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BREAKING OUT OF THE (SHOE) BOX: PERSPECTIVES ON NON-TRADITIONAL ARCHITECTURAL GEOMETRIES IN SYMPHONIC CONCERT HALL DESIGN OVER THE PAST HALF-CENTURY

P. Scarbrough Jaffe Holden Scarbrough Acoustics, Inc., Norwalk, CT
J. C. Jaffe Jaffe Holden Scarbrough Acoustics, Inc., Norwalk, CT

1. INTRODUCTION

On July 26, 1987, Thomas Hine, architecture critic for the Philadelphia Inquirer wrote about the design inspiration for a new home for the Philadelphia Orchestra. Hine suggested that the Orchestra would do well to emulate the characteristics of a building that Stephen Sell, late executive director of the Orchestra, called "a design beacon" for the Orchestra's new concert hall. So what was this beacon? Vienna's fabled Musikvereinssaal? Was it Boston's venerable Symphony Hall or New York's storied Carnegie Hall? No on all counts. Hine and Sell referred to a concert hall that broke new ground when it was built; a hall that represented a truly revolutionary approach to acoustics, architecture and music: the Berlin Philharmonie.

Twelve years later, construction has finally commenced on the Philadelphia Orchestra's new concert hall. Much has changed in the intervening years: the Orchestra no longer directs the project although it continues to shape its key features, and architect Robert Venturi has been replaced by Rafael Viñoly. Perhaps most startling, however, is the design of the concert room itself. In designs unveiled in 1998, Viñoly proposed a soaring glass vault to enclose the new concert hall and its smaller multiple purpose sibling. But the concert hall under Viñoly's vault draws much more from Boston Symphony Hall or the Vienna Musikvereinssaal than the Berlin Philharmonie. What happened?

Of the many developments in architectural acoustics in recent decades, few have received more attention or generated more controversy than the use of new architectural forms in concert hall design. Construction of the Berlin Philharmonie in 1963 and the impact of social upheaval in the 1960s encouraged acousticians and architects to rethink the concert hall and address how issues of architectural form influence and shape the concert-going experience.

Did architect Hans Scharoun and acoustician Lothar Cremer open the door to greater complexity and variation in concert hall design or did they lead us down a blind alley? Are there acoustical advantages inherent in the shoebox concert hall or is the passionate adherence to this traditional form grounded more in marketing hype than science?

This paper will trace the development of non-traditional concert hall forms and attempt to assess what the profession has learned from these designs. Through this study, the authors hope to reinvigorate the on-going debate about this sensitive topic.

2. CONVERGENCE OF FORCES

Revolutionary buildings usually result from a confluence of several factors:

- Changing social and cultural conditions
- Visionary clients
- Daring architects and engineers
- New technologies

In the Berlin of the 1960s, three of these came together to shape the new home of the Berlin Philharmonic. The Cold War atmosphere with its competing political ideologies shaped the hall as much as did musical and acoustical considerations. Hans Scharoun set out to design a very different kind of concert hall for the Berlin Philharmonic. With messianic fervor, he convinced his client and a doubting Lothar Cremer that the traditional form of the concert hall with the orchestra seated on a stage at one end of the room (typically but not always behind some form of proscenium arch) prevented the audience from being a part of the performance. For the audience, Scharoun perceived the concert experience to be more passive than active. He argued that surrounding the orchestra platform with the audience would provide opportunities for the musicians and listeners to interact and communicate more freely and intensely.

The result was seen as a striking new architectural concept, one that is perceived to be more open and democratic than that found in more traditional halls. The hall with its expressionist modern design was hailed from the start as an architectural and acoustical triumph. And it has withstood the test of time. While few would claim its acoustics to be among the very top rank, most would suggest that it is first rate and the space itself is highly regarded by conductors, musicians, critics and audiences.

3. CROSSING THE POND

It took some years before the daring of Scharoun and Cremer was replicated elsewhere, particularly in America. A number of factors probably contributed to this delay, including:

- The American predilection (particularly in the 1960s) for constructing multiple-purpose halls instead of separate facilities for symphony, opera, dance, drama and contemporary music. This resulted in the construction of few concert halls of large scale in the years 1963-1975.[1]

- Perceptions that acoustical design was more a poorly understood art than a well-defined science, an impression given wide play by the critical reaction to the opening of Philharmonic Hall at Lincoln Center in 1962.[2]

By the early 1970s, however, social upheaval in the United States, a product of many factors notably the civil rights movement and the Vietnam War, led many architects to question traditional approaches to the design of performance halls. At the same time, performing arts institutions were beginning to question their role in society and some symphony orchestras began to experience difficulty attracting new generations of listeners to their concerts.

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[1] The only major American concert halls opened in these years were the Concert Hall at the Kennedy Center in Washington (1971) and Orchestra Hall in Minneapolis (1974). With the national prominence of the Kennedy Center commission, acoustician Cyril Harris was not about to take chances. Thus, when the Kennedy Center Concert Hall opened with a performance of Leonard Bernstein's *Mass*, the audience found itself in a stripped down, modern version of Symphony Hall in Boston. Harris' design for Orchestra Hall in Minneapolis is nearly identical.

[2] Given the massive public relations campaign leading up to the opening of Philharmonic Hall and the reluctance of Lincoln Center and architects Harrison and Abramovitz to heed some critical advice from Leo Beranek, it was virtually pre-ordained that the space would fail to meet listener expectations. The dissatisfaction was compounded by the fact that the New York Philharmonic moved to Lincoln Center from Carnegie Hall, a space much loved by New York audiences, musicians and critics.

It was in this atmosphere that Christopher Jaffe and the architects of Hardy Holzman Pfeiffer Associates (HHPA) began the planning of a new concert hall for the Denver Symphony Orchestra. Jaffe was passionately interested in the nature of the concert environment and architects Hugh Hardy, Malcolm Holzman and Norman Pfeiffer shared Jaffe's goal of creating a concert hall that would, as Scharoun envisioned in Berlin, break down the barriers between audience and performers. Fortunately for Jaffe and HHPA, Denver Symphony Music Director Brian Priestman and Manager David Kent were open to the possibilities.

In December of 1972, the Board of Trustees of the Denver Symphony adopted a formal statement concerning the design of the new hall. The essential ingredients for the new hall were contained in a few brief sentences on the first page of the document:

> *"The basic philosophical premise of the Denver Symphony Trustees toward Denver's new music hall is that it should be contemporary in concept and design. The hall should be built with an eye for contemporary and future audiences, lending itself to the development of orchestral and other musical events that are not necessarily to be presented in traditional forms. It is essential that the whole audience have a close proximity to the event taking place in order to provide the greatest number of patrons with optimum visual and aural experiences. There should be no compromise in the symphonic sound concert-goers are accustomed to hearing in traditional music halls."*

Planning of the new hall commenced in 1973 with a tour of European concert halls. A team consisting of David Kent, DSO Principal Violist Lee Yeingst, Chris Jaffe and Norman Pfeiffer visited four concert halls: London's Royal Festival Hall, Amsterdam's Concertgebouw, Rotterdam's De Doelen Hall, and the Berlin Philharmonie.

The tour participants brought back many impressions about each of the halls but one hall clearly stood out from the rest. Kent summarized his thoughts as follows, "In reviewing the experience of all of the concert halls, the Berlin Philharmonie created the strongest and most positive effect in terms of an intimate visual and oral [sic] experience, fulfilled all of the needs for musicians, administration and public to an extent far beyond any of the other halls visited." Yeingst wrote, "In summation, the Philharmonie stands out in my opinion as the kind of concert hall needed in Denver. No other concert hall could compare with the intimacy and that special atmosphere I experienced in the Philharmonie."

Over the next two years, Jaffe and HHPA developed their design. Although Berlin was the model, circumstances in Denver required the team to venture beyond what Scharoun and Cremer had created. Some of these changes were driven by the Denver Symphony's desire to seat 2,750 patrons in the hall. While Cremer had placed 260 seats to the side and rear of the orchestra or little more than 10% of the Philharmonie's 2,300 seats, Jaffe placed nearly 20% of Denver's seats at the sides and rear of the stage. Where Berlin had been designed almost exclusively for symphony concerts, Denver had a multiple-use character, including provisions for a sizable orchestra pit and an extensive catwalk system for theatrical lighting purposes.

Jaffe and HHPA were particularly concerned about physical intimacy in the hall. In the resulting design, no seat in the hall was more than 85 feet from the stage and 80% of the listeners were within 65 feet. To compensate for the surround nature of the audience seating, Jaffe incorporated more volume inside the hall than would normally be required. He placed much of this volume above the platform giving the room a hard, acoustically-reflective cap. To preserve acoustical intimacy, the design needed to provide strong early reflections. Since the side walls of shoebox halls typically provide these reflections and Denver would have few such walls, Jaffe created a "room-within-a-room" around the seats facing the stage and added substantial fascias to the seating terraces throughout the concert hall. He also designed a large acoustical canopy over the platform. The architects initially objected to the canopy but yielded when Jaffe's scale model studies demonstrated that it was essential to the hall's acoustical success.

Jaffe also worked to address the one significant negative perception registered about the Philharmonie, namely, the hall's thin bass response; a particular concern for listeners seated close to the front of the stage. To address this concern, Jaffe developed a large acoustic volume under the stage to act as a coupled chamber for bass energy. The acoustic moat, as Jaffe referred to it, was coupled to the hall via grilles at the front edge of the stage and under the first few rows of audience seating.

Boettcher Concert Hall opened in March 1978. Critics reacted favorably to the space, particularly the way that the design altered the relationship between performers and audience. Paul Goldberger, architecture critic for the New York Times, perhaps summarized the reactions best in his opening night review:

> *"...the positioning of the orchestra in the middle utterly changes the relationship of the audience to the musicians. Instead of feeling like schoolchildren, seated in orderly rows to receive the wisdom of the musicians as it is handed down from the stage at the end of the hall, the audience at Denver is made to feel as if it is sharing with the orchestra the role of participant in a joyous ceremony."*

For a variety of reasons, Boettcher Hall has never achieved the acoustical reputation that Berlin acquired. DSO Music Director Brian Priestman, who played a central role in the development of the hall, announced his resignation mere months before Boettcher Hall opened. He conducted a handful of concerts in the hall before departing. It took the DSO two full seasons to find a new music director, during which time the Orchestra was directed by a succession of guest conductors and music advisors, hardly an ideal circumstance for an orchestra settling into any new hall let alone one with Boettcher's unique qualities.

In addition to this challenge, cost constraints precluded installation of the hall's variable acoustic draperies. This feature was essential to the success of amplified popular music. Needless to say the first of these high energy concerts were dismal affairs, leaving the impression among some in Denver that the hall's acoustics were somehow flawed. The variable acoustic devices were finally installed in 1989 along with some minor changes to the perimeter walls at the stage.

Despite these factors, Boettcher has demonstrated that it can be a highly successful performance venue. When the Denver Symphony (now reconstituted as the Colorado Symphony) was under visionary musical leadership, such as the music directorship of Phillipe Entremont in the late 1980s, both the orchestra and the hall won plaudits from critics. Nathaniel Merrill's company, Opera Colorado, has successfully presented opera in the round for many years in Boettcher. Appearances by touring orchestras such as the New York Philharmonic have also garnered praise for Boettcher Hall.

4. OTHER PRECEDENTS

While Jaffe was on tour with the Denver Symphony, he was greatly intrigued by Amsterdam's Concertgebouw. Built in 1888, the Concertgebouw was distinctly different from virtually every other concert hall built during the late 19th century. Where most of the halls built in the late 19th century (save Edinburgh's Usher Hall) were long and narrow in plan and tall in section, Amsterdam was almost square in plan and it accommodated 25% more people (2,000 versus 1,600) than the typical shoebox hall of the period. A significant number of these seats are located behind the orchestra platform and are alternately used for audience or chorus, depending upon the program. Despite the significance of these differences, Jaffe noted that the Concertgebouw enjoyed an acoustical reputation equivalent to the Musikvereinssaal and Symphony Hall.

In 1972, prior to the DSO's European tour, Harold Marshall completed work on Christchurch Town Hall in New Zealand. Jaffe recognized the parallels between Marshall's design and the Concertgebouw. He also observed that both halls suffered from a similar problem. Musicians in both complained that it was hard to hear on stage, particularly during rehearsals. Jaffe was convinced that the Concertgebouw offered another viable model to follow and that his study of Berlin, coupled with the ongoing design studies for Denver, suggested ways to provide good on-stage hearing for the musicians.

In 1975, while design work on Denver was proceeding, Jaffe was commissioned to design another major new hall at the Universidad Autonoma de Mexico (UNAM). From the beginning Jaffe was given wide latitude to shape the form of the room. Using the Concertgebouw as his model, Jaffe convinced architects Orso Nuñez and Acardio Artis Espríu to develop what Jaffe referred to as a "shallow surround" hall. By shallow surround hall, he meant that the audience seating did surround the platform, but only in a fairly narrow band at the side and rear of the platform, as in the Concertgebouw.

As in Denver, Jaffe incorporated both additional volume and an acoustic moat into the design to ensure adequate reverberance and bass response. To provide adequate on-stage hearing and improved early reflection patterns, he added a substantial acoustical canopy over the stage and forward parts of the auditorium. He also created a "room within a room" at the stalls, framing these seats with a substantial set of walls that were quite close together compared to the larger outer envelope of the hall above.

Jaffe and the architects worked very closely to achieve an effective synthesis of acoustics and architecture. The final design featured bold and dynamic use of materials, geometries and craftsmanship allowing the hall to reflect uniquely Mexican architectural aesthetics.

The result of this collaboration was the Sala de Conciertos Nezahualcóyotl. The hall opened in 1977 to great acclaim with concerts by the Cleveland Orchestra.[3] The hall quickly became a popular venue for touring orchestras and in the first few years after opening, played host to a large number of important ensembles from around the world. During this period, the hall elicited favorable reactions from a broad array of conductors and musicians. In the early 1980s, the collapse of world oil markets sharply reduced Mexican Government revenues, leading to the elimination of funding for touring orchestral ensembles. Today, the hall regularly presents UNAM's excellent fully professional orchestra, but only rarely presents international orchestras.

5. A NEW STANDARD FOR DESIGN

The success of Berlin coupled with the generally favorable reactions received by the halls in Denver, Mexico City and Christchurch[4] seemed to indicate that surround halls of either the vineyard type (Berlin and Denver) or shallow type (Mexico City and Christchurch) were indeed the wave of the future. It seemed that a new standard for concert hall design was emerging. Many new halls then in design were using one of these alternate forms.

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[3] Design and construction projects in Mexico generally proceed on much faster schedules than those in North America and Europe. Projects like the Sala Nezahualcóyotl are often being built as they are designed, posing additional challenges for the acoustical consultant.

[4] The comments on musician hearing problems in Christchurch had not gone unnoticed by Marshall. He began researching the possibility of over stage reflectors as early as 1972. By 1977, a reflector design had been completed and tested in model form. In May 1978, Marshall returned to New Zealand from a sabbatical to find that the design had been implemented in the hall with favorable results for the musicians.

6. FURTHER DEVELOPMENTS

In the late 1970s, the firm of Bolt Beranek and Newman (BBN) was commissioned to design four new concert halls nearly simultaneously. The design of all four was substantially directed by the late Theodore Schultz and two of the four are based on the shallow surround form. All featured non-traditional geometries. The first of these halls, Davies Symphony Hall in San Francisco, opened in 1980. Critics gave the hall poor marks almost from the start.

Two years later, Meyerhof Symphony Hall opened in Baltimore, followed within weeks by Roy Thomson Hall in Toronto. The initial critic reactions were guarded but generally favorable. Meyerhof, in particular, generally grew to be perceived as a reasonably good although not great hall. Roy Thomson did not fare so well. By 1986, the musicians of the Toronto Symphony were complaining bitterly about hearing conditions on stage. That same year, Ted Schultz asked Pieter de Lange (the Dutch acoustician responsible for the design of the Musiekcentrum Vredenburg, a vineyard style hall in Utrecht) to conduct an acoustical audit of the hall. De Lange made a number of observations about the hall, including:

- Musicians' inability to hear one another on stage.
- Musician perceptions that they needed to force their tone to be heard in the hall.
- Lack of bass response.
- Lack of singing tone.

The acoustics of all four halls has been found wanting to a greater or lesser degree. While there are differences among the four, the problems revolve around some common themes:

- The acoustical canopies were not extensive enough to provide adequate hearing conditions for the musicians or to generate sufficient patterns of early reflections in the stalls (or, in some cases, were deficient on both counts).
- The lower parts of each room tended to be wider than desirable, thereby failing to provide adequate lateral early energy.
- The seating capacities of Davies (3,000) and Roy Thomson (2,850) were too large.

Davies Symphony Hall was subjected to a major renovation under Larry Kirkegaard's direction in 1991 and 1992. In the process, he replaced the canopy, reduced the seat count and cubic volume of the hall, added boxes at the sides of stalls to narrow the room at that level, redesigned the orchestra platform and added new orchestra risers. Critics have generally responded favorably to these changes, although a small number have remained negative. The overall sense is that the hall has been improved but is still not a great space for music.

The other three halls are either presently undergoing or planning major renovations. Significant changes are being made in Meyerhof Hall under Larry Kirkegaard's direction, and Roy Thomson Hall is presently being studied by Artec. Melbourne is said to be moving toward the selection of a consultant in the near future.

The most unfortunate legacy of these halls was to feed a growing perception among symphony orchestra conductors, musicians, managers and audiences that the acoustical profession could not be counted upon to deliver results in new facilities. In parallel with this was a growing impression that only the traditional shoebox shape offered a viable model for new concert halls (despite the existence of more than a few shoebox shaped halls whose acoustics range from merely mediocre to positively abysmal).

The largely successful opening of the Meyerson Symphony Center in Dallas in 1989 seemed to confirm the establishment of the shoebox form as the preferred model for concert hall design. One might also go so far as to suggest that the promotion of the shoebox form has become the conscious objective of a small number of consultants. In light of the acknowledged success of halls such as Berlin and Mexico City, one wonders whether these consultants lack the insight necessary to design concert halls in these alternative forms, or if they see a marketing advantage in perpetuating the shoebox mythology.

The result of this has been an almost total repudiation of the vineyard style form of concert hall design and a sharp decline in the use of shallow surround form.[5] It is ironic that this has happened at a time when scale and computer modeling tools can enable the consultant to refine the design of such forms much more readily than was true in the past.

7. WHAT HAVE WE LEARNED?

Our firm's association with the design of both the Sala Nezahualcóyotl and Boettcher Hall, as well as a number of shoebox concert halls, has given us some important insights into the issue of concert hall form. What have we learned from these experiences?

- Issues of form are not sufficient to determine or limit acoustical quality. There are good and bad examples of non-traditional concert halls, just as there are good and bad examples of shoebox concert halls.
- Non-traditional concert hall forms do indeed elicit positive acoustic judgments from conductors, musicians, critics and concert-goers.
- Non-traditional concert hall forms do engage audiences in ways that are fundamentally different from more traditional shoebox forms.
- The sense of participation and informality engendered by surround and vineyard style halls coincides with societal trends towards these qualities throughout the public realm.
- The nature of a resident ensemble and its local audiences (both current and anticipated) must be considered when evaluating the form of a concert hall for a specific community.
- An ever-improving understanding of the acoustical phenomena at work in the concert hall coupled with new analytical tools provide a solid foundation for the design of such halls.
- There are significant limitations in the traditional shoebox form itself. The most significant of these relates to seating capacity. The experiences of the last three decades suggest that it is increasingly difficult to realize the acoustical benefits of the shoebox form as the seating capacity rises above 2,200 seats. Contemporary standards of seating comfort, coupled with more rigorous safety codes require the shoebox model to be adapted to achieve larger seat counts. Unfortunately these adaptations have rarely produced a successful acoustical result.

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[5] The shallow surround hall form continues to be an accepted model in some parts of the world, particularly in Japan where spaces like Suntory Hall clearly show the influence of the Sala Nezahualcóyotl. Even today, Minoru Nagata's design for the new Disney Concert Hall in Los Angeles (soon to commence construction) reflects an amalgamation of both shoebox and shallow surround features. In Europe few such non-traditional halls were built after Utrecht in 1978, the notable exceptions being the new Gewandhaus in Leipzig, Germany (a shallow surround hall opened in 1981) and the new Bridgewater Hall in Manchester, England (a vineyard hall opened in 1998).

8. CONCLUSIONS

The twentieth century has made monumental contributions to a musical tradition begun in Europe centuries ago. A short list of these contributions might include:

- A vast expansion in the range of musical expression and idioms available to composers.
- An explosion in the number of symphony orchestras.
- The transformation of the concert-going experience from one reserved for a wealthy elite to one available quite widely to the public-at-large.

To these, one must certainly add the development of new design forms for the concert hall and the fundamental rethinking of the concert experience that these spaces engender.

The news is not all good however. At the present time our musical institutions find it increasingly difficult to compete with a flood of entertainment, sports and leisure options. In the United States, over a decade of cutbacks in arts education has left us with a generation of young people who do not even know who Bach, Beethoven and Brahms are let alone Mahler, Britten, Hindemith or Corigliano.

Numerous studies over the past quarter century have confirmed that many young people shun the formality of the symphonic concert experience. To the extent that this formality is fostered by the acoustical profession's insistence on the shoebox form, we subtract from rather than add to the culture of concert-going.

A vineyard hall or shallow surround hall is not the ideal solution for every orchestra. Such designs may not even be appropriate models for most orchestras. But to exclude them from the discussion, to steer clients only to the traditional shoebox model... is to do a disservice to our clients, to audiences new and old, and to music in general. Surely we can do better.

There remains much for us to learn from spaces like the Berlin Philharmonie, the Sala Nezahualcóyotl and Boettcher Hall. It is clear that these spaces offer a unique perspective on the nature of performance and perhaps the nature of music itself. And they demonstrate that these perspectives need not necessarily sacrifice acoustics in the process.

9. REFERENCES

Hine, Thomas; "Drawing parallels from the success of West Berlin's concert hall," The Philadelphia Inquirer, July 26, 1987, page 13-I

Beranek, Leo; *Concert Halls and Opera Houses, How They Sound,* Acoustical Society of America, 1996

Marshall, A. Harold; Recent Measurements in the Christchurch Town Hall and the "Interval of Indifference" for Reverberance," Proceedinngs of the 15th International Congress on Acoustics, June 1995

Goldberger, Paul; "Denver's Boettcher Concert Hall," Architectural Record, March, 1979, pages 99-110.

Jaffe, J. Christopher and Richard L. Medlin; Environment and the Concert Experience, Report to the National Endowment for the Arts, 1974