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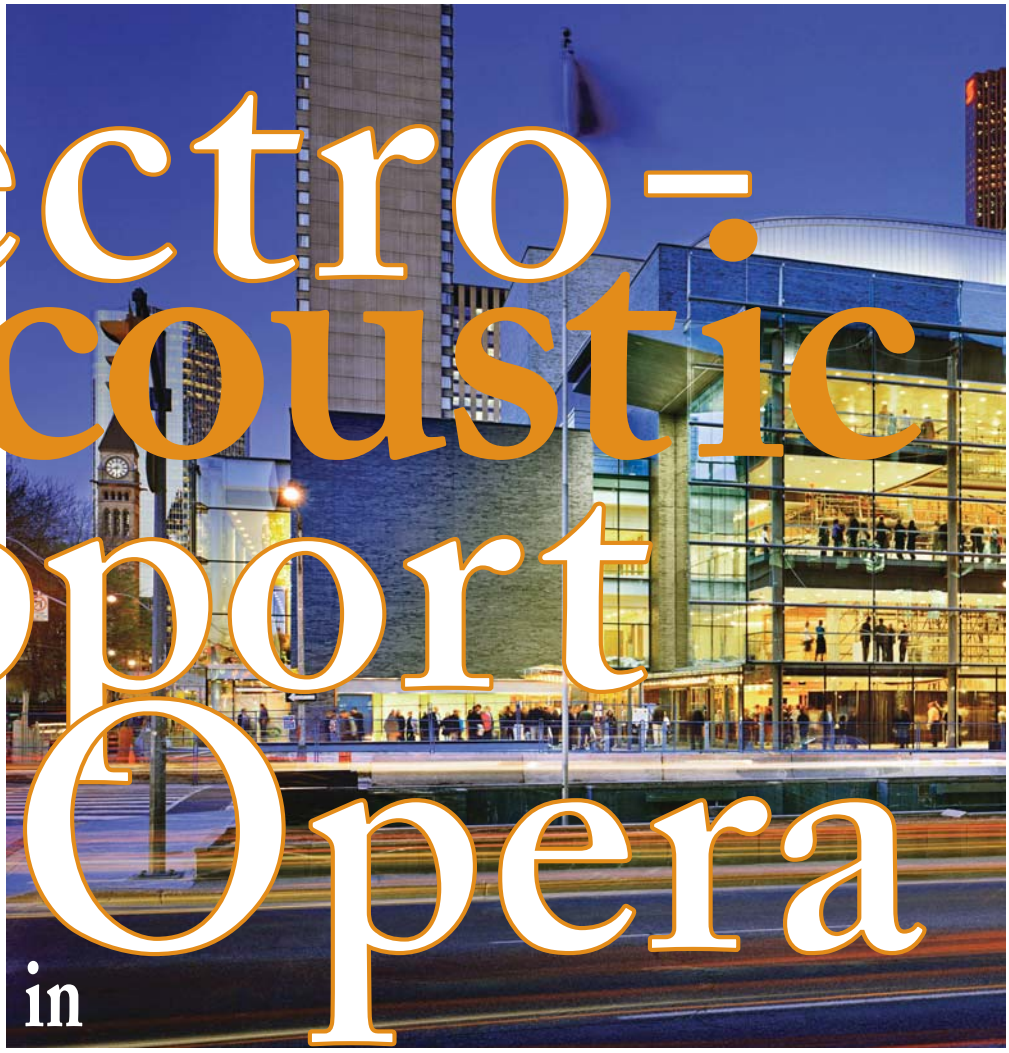
Electro-Acoustic Support for Opera in Toronto's Four Seasons Centre for the



In the classic opera house, the architecture and acoustics are carefully tailored to support the performance of natural, acoustic music. The horseshoe-shaped auditorium wraps around the performers and audience in order to contain and support the sound, and the orchestra pit is designed to achieve just the right balance between singers and orchestra. The R. Fraser Elliott Hall in Toronto's new Four Seasons Centre for the Performing Arts (FSCPA) is a prime example of the classic opera house, and internationally acclaimed acoustician Bob Essert has worked closely with the Canadian Opera Company to ensure that it sounds superb.

A key member of the design team behind the FSCPA, Essert specializes in the design of concert halls and theatres. His work has included principal roles (while at Artec) on the acoustical design of the Toronto Centre for the Arts in North York and the Chan Centre at the University of British Columbia in Vancouver, as well as a considerable number of theatre and concert hall projects in Europe and Australia. Founder and director of Sound Space Design, headquartered in London, England, Essert recently opened a new concert hall at the Yehudi Menuhin School, Surrey, UK, and is acoustician for renovations to Trinity St. Paul's Church, Toronto, home of the Tafelmusik Baroque Orchestra.

"One of my goals in designing the natural acoustics of the Four Seasons Centre for the Performing Arts—and I feel we've gone a long way toward achieving it—is that the sound of the orchestra is very much an enveloping sound," Essert explains. "It comes at you from around you and you feel drawn in by it. And the voice is clear and it carries through that, in power and loudness and also in spatial terms—the orchestra wraps around you and the singer is in the middle. Draw yourself a picture frame with the orchestra around the perimeter and right in the middle of the picture frame is the soloist. It helps to achieve the subjective strength and clarity of the singer amid the voluptuous orchestra sound. In opera, the balance between the voices and the orchestra is a hugely important issue. The bigger the house and the bigger the orchestra, the harder it is to get the voices to carry over with sufficient impact.

"The resonance and warmth of the sound are important—in an opera theatre we are not looking for as much reverberation as in a concert hall, certainly not as much as in a cathedral. That would blur the text. An excellent opera acoustic has a sound that is warm enough for the orchestra but not so resonant that the orchestra swamps the singer or that the text is lost in the reverberation. The clarity of diction is important too,

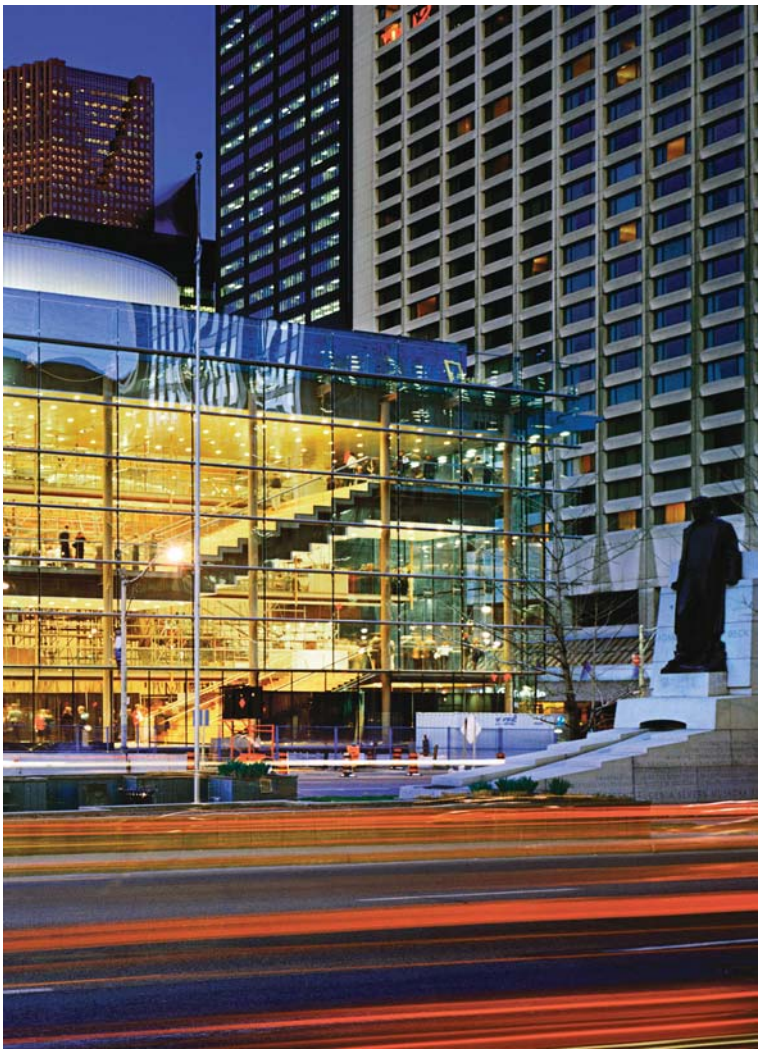


PHOTO: STEVEN EVANS

Diamond and Schmitt Architects Inc.

Performing Arts

by Alan Hardiman

and although that has a lot to do with the artist, the room can help or hinder. Again, it's a need for balance."

It may come as something of a surprise then that a performance sound system is included in the specifications for the hall, along with a requirement for mixing, given that electro-acoustic sound reinforcement seems completely out of place in an auditorium designed specifically to support the performance of acoustic music. In contemporary opera performance, however, sound reinforcement is often required to expand the artistic scope.

Essert is quick to point out that, strictly speaking, in the case of opera it's not really sound reinforcement. "There could be reinforcement for very specific artistic reasons, if one is doing something that borders on a musical, like *Sweeney Todd* or *Candide*—the New York City Opera does both of those—and they do use a little bit of amplification because they're not using operatic voices for all of the parts.

"But for the most part the audio system in an opera house is not intended for reinforcement—it's about sound effects and sound transfer from one place to another. In opera there is a fair bit of off-stage chorus, backstage or in the wings. In an auditorium of 2,000 seats, sometimes the amount of sound that gets around the corners from the wings out to the back rows of the audience isn't as much as the music director would like, so the audio system helps transfer the off-stage chorus out into the front-of-house. Similarly with sound effects, the traditional artillery and thunder storms—the big, loud effects—or with something more subtle, the audio system gives you the capability to bring sound design, as happens in drama on Broadway for example, into the world of opera."

In order that the reinforced sound blends seamlessly with the acoustic sound issuing from the stage and orchestra pit, a very fine touch is required. For this reason, Essert subcontracted the design of the performance sound system to consultants Engineering Harmonics of Toronto. "We retained Engineering Harmonics not just because they are a local design firm," Essert says, "but because we respect them and we respect the quality of their work—both the results they had obtained on their previous projects and the process they employed in achieving those results." The firm's projects include Hollywood's Kodak Theater, home of the Academy Awards, Dewan Filharmonik Petronus in Kuala Lumpur, Metropolitan Kansas City Performing Arts Center, and the Richard B. Fisher Center for the Performing Arts at Bard College. Engineering Harmonics is also working with Sound Space Design on two other current projects, the Telus Centre, Royal Conservatory of Music, Toronto, and the Winspear Opera House in Dallas, Texas.

Engineering Harmonics was given responsibility for all PSVC (performance sound, video and communications) systems in the Four Seasons Centre. Dave Clark, Director of Engineering, explains their role:

"We design the tools for sound designers to create the artistic content and direction, and we make those tools consistent with the needs of sound designers so they won't have to bring in outside equipment. For example, when off-stage performances are brought into the hall via electronics, the requirement is to capture these sounds via microphones and mix them with the acoustic sounds from the on-stage performers and orchestra in a way that is transparent to the audience. So the microphone outputs are shaped, mixed, and distributed to loudspeaker systems so those sounds can blend acoustically in the hall with the sounds emanating from the stage and orchestra pit. A centre cluster and side loudspeakers cover the entire hall, and front fills cover the front of the hall. These components help the audience to triangulate and localize apparent sound sources as necessary. But there are no visible loudspeakers in the hall at all. They are all buried in the proscenium, pit railings, and ceiling," Clark says. "Theatre Consultant Fisher Dachs, COC Technical Director Julian Sleath, and architect Diamond & Schmitt all worked tirelessly toward this goal to hide the audio technology."

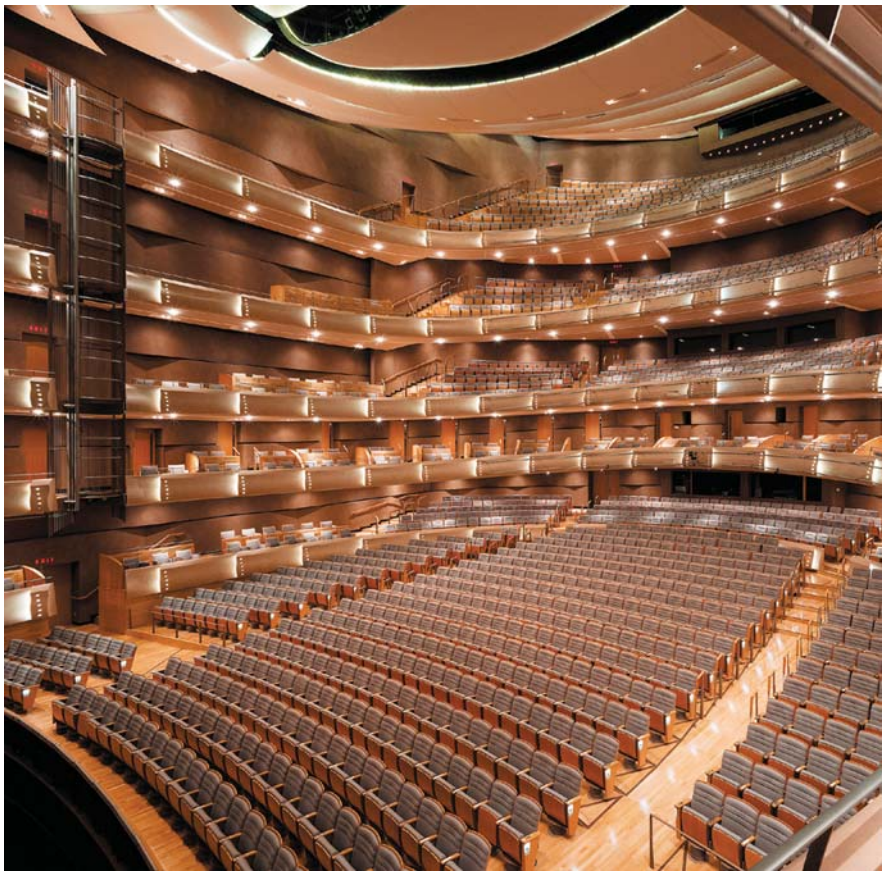
In addition, there are two "chimneys," vertically oriented spaces about six feet deep and three feet wide on each side of the proscenium for rigging additional loudspeaker systems. Each one provides space from the floor of the stage all the way up, complete with doors at every level and outfitted with a vertical uni-strut rigging system so that additional loudspeakers can be mounted anywhere in the chimney they are needed. Hard panels can be pulled out as required, revealing painted fabric that Clark describes as "transondent"—that is, transparent to sound but effectively camouflaging the loudspeakers.

Also available are a subwoofer, celestial speakers out in the hall and up high, an upstage cluster for loud "picture frame" sound effects emanating from the stage, and other portable loudspeaker systems for on-stage sound effects. Delayed systems are installed in the under-balcony

Looking down one of the "chimneys."

Crew making openings for the over-balcony delayed loudspeaker system.

Auditorium of the Four Seasons Centre for the Performing Arts.



"shadow zones" to support the front systems, and a comprehensive set of surround loudspeaker systems rings the audience. All loudspeaker systems in the hall are from Meyer Sound Laboratories.

"We provided sixteen channels of surround for each of the five audience levels—the orchestra and four balconies," Clark explains. "Locally the surround loudspeakers are quite small, but the sound is additive. There is line-of-sight from the upper balcony loudspeakers to the orchestra level so these loudspeakers also provide surround to the orchestra level. At the rear of the orchestra level itself the audio to the surrounds is delayed to be in sync with the sound arriving slightly later from the upper-level surrounds. We mounted the surrounds in the ceiling soffits, *near* the rear walls but not *in* the rear walls because the curtains that are part of Bob Essert's variable acoustics would otherwise cover the loudspeakers. At the front of the balconies, the loudspeakers face back to support the front-of-house system, while at the rear of the balconies the loudspeakers are of course facing forward."

Essert stresses that the surround loudspeakers are intended only for special effects; "for example, placing a choir behind you. And a lot of opera productions today are starting to use contemporary settings—taking Puccini and Mozart and translating them into the twenty-first century. The setting becomes a parking lot on Yonge Street for example, that's the scene, and they want to design the show that way so that it looks, feels and sounds like that. With proper sound system design, they can have all kinds of things happening from all around the room. The San Francisco Opera does a fair bit of this already, with fairly sophisticated sound design by Roger Gans, as does Covent Garden in London. So we consulted with Roger Gans on the requirements for sound design," Essert says.

According to Gans, who began his career as resident sound designer for the San Francisco Opera way back in 1978, "Mixing for opera is a misnomer. It's more of a cue-based thing. We do a lot of things with samplers, triggering door openings and closings, or thunder, and it's more efficient and more accurate if one of the musicians in the orchestra executes that under the conductor's direction. And depending on the interpretation, we'll place thunder or the voices of gods and spirits in specific locations on stage and elsewhere in the hall. Localization of these sounds is mostly a traditional sort of thing, although there are new pieces and new people always arriving on the scene, so you try to build as much flexibility as possible into the sound system design."

Not everyone approves of sound design in opera, however. Critic Allan Ulrich once savaged Gans in a year-end arts review in the San Francisco *Examiner* with this assessment: "Musical Public Enemy No. 1: Sound engineer Roger Gans, whose electronic 'enhancement' devices for the S.F. Opera spell a dire future for an art form that has survived very nicely for 400 years without knob-twiddling subterfuge."

Gans shrugs off the criticism. "I've always been pro-active," he says. "I'll study the scores. A lot of the pieces have very key elements that present a problem every time the opera is staged. For example, *Tosca* has bells, *Othello* has thunder, and the *Ring Cycle* has all kinds of sound effects that will present a challenge. I have ideas, the director and conductor have their own ideas, and we collaborate. It depends on the people and the equipment that are available."

Referring to the FSCPA, acoustician Bob Essert says succinctly: "We

wanted to give the Canadian Opera Company the facility to do sound design on a production by production basis."

The performance sound system is augmented by a point-to-point distributed base-band video system. A high-resolution Panasonic video camera on the balcony railing of the box level (first level above the orchestra) provides what Clark calls the picture-frame shot. "The video is near-broadcast quality, better than standard definition NTSC. That image gets distributed in the analog domain to performance-critical locations—performers, stage management, lighting—anyone who needs to see a real-time quality image with absolutely no delay. Performance video also feeds cable television for slightly lower-resolution image distribution to ordinary TV sets in dressing rooms, shops, and other off-stage locations as required," Clark says.

The video signal is also distributed digitally to two forty-inch plasma screens and one sixty-five-inch plasma screen—all provided by Panasonic—in the glittering four-storey transparent City Room, where the high resolution feed from the camera in the auditorium can be displayed to advantage. The ceiling loudspeakers are multi-zoned in order to manage delay and reverberation issues.

In the Richard Bradshaw Amphitheatre, a small independent performance space used for functions or pre-functions and latecomer seating, a portable mixer rack can be deployed to handle routine audio tasks, routing the sound to an almost invisible loudspeaker column a mere four inches wide yet stretching some fifteen feet high. The column is further camouflaged by its mauve-mud hue matching the structural column on which it is mounted.

"We made a single column consisting of five individual Bose MA-12 column arrays," Clark says. "It's a true line array to provide high directionality and clarity for voice and light music reinforcement. The amphitheatre shares the acoustic environment of the whole lobby, which with glass walls and marble floors is by no means a dry acoustic space."

Rounding out the PSVC systems complement are the intercom, paging and program monitor, and hearing assistance systems. The intercom comprises both wired and wireless components. The wired intercom serves up to twelve departments with a designated stage manager location in several rooms and dozens of remote locations accommodating 2-channel remotes. "You patch the remote locations onto the departments as required, so at any one location you can have up to two departments set up on intercom," Clark explains.

The wired intercom is augmented by a single-channel eight-belt pack wireless system that can be associated with any of the twelve departments. One channel is broadcast to all eight, and each of the eight has its own channel to broadcast back. The output of the eight receivers is mixed in audio and re-broadcast back again so that everyone can hear everyone else.

Interconnected with the intercom is the paging and program monitor system. A zoned broadcast system, it allows paging into production areas, talent areas, star-talent areas and elsewhere backstage di-

MAIN REINFORCEMENT & SFX SYSTEM

BSS "BLU-80" Signal Processor (3)
BSS, "BLU-32" Signal Processor I/O Expander (4)
Drawmer "M-Clock" Master Clock Generator (1)
Echo "Audio Fire 12" Firewire Audio Recording Interface (1)
Edirol "UA-1000" Hi-Speed USB 2 Audio Interface (1)
Lexicon "PCM-91" Digital Reverb Effects Processor (2)
Marantz "CDR510" Dual Bay CD Recorder/Player (1)
Marantz "PMD-371" 5-Disc Carousel CD Changer (2)
Meyer "CQ-1" Self-Powered Wide Coverage Main Loudspeaker (1)
Meyer "CQ-2" Self-Powered Narrow Coverage Main Loudspeaker (2)
Meyer "MM-4" Miniature Wide-Range Loudspeaker (112)
Meyer "MSL-4" Self-powered Horn Loaded Long Throw Loudspeaker (2)
Meyer "PSW-2" Self-Powered Subwoofer (4)
Meyer "UM-1P" Self-Powered Stage Monitor (4)
Meyer "UPA-1P" Self-Powered Compact Wide Coverage Loudspeaker (3)
Meyer "UPM-1P" Self-Powered Ultra-Compact Wide Coverage Loudspeaker (6)
Meyer "UPJ-1P" Self-powered Compact VariO Loudspeaker (14)
Neuman "KM184MT" Cardioid Condenser Microphone (2)
QSC "CX168" Power Amplifier (16)
Sennheiser "EM550G2" Dual Channel True Diversity Receiver (2)
Sennheiser "MKH40" Cardioid Condenser Microphone (3)
Sennheiser "MKH416" Short Shotgun Condenser Microphone (2)
Sennheiser "SKM535G2" Wireless Handheld Dynamic Cardioid Microphone (2)
Sennheiser "SZI 1029" High Power Infrared Emitter (6)
Sennheiser "SI1015" Wideband Modulator (1)
Tannoy "System 800" Nearfield Monitor Loudspeaker (2)
Yamaha "DM-2000v2" Digital Mixing Console (1)

INTERCOM

Clear-Com "KB-211" 2-Channel Speaker Station (10)
Clear-Com "RM-440" 4-Channel Headset/Speaker Station (3)
Clear-Com "MS-812-12" 12-Channel Programmable Master Station (1)
Clear-Com "PS-464" 4-Channel Power Supply (4)
Clear-Com "RS-601" Single Channel Belt Pack (15)
Clear-Com "RS-602" 2-Channel Belt Pack (10)
Clear-Com "TW-12B" Clear-Com to RTS Interface (2)
HME "Pro850" Wireless Intercom System (3)

VIDEO

Blonder Tongue "FA3M-50-860" Audio-Video Modulator (1)
Blonder Tongue "OC-8d" Output Combiner (1)
Blonder Tongue "RMDA 860-30" Distribution Amplifier (60)
Panasonic "TH-42PWD7UY" 42-inch Flat Panel Plasma TV (4)
Panasonic "CT-20SL15" 20-inch TV (20)
Panasonic "CT-27SL15" 27-inch TV (20)
Panasonic "CT-32SL15" 32-inch TV (10)
Canare "242U-DVJS " Serial Digital Patch Bay (6)
Panasonic "WV-CM1020" 9-inch Color Monitor (10)
Marshall "V-R44P" Quad 4-inch LCD Display (1)
Marshall "V-R151P" 15-inch LCD Monitor (1)
Panasonic "WV-CM2080" 20-inch Color Monitor (10)
Kramer "PIP-200" Picture-in-Picture Inserter (1)
Kramer "SG-6003B" Sync Generator (1)
Kramer "VS-402XL" Video/Audio Matrix Switcher (1)
Sierra Video "Series 10 501019" Equalizing Video Distribution Amplifier (1)
Panasonic "DMR-ES10" DVD Recorder (1)
Panasonic "AW-E650P" 1/2-inch 3-CCD Camera (3)
Panasonic "WV-CL920A" Surveillance Camera (1)

rectly from the intercom system. The ability to use the headset intercom microphone as an alternative to the paging microphone has tremendous benefits in the pressure-cooker of live performance with dozens—if not hundreds—of performers, crew and staff to coordinate. "The stage manager has a paging controller as part of her kit," Clark notes. "All she has to do is press a button on her intercom station to page into the paging zones as required, with the added benefit that she doesn't even have to take off her headset." Program shotgun microphones in the hall pick up sound from the stage which is then routed to program monitor, cable TV, paging, intercom and hearing assistance systems.

Hearing assistance is provided via a Sennheiser infra-red system. While it was mandated to meet the specifications of the Ontario building code, Engineering Harmonics ensured that the system met the even higher requirements of the Americans With Disabilities Act, which specifies that hearing assistance be available at every seat in the house and that receivers be available in a quantity equal to four per cent of the total seat count. The design challenge lay in getting line of sight from the infra-red LED emitters to the receivers which are worn under the chin, particularly in getting the emitter signal under the balconies. Solving this problem, like many others, entailed close coordination between Engineering Harmonics and the architect, Diamond and Schmitt Architects, Inc.

Clark notes that one area often overlooked in appraising PSVC systems is conduit. Noise and electromagnetic interference can wreak havoc on even the best acoustic and architectural marvels, and for this reason conduit and the provision of special power typically account for twenty-five to thirty-five per cent of the overall cost of the PSVC systems. In the case of the FSCPA, that amounted to some $400,000.

Installation of the systems was completed by MacLean Media Systems Inc. of Burlington, Ontario. "Project coordinator Gregory Cross and site supervisor Ron Hebbard did a terrific job with the installation," says Engineering Harmonics president Philip Giddings. "We are very impressed with their work, particularly their attention to detail, which is vital in a project of this complexity."

Built at a cost of CA$181 million and already praised in Canada's national press as "one of the world's great opera houses" and "nothing short of triumphant," the Four Seasons Centre for the Performing Arts is the new home of the Canadian Opera Company, the largest producer of opera in Canada and the sixth largest in North America. The company celebrated the official opening of the FSCPA in September 2006 with the inaugural production of Wagner's *Ring Cycle,* featuring an orchestra of more than 100 musicians.

The FSCPA will also be the new performance venue for the National Ballet of Canada. The National Ballet, a company with more than fifty dancers and its own symphony orchestra, is Canada's premier dance company and ranks as one of the world's top international dance companies.

Engineering Harmonics is headquartered in Toronto with a staff of fifteen, including eleven designers and project managers, and is a world leader in the design of performance sound, video, and communications systems for performing arts centers, sports facilities, public buildings, and houses of worship. ❖

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