



Construction work on Terminal 2.



## PILGRIMS' PROGRESS

Unique among airports, Jeddah's King Abdul Aziz International handles the traffic for the world's largest human gathering – the Hajj. **Richard Lawn** examines the audio system that is essential to its operation

### OWING TO ITS CLOSE PROXIMITY

to the holy sites of Mecca and Medina, the King Abdul Aziz International Airport in Jeddah, Saudi Arabia has become the gateway to Saudi Arabia for the large number of worshippers each year who descend from all corners of the Muslim world for the annual pilgrimage or Hajj. The Hajj, which dates back to the 7th century, sees around two million pilgrims arrive in Mecca, all of whom enter and depart from the airport during a six-week period and, in doing so rigorously test all of the announcement and safety facilities.

The Hajj Terminal was built when the airport was first opened in 1981 and handles pilgrims coming for the Hajj season and other visits to Islam's most holy place, and, at 465,000-sq-m in size, is the world's second largest air terminal after Hong Kong International Airport's terminal. Made distinctive by its tent-shaped roof, it is designed to serve 21 million passengers per year for the next 20 years, for which Prince Sultan stated that the project would incorporate the highest technology available to bring the airport utilities in-line with the latest developments.

The structure is not actually a tent but is, in fact, a white-coloured Teflon fibre-glass membrane, and is

one of the largest structures of its type in the world. The semi-conical roofs are made from 4.6-sq-m of this fibre-glass which – given the harsh sandstorms that they regularly experience – need to be self-cleaning and have a life expectancy of 30 to 50 years. The terminal also incorporates a mosque and can accommodate 80,000 travellers at a time. Geiger Berger Associates, Schlaich, Bergemann und Partner, and Skidmore, Owings & Merrill were appointed as structural engineers for the project, with Hochtief AG the general contractor.

The terminal is comprised of two rectangular, two-storey, air-conditioned buildings, which contain immigration services, customs, baggage reclaim areas, check-in counters and so on, and rectangular platforms covered by the tent-like roofs. The building is further divided by a central spine, providing an entry road for buses and other vehicles. A grid of 144 epoxy painted 50m-high steel columns, tapering from 2.6m in diameter at the base to 1m at the top, are used to support the tensioned support cable for the 210 fabric roofs, with the base of the fabric suspended 20m above the floor. Thirty-two radial steel cables rise a further 12m attached to a 4m-diameter tension ring,



Configuring the Klotz Digital Varizone PA system.

making the large roof units possible. Warm light filters through this translucent material but, because it is made for low transmission of heat, only seven per cent of the available light is admitted. Therefore, when the exterior temperature is over 120°F, the temperature under the tents seldom exceeds 80°F. As the pilgrims often spend from 18 to 36 hours in the terminal on their way to or from Mecca, it is vital that they are not exposed to excessive heat and consequent dehydration. Wind loading is another stress consideration for the building but, given the open sides of the structure, the wind not only causes lateral loads but can also create powerful up-lifts. Other loading considerations include the collection of dirt on the tent roofs and live loads due to maintenance and repair.

The high ambient noise levels generated by 80,000 passengers demands a sound system that will clearly and reliably deliver messages and announcements. The airport authorities were introduced to the Renkus-Heinz Iconyx column speakers on the

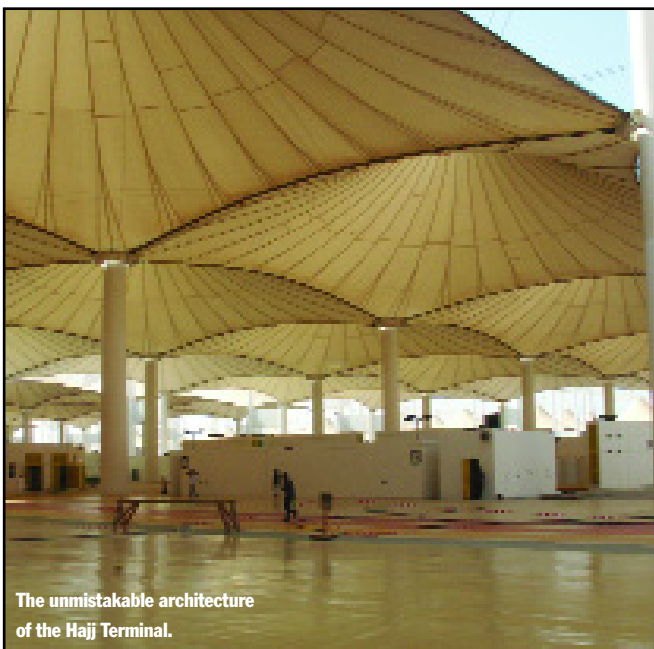
Citytec Mediatronics-ME booth at an Airport Trade Show that took place in Dubai in June 2007. General manager for the Dubai-based distribution company Norbert Bau recalls meeting the delegates from the airport for the first time: 'I wasn't sure whether we were exhibiting at the right trade show initially,' he recalls. 'However, upon meeting the Saudi contingent from Jeddah Airport, that changed. We were demonstrating the Klotz Digital Vadis networking products and decided at the last minute to showcase just one Renkus-Heinz Iconyx IC24 column speaker so that we could conduct voice announcements in Arabic on our booth. It was like Eureka – the contingent from BT Applied Technologies realised it had found the solution to its paging network problem. Until that point, they were completely unsure as to how the airport announcements in the Hajj Terminal could be managed.'

Citytec Mediatronics-ME was awarded the contract to design, supply and commission the Hajj Terminal's voice announcement system, one third of which was completed before the 2007 Hajj,

with Phase Two to be completed shortly afterwards.

The terminal acts as a single incoming terminal for the first three weeks of the Hajj, and as a departure terminal for the latter three weeks, in contrast to its two-way operation at other times. Consequently, all gates, routes, signage and logistics are reversed at the halfway-point of the festival. Pre-recorded announcements are made in Arabic in addition to Urdu, Bahasa Indonesia, French and English by an automatic announcement system from Sittig Industrial Electronics/Germany, which will be extended during the next phase to accommodate at least three additional languages. The audio distribution is handled by a Klotz Digital Vadis triple eight framework, a real-time system that can simultaneously play eight different announcements to an unlimited number of zones.

There is no room for error in a setting involving the safety of so many people, and so a combination of Iconyx IC16 and IC24 arrays are installed in the main terminal hall. The spacious nature and reflective surfaces of the terminal structure



The unmistakable architecture of the Hajj Terminal.



produce long reverberation times, making it difficult for people to communicate, but the use of the nine steerable arrays allow announcements to be delivered without misunderstanding. To achieve this, the Iconyx system uses class-D amplifiers controlled by DSP engines and patented algorithms to deliver sound in tight beams that can be directed where they are required. Internally, the IC16 columns are assembled from 16-transducer/16-amplifier modules, while the IC24 is composed of 24 transducers and amplifier modules. The onboard DSP modules can be configured remotely from a laptop or PC to suit a specific installation, so that the shape and aiming of the vertical beam can be directed accordingly. A remarkable STI (speech transmission index) of 0.7 has been achieved, which is unique among the airports throughout the Middle East. The on-site mosque also chose Iconyx speakers to deliver clear speech to worshippers, installing two IC16/8 arrays.

Elsewhere in the terminal, less sophisticated sound solutions were required, and around 270 CES

Audio ceiling speakers have been installed into the corridor walkways with 39 all-weather Community Audio R5 speakers in the outdoor areas. In total, Phase One of the installation has required 40 Bittner XV600 amplifiers to provide power to the non-column speakers.

With the prospect of new double-decker aircraft like the Airbus A380 – which is twice as tall as a Boeing 747-400 and will carry more than 500 passengers – coming into service, the capacity of all international airports is under review. The audio systems at the King Abdul Aziz International Airport are ready, as it can be directly connected to the airport's FIDS (flight information display system) in order to play out all necessary arrival and departure announcements automatically, down to the boarding announcements in the gate lounge.

And in order to speed up the boarding process, the system is able to recognize the layout of the aircraft by flight number in order to automatically play the relevant boarding message for both levels of the aircraft simultaneously.

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