Howzat for World’s Largest Cricket Stadium

The design of Motera Stadium allows it to play host to international cricket matches as well as community events.

Motera Stadium, the world’s largest cricket stadium, has debuted in Ahmedabad, India.

The new stadium was inaugurated by world leaders, Prime Minister of India, Narendra Modi and President of the United States, Donald Trump, during the ‘Namaste Trump’ gala on Monday 24th February.

Designed by Populous in collaboration with India’s top construction contractor, Larsen & Toubro (L&T), the world class stadium can host up to 110,000 passionate cricket fans, creating an iconic stadium for India.

Located in India’s western state of Gujarat in the city of Ahmedabad, the stadium was designed and constructed within three years at a cost of $100 million.

Motera Stadium is a destination for true cricket fans to immerse themselves into an interactive, colourful and large sporting event atmosphere. Cricket is the biggest sport in India and this stadium has been designed to bring together as many fans as possible, creating an incredible atmosphere for international cricket, IPL matches through to regional and community games.

“Every one of the 110,000 seats has uninterrupted sightlines of the field and pitch, and with a deliberate round, open stadium providing 360-degree views, you feel you’re a part of what’s happening.

“Drawing on our expertise with cricket and major sports venues around the world, the bowl design consists of two large seating tiers, each with approximately 50,000 general admission seats, designed to fill the lower levels for smaller events and still bring that sense of occasion, the sight
and the sound to make every experience a special one.”

**DESIGN MASTERPLAN**

The timeline of the project, from inception to delivery was 2017 to 2020. The Gujarat Cricket Association, along with L&T as construction contractors were the client. Populous were contracted by L&T to deliver architectural design services up until schematic design.

This included the full masterplan, the original architect’s vision for the stadium, the landscaping plan, interior design and the wayfinding.

Populous’ masterplan includes a community indoor cricket academy housed under the stadium, with a dormitory for up to 40 athletes, six indoor practice pitches and three outdoor practice fields.

The stadium design features four-team dressing rooms and facilities, state-of-the-art club facilities and a VIP pavilion, three practice grounds, an indoor cricket academy, an Olympic-size swimming pool, 76 corporate boxes and a media lounge with press rooms.

“The stadium will become an iconic sports venue for both aspiring and elite players. It will become one of the world’s great cricket stadiums, putting the Gujarat Cricket Association on the global sporting map,” James said.

He added: “People in India identify with cricket as a national sport, a game that unites everyone. It holds a deep passion within them and the stadium provides both the capacity for 110,000 fans to attend any match, with the majority (100,000) of them as General Admission seats.

“This is a stadium for the people. The ratio of general admission seats to corporate boxes means this stadium has more affordable seating prices making it very accessible for all.”

**MULTIPURPOSE VENUE**

Cricket is the biggest sport in India and this stadium has been designed to bring together as many fans as possible, creating an incredible atmosphere for international cricket, IPL matches through to regional and community games.

The stadium will not just be for major local and international cricket matches,
it will also be for community use. There is a community indoor cricket academy housed under the podium in the stadium, with a dormitory for up to 40 athletes, allowing students from across India and the globe to attend.

The academy also has access to six indoor practice pitches and three outdoor practice fields.

James said: “The sheer scale of this project presented the biggest challenge. On top of that the site itself was barely large enough to fit the width of the stadium and had to design around the preservation of an existing temple on the site too.

“We were able to overcome this with the bowl design consisting of two large seating tiers each with approximately 50,000 general admission seat capacity, designed in a way to direct an efficient circulation of patrons to fill the lower levels for smaller events, while maintaining the spectator atmosphere even when the seating bowl isn’t full.”

ROOF STRUCTURE

Motera Stadium is double the size of the venue it has replaced and creating a roof for the venue proved a challenge.

Walter P Moore was contacted by L&T to join the project team because of their experience in sports structures and lightweight longspan roofs.

Once the team was selected and design began, the experts at Walter P Moore began to consider options for Motera’s roof system.

Taking into consideration the fact that the city of Ahmedabad is located in seismic zone 3, the roof needed to be lightweight to reduce seismic demand and develop an economical roof system. Therefore, very early in the design phase, it was decided that the best option would be to incorporate a lightweight cable-supported tensile membrane roof supported by steel columns. Additionally, the team decided that the reinforced concrete bowl and the roof structure needed to be independent of each other. This decision was primarily motivated by the seismic hazard for the project. Without such an approach, the cost premium on the roof and the supporting structure due to seismic forces could have been significant.

Amol Acharya, Director of Structural Engineering for WPM in India, said: “The reinforced concrete bowl structure had expansion joints whereas the roof structure, due to virtue of its nature cannot have such joints. A combined interaction, analysis, and behaviour of such structures are complex. This problem was simplified by having a separate structural system for the roof and the bowl. This strategy also allowed independent teams to work simultaneously on two separate structures to meet an aggressive project schedule.”

The cantilever span of the tensile membrane system is around 30m and covers the upper bowl of the stadium.

The tensile membrane system primarily comprises of a two-chord compression ring at the outer edge (stadium perimeter) and a single tension ring cable on the inner edge (toward field of play).

The radial cables are pretensioned and tied to the outer compression ring with cable connectors forming ridges and valleys for the membrane roof. The radial cables are aligned in such a way that rainwater flows over the membrane and drains into the gutter positioned along the lower chord of the compression ring, this, in turn, provides shape to the membrane panel.

The outer compression ring is supported on the structural steel ‘V’ columns along the circumference at regular intervals. In addition to serving as gravity supports, ‘V’ columns also provide resistance to lateral loads for the roof.

The structural steel columns are typically supported on the RC column at the concourse level. The inner tension ring also supports a catwalk running all through the inner tension ring circumference.

INSPECTION AND MAINTENANCE

The field of play lights are mounted on the catwalk along its perimeter and it also allows access for inspection and maintenance of the tensile structure. A non-linear analysis program NDN was used to analyse and study the behaviour of the structure for a number of gravity, seismic, and wind load combinations.

The stadium roof follows the oval shape of the stadium bowl, the massive compression truss thus trails this oval shape around the perimeter of the stadium. The entire length of the oval-shaped compression truss would be around a kilometer.

The roof erection involved synchronous pulling of the cables from the compression ring supported by the columns, this was imperative to avoid
Let there be light

Signify has helped provide cricket fans in India with a perfect view on the nation's favorite sport as it illuminates the Motera Stadium.

Signify equipped the Motera Stadium with 580 luminaries of Philips ArenaVision LED Floodlighting system for day-and-night games. This installation complies with the ICC (International Cricket Council) Broadcasting standards for sports illumination.

The lighting system has been designed exclusively for sports and multi-purpose venues, offering outstanding light quality, higher energy efficiency, effective thermal management and a long lifetime.

Sumit Padmakar Joshi, Market Leader of Signify’s operations in India, said: “We are very proud to illuminate the world’s largest cricket stadium using our Philips ArenaVision LED Floodlighting system. It is also India’s first LED floodlit cricket stadium that meets the ICC Broadcasting standards. This system will offer an unparalleled sporting experience for cricket fans in the country. At the same time, it will help the stadium in achieving its responsible and environmental goals enabling durability through longevity and significantly reduce maintenance costs.”

unbalanced loading on the compression ring. Although challenging due to a limited number of strand jacks that were used during erection, various parties including L&T, Walter P Moore, and a specialty contractor for cables, came together and worked collaboratively which resulted in a successful erection process.

“The bowl is a reinforced concrete structure that is inherently very heavy,” explains Director of Design Viral Patel. “The lightweight roof structure, on the other hand, is not arranged to readily accommodate inelastic behavior. Without separating the bowl from the roof, the bowl would have been subjected to amplified seismic demand from the roof.”

PTFE (polytetrafluoroethylene), Teflon-coated woven fiberglass, was stretched between a circumferential inner tension ring and an outer compression ring. A wind tunnel test was also performed to optimise roof design. Wind load provisions in most codes do not address roof structure for stadiums such as Motera. Additionally, for a structure such as Motera’s roof, it is important to study the effects of unbalanced wind loads, which is not covered in building codes. Walter P Moore used Load Response Correlation Method to develop critical wind load patterns from the wind tunnel test.

The stadium exists in tiers to accommodate smaller events and maintain the atmosphere for spectators even when the bowl isn’t full. These tiers carry through to the roof, making the fact that it is structurally independent a crucial design element.

MOTERA STADIUM

Project Team and Fact File

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<thead>
<tr>
<th>Location</th>
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<td>Opening Date</td>
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<td>Walter P Moore</td>
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<td>Lighting Contractor</td>
<td>Signify</td>
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Amenities

- Community indoor cricket academy, six indoor practice pitches and three outdoor practice fields, four-team dressing rooms, state-of-the-art club facilities, VIP pavilion, three practice grounds, Olympic-size swimming pool, 76 corporate boxes and a media lounge with press rooms.