

Midfield Terminal, Abu Dhabi International Airport

Client: Abu Dhabi Government
Contractor: L&T, China State Construction Engg Corporation (CSCEC)
Location: Abu Dhabi, UAE
Products: Megashor, Rapidshor, Alshor Plus, Superslim Soldiers

Case Study

Engineers from RMD Kwikform have used specialist 3D modelling techniques to design complex formwork and shoring solutions to support the delivery of the new Abu Dhabi International Midfield Airport terminal.

Commissioned by the Abu Dhabi government, the new \$2.94bn terminal will cover an area of 630,000m² and service up to 20 million passengers per year. For the TAV, CCC and Arabtec joint venture (TCAJV), bringing the iconic architectural vision to life required numerous shoring, propping and formwork solutions to accommodate for the complex design and geometry of key parts of the structure.

One of the most difficult design challenges was the formation of the main terminal building with its huge curved roof structure. This required the careful installation of some of the world's largest steel archways and girders, to create the impressive visual impact of this important part of the project. Curving in both the horizontal and vertical axes, the construction of the terminal building relies on millimetre accuracy to install each specially fabricated segment, which forms the arches and a central girder.

As part of the construction planning process, RMD Kwikform engineers worked with steel roof sub-contractor, China State Construction Engg Corporation (CSCEC), to design bespoke components and solutions using 3D modelling for the phased erection of the arches. This process included the design of a modular Megashor heavy-duty support system for the erection of the steel arches. This was coupled with additional shoring solutions for the steel buttresses and transfer slab that formed the foundations for the arches.

With a need to support the arches in both the vertical and horizontal planes, a critical component of the solution was the design of a special ball joint, with an additional jacking frame system. In order to ensure the frame was able to cope with the key loading forces and changeable climatic conditions, including high wind and heat, the engineering teams used the latest modelling technology before components were then fabricated and tested.

Commenting on the support solution, RMD Kwikform UAE General Manager, Chris Jardine said: "Loading and stresses on the formwork and shoring were different for every single node point; we had to take a 3D model to form a solution that could operate safely and securely. As the contractor wanted to be able to use the frames multiple times, our solution had to be flexible enough to cope with the adjustments required at different parts of the erection phasing."

In addition to designing the jacking frames, RMD Kwikform designed and supplied the support towers, which varied in height from 15 to 45 metres.



Using its unique heavy duty Megashor propping system, RMD Kwikform engineers had to vary the footprint of the towers to increase or reduce stiffness, to both optimise sharing of the load and cope with thermal movements (due to temperature variance from day to night) of wind forces and dead loads. The support system had to cope with vertical loads of up to 500kN and horizontal loads of up to 75kN.

In addition, the Megashor system needed to be reused for subsequent steel arches, so the design had to be versatile and easy to reconfigure into a new tower design.

The steel buttresses and transfer slabs used to form the foundations for these steel arches were supported by RMD Kwikform's high load Rapidshor modular steel shoring system. Each steel buttress weighed up to 40 tonnes and the concrete transfer slabs were up to 2.5 metres thick.

Finally, with each of the 16 steel buttresses and concrete slabs mounted two floors up, the RMD Kwikform team had to design a back propping solution for the two levels below the raft. This was achieved using its lightweight aluminium Alshor Plus shoring system.

Commenting on the engineering challenges faced in the project, RMD Kwikform UAE Engineering Manager, Anvar Sadat, said: "To achieve the architect's stunning vision for this structure, we've incorporated a lot of complex engineering and design.

"Not only did the engineers have to account for extreme loading, but loading in a number of different planes and variations due to the affects of both thermal changes and wind."

TACJV also employed RMD Kwikform to design and supply equipment for a number of other structures for the Midfield Terminal building.

Complex slab solutions

This included back propping of the complex concrete structure of the airport slab. The slab itself had to be supported at key points to ensure the construction and halving joints, which created concrete cantilever structures, were formed correctly. Here RMD Kwikform engineers designed a solution using Megashor to prop the concrete sections up to the raft levels on the transition areas, before concrete pour strips completed the structure. Using the Megashor system also allowed other specialist trades greater access to the work area, as the system used fewer legs and beams so it was easier to work around.

For the VIP area, Alshor Plus was used to support primary beams. These had a depth of up to 3.2 metres and a propping height of up to 13.5 metres. The Alshor Plus system reduced the number of loose components used, and being an aluminium system, it decreased the manpower needed due to its lightweight but heavy loading capability. This allowed for the completion of this area in less than five months.

From internal bridges to ramps

The vast scale of the terminal building called for numerous additional projects, requiring engineering support. One such project was an internal long span bridge. RMD Kwikform engineers designed modular Rapidshor steel shoring to support not only the concrete weight of the bridge, but also its steel buttress and precast central beams. As part of the design process for this bridge the engineers had to consider other site users, achieving load transference to meet special restrictions for mobile equipment platform users, and for those completing finishing works on the levels below.

Another unusual request saw engineers design a 20 metre temporary ramp with a five per cent slope, allowing a 40 tonne tower crane to be moved between two levels. By using Megashor and steel Superslim Soldiers, the solution proved to be far more convenient than constructing a concrete ramp; the speed of erection and dismantling assisted the overall access and programme management of the site.

Additional tunnel support

In addition to the main terminal building, RMD Kwikform equipment has also been used to provide solutions for a number of ancillary buildings and structures for contractor L&T. These include shoring and formwork for the construction of a traffic tunnel, plus a three-carriageway road tunnel.

Talking about the scale of the construction, Project Director Adrian Brown from L&T, added: "The new Abu Dhabi International Midfield Airport Terminal building is a massive project, with a number of different construction phases. The engineering design and support that RMD Kwikform has supplied was absolutely vital in helping us to achieve some of the more complex engineering structures needed within the airport."



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