

## Feature

# World Cup stadiums use BIM software

Structural design and construction challenges of the stadiums of the FIFA World Cup in South Africa needed up-to-date software to achieve results



BIM (Building Information Modelling) software has been used in the structural design and construction of the stadiums of the FIFA World Cup taking place between June 11 and July 11 in South Africa. Three have been modelled using Tekla Structures 3D BIM software. Five completely new stadiums were built for the Cup. Two of them, the Mbombela Stadium in Nelspruit and the Nelson Mandela Bay Stadium in Port Elizabeth, were modelled using Tekla Structures. In addition, the modelling of the Royal Bafokeng Stadium in Rustenburg, renovated for the Cup, was carried out with Tekla software.

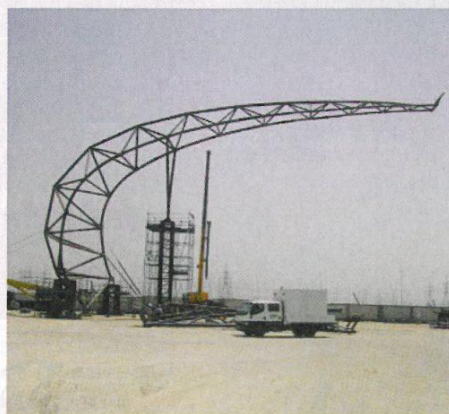
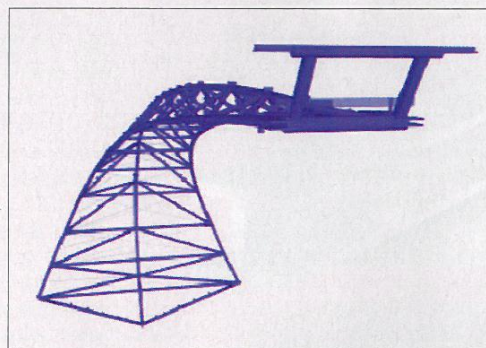
Tekla Structures BIM software provides an accurate, dynamic, and data-rich 3D environment that can be shared by contractors, structural engineers, steel detailers and fabricators, as well as concrete detailers and manufacturers. The highly detailed as-built structural models created in Tekla Structures enable the highest level of constructability and production control. Centralising model and non-model based data into the model allows for more collaborative and integrated project management and delivery.

'The World Cup stadiums are large and structurally challenging buildings in which attention has been paid to appearance. Building them without the help of 3D BIM software would have been very difficult,' said Risto Rätty, Executive Vice President of Tekla Corporation.

### Roof structure of main stage

The Nelson Mandela Bay Stadium in Port Elizabeth stands out, thanks to its unusual roof structure. Completed this year, the stadium is one of the main stages of the Cup. In addition to the group-level matches, also one of the semi-finals and the match for third place will take place there. The individually shaped white roof structure, made of PTFE-coated fibreglass, is held up with 36 steel girders. The total weight of the curved beams supporting the futuristic structure is nearly 2500t.

'One of the most interesting parts of the project was the compression ring. To make the 3D model, we had to duplicate the model and simulate the deflection so the compression ring could be fitted properly after the girders erection,' said Daniel Barbeau at CadMax, who was responsible for information modelling.



- 1 Located by a lake, the Nelson Mandela Bay Stadium is a magnificent sight, especially in the dark (Photo: NelsonMandela Bay Municipality)
- 2 3D building information modelling enables error-free assembly of parts at the site (Photos: CadMax)

The complex nature of the structure put the Canadian steel detailer, CadMax, and Tekla Structures software to the test. Seamless coordination of the 4200 drawings required for the erection of the stadium between project parties was an additional challenge. Membrane designer and connections engineer Birdair was located in Buffalo USA, the steel detailer of CadMax was in Québec, Canada, the part manufacturer in Kuwait, the structural engineer in Germany, and the contractor in South Africa. Despite the tight schedule, the stadium was completed well ahead of time for the games, in summer 2009. The CISC (Canadian Institute of Steel Construction) in Québec awarded CadMax's modelling of the steel structure of the Nelson Mandela Bay Stadium as the best project in 2009 outside of Québec.

### Renovation of Royal Bafokeng stadium

Tekla Structures was also used in the renovation of the 44 530-seat Royal Bafokeng stadium, named after the Bafokeng people who live in the area. 'The erector stated to us on one of our many site visits, that he would not have been able to erect this structure without the 3D model', said Tommy Mulherron and Oscar van Rensburg of Pinnacle Projects, the South African company responsible for the structural design.

The benefits included accurate amounts of building materials and the faultless fabrication process of structural parts facilitated by accurate model drawings. The same information model was

utilised both in steel shops and on site. In addition, through the information model the project management was always up to date with the progress of the work.

According to Mr Mulherron, the project was unique as a whole, and the success in the demanding job did not go unnoticed: the Southern African Institute of Steel Construction picked the renovation of the Royal Bafokeng Stadium as the winner in its Technical Excellence category.

### Mbombela Stadium

The third stadium modelled using Tekla Structures was the Mbombela Stadium in Nelspruit, completed in 2009 for the event. Its capacity is 43 589; the word 'mbombela' literally means 'many people together in a small space' in the local SiSwasi language.

It was modelled by the South African company Mondo Cané, a user of the Tekla Structures software since 1999. The Web Viewer model they created was utilised by architects, detailers as well as fabricators. The steel structure of the stadium weighs approximately 1500t and 90% of the superstructure was made from tubular sections that required accurate profiling.

'The project was split between two fabricators so we separated the model into various phases and assigned different assembly marks per phase. We used cloning effectively to reduce the amount of work,' said Rob Chalmers who was responsible for detail design and workshop drawings.

- 3 Royal Bafokeng stadium was refurbished for the World Cup
- 4 The Tekla building information model contains the smallest details of the building (Photos: Pinnacle Projects)

