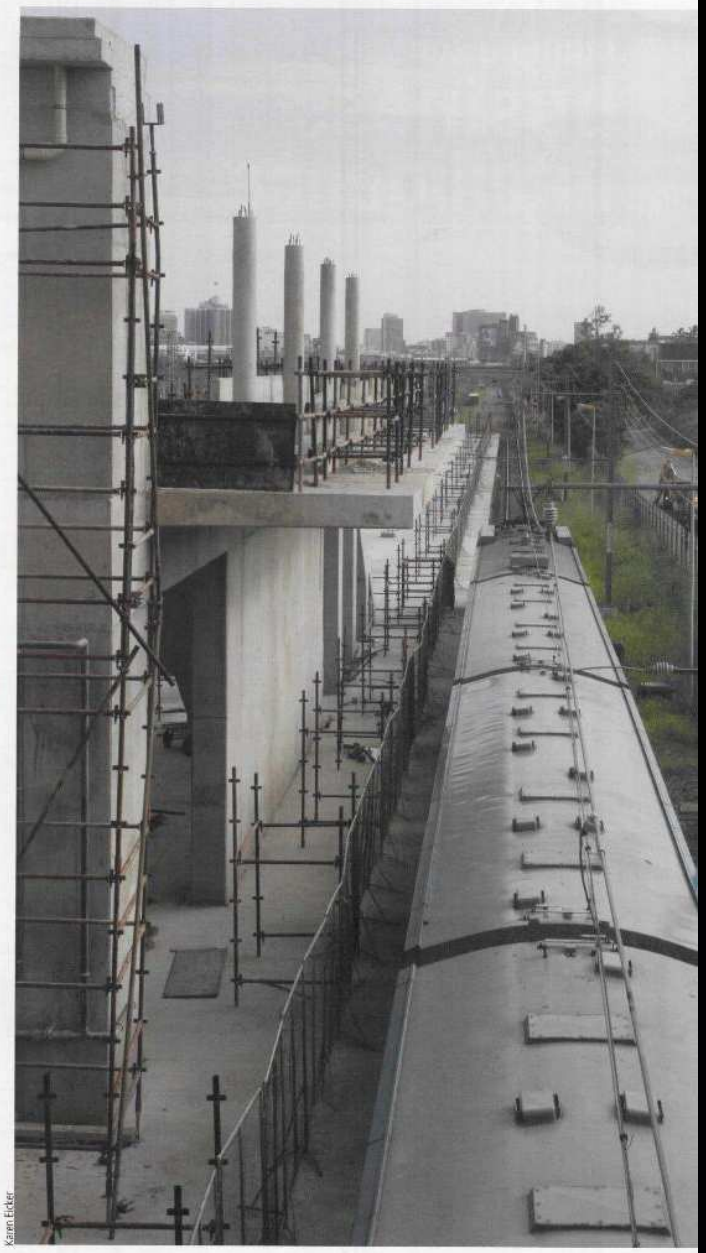
Building Africa
April 2010

BUILDING AFRICA
01 Apr 2010
Page : 4 #

SITE VISIT



Karen Ecker

Project at a glance

Name of project
Moses Mabhida Station

Location
Kings Park Sporting Precinct, Durban

Timeline
June 2009 to April 2010

Structural division
- Approximate overall building area (including platform level): 2 800 m²
- Overall height from platform level: 13,5 m

Particular challenges
- Designing for various operational needs
- Building over live rail site
- Site under construction while train services continue to operate
- Rail-engineering skills shortage

Solutions to challenges
- Dynamic modelling to confirm station sizing for events-based patronage
- Adequate safety induction and measures
- Client allowed access to half the site while reducing number of tracks in operation
- Engineering-skills transfer
- Teamwork, communication and collaboration between all role players

Building Africa
April 2010

Client
Passenger Rail Agency of South Africa
Metrorail
Project manager/design consultant
Arcus Gibb
Architect
Arup
Structural engineer
Iliso Consulting
Main contractor
Grinaker-LTA
Dynamic modelling
Goba

Moses Mabhida Station

Fan stop

Construction of this station is as fast-paced as its users and reflects the country's aspirations for a contemporary transport system, finds *Karen Eicker*.

As a specialist construction project on a tight programme and constrained site, the Moses Mabhida Station in Durban relies heavily on teamwork in order to ensure successful delivery of the building.

The station's construction started in June 2009 and is due for completion in mid-April 2010. The approximate overall area of the building, including the platform level, is 2 800 m² and the overall height of the building from platform level is 13,5 m.

Anita Govender of Arcus Gibb provides a background to the project. "In 1999, Metrorail completed the Stamford Hill Feasibility Study, which looked at the possibility of having a halt in this area. Umgeni and Durban stations served this area so it was quite a distance for people to walk to work. Then the stadium was planned next door. The question of how to get people to and from this major sporting precinct added further motivation for the facility which then evolved from a halt to a fully fledged station."

The new station is situated over live railway infrastructure. The area below the building includes five running lines used for freight, mainline and metro passenger transport, in addition to the main staging yard for Metrorail's train fleet.

Govender observes: "The unique site provided challenges in terms of working safely within a live environment efficiently while maintaining productivity and operation of the railway service.

Two-part construction

The unique environment also created a number of construction challenges but most were foreseen and catered for at tender stage.

"We would have liked to use a tower crane on a job of this size," says Steve Poorter of Grinaker-LTA. "But working over live lines made it impossible so we had to work with a mobile crane and all the concrete had to be pumped."

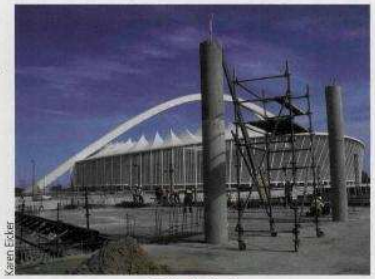
Relocating the site office half way through the project was not viable due to space constraints so materials had to be transported over 7 km instead of a mere 80 m. "In the second stage of the project, live railway lines separated the site office and store from the half of the site under construction," adds Poorter. "Any materials that had to be moved from store to site, had to be driven down to Durban Station and then all the way back again."

Designing the large span concourse with minimal deflections was a challenge," Samad Khalpey, of Iliso Consulting, says. "This was overcome using a combination of post-tensioned beams and conventional slabs. These beams and their support columns had to be positioned to allow for construction with partial occupation of the site."

Poorter adds: "We could not use pre-casting or any sort of pre-manufacture because the span between the columns was too great (about 15 m) and the site was constrained."

Ross Urquhart, also of Grinaker-LTA, notes that the excavations revealed the water table to be higher than initially expected – about a metre below ground level at its highest point. "Normal strip footings were used for the platforms and we had to request that the engineers revise the design to move the foundations up. Some of the track infrastructure was also affected by the high water table. We dug out and put dump rock into the water, and then put geofabric on top of the rock and the construction material on top of that. Poorter says: "As building contractors, it was a challenge working in a specifically rail-related environment. We have learned a lot about what each discipline requires and we have had to work closely as a team with the engineers."

Rail-service operations will return to normal at practical completion in April.


Karen Eicker

Fully fledged
Moses Mabhida Station was initially conceptualised as a halt but developed into a fully fledged station once the stadium was planned.

Building Africa
April 2010

Key challenges

Arup

1 Minimising deflection

2 Connector

Photographs by Karen Eicker

3 Foundations moved

The approximate overall area of the building, including the platform, is 2 800 m² and the overall height, measured from platform level, is 13,5 m.

1 Minimising deflection
Designing the large-span concourse with minimal deflections was a challenge overcome using a combination of post-tensioned beams and conventional slabs.

2 Connector
A determining design consideration was the need for a bridge structure which connected the two tracks across a yard – the width of the concourse was dictated by the position of the platforms relative to the tracks.

3 Foundations moved
The water table was higher than expected – only a metre below ground. Strip footings were used for the platforms but foundations were raised. Rock was dumped into the water, covered with geofabric and then with the construction material.

Services coordination

"This is an intensive rail infrastructure area so services coordination was critical," says Poorter. The programme was developed around the fact that we had to maintain the environment as live and we had to allow for the train services to continue running.

"To make this possible, Metrorail agreed to give us access to half the site for construction. They shut down all services on that side of the site and operated all services (commuter and freight) on the other side of the site. Once work was completed on the first side, we crossed to the other side. So operations continued as normal using just two lines but Metrorail did not have the flexibility previously allowed with five lines running. It has worked well so far and was the only way we could optimise the programme."

Safety

Being a fairly old rail facility, a lot of the services on site were unknown. "Right at the beginning, we found a section of large-diameter, old cast-iron sewer pipe which delayed the piling and took some time to remove," says Poorter. "We occasionally came across live cables we didn't know were there – that is one of the challenges of working in a live environment. Technologies to locate these services don't work in this area because there is too much interference. However we have a good safety record without one lost-time injury on the job to date." Urquhart adds: "We have two full-time safety officers on site – one night shift and one day shift. And a specialist rail consultant sorts out occupations and safety from Metrorail's side. Everyone who works on a railway site has to be properly inducted to work in this particular environment."

Building Africa
April 2010

BUILDING AFRICA
01 Apr 2010
Page : 7 #

1 Hidden services
Many services on this old site were unknown and technologies to locate them did not operate due to excessive interference. Despite this, the contractor has a good safety record.

2 Live wire
Metrorail provided access to half the site for construction and shut down all services on that side of the site. All services (commuter and freight) operated from only two lines during construction.

3 Train spotting
The new station is situated over live railway infrastructure – five running lines are used for freight, mainline and metro passenger transport as well as the main staging yard for Metrorail's train fleet.

1 Hidden services

2 Live wire

3 Train spotting

Building Africa
April 2010

BUILDING AFRICA
01 Apr 2010
Page : 8 #

1 Waste as backfill


2 Iconic structure


Photographs by Karen Ecker
3 Strategic positioning

'Green' considerations

In terms of the layout and orientation of the scheme, the offices and recreation areas were positioned strategically beside the perimeter of the building in order to maximise exposure to natural lighting and ventilation, Elaine Lamb, of Arup, explains. Rooms with lower occupancies such as storerooms and service rooms are located deeper into the plan.

"Wherever possible, we have made use of locally sourced and highly robust materials," she adds. "For example, the building is clad in Corten steel – a durable and contextual material commonly used in this industrial setting.

"In order to minimise excessive levels of solar gain, we have implemented the use of solar shading in the form of timber slats which are fully integrated into the architectural language of the building."

The building has also been designed to use only cold water and, thereby, eliminate hot-water geysers and associated pipework, sanitary ware and brass. Water use is based on the "probable demand" system and not maximum demand. Water-saving devices have been specified in the form of dual-flushing systems and electronically operated flush valves on the urinals.

"As a company, we try to keep construction waste to a minimum. As there are no great loads on the platforms, which are 275 m long, we used extra concrete waste from the site as backfill; avoiding additional transport and dumping of this material."

On the rail side, some challenges were experienced in sourcing materials and equipment – mostly due to long lead times associated with imports. Govender says: "We have obtained materials from other rail companies or other regions as a temporary measure to make sure that the project is stocked. These will be replaced when our deliveries arrive. In this respect, it is useful to have a network of people you can call on if necessary."

The construction team is working 24 hours a day but, as the surrounding area is mostly industrial, noise at night is not a significant problem.

Iconic station

The structural elements of the Moses Mabhida Station differ considerably from those of the main Durban Station. The former is an iconic station which forms part of a sports precinct while the latter is the central hub for the entire Metrorail service in KwaZulu-Natal. It is, therefore, bigger with platforms and a different operational function. However there are certain minimum requirements and standards which apply across the board. "We have complied with the norms, standards, and guidelines for station facilities of the Passenger Rail Agency of South Africa as well as requirements for special needs passengers," says Govender. "Standard platform lengths have been used and standard operational facilities have been included such as ticket counters, offices, security and elevators for special needs passengers. There is common infrastructure between the stations so there is a high level of compliance. But, in terms of technology, we are providing the latest in communications for the new station in the form of automated announcements and electronic display boards showing the status of a train service such as arrivals and delays."

Team overcomes

Govender indicates that, from inception, the project body has comprised all relevant stakeholders: client, professional team, contractor, specialists and local community representatives.

"The EIA required consultation with the community and the feasibility process, through

Building Africa
April 2010

BUILDING AFRICA
01 Apr 2010
Page : 9 #

Arup

4 Solar shading

Karen Ecker

5 Specialist skills

1 Waste as backfill
As there are no great loads on the 275 m-long platforms, extra concrete waste from the site was used as backfill; avoiding additional transport and dumping of this material.

2 Iconic structure
Structurally, Moses Mabhida Station is an iconic station as part of a sports precinct. It differs considerably from main Durban Station – the central hub of the entire Metrorail service.

3 Strategic positioning
Post-tensioned beams and their support columns had to be positioned to allow for construction with partial occupation of the site.

4 Solar shading
Timber slats will serve as solar shading to minimise excessive levels of solar gain.

5 Specialist skills
On the signalling side, the rail-interlocking system is one of only two in the country. A group of engineers with extensive experience in signalling has trained six young engineers in this old but functional system.

to detailed design, required consultation with all stakeholders. There is a commitment to getting the project up and running on time, and everyone has come on board to make it work. Also, through this participative process, everyone has been able to contribute in an appropriate manner. The client, professional team and specialist rail subcontractors have forged a strong relationship in the project. This close working relationship and partnership approach have made it easier to overcome challenges posed by the project."

Specialist rail skills

Approximately 160 people have worked on this site at any given time, including the night shift. Capacity building has been addressed at various levels on the project. As this is a field which requires specialist knowledge, it would have been challenging to train local labour through the project in the specialist areas. Local labour has however been used in the project. Govender says: "The entire project team is constituted of a number of specialist companies – each one an expert in their field. Securing an appropriate mix of expertise for the project has been a critical success factor to date. The predominant challenge in the engineering and construction industries is definitely the skills shortage. The rail industry faces an even more severe shortage of skills. The project has a substantial range of specialists ranging from those with decades of experience to those with a few years of experience. Through appropriate skills transfer and using the team in positions which support their strengths, the project has been able to address the skills shortage with minimal impact on the project programme. Indeed, the project has been an opportunity to transfer skills and the commitment of all parties to succeed has ensured that individuals have grown as a result of being a part of this project while making a valuable contribution to the project."

This dynamic is illustrated in a particular challenge on the signalling side. The rail interlocking system is one of only two left in the country. The existing equipment is fully functional and did not need replacement but the technology is old.

"While there is nobody left in the country who knows how to design the system, we managed to get hold of a group of engineers who have a lot of experience in signalling," says Govender. "They have gone through the necessary process and have taken some of the younger engineers on board so now we have five or six individuals who know the system inside and out."

Building Africa
April 2010

Dynamic model
Dynamic modelling was used to show how many people could move through the station in specific time frames. This dictated:
- optimal width of the staircases;
- optimal width of the concourse; and
- the balance between structure and operational procedures for human safety.

Arup

Karen Ecker

Three design challenges

The design of the station had to ensure appropriate suitability for the site as well as integration with the precinct. These considerations posed three design challenges: identity, logistics and site parameters.

"The project had to respond to the functionality and design elements of the precinct," says Govender. "We worked closely with the city's design team who had input into design decisions from the outset. So the station and stadium have a uniform feel while retaining their own identities. In the conceptual planning phase, we actually had three different sites but, when we optimised the logistical issues, in terms of how people access the station and how the station responds to commuter needs, we chose this site."

Daily operational needs had to be balanced with the needs of an event within the precinct such as a soccer match or concert. For example, on a daily basis, the station might cater for around 10 000 commuters while up to 70 000 people might pass through the facility during an event.

"Dynamic modelling showed us how many people we could move through the station in a certain time frame," explains Govender. "This dictated the optimal width of the staircases and area of concourse, as well as the right balance between structure and operational procedures in order to manage people safely in and out of the station."

Another determining design consideration was the need for a bridge structure which connected the two tracks across a yard. Ultimately, the width of the concourse was dictated by the position of the platforms relative to the tracks.

Lamb says: "From the onset, our primary architectural concerns related to the issues and processes around the flow of people and trains into, out of and around the station, in conjunction with staff, operational and maintenance requirements. Our approach to the design was, consequently, informed by the analysis and interpretation of these concerns, as well as integrating the building into its context in terms of a design language and operational requirements. The building has also been fully designed to conform to the requirements for people with disabilities and impairments."

Khalpey adds: "Although this station structure is relatively small, it challenged the whole professional team from all aspects. I believe the 'design to cater for logistics' was the main challenge. With limited time, working space and budget, as well as construction requirements, among other constraints, we had to deliver this station to completion within the programmed dates. Budget limitations also dictated the type and use of materials as well as the final finishes."

Emerging aspirations

"This is the first station in the region that will have a different look and feel so it is associated with a different expectation," Govender points out. "I must commend the client for allowing us the artistic freedom within the required functionality. It has been a fantastic opportunity in terms of design."

Thandi Mkhize of Metrorail Durban concurs. "The client is looking forward to the completion of this station, particularly as this is a high-profile project."

Lamb says: "This iconic building was designed as a new flagship station. It could not have been realised without the teamwork and close cooperation of all parties concerned. The new station will, ultimately, provide a contemporary space which reflects the excitement of the new emerging aspirations for public transport in South Africa." ■

Building Africa
April 2010

BUILDING AFRICA
01 Apr 2010
Page : 17 #

OVERSTRAND

Development lauded

The Southern African Housing Foundation has given the Housing Project of the Year Award to the joint-venture contractors on a low-cost housing development in Overstrand – Gibb and M5 Developments Cape.

The project comprises a low-cost, 88-house development, outside Hermanus, selling for less than R80 000 per unit. Sean Molloy, project manager for Gibb, commenting on the planning and design of the houses, says: "The design of the house incorporated the economic use of cement blocks with T and corner blocks manufactured specially to suit a modular design." This results in very little wastage and allows for extra spend on other higher-quality products, such as concrete-frame windows with aluminium closures, rather than steel. "In addition, a specially designed window-sill block and a Meranti back door with a recessed glass panel were used to bring more natural sunlight into the house."