

# With a new building providing a new landmark for the area, the acoustic design of the Daedeok Presbyterian Church needed to be brought into line. **Tim Goodyer** reports

## ALTHOUGH IT WAS ESTABLISHED

50 years ago, a new sanctuary distinguishes the Daedeok Presbyterian Church from others in Daejeon, South Korea. The Daedeok district is a special area established by the Korean government to support the country's science and engineering research. As a result, many of the congregation are from the surrounding colleges and laboratories, and devoted some of their talents and knowledge to the building of the sanctuary. 'From the beginning of the design, I had a dream of a church as a landmark of the Daedeok Research Area, so I visited a lot of beautiful and artistic buildings to use as benchmarks,' says church elder Kim Eun Ka, chairman of the new sanctuary.

The new building has a 1,000-seat main hall and 500-seat multipurpose sub hall. There are also dining facilities and a cafeteria. Its exterior design, meanwhile, was partly inspired by the Opera House in Sydney. But while architecturally impressive, the building proved acoustically problematic.

The architectural design of the church is the work of Professor Kerl Yoo of the Kyunghee University, with acoustic design for the main hall and the sub halls provided by Professor Sam Toyoshima of Yokkaichi University in Sendai, Japan, and Professor Hong Jin Kong of KAIST (formerly known as the Korea Advanced Institute of Science and Technology), the country's first graduate school specialising in science and engineering education and research.

The main hall contains pews to seat a total of 900 parishioners as well as pews for the 100 members of the church choir, and has dimensions of 25m wide by 45m long and 18m high. The totally asymmetric architectural shape of the hall is intended to reduce the problem of flutter echo created by parallel walls, in order to give the room good articulation and a more uniform soundfield. There are two main Adamson array-type loudspeakers, which are sufficient to cover all of the seating areas with a sound level uniformity of  $\pm 2$ dB.

The cross angles of the adjacent walls are not perpendicular, and some of the walls are inclined  $6^\circ$  from the vertical. This asymmetrical design is very helpful when creating a good sounding space. The ceiling is highest above the stage and the choir and lowest at the rear of the congregation pews. In addition, the pews are separated into groups

of 10 and their sizes and shapes are non-uniform. The pews for the choir are on the right-hand side of the stage facing the congregation pews. The shape of the ceiling – reducing in height from above the choir towards the rear of the congregation pews, is bad for sound propagation from the stage and the choir seats, however, and required the installation of two reflectors to overcome it.

Because of the high ceiling and the inverse angle of the ceiling above the stage area, it was difficult to obtain the early reflections from the ceiling needed to reinforce the direct sound from addresses and performances on the church stage. To solve this problem, Professor Toyoshima and Professor Hong Jin Kong designed ceiling reflectors to be positioned above the main area and the choir area. The ceiling reflector above the main area is composed of five tiers of reflector panels, while the ceiling reflectors above the chorus area are composed of four tiers of panels, each panel is angled to uniformly reflect the sound from the stage to every seat. Vertical stage reflectors are designed to provide good sound diffusion.

Along with the reflectors, all of the walls, floors and seating in the hall are made of wood, so there are no sound absorbing areas other than the people who make up the church congregation. To prevent long pass echoes developing from the wall behind the stage, and also to adjust the reverberation time of the room, the rear wall and the ceiling near the rear wall (5m from the rear wall) were fitted with soft absorption.

The walls have been designed to randomly scatter the sound to make the reverberation characteristic 'smooth and beautiful'. The random structure of the walls is provided by



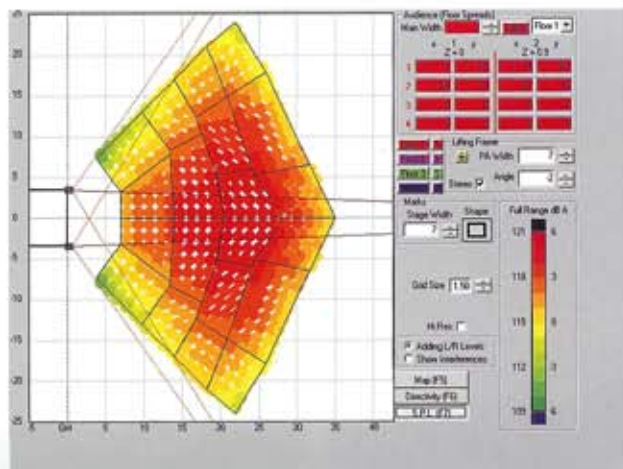
The sanctuary auditorium

blocks of sizes ranging from 300mm to 1.5m, which are effective for acoustic frequencies in the 100Hz to 20kHz range. The units used for this are rectangular parallelepiped (a three-dimensional figure formed by six parallelograms), asymmetric trapezoidal and tetrahedrons.

The reverberation time for musical performances in the church is required to be long, while for speech it should be short in order to allow good articulation. The designers settled on a reverberation time of 2.5s for musical performances and 2.0s for speech using the Adamson line array speakers, which have good directivity. To achieve these two acoustic environments in the



Acoustic absorption panels in the ceiling



The rising sanctuary ceiling and variable acoustic panels at the stage sides

same space, we installed a variable acoustic system on the walls," says Mr Toyoshima. "The main unit of the system looks like a pillar with a square cross-section. Two surfaces of this pillar are soft – and therefore absorbent – and the opposite two surfaces are hard and reflective."

In all, 84 acoustic pillars have been used for the variable acoustic system. Each of these acoustic pillars is rotated by remote control using a motor system – they can be rotated in various numbers of pillars by up to 180°, in order to allow the hard or soft wall to be exposed. The reverberation time at 500Hz of the most live position is almost 2.5s and the time for the deadeest position is 2.0s. These 84 pillars are separated into 10 remote control groups for a total of 10 different reverberation times in 0.056s increments from 2.0s to 2.5s.

The outside of the babysitter room and the front wall of the veranda are flat concrete walls that address the hall's interior and can cause echoes to reflect onto the stage. In order to prevent this, these walls are covered with a 'wavy' shaped composite absorption layer composed of 25mm of polyester fibre plus a 5mm graphite net and a 5mm thick cotton ball spray (1-3mm diameter). Likewise, the large vertical glass window in the corridor wall is good for viewing the beautiful outdoor scenery but also creates a flutter echo in the hall. This echo effect has been reduced with the installation of a rolling screen on the window side, and further by the wavy shaped composite absorption on the corridor wall.

The sound reinforcement system was supplied by Acoutek, Adamson's South Korea distributor, and is comprised of 12 SpekTrix boxes and two SpekTrix Subs arrayed in a left-right pair. In addition, there are six SpekTrix Waves flown for down fill. The complete system is powered by Lab.gruppen amplifiers with a Dolby Lake loudspeaker management system. The console used for the front-of-house mix is a Midas Legend 300/48 with Klark Teknik EQ/compressor/noise gates and Lexicon effects processors to round out the audio facilities.

The church held its opening ceremony in November 2007, with the PA system used for addresses from the pulpit, anthems performed by the choir from the choir seats and several performances on the stage. Along with its architectural merit, the church's reputation for its acoustics is now also very good and it is reckoned to be one of the best sounding churches/halls in Korea.

ddpc.or.kr  
www.kaist.ac.kr  
Acoutek, South Korea:  
+82 3 1719 0022  
www.acoutek.com



The Adamson SpekTrix FOH sound reinforcement system in position



The mix position with Midas Legend console

On the Road with:

Linkin Park World Tour

Nelly Furtado "Get Loose" Tour  
USA & Canada

Keith Urban "Love, Pain & the  
Whole Crazy" Tour, Australia

Peter Gabriel "Warm Up  
Summer 2007" Tour, Germany

"Project Revolution Tour"  
with Linkin Park, My Chemical  
Romance, Placebo...

V-Fest Toronto 2004  
with The Flaming Lips, MUSE,  
The Strokes...  
V-Fest Vancouver 2007  
with The Killers, Hot Hot Heat,  
Metric...

Les Vieilles Charrues Festival  
2004 & 2007  
with Peter Gabriel, Arcade Fire,  
Brian Ferry... France

Gurtenfestival 2004 & 2007  
with Avril Lavigne, Scissor  
Sisters... Switzerland

Austin City Limits 2007  
Austin Venture & AT&T Blue  
Room Stages, USA

Skanderborg Festival 2007  
with Snoop Dogg, Peter  
Gabriel, Status Quo... Denmark

Gigi D'Alessio "Made in Italy"  
European Tour

Beauty

and the  
Beast

Happily Ever After

The romance between power and beauty has been with us always.  
(Ask any FOH engineer.)

Gut power without the silk is not the stuff legends are made of. A brilliant marriage of these legendary qualities has emerged from Adamson's research laboratories. Many will try to match the power of the T21, but our years of research with composite cone materials\* and advanced motor designs, provide our systems with power handling that is hard to fathom. Coupled with the lowest distortion and best transient response found in the Y-Axis, you have the stuff of great memories. Maybe even legends.

For more info and worldwide distributors list visit:  
www.AdamsonProAudio.com  
Adamson International  
Tel: +1 (905) 982-0520

ADAMSON  
BUILDING EXCELLENCE SINCE 1978

\* Adamson's Kevlar™ cones are indestructible

