

Pioneering the world’s largest tent presented unexpected moments of innovation. The machinery that was originally made available onsite wouldn’t allow for our plans to attach numerous cables at once.
Therefore we created a bespoke system that utilised parts from 20 disused Russian cranes, to winch 193 cables in place. With the cables now secured to the tripod, we were able to gradually increase the tension until we reached the correct level to hold the ETFE cladding over the framework.

ETFE is an advantageous material choice for the cladding of tensile constructions. Known for its tough, lightweight properties, ETFE cladding allows light to flood large spaces while protecting the structures interiors from powerful sunlight, wind and snowfall.

Our team needed to develop an engineering strategy to ensure that the interior temperature could be maintained between 15-30°C despite Astana's average yearly temperature of 3.5°C (38.3°F) outside. To meet this objective we deployed an aquifer thermal energy storage (ATES) system to provide a year-round sustainable source of base-load heating and cooling. Thermal modelling and 3D CFD (computational fluid dynamics analysis) allowed the complex building physics of the 100,000m² centre to be carefully tested, enabling us to make optimal design improvements.

By working together, our specialist teams delivered a unique project, breathing life into the architect’s vision of ‘a world within’ and creating a world recording breaking entertainment experience for the visitors of Kazakhstan’s capital city.