

AHMAD BIN ALI STADIUM
BY SCOTT STONEHEWER

AHEAD OF THE GAME

Ahmad Bin Ali Stadium, Qatar's latest FIFA 2022 World Cup venue, has been delivered two years before the tournament amidst a diplomatic crisis, season change and a global pandemic. **Stadia** takes a look inside its air-cooled interior to discover the secret behind the project's success



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The Ahmad Bin Ali Stadium in Qatar is an emblem of the country's ability to excel under pressure, having opened exactly two years ahead of the FIFA 2022 World Cup soccer tournament.

The open-air 40,000-seat venue in Al Rayyan sits on the western edge of Doha's metropolitan zone and will host seven games during the tournament on an artificially cooled pitch.

Designed by UK architecture studio Pattern Design, (who also served as the stadium's masterplanner) it has evolved significantly since its initial scheme, which won the project design competition in 2013.

"The biggest change was the roof – pre-tender it was based on four mega columns similar to [Arsenal FC's] Emirates Stadium. This was modified to a flying truss system with a compression and a tension ring that is cantilevered off a single column on the façade that acts as a counterbalance," explains Luke Harrison, associate director at Pattern Design.

"This freed-up a lot of surface area that we were able to occupy with seating and make the overall footprint of the building smaller. This reduced cost and lowered the bowl closer to the pitch," he says.

Thermal management

The stadium's design team also had to manage a change in seasons as the tournament was flipped from a traditionally summer event to winter for health and safety reasons for players to avoid the extreme heat.

"We were able to make some savings by removing some cooled covered walkways although the stadium is still capable of operating in a 50°C (122°F) Qatari summer," says Simon French, partner and project lead at Hoare Lea, which supplied the stadium's MEP engineering, fire, acoustics, and building physics.

Cooling an open-air stadium in the heart of the desert was a significant challenge, which required a complex mix of digital and physical modelling.

"We used computational fluid dynamics to investigate maximum wind speeds to test the façade and wind screen. We also modelled maximum dry bulb and wet bulb temperatures to prove that the stadium works in all conditions and that we could achieve a steady 26°C (78°F) within the venue," explains French.

A 1:300 scale replica of the stadium was 3D-printed and tested in a specialist wind tunnel for aerodynamic performance. Within the tunnel, the model was systematically analyzed with laser beams that recorded airflow over the design. This allowed analysts to measure the temperature per tier and model variants such as sweat produced and number of spectators to simulate optimal outcomes. This helped decrease the cost and improve the environmental footprint.

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Architects Pattern Design
worked with Schlaich
Bergermann Partner on the
roof's flying truss design
and structural engineering

The stadium's façade forms an innovative cooling system using
a permeable material that enables air flow into the venue

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Simon French, partner and project lead, Hoare Lea

“We were able to simplify the design, reduce flow rates and the amount of equipment needed need to move the cool air around. Originally, we had overhead ductwork which was redesigned to blow air from underneath the seats, which reduced cooling loads by 40%” French adds.

This reduction was also aided by the innovative façade system, which has a mesh-like permeable material built into a wind shield that optimizes airflow into the space. The façade features a rich cultural lattice of traditional Qatari Naqish patterns that have been reimagined into a new parametric blend using specialist tools explains Harrison.

“Each pattern is rooted in the heritage of Qatar and can be found on the houses of craftsmen and tradesman across of Doha.”

While the façade was value engineered to simplify the patterning and improve buildability, it retained its visual integrity throughout.

“We managed to achieve culturally significant patterns that speak to the Qatari people and engage local communities. It's a very powerful keystone that makes the venue even more memorable,” he says.

Built into the façade are two LED systems that allow for media projections around its entire perimeter.

“Panels with white light and LEDs have an RGB projection onto the back [of the façade] that can be used in myriad configurations that are all based around national, Islamic and Al-Rayyan Sports Club colors,” describes Harrison.

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Cable craft

To allow for a multitude of engineers and cameramen to simply turn up on the day and plug-in onsite, the venue's engineers developed a new fiberoptic core legacy infrastructure system.

“There are a host of well detailed connection points around the stadium, so when the cameras get rolled out, they can plug directly into the fiber, which is an exceptionally efficient way to operate now and in the future,” explains Magnus Leask, project director at Hoare Lea.

Overlay accessible systems – down to trays and cable hooks running through the tunnels complete the architecture for easy connectivity Leask continues.

“FIFA can reliably send outbound signals over fiber rather than satellite, which is used more as a backup system. The raw – and some edited feed – is channeled off site to be mixed and broadcast to the world live.”

Notably, this approach to fiber-based broadcast infrastructure was replicated in other stadia for the 2022 World Cup.

Qatar is one of the world's leading countries for 5G connectivity and FIFA-approved stadia require perfect Wi-Fi coverage. Ahmad Bin Ali Stadium and the entire surrounding precinct has 5G coverage to support the increased demand on bandwidth, which Leask says fans coming to the tournament will expect.

“Uniquely, this world cup will have five games going on at the same time, all in the same city. Many fans will be watching other games on their devices

simultaneously, so we've put the raw horsepower in there ready.”

One of the biggest challenges was not coverage but throughput explains Leask.

“Due to the number and density of people in the stadium, we had to model the number of available devices and use directional antennas to cover individual segments within zones over three tiers.”

Different techniques were also used to keep all of the equipment within operable temperatures.

“For site-wide connectivity we worked a lot with Cisco to keep equipment cool, using different ways to reflect sunlight, testing variable fabrics and airflow conditions and even the installation of housing to mitigate not just the heat but also the dust,” says Leask.

Leaving a legacy

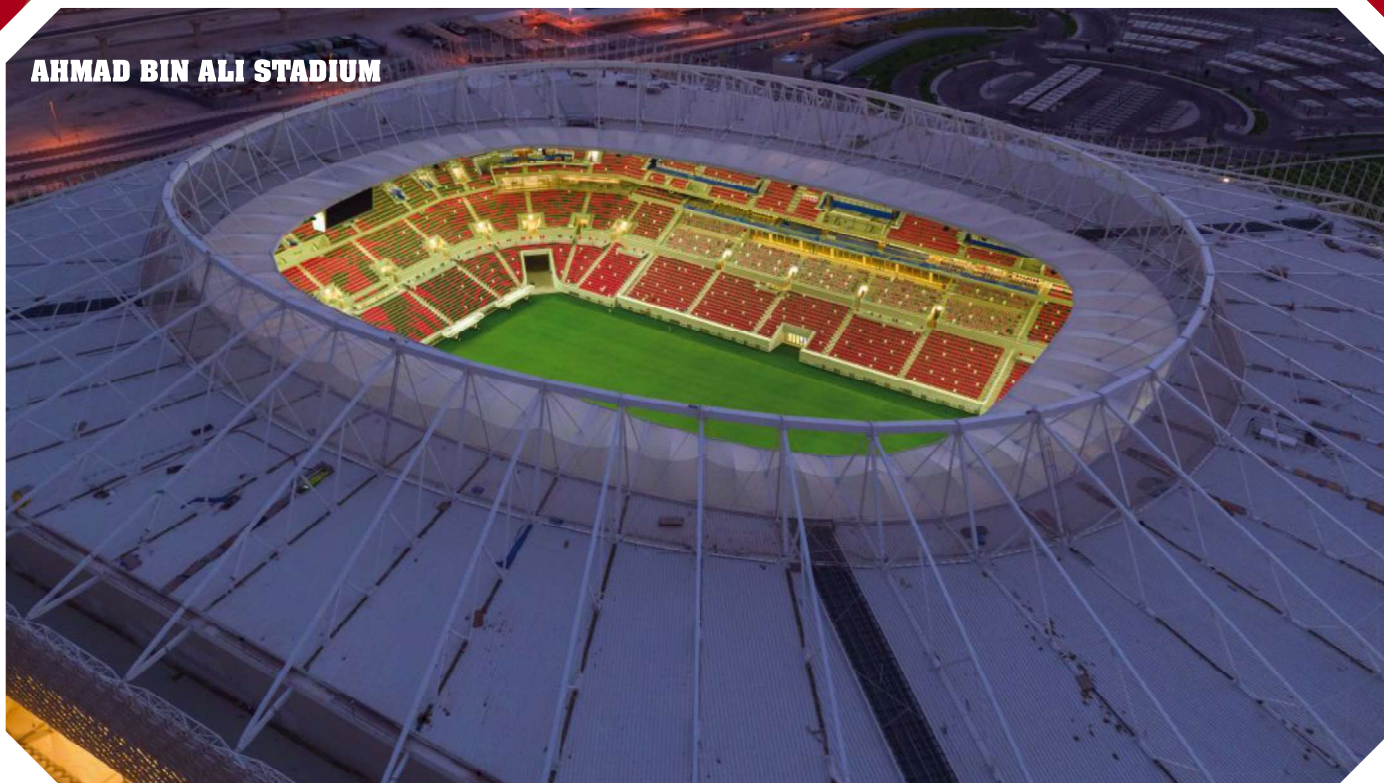
Environmental sustainability is a fundamental aspect of Qatar's Supreme Committee for Delivery & Legacy (SC) – the entity responsible for overseeing all construction and infrastructure projects for the 2022 FIFA World Cup.

As a result, the new stadium achieved a four-star Design and Build Certification from Global Sustainability Assessment System (GSAS), which is the performance-based standard for sustainable infrastructure in Middle East and North Africa.

An array of sustainability, environmental and energy saving measures were implemented from the start, including the deconstruction of the original



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Al Rayyan stadium – home to one of Qatar's oldest soccer clubs – of which 90% was reused and recycled.

"We demolished the old stadium and salvaged the remains as aggregate in masterplan areas, pavers and the surrounding landscape," explains Harrison.

Water is recovered from the cooling coils for reuse in grey water functions and toilet flushing, while drainage and other reclamation systems are seamlessly integrated into the grounds, explains French.

"Planning for maintenance was a key part of the design strategy so we were able to house water supplies for sprinklers, LED grow lights and power supplies into service trenches around the edge of the pitch."

Built with sustainability in mind, 20,000 seats that form the top tier will be demounted and donated following the World Cup

Following the World Cup, around 20,000 seats in the upper bowl will be removed to make way for a community sports center, with all of the seats being reused in other venues throughout the region.

"The whole upper tier is a temporary metal and bolt system that can be demounted onto the pitch with every element being sized to allow for easy removal through the tunnels," Harrison adds.

Building blocks

In spite of Qatar's neighboring countries from the Gulf Cooperation Council (GCC) severing diplomatic ties and imposing a trade embargo in 2017 that restricted Qatar-registered planes and ships from utilizing surrounding airspace and sea routes, as well as Saudi Arabia blocking Qatar's only land crossing, the stadium was still completed on schedule.

This impressive feat was achieved thanks to the majority of outstanding construction elements being rerouted reveals Hoare Lea's Magnus Leask.

"There were so many key players in a project of this scale that are well versed in major infrastructure design, so the supply chain was able to respond and reroute quickly," he says.

While technology and engineering acumen was paramount to the stadium's delivery, the key driver behind its design has always been the fan experience, believes French.

"We considered every aspect of fan engagement to understand the human experience of being in the stadium, even down to clothing types and styles to assess the physics of comfort."

"The whole culture of the site is about inclusion and providing community access through sport and with this project, we can enact real change and start new conversations," adds Pattern Design's Harrison. ■

LIGHT YEARS AHEAD

During the five-year design process, technology evolved at such a rate that the pitch lighting scheme, supplied by MA Lighting had to be redesigned explains French.

"We had planned installing metal halide lighting fixtures but half-way through we had to accommodate for an LED system instead. It was tricky to get LEDs to work reliably in high temperatures, so we worked extensively on getting the heat syncs right. LEDs are also more evenly distributed around the pitch although we have an access walkway at the base of the oculus to enable easy installation and maintenance. It's great to work with the best technology available as it lets you do more exciting things and provides a better spectacle for the fans," he says.

For the inauguration ceremony of the Ahmad Bin Ali Stadium, the lighting technology was on full show where the creative design concept utilized over 150 moving lights plus all other lighting fixtures using two of MA Lighting's flagship grandMA3 full-size consoles and Network Switches.

PERFORMANCE INNOVATION EXPERIENCE

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SPORT FACILITIES

45

VENUES
IN THE PAST 5 YEARS

40

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