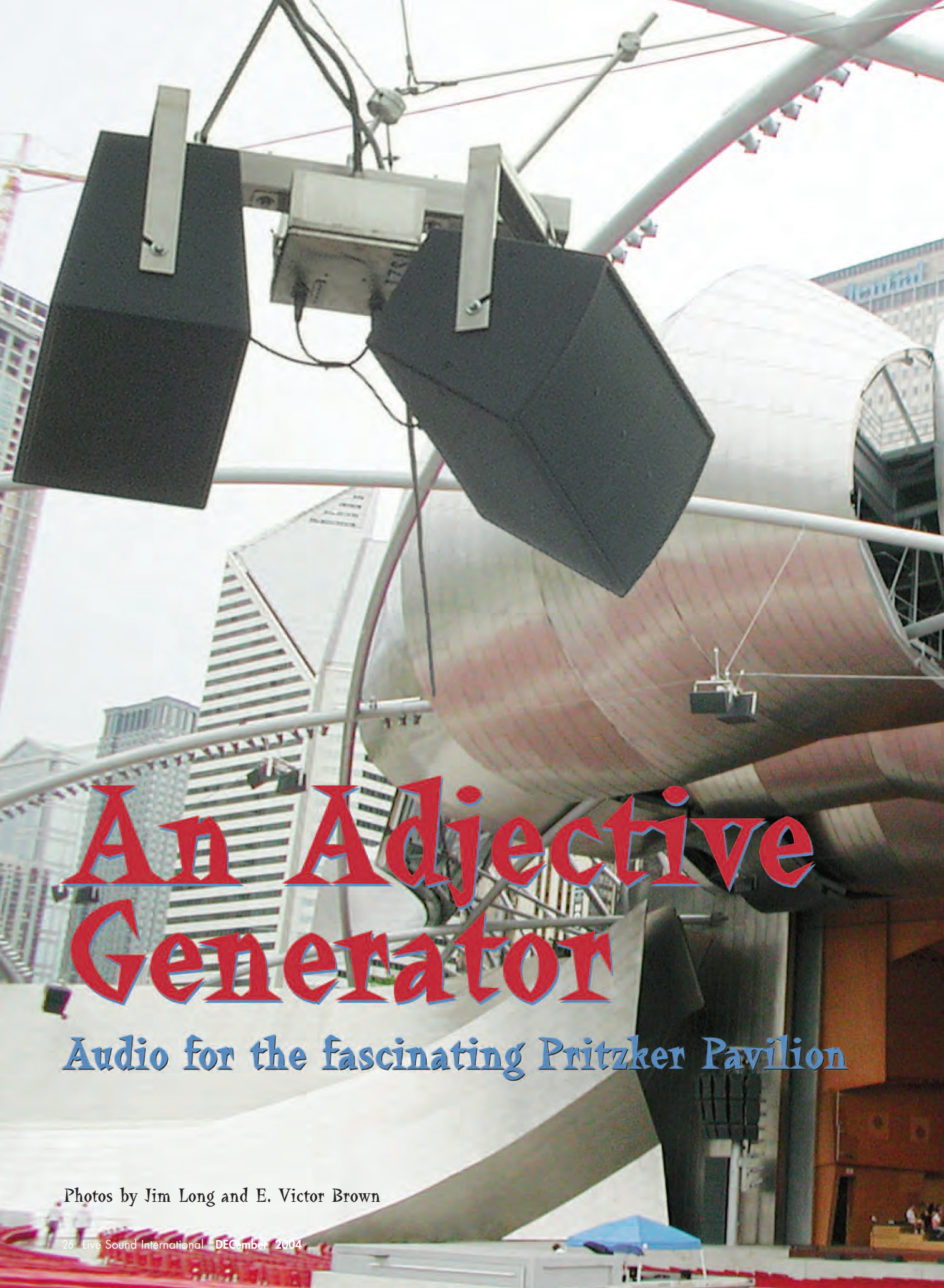
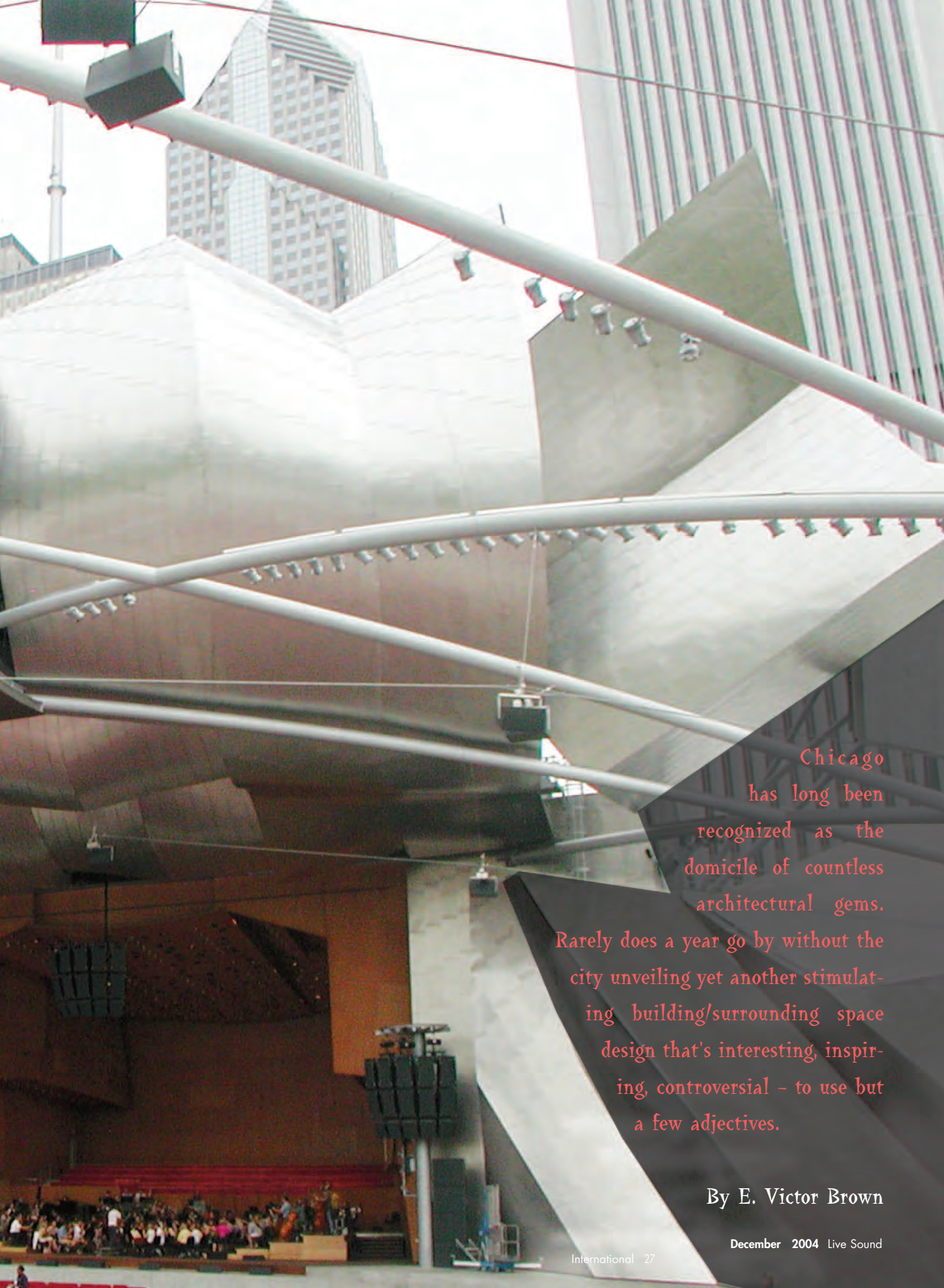


An Adjective Generator

Audio for the fascinating Pritzker Pavilion

Photos by Jim Long and E. Victor Brown



Chicago has long been recognized as the domicile of countless architectural gems. Rarely does a year go by without the city unveiling yet another stimulating building/surrounding space design that's interesting, inspiring, controversial – to use but a few adjectives.

By E. Victor Brown







A general and closer view of some of the 100-plus distributed loudspeakers.

The latest architectural "adjective generator" is Millennium Park, which recently opened in the heart of the Chicago's beautiful downtown lakefront. The estimated $456 million project is headlined by the Jay Pritzker Pavilion, where in addition to bold design, an equally bold attempt to provide the same auditory experience for audiences of more than 10,000 bears a closer look.

Owned by the city of Chicago and designed by renowned Architect Frank Gehry as the new home of the Grant Park Orchestra, the pavilion offers fixed seating for about 4,000, with another 7,000 able to be accommodated on an expansive lawn. Audio and acoustical consultant the Talaske Group, and lead installation/integration firm db Integrated Systems (dbIS) hatched the complex systems over the course of nearly six years.

Talaske Group Principal Acoustician Richard Talaske and Senior Audio Designer Jonathan Laney envisioned taking amphitheater audio and acoustical experiences to a different level. More specifically, Laney defines the project's primary challenge as a quest for an exceptional orchestral music experience in an outdoor urban environment, while also accommodating additional musical styles like jazz, blues and even rock 'n' roll. Ultimately, it led to the direction of a dual system approach.

"We needed a sound reinforcement system to provide loudness, clarity, and localization to the stage, and an acoustic enhancement system to provide the important reverberation and reflections of an orchestral listening experience, giving a sense of envelopment and immersion in the music," explains Laney. "An enhancement system requires a distributed approach, which also serves the needs of the sound reinforcement system by minimizing both leakage to the surrounding urban area, and the weather related effects of throwing sound over long distances. The distributed approach, along with the required horizontal coverage of the seating area, led us to utilize a traditional array rather than a line array for the main reinforcement system."

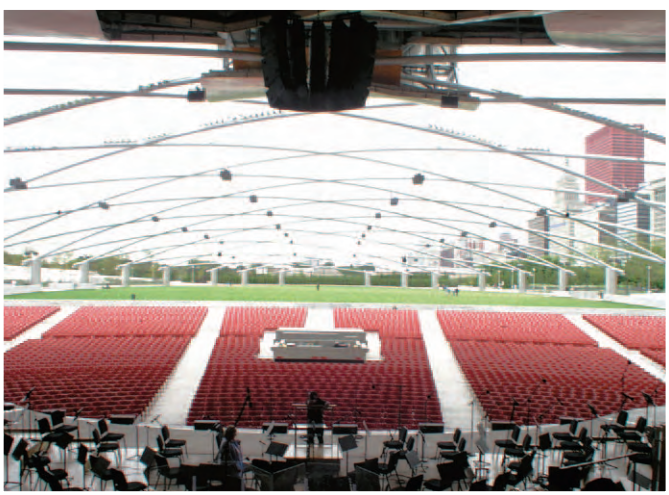
Strategically placed poles were initially seen as the only way to get loudspeaker coverage points in the nearly city block-long site. But both Gehry Partners and Talaske Group wanted a more elegant and efficient way to deliver sound to the lawn.

As an answer to this mutually stated desire, Gehry created unique "trellis structure" spanning the entire area. The trellis, made up of arcing aluminum poles forming an interlacing grid reaching a height of up to 60 feet above the lawn, was envisioned as capable of creating grand sense of architectural envelopment while also accommodating more than 100 distributed loudspeakers.

By and large, the structure would also meet the Talaske Group's sound design goal of placing the loudspeakers an average of 35 feet above the heads of the audience. This would help put primary sound source localization on the stage.



The coverage from main LCR arrays is supplemented by an extensive distributed and LARES system extending well out (and above!) the audience area.





"Frank Gehry and his design team have devised a very elegant solution providing the functional means of supporting the loudspeakers and lighting while also lending a sense of the room for the audience coming in from the east, west, north or south," notes Laney. "You can arrive from any direction, walk under the trellis and feel a part of the performance and 'in the room.' That not only helps define the space, but does so with an architectural vision that marries it to an auditory one."

The more "traditional" concert sound reinforcement system implemented within the pavilion has been seamlessly merged with both related delay locations as well as the expansive acoustic enhancement system. The pavilion main system includes customized, weatherproof versions of Electro-Voice (EV) X-Array loudspeakers arranged in left, center and right clusters flown around the stage, aided by eight custom EV CS91 frontfill loudspeakers.

The cluster arrangement utilizes the shape of the arrays to obtain necessary horizontal coverage, with EASE implemented for design assistance and prediction on this facet. EV supplied custom touches for the loudspeakers, including weather resistant finishes and grilles, facilitated by close work with EV's Jim Long, Mike O'Neil and Dave Carlson.



One of three sets of Crown amplifiers, outfitted with P.I.P. loudspeaker processing, that drive the system.

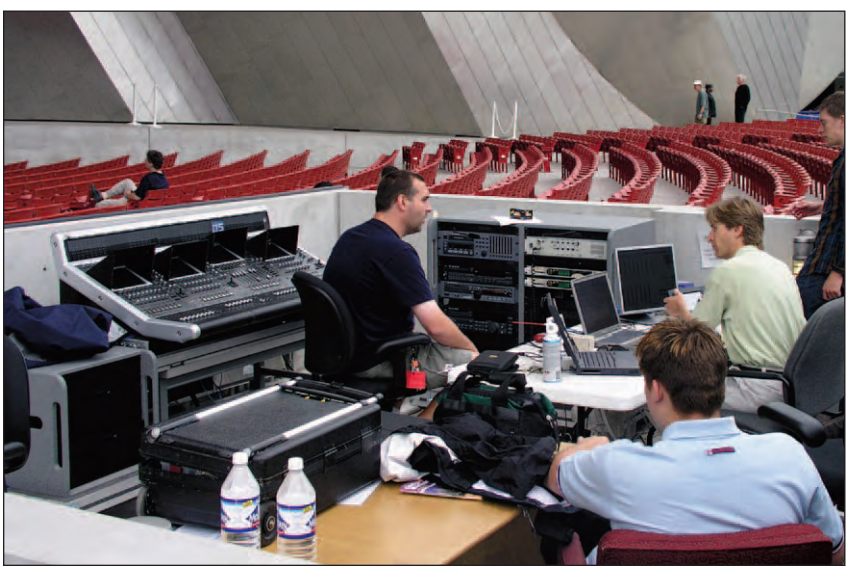
Further, left and right clusters are suspended from Gehry-designed towers carefully located so they don't obscure the surrounding architecture. According to Laney, Gehry finds out the technical requirements and then designs architecture to accommodate those requirements.

The main clusters are arranged in three tiers, each five cabinets wide. The top two tiers offer three X-Array Xf cabinets and two Xb cabinets arranged in an alternating pattern. The bottom tier consists of half-sized Xc loudspeakers, some with their horns rotated to optimize coverage, resulting in added downfill to the front seating rows. Low-frequency output is bolstered by single four-cabinet vertical stacks of Xds subwoofers, each loaded with dual 18-inch woofers in the company's Manifold Technology configuration.

"The distributed approach, along with the required horizontal coverage of the seating area, led us to utilize a traditional array rather than a line array for the main reinforcement system. When deciding on the appropriate sound reinforcement loudspeaker for this project, we wanted loudspeakers with a very transparent character for the orchestral programming, and one that also had the power handling and transient response demanded by the other musical presentations," Laney explains.

The delay system that mirrors programming from the mains to provide coverage to the lawn, as well as providing discrete LARES enhancement, is comprised of more than 100 loudspeakers (113 to be exact), flown from Gehry's unique overhead structure in nine concentric arcs. These loudspeakers are split about evenly between customized variants of EV Xi-1123A three-way loudspeakers as well as similar units from Frazier. Six subwoofers, modified EV Xi-1191F units, are also distributed throughout the region.

To create/add a sense of envelopment for certain productions, the Talaske Group collaborated with Steve Barber of LARES Associates to formulate a LARES-based system using a combination of the carefully placed



The house sound crew chillin' at the FOH booth, located centrally in the main audience area.



loudspeakers combined with advanced digital signal processing.

The first arc's loudspeakers, offering enhancement program only, fire downward to create "ceiling-canopy" reflections. And, loudspeakers at the end of all arcs fire inward and can impart simulated "wall reflections." The perimeter of the coverage area is lined with what Laney terms "lobby speakers," further extending the reach of audio into the park.

JOIN THE TEAM

System installation was handled by Chicago-area-based dbIS, headed up by partners David McNutt and James Wicker. They teamed up with the design team on several crucial aspects of the project.

For example, Laney, Gehry's office and the project's structural engineers were committed to rigging points that were exact in all three dimensions (X, Y and Z). Wicker then wrote a comprehensive "Means and Methods Statement" explaining the necessary equipment, procedures, and process of getting the cable up into the air and lashing it to the messenger cable system.

"The lashing process is similar to how cable TV and other wires are wrapped around the steel cables running between telephone poles," says Wicker. "Very few are experienced in the methodology, so we had to detail it completely."

Although the engineering and logistics of the messenger cable system and loudspeaker rigging were primarily a design challenge, the actual work brought its own difficulties. "Hanging the trellis loudspeakers involved anywhere from four to six people and a lift, but the base for the lawn could have no contamination," Wicker explains. "This required a group of people to move plywood out in front of a lift as it traveled under the messenger cable while our guys in the lift installed and terminated the plug boxes, and put in the yokes, and then they came back to install the cabinets."

dbIS designed several jigs to set the side-to-side azimuths of the speakers and used an inclinometer (a protractor-like device outfitted with a magnetic needle) to set the elevation angles. "It was more the art of aiming rather than science as we weren't far off at all on the specific parameters that had been dictated by the Talaske Group," adds McNutt.

Sophisticated digital signal transmission carries audio and control data in cohesively tying the system together. The all-digital signal path begins at the house DiGiCo D5Live digital console, with its 96 possible inputs (as well as all processing) sent to the stage via an Opticore fiber optic snake system.

From there, signal and data are routed to the system's 149 Crown CTs Series power amplifiers (housed in three remote, secured rooms) via a QSC Rave analog to digital system that incorporates a CobraNet bridge. Loudspeaker processing is handled by Crown US3/CN P.I.P. modules included with each power amplifier, and it's all under Crown IQ computer control.

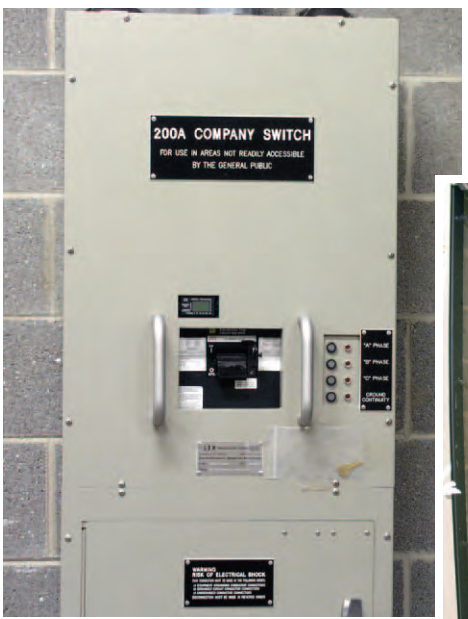
"Each trellis loudspeaker is biamped with its own amplifier, and as a result, I was able to use CobraNet technology to send any channel of source material from the console and to any individual loudspeaker in the enhancement system through the use of software," Laney notes.

POWER IT UP

Each of the three remote amplifier rooms is equipped with power conditioner for voltage regulation and EMI (electro-magnetic interference) filtering. Power grounds are all isolated, and power distribution includes a 200-amp disconnect for visiting road shows and monitor rigs as well as 60-amp, three-phase pin/sleeve disconnects. Breakout boxes are located downstage left, right and the house mix position for quick distribution.

The main patch rack located backstage (left) provides access to the 96 inputs, as well as direct and two isolated multipin breakouts, the house console's "Digiracks" and LARES system control (via Crestron). Various tie lines allow patching to the house mix, the stage deck, equipment rooms and the new 1,525-seat Harris Music and Dance Theatre, located adjacent to the Pritzker Pavilion.

Main input panels for the stage are located downstage and upstage left and right with three more in the choral balcony and several more in the ceiling. Eight Schoeps hanging microphones directly feed the LARES system. Intricate individual and sectional mic'ing for orchestral reinforce-





One of the 200-amp power services available, and a look at the rather extensive patching incorporated in the system.



ment is used to feed the sound reinforcement system.

The pavilion is also designed to accommodate any "racks and stacks" that might be brought in, with rigging beams left, right and center. Although the center cluster has its own rigging, it can be lowered to allow an adjacent center rigging beam to hang visiting center clusters.

LARES President Steve Barber worked with Laney on critical design and implementation issues, and he personally handled all software programming for the system. Laney, Talaske, Barber, McNutt and Wicker then spent two weeks adjusting and tweaking both the enhancement system and the reinforcement system through critical listening and measurement.

GETTING THE SIGNATURE

Lynne Pilon and Craig Webb of Gehry Partners worked closely with Richard Talaske to track acoustical needs and integrate them into the design. Rather than creating one sound reflection path between various instrument sections, Talaske created five to six opportunities for sound reflection to travel from one side of the stage to the other.

Large soffits and irregular corners were also added to deliver sound across the stage. "We knew from experience that the variability of sound directivity patterns from different orchestral instruments and sections required more than one path for effective communication across the stage," says Talaske.

Each surface was assigned an acoustical attribute deemed reflective, absorptive or diffusive. Shape and materials were further defined through analysis predictions of the timing and strength of individual sound reflections. While 95 percent of the surfaces are reflective, some perforations expose sound absorbing materials that afford a measure of acoustical control.

The interior surfaces of the stage utilize an MDO-type material with Douglas fir on the surface of multiple bonded plywood layers. Numerous surface holes stimulate sound diffusion and provided a desired architectural effect as well. The varying sizes and depths depend on location with smallest dimensions on the side walls, slightly larger elsewhere and the largest in the ceiling. Lighting surfaces were also intentionally recessed for sound diffusion purposes.

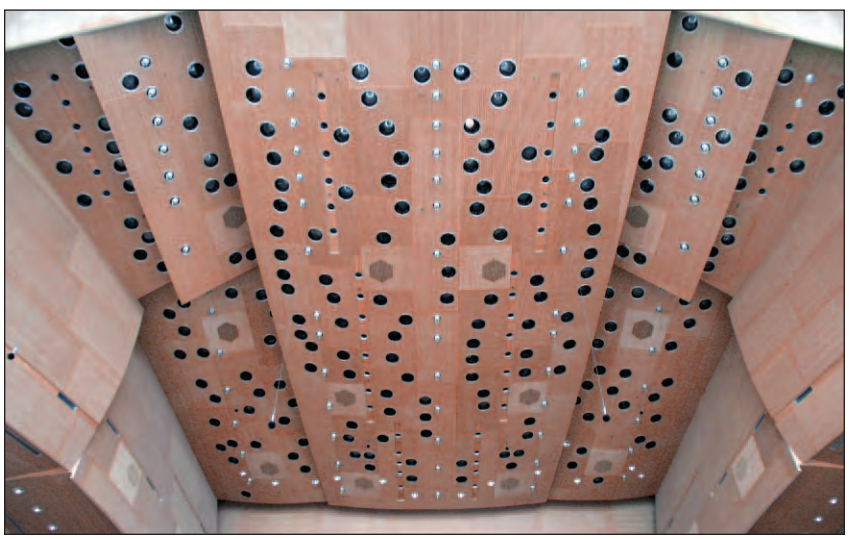


Distributed loudspeakers criss-crossing the lawn area – a majestic sight.

Wooden sound-reflecting panels tucked behind the metal surfaces deliver longer sound reflections back to the orchestra to mimic those of a room. Talaske and his team developed an overall layout for the orchestra including a comprehensive interlocking riser system loosely interpreted from Gehry's Disney Concert Hall in Los Angeles. (for more about this project, see November 2003 issue of *Live Sound*.) The risers have resilient material underneath for free transmission of vibration across the stage while the raised choir loft is also designed for effective transfer of sound across the stage.

The bold experiment has so far proved a success with the city and the multitude of visitors and concert goers. For Talaske and Laney, it was not only the technology, opportunity and people who made the project a success, but the foresight of owners and builders to the growing importance of live audio in performance venues.

"We were fortunate to have the donor group pick up the cost of funding us for the first season as it's rare that a consultant gets the opportunity to spend a whole season working with the client, and getting the last bit of system tweaking that the more typical two or three days cannot teach," concludes Laney. ■



The acoustical shell design above the stage.

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