

Auditorium Acoustics and Architectural Design, 2nd Edition

Michael Barron

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The second edition of *Auditorium Acoustics and Architectural Design* by Michael Barron is a necessary addition to the library of any students, professors, acoustical consultants, architects, theater designers, contractors, concert hall owners, developers or others who are involved with the evaluation, design and analysis of the acoustics of performing arts venues. Performers, concert-goers, and other “lay persons” who are interested in the acoustics of concert halls, theaters, opera houses and other performing arts venues will also find the volume very interesting as an introduction to the technical issues, history and recent research that form the background for current theories on the acoustical design of these venues.

When the first edition of the book was published in 1993, it was a landmark text that compiled theories, research and information that was previously only available in technical journal publications and conference proceedings. The book presented a comprehensive theory on the evaluation and design of performing arts venues along with many original acoustical measurements in significant venues conducted by the author. Michael Barron has dealt comprehensively with the subject covering the basics of sound behavior and hearing in rooms; qualitative and quantitative assessments of music and speech as sound sources; methods to measure various acoustical attributes of sound; as well as a theoretical framework to approach the design of these complicated venues. He describes acoustical issues in the design of concert halls, chamber music halls, recital halls, theaters, opera halls and multi-purpose halls and then illustrates each type of room with case studies that are thoroughly documented with photographs, plan and section drawings and detailed acoustical measurements. The book is a rich resource of architectural and acoustical data on significant performing arts venues.

All sections of the book as well as the illustrations have been updated since the original edition. Special emphasis, addressing issues of recent interest, has been added throughout the book. Diffusion and scattering have been added to the sections on basic theory. A section on computer modeling has also been significantly expanded. Auralization has been covered in much more detail than the first edition. Recent research such as the results of work by Bradley and Soulodre on listener envelopment is included in multiple sections.

When one steps back and reflects on the merits of this new edition of a classic book, four main issues come to mind.

1. The book presents a comprehensive theory about ways to approach the design of performing arts venues that is based on historic precedent, rigorous acoustical studies of a number of rooms and emerging acoustical theories linking the measurements to qualities of sounds heard by people listening.
2. The book contains a significant data base of architectural and acoustical measurements of performance facilities.
3. The book tries to cross the boundaries between architecture, performance and acoustics by finding ways to provide a common framework for these three disparate professions whose work is inextricably linked to the success of performing arts facilities to establish a common set of operating principles.
4. Great effort is made by the author to maintain a very readable book for multiple audiences that can be accessed at several levels. There is an abundance of technical information and detail presented that compliments the general progression of the theoretical arguments and historical development of the building type.

While many who read this book will likely be involved in design or research on the architecture and acoustic design of performing arts facilities, for readers with more general interest Michael Barron has done an exceptional job of addressing the acoustical issues in these venues in a very readable way. The state-of-the-art research is described in enough detail for the seasoned practitioner while the historical and theoretical issues are described in ways appropriate for theater history, history of science and music history students in addition to more technically-oriented readers.

An outline of the chapters of the book describes its comprehensive approach with new sections identified.

1. *Introduction* which presents a concise argument on the evolution of the scientific basis of auditorium design.
2. *Sound in Rooms* covers the basics of sound propagation in rooms.
3. *Acoustics for the Symphony Concert Hall* covers what Barron calls objective and subjective attributes of concert halls. There is a new section on diffusion which comprehensively addresses the subtleties of the role of diffuse reflections in halls. The discussion covers the balance between early reflections that contribute to spatial widening of the source while avoiding tone coloration and false localization of the sound source as well

as providing a spatial sensation to the reverberant sound in a room where the sources are directional and located at one end of the room, most of the absorbent material is located on the floor in the form of audience seating and generous space located above the audience.

4. *Development of the Concert Hall* covers the historical evolution of the building type. There is a new section on *Return to Precedents*. This section discusses important halls and design innovations since the publication of the original edition, most notably, the trend towards rectangular shaped concert halls. The Benaroya Hall in Seattle by acoustical consultant Cyril Harris; Seiji Ozawa Hall by Kirkegaard Associates at Tanglewood; the McDermott Concert Hall in Dallas by Artec acoustical consultants; and the Takemitsu Memorial Hall at Tokyo Opera city by acoustical consultants Leo Beranek and the Takenaka R & D Institute are among the buildings discussed. The Kitara Concert Hall in Sapporo by Nagata Acoustics acoustical consultants is included to address advances in terraced hall design.
5. *British Concert Halls and Conclusions for Concert Hall Acoustics* presents detailed case studies of 16 significant halls with a summary of the acoustical design principles for this building type. There are 4 new case studies including important new halls in Birmingham, Belfast, Manchester and Glasgow.
6. *Chamber Music and Recital Halls* presents a summary of design principles for these rooms with 4 case studies.
7. *Acoustics for Speech* starts with the basics of speech as a sound source and discusses concepts for the measurement of acoustical parameters which affect speech in theaters. There is a new section on *Prediction of Reverberation Time in Theaters* which covers the concepts associated with estimating the reverberation time of a theater with an absorbent stage house volume coupled to it.
8. *Theater Acoustics* summarizes the historical evolution of theaters, discusses different stage types and illustrates the concepts with multiple case studies.
9. *Acoustics for Opera* discusses opera as an acoustic issue, presents acoustical criteria for opera houses and illustrates the concepts with case studies. There is a new case study of the Glyndebourne Opera House
10. *Acoustics for Multi-purpose Use* discusses the acoustical issues inherent in multi-use halls.
11. *Multi-purpose Halls in Britain* presents case studies of 8 halls.
12. *The Art and Science of Acoustics* presents the conclusions of Barron's work which is a summary of design issues for each of the building types addressed.
13. Four appendices covering sound reflection and reverberation calculations; objective measures for music auditoria; further objective results in concert halls; and objective measures for speech auditoria. The appendices are not just fillers or technical data. They are clearly written explanations of each of the topics that add meaning and depth to the text. Barron provides extremely clear explanations of complex acoustical phenomena. For example, the explanation of Speech Transmission Index (STI) in the original edition of the book which is retained in the new edition is perhaps the most clearly presented discussion of this topic for people with limited technical background. This clarity of discussion permeates both editions of the book.

The format of the extensive case studies of concert halls, recital halls, opera houses and theaters remains essentially the same as in the original edition. These case studies which form the research basis of the book present well illustrated documentation of what Barron calls objective and subjective characteristics of the rooms that were obtained by the author. The clearly presented octave band measurements of reverberation time, early decay time and occupied reverberation time, C80, source broadening and mid frequency sound level v. distance in the hall plotted against sound level v. distance for a room with an exponential decay provide a valuable resource for consultants and researchers. Plan and section drawings at a common scale, photographs and side bars with architectural data, materials and uses are also included for each room. The insightful comments of Michael Barron on the acoustical qualities of each room, diagnostics of subjective qualities and comments based on his visits and listening experiences in the rooms make this a noteworthy data base of design information. The qualitative and quantitative diagnostics of the rooms are given on an area by area basis rather than for the room as a whole which provide much needed depth to the evaluation of performance halls.

The use of impulse response graphs to illustrate the links between quantitative and qualitative components of the sound field in the early chapters of the book provides a clear way for readers to understand how specific surfaces in rooms contribute to the acoustical response of the room and the acoustical measurements made in the rooms. The extent of the case studies which includes not only concert and opera halls but also multi-purpose

halls, chamber and recital halls and various types of theaters in one volume is helpful to establish a common method to address architectural acoustic issues across all performing arts venues rather than to segregate music and theater into separate documents.

The breadth of Michael Barron's own career is strongly represented in the book. His experience which includes being a professor, researcher and consultant is perhaps what gives the depth and breadth to the book. The historical development of acoustical design for each performance venue is covered with adequate detail. Barron's research in acoustical measurement, modeling and subjective effects adds depth to the discussion. The experience as a consultant on large, complex performing arts projects enhances the discussion with a reality check that the issues raised have a place in real projects and furthermore, that they add to the acoustical quality of the completed spaces is a noteworthy component of the book. This unique experience that Michael Barron has put together in his prolific career provides

the basis for the valuable insights he offers in each of the sections that give clear priority to the factors that create outstanding acoustics in performance halls. These reflections on each of the halls and on each of the issues make this a book that is worth reading and re-reading at various stages through ones' career working in various areas of performing arts design.

I would heartily recommend reading and re-reading this wonderful text. It, like other classics by Sabine, Cremer, Beranek, Kuttruff and others, forms the basis of our discipline.

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