The next steps: Four examples of Artec's evolving room acoustics philosophy

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Abstract: This paper examines four Artec projects that have opened in 1997, and relates them to a room acoustics philosophy that has been evolving in Artec's designs since 1970. An illustrated discussion of the Chan Centre (Vancouver, British Columbia), the Winspear Centre (Edmonton, Alberta), the Living Arts Centre in Mississauga (Ontario), and the New Jersey Performing Arts Center (Newark, NJ), highlights the importance of seat-count, complete freedom from noise, room shaping, and a considerable amount of acoustics adjustability in order to create excellent performing arts facilities.

INTRODUCTION

The four newly-opened facilities which are the subject of this paper fall readily into two groups. The Chan Shun Concert Hall at the Chan Centre for the Performing Arts and the Winspear Centre are concert halls with seat counts of 1400 and 1850 respectively. The Living Arts Centre, Mississauga (LACM) and the New Jersey Performing Arts Center (NJPAC) each have as their main performance space a proscenium theatre with stagehouse. The seat count of the main space at LACM is 1350; at NJPAC 2750.

CHAN CENTRE FOR THE PERFORMING ARTS

The seats at the Chan Shun Concert Hall are organized into an orchestra level (with a continental main seating area flanked by a raised parterre zone) and two balconies, each of which has fixed seating at the rear and loose chairs in boxes along the sides. The remaining 200 seats are behind the concert platform in a Choir Gallery, and are sold to the public when a chorus is not required. The Chan Centre opened in May 1997 at a cost of CAN$21.5m. Artec provided basic room design, acoustics consulting, and sound and communications systems consulting for the Chan Centre.

The main walls are constructed of 300mm of poured concrete. The walls are segmented into convex-bowed sections, each several feet across. The walls were bush hammered to create a rough surface. In plan, the room exhibits a reverse-fan shaping more extensive than that used in the Artec acoustic designs for the Meyerson Symphony Center (Dallas), Symphony Hall Birmingham (England), or the Concert Hall for the Lucerne Festival. The side seating ledges are narrow, and their soffits are horizontal. The balcony fronts and the upstand for the main floor parterre level seating are constructed of slotted wood bonded directly to the concrete. The slots provide some sound diffusion. A series of horizontal panels behind the Choir Gallery provide early sound reflections to the stage.

A massive, one-piece canopy covers the platform, and can be adjusted in height to control the amount and arrival time of reflected sound energy at the platform and reaching the main floor. It also acts to some degree as a gate or valve, controlling the amount of energy that reaches the hard, parallel-surfaced upper portion of the room. Vertically moving two-layer velour banners can be deployed over all wall surfaces in the lower part of the room. There is no fixed or variable sound absorption in the upper part of the room. Hinged panels concealed behind loudspeaker grille-cloth in the chorus riser can be opened to adjust the amount of sound energy on the platform.

The acoustical design for the Chan Shun anticipated the installation of a concert organ in some years' time. The volume of the room was kept large (by keeping the ceiling high), to allow for sufficient reverberation to support the organ sound properly. The reverberation develops particularly in the upper part of the room, between large vertical surfaces that are well above the plane of the audience. At the same time, the variable acoustics banners were designed to allow the reverberation time of the room to be reduced to the more modest levels sometimes required by orchestras, chamber orchestras and recitists.

During the opening months of concerts, a variety of different settings for the variable acoustics elements was developed by Artec. It was found that a canopy height above the platform of approximately 11m provided the best acoustics (considered from the positions of both performer and audience member) for small ensembles and recitists, while for larger groupings the canopy was raised to a height of around 14.5m. Listeners at the rear of the main floor perceived a very distinct change in the sound quality if the canopy was moved through a particular elevation while musicians were rehearsing. As the canopy descended from a high elevation (the highest elevation used in rehearsal was 16m), there was, as expected, a steady change in the ratio of early to late energy, as heard on
the main floor. However, as the canopy passed through an elevation of around 14.7m there was a significant and
dramatic change in perceptual attributes of the sound, especially in the relationship of clarity and reverberance. The
detail of inner orchestral parts was significantly more audible, singers’ words were heard with much greater clarity,
and overall, the music became sonically more interesting. As the canopy was moved below this elevation, the
changes in the early-to-late ratio were once more steady. A fuller understanding of the objective criteria underlying
this dramatic perceptual change will be invaluable in the design of future halls.

The reverse fan shaping produces a strong sense of envelopment in all seats, but especially in those towards the rear
of the main floor. Indeed, in a small number of these seats, the sound levels can be, on occasion, rather high. Our
impression in these few seats was that the effect of the provision of a large amount of lateralized energy, in
conjunction with a particular room width, is not always ideal.

WINSPEAR CENTRE

The concert hall at the Winspear Centre seats 1900. Seats are arranged on the main floor, on two levels of side tiers,
and on three balconies at the rear of the room. A choir gallery, seating 200 patrons or chorus members, wraps
around the rear of the orchestra platform. The Winspear Centre opened in September 1997 at a construction cost of
CANS$32m. Artec provided programming, basic room design, theatre consulting, acoustics consulting, and sound
and communications systems consulting for the Winspear Centre.

The acoustics design philosophy for the Winspear Centre was similar to that for the Chan Centre. An organ was
planned for (although not installed on opening night). The acoustics were designed to provide sufficient
reverberation for organ, while at the same time provision was made to reduce the reverberation time for smaller-scale
and amplified events using a system of motorized double-layer sound-absorptive banners. Sound diffusion,
particularly at high frequencies, is provided in the Winspear Centre by means of a decorative pattern that was
incorporated in the concrete form as the walls at the sides of the audience chamber were poured in place.

Of particular note in the Winspear design are the measures taken to achieve silence in the performance space. Very
large quantities of air must be supplied to the hall to provide enough heat to counter the Alberta winter, so in order to
achieve the extremely low velocities needed to avoid airflow noise some very large ducts were designed. The largest
of these ducts measures 3m by 2.5m. Careful specification of lighting instruments and dimmers, the design of a
series of acoustical joints—which structurally isolate the performance space within the building—and the creation of
massive room boundaries have resulted in a hall that is completely free from noise.

LIVING ARTS CENTRE, MISSISSAUGA; NEW JERSEY PERFORMING ARTS CENTER

The main theatre at each of these centers is a multipurpose facility; that is, the required uses include some staged
events, and thus each hall incorporates a stagehouse and a proscenium wall. While some elements of the acoustical
design of each facility are clearly related to the equivalent elements in the two concert hall designs discussed above,
others are specific to these rooms. Artec provided programming, theatre consulting, acoustics consulting and sound
and communications systems design for LACM, and acoustics consulting and sound and communications systems
consulting for NJPAC.

The main theatre at LACM has 1350 seats, arranged on three levels in a horseshoe-shaped room. The ceiling of this
room is again high, in order to develop proper reverberation for music events, and again, this reverberation can be
reduced with a series of sound-absorbing banners. The same is true of the Prudential Theatre at NJPAC, which seats
2750 people on five levels, and shares room-shaping and acoustics design elements with the LACM room. Both
rooms adapt for music performance by using a series of castered towers to form a concert enclosure. These towers
are descendants of the towers used in previous Artec designs for Thunder Bay Community Auditorium, Pikes Peak
Center, and the Kravis Centre. Both the LACM and NJPAC stagehouses are used to develop a reverberant tail. And
the sound at the main floor seats in each hall is assisted by the use of a large forestage reflector.

The LACM and NJPAC rooms, together with the Chan Shun and Winspear concert halls, illustrate a development of
room shaping and adjustable acoustics philosophy that will see its next incarnation in Artec acoustics designs for
Philadelphia, Miami, Seoul, and Lahti, Finland.