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**An Iconic Building And A Successful Stadium**

# Moses Mabhida Stadium



The Moses Mabhida Stadium is a stadium in Durban, South Africa, named after Moses Mabhida, a former General Secretary of the South African Communist Party. It is a **multi-use stadium**. It was one of the host stadiums for the **2010 FIFA World Cup**.



# Moses Mabhida Stadium



**Address:** Stamford Hill, Durban, South Africa

**Capacity:** 85,000

**Opened:** November 28, 2009

**Height:** 344 feet (105 m)

**Stadium:** 320m x 280m x 45m

**Client:** Strategic Projects Unit, Ethekewini Municipality

**Professional Team:** Ibhola Lethu Consortium (Pty) Ltd

**Main Contractors:** Group 5, WBHO, PANDEV Joint Venture

# Introduction:

- The multifunctional stadium is situated on a raised platform and is accessed from the South by a **broad flight of steps**.
- The **85,000 capacity** stadium sits on an elevated platform, with a façade of perforated metal sheeting and a cable-tied canopy roof.
- Construction began in **2007** and was completed November, **2009**.
- The Ibhola Lethu Consortium (ILC) was responsible for the design and project management of the stadium. Schlaic, Bergermann und Partner (sbp) served as conceptual structural engineers.



# Concept of the Stadium Design

- **Major concept** : representing **Unity** among the different parts of the nation.
- The arch design representing unity has been inspired by the **African Flag**.
- The arch as a **landmark** forms an imposing part of skyline of Durban.
- From the **sky deck**, visitors can enjoy a spectacular view over the city and the Indian Ocean.



# A World First In The Design Of The Roof Arch Foundation

- The stadium stands on **saturated swamp-land** that was blanketed with sea-sand.
- In these **marshy condition** all heavy structures must be piled down to the **bedrock**, 20 meters below the ground level.
- **Diaphragm walls** chosen because they were the most practical and least time consuming.
- Foundations are **elongated rectangular boxes** with 800 mm thick reinforced concrete walls. The northern foundation is 44 m x 7 m in plan and the two southern foundations are 30 m x 4 m in plan.

Aerial view of the 240 KN diaphragm wall reinforcement cage being lifted for transportation to form part of one of the two southern foundation.



# A World First In The Design Of The Roof Arch Foundation

- The main forces transferred through the **arch** onto the **reinforced concrete foundations** are in excess of 100 MN applied at an inclination of 38 degree to the horizontal.
- Finally it took **five and a half months** and required a total of 4000 (cubic meter) concrete and 9 Km of anchor cables, and 800 tons of reinforcing.

A view of northern foundation with the partially complete arch supported off a steel trestle assisted by cable tiebacks onto the concrete foundation.



# A World First In The Design Of The Roof Arch Foundation

The **connection** of the **arch** to its **foundation** is facilitated through the application of a **reinforced concrete plinth**.



- Southern foundation structure showing cables used to post-tension the diaphragm panels.



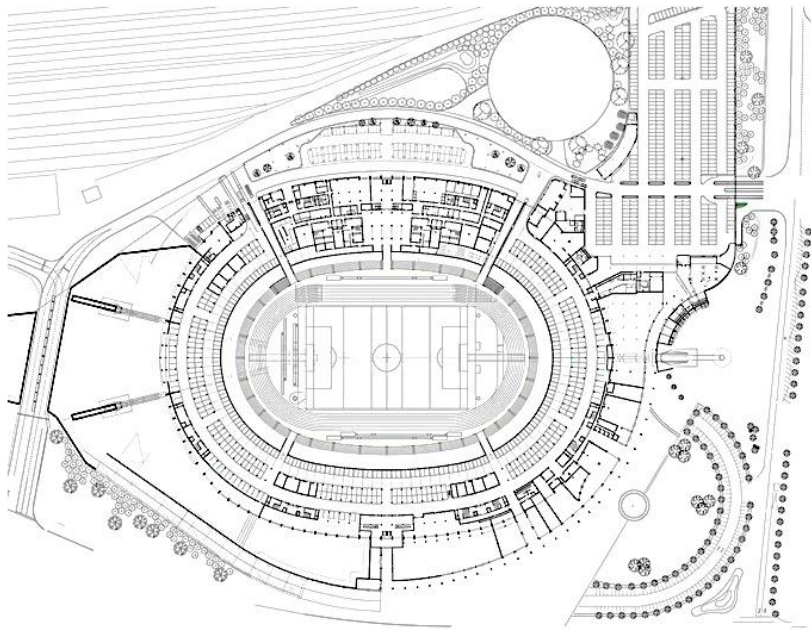
- Concrete plinth where arch meets its foundation with a trapezoidal shape.



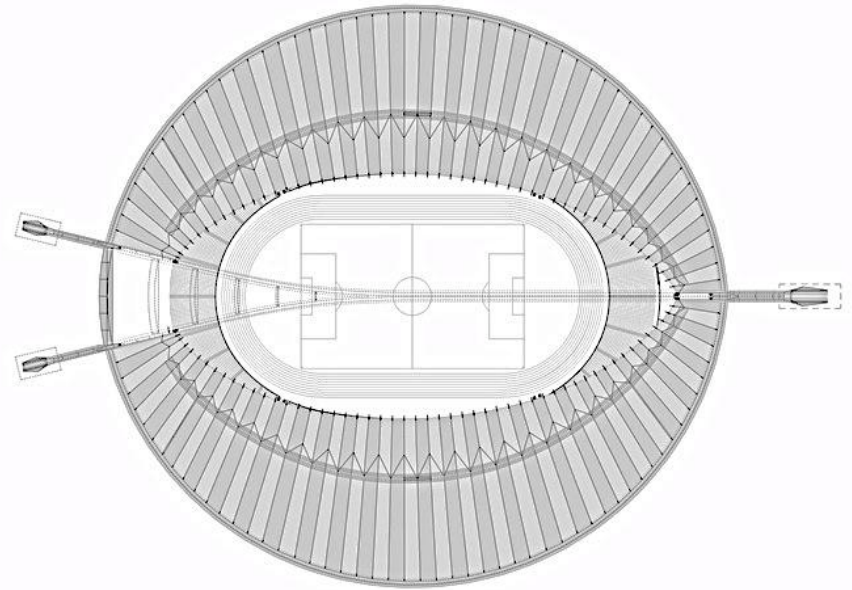
# Building Layout

The stadium includes:

- **Indoor Arena**
- **Institute Of Physical Education**
- **Football Museum**



Floor Plan



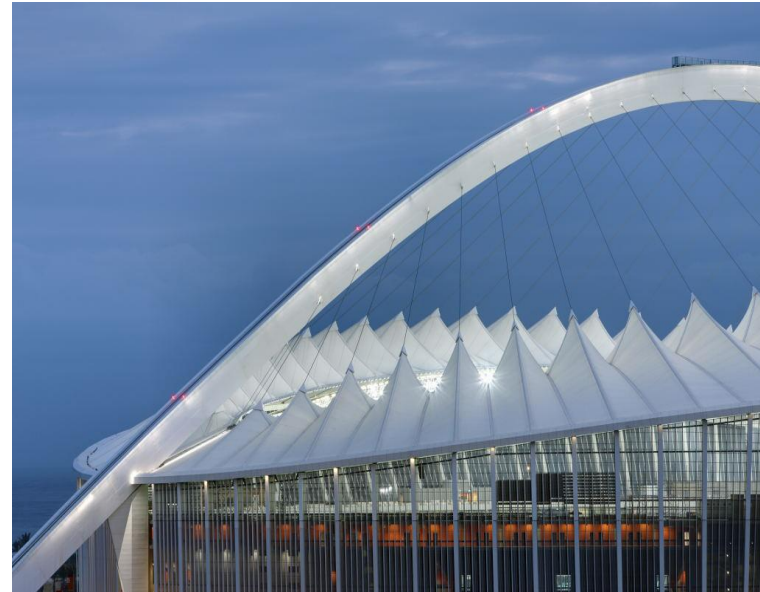
Roof Plan

# Moses Mabhida Stadium's Structure

- A 105 M (Two-pronged) Arch
- Radial Pre-stressing Cable System
- PTFE-coated Roof Membrane (Tensile Roof)
- Compression Ring And Façade
- Precast Concrete Columns Below And Hollow Box Steel Columns Above
- Raised Platform

# The Great Arch

- The expansive **350 meter arch** (two-pronged) rises **105 meter** and carries the weight of the **roof's inner membrane**.
- At the northern end, a **cable car** transports visitors to the **'Sky Deck'** at the apex of the arch.
- The arch consists of a 5×5m **steel hollow box** and weighs 2,600 T



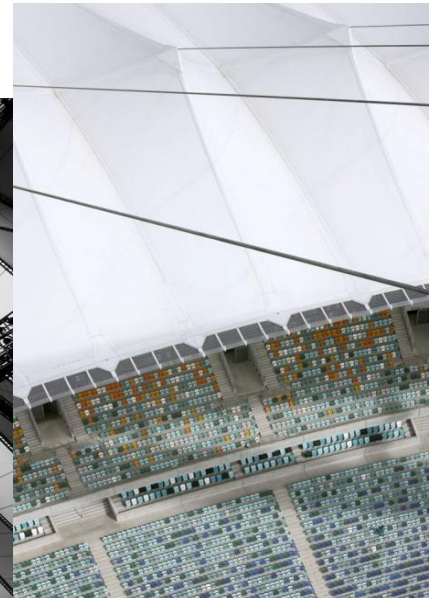
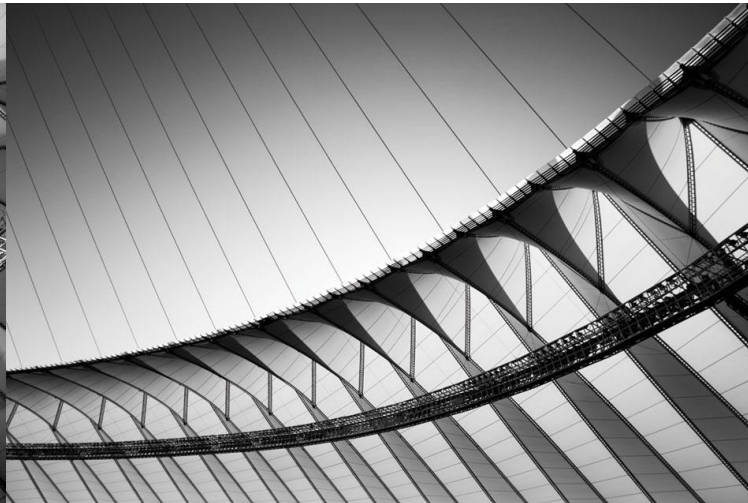
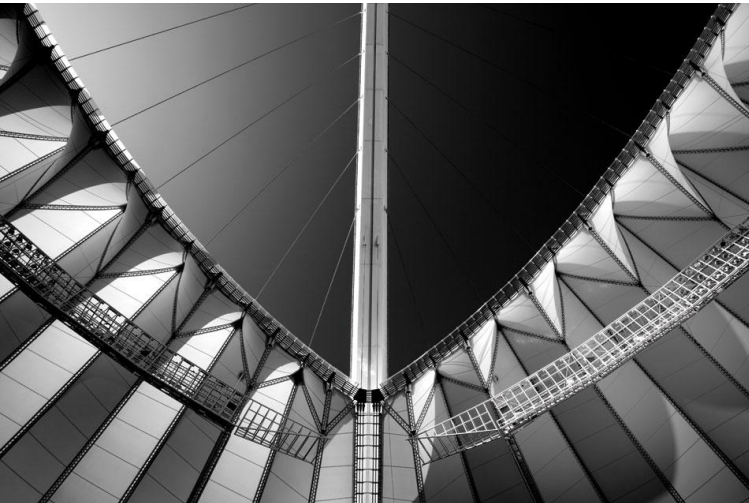
## Radial pre-stressing cable system

- The **arch** is connected by cable system to the **external** edges of the roof.
- The **unusual geometry** of the cable system is derived logically from the structure.
- Radial **pre-stressing cables** are attached to the external edge of the roof all round the stadium and the great arch on one side, and the inner edge of the roof on the other.
- **95mm diameter steel cables.**



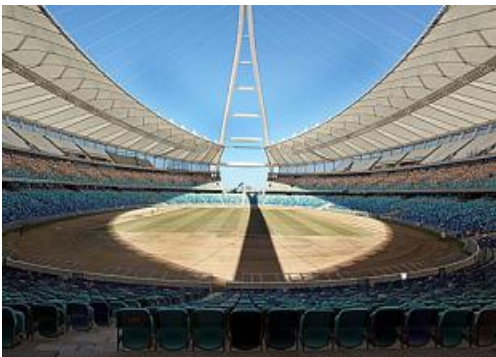
## PTFE-coated roof membrane (Tensile roof)

- **Roof consists of a 46,000 sqm (500,000 sqft), Teflon-coated glass-fibre membrane**
- **The PTFE-coated roof membrane admits 50% of the sunlight** into the arena, while providing shade with providing protection against glare and rain.



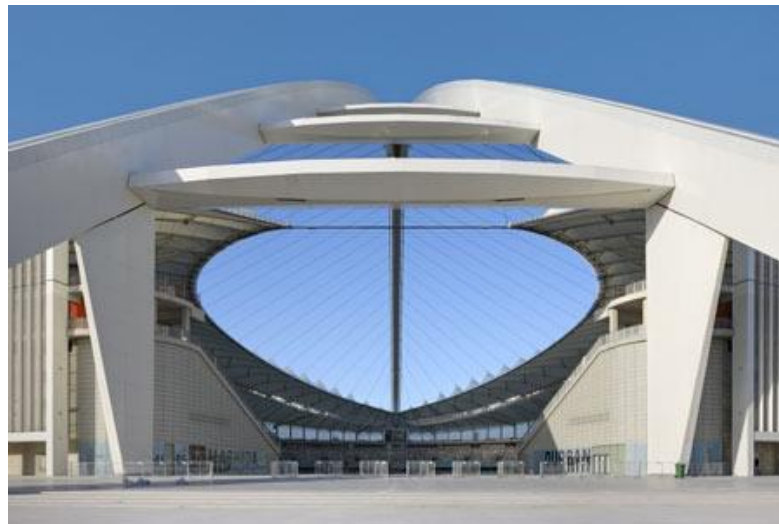
# The Bowl

- The shape of the bowl results from the **interaction of the circular roof structure** with the **triple-radius geometry of the arena**.
- Around the field, **900m of retaining walls** stretches 8m high.
- A **total of 1,780 pre-cast concrete seating panels** creates the bowl form.
- The stadium's bowl was created by a total of **1780 precast concrete** seating panels, with **1750 columns** and **216 raking beams**.

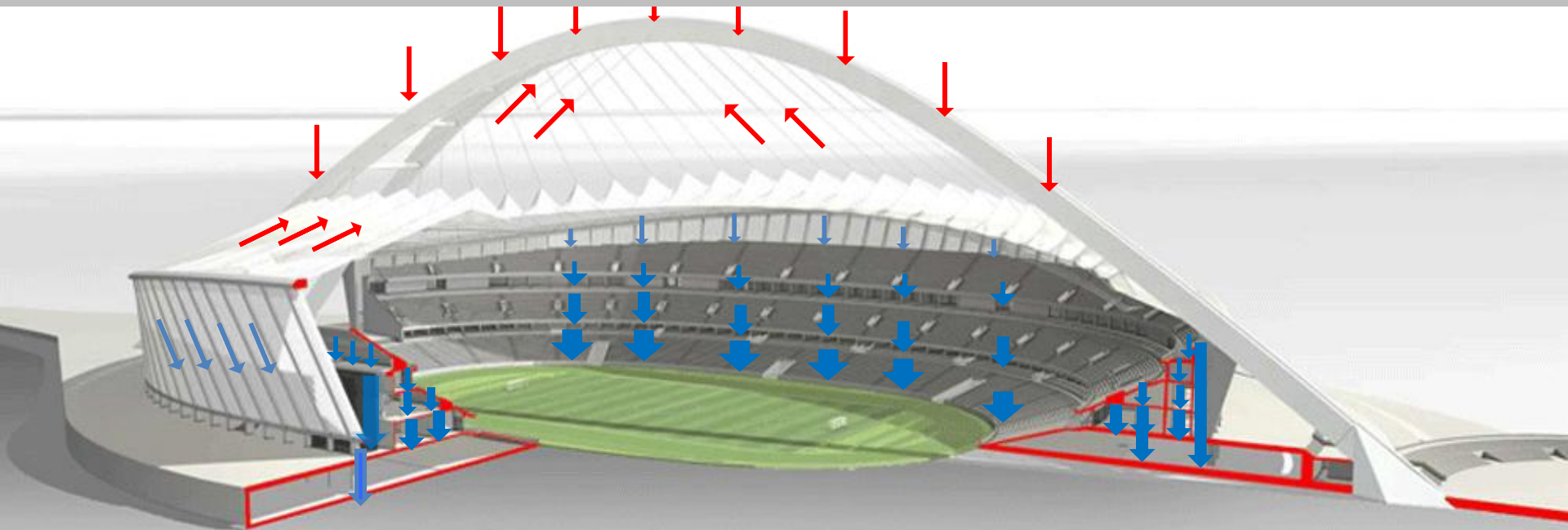


# Compression Ring And Facade

- The **compression ring** and **facade** are carried on **precast concrete columns below and hollow box steel columns above**.
  - **Over 100 columns surround the stadium**. The height and angle of inclination varying around the stadium.
  - The **facade membrane** of perforated **metal sheeting** provides **protection against driving rain, strong winds and direct sunlight**.
  - Perforated facade membrane forming a **live pattern of light and shadow**
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- In total **15,000 sqm(160,000 sqft)** of facade will surround the stadium.

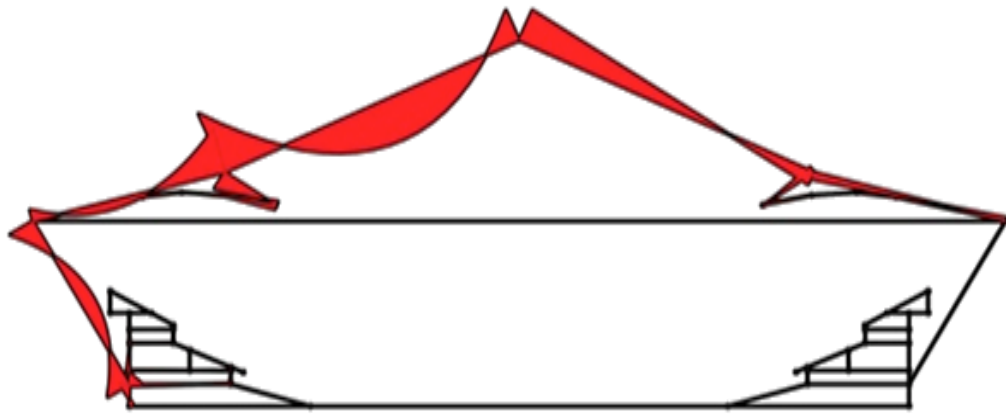


# Load Tracing

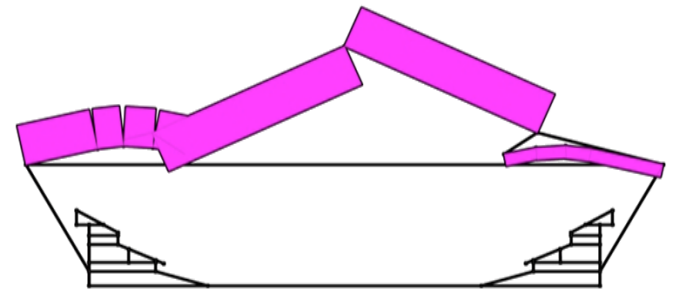




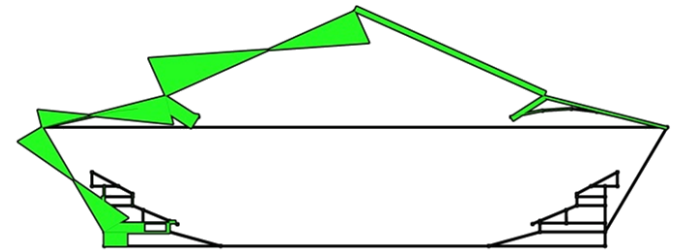
# Multi-Frame



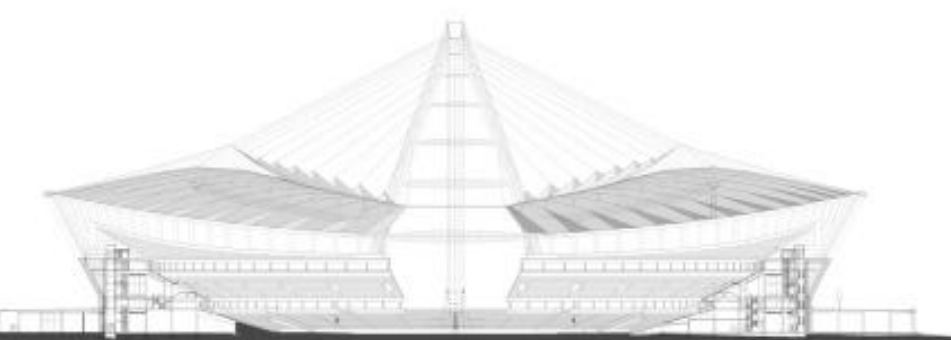
**Moment**



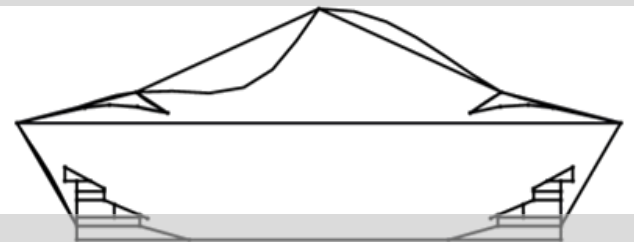
**Axial Loading**



**Shear**

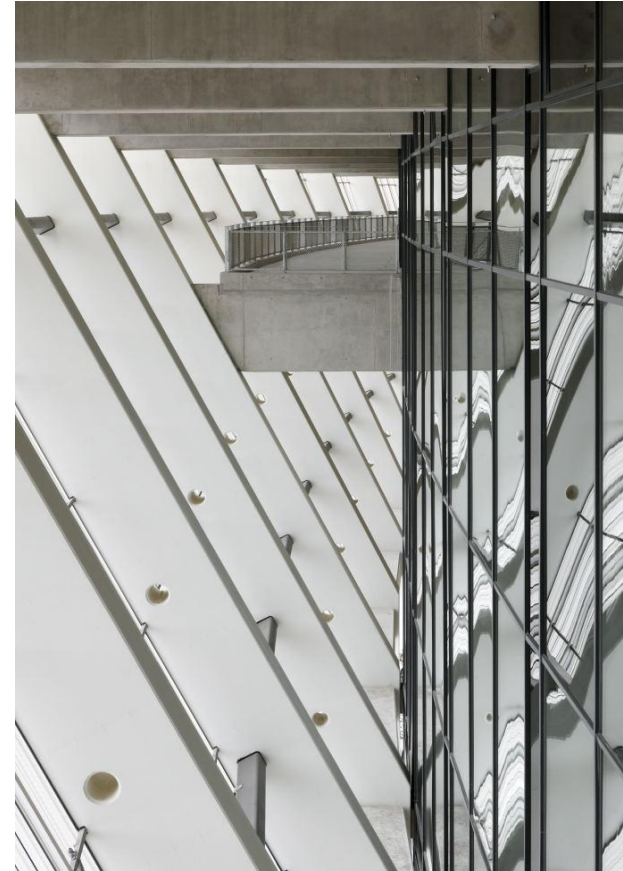
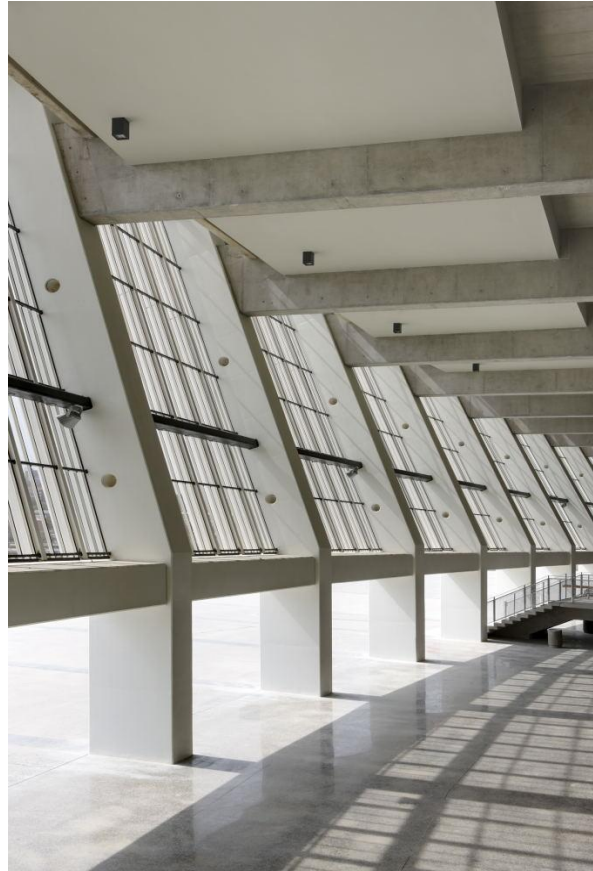
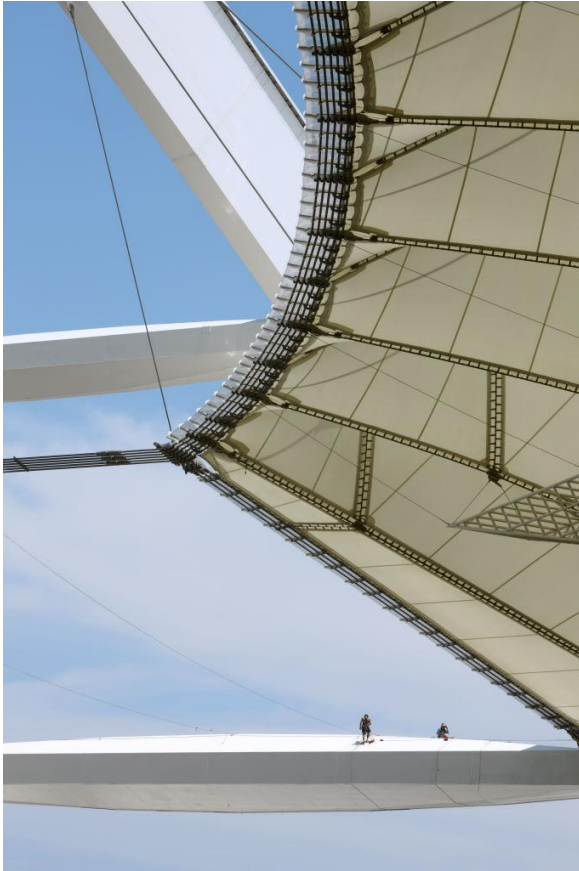


**Deflection**



## Artificial Lighting - Indoor

- The **artificial lighting** of the stadium is not just functional, but also serves to **illuminate the architecture**.



# Artificial Lighting - Outdoor

- The **roof surfaces** on either side of the great arch are **illuminated on top** by a **line of LEDs** mounted directly on the arch.
- **Atmospheric quality and functional efficiency** have been combined to put Durban's new icon in the right light.



# Material Details

- A total of 225 520 T of **concrete** and 9150 T of **reinforcing steel** has been used in the project
- **concrete slabs** for level floors
- 56\*10 meter long **steel segments** for the arch
- 95-mm-diameter **steel cables**
- 880-m-long steel **compression ring**

# A Green Stadium

- 90 percent of the **labor used was local**
- 85 percent of the **materials used were locally sourced.**
- Some **fly-ash** from post-consumer use was used in the **cement mix** of this beachfront monolith.
- High percentage of **recycled steel** components were used
- All of the 70000 **seats** have been manufactured from 100 percent **recycled plastic.**
- The stadium has a high energy usage during an event which would last four hours and then low energy usage during non-event periods.



# Process of Construction

Peter Bendheim



# Process of Construction of Arch And Compression Ring



# Process of Construction of Arch





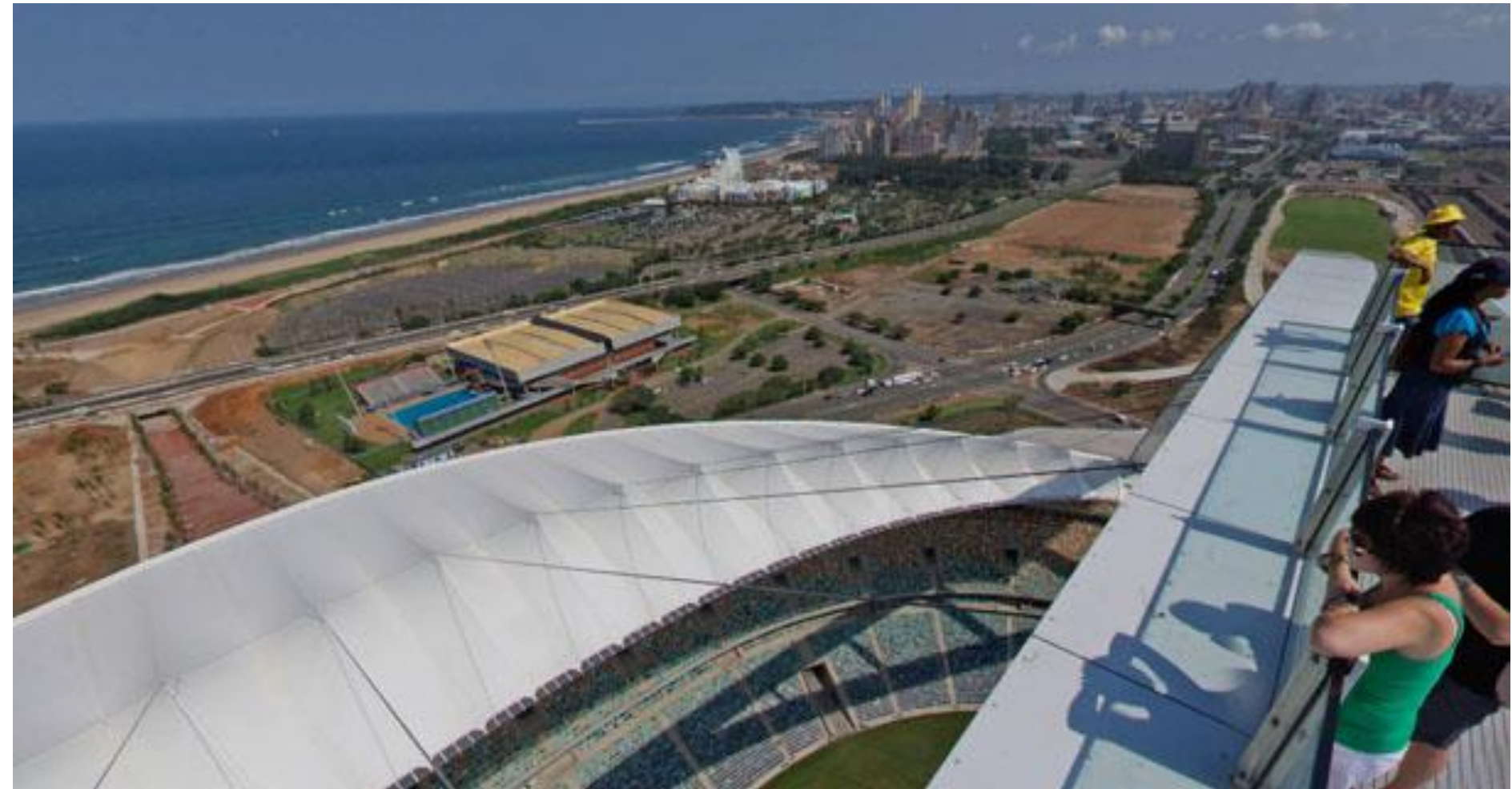
# Process of Construction-Arch and hollow columns Completed.



# Process of Construction of Roof



# Process of Construction-Arch Completed.



# References

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