Concert Halls by Nagata Acoustics

Thirty Years of Acoustical Design for Music Venues and Vineyard-Style Auditoria

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Yasuhisa Toyota
Nagata Acoustics
Los Angeles, CA, USA

Daniel Beckmann
Nagata Acoustics
Los Angeles, CA, USA

Erik Bergal
Nagata Acoustics
Los Angeles, CA, USA

Motoo Komoda
Nagata Acoustics
Los Angeles, CA, USA

Marc Quiquerez
Nagata Acoustics
Paris, France

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The ASA Press

ASA Press, which represents a collaboration between the Acoustical Society of America and Springer Nature, is dedicated to encouraging the publication of important new books as well as the distribution of classic titles in acoustics. These titles, published under a dual ASA Press/Springer imprint, are intended to reflect the full range of research in acoustics. ASA Press titles can include all types of books that Springer publishes, and may appear in any appropriate Springer book series.

The Acoustical Society of America

On 27 December 1928 a group of scientists and engineers met at Bell Telephone Laboratories in New York City to discuss organizing a society dedicated to the field of acoustics. Plans developed rapidly, and the Acoustical Society of America (ASA) held its first meeting on 10–11 May 1929 with a charter membership of about 450. Today, ASA has a worldwide membership of about 7000.

The scope of this new society incorporated a broad range of technical areas that continues to be reflected in ASA's present-day endeavors. Today, ASA serves the interests of its members and the acoustics community in all branches of acoustics, both theoretical and applied. To achieve this goal, ASA has established Technical Committees charged with keeping abreast of the developments and needs of membership in specialized fields, as well as identifying new ones as they develop.

The Technical Committees include acoustical oceanography, animal bioacoustics, architectural acoustics, biomedical acoustics, engineering acoustics, musical acoustics, noise, physical acoustics, psychological and physiological acoustics, signal processing in acoustics, speech communication, structural acoustics and vibration, and underwater acoustics. This diversity is one of the Society's unique and strongest assets since it so strongly fosters and encourages cross-disciplinary learning, collaboration, and interactions.

ASA publications and meetings incorporate the diversity of these Technical Committees. In particular, publications play a major role in the Society. *The Journal of the Acoustical Society of America* (JASA) includes contributed papers and patent reviews. *JASA Express Letters* (JASA-EL) and *Proceedings of Meetings on Acoustics* (POMA) are online, open-access publications, offering rapid publication. *Acoustics Today*, published quarterly, is a popular open-access magazine. Other key features of ASA's publishing program include books, reprints of classic acoustics texts, and videos. ASA's biannual meetings offer opportunities for attendees to share information, with strong support throughout the career continuum, from students to retirees. Meetings incorporate many opportunities for professional and social interactions, and attendees find the personal contacts a rewarding experience. These experiences result in building a robust network of fellow scientists and engineers, many of whom become lifelong friends and colleagues.

From the Society's inception, members recognized the importance of developing acoustical standards with a focus on terminology, measurement procedures, and criteria for determining the effects of noise and vibration. The ASA Standards Program serves as the Secretariat for four American National Standards Institute Committees and provides administrative support for several international standards committees.

Throughout its history to present day, ASA's strength resides in attracting the interest and commitment of scholars devoted to promoting the knowledge and practical applications of acoustics. The unselfish activity of these individuals in the development of the Society is largely responsible for ASA's growth and present stature.

In memory of Dr. Minoru Nagata, friend and mentor.
(1925–2018)

Foreword

What for me sets Yasu Toyota aside from other acousticians is that he does not listen to music only as an acoustician but also with musical ears. The greatest difficulty is to find the right balance between transparency and reverberation. Neither of these can really work without the other and in my view he hears that perfectly.

Tel-Aviv, November 2018 *Daniel Barenboim*

I met Yasu Toyota when we began to work on the Walt Disney Concert Hall project together many years ago. He was more collaborative than I had experienced with acousticians, and he was open and interested in exploring new ideas and innovative solutions. He was very respectful of the architectural considerations necessary to make user-friendly spaces. When we started our work, we agreed that Hans Scharoun's Berlin Philharmonie had the qualities that we wanted in the Walt Disney Concert Hall. It became a starting point for our conversations, especially in terms of the feeling of the room and the feeling of connectivity between the performers and the audience. This hall created a communal experience unlike any other space that either of us had experienced. The audience connected with the performers; the performers felt the adulation and performed better; the audience responded with more love. It was a truly a virtuous cycle, and Yasu and I have spent the last twenty years studying and developing new and different ways to achieve this connectivity in our halls. Our work together has resulted in innovative solutions, and we have created some very successful rooms for music.

I rely on Yasu, and I trust him. He has been my great collaborator all of these years, and it has been my honor and privilege to work with this great and talented man.

Los Angeles, January 2019 *Frank Gehry*

My name is Valery Gergiev and I'm a friend of Yasu Toyota. If I had been born 300 years ago, I would have been a friend of Antonio Stradivari or whichever of the Guarneri family you prefer, many would say del Gesù. Of course, there were many smaller luthiers who followed: I love Guadagnini instruments, other members of the Guarneri family, Bergonzi, Amati, and da Salò. But Yasu Toyota, I put him in the league which I previously introduced, of Stradivarius and Guarneri.

In the 20th century, in the last thirty years all of a sudden, a success story was emerging belonging to a group of acousticians from Japan making fantastic halls. Even in Europe, America, and Russia, people were saying "Oh, there is a fantastic hall in Tokyo, a fantastic hall in Kyoto, and in other Japanese cities.' It is difficult to explain how Japanese professionals learned so much about acoustics while in Europe, they could enjoy the Amsterdam Concertgebouw and Vienna Musikvereinssaal.

I am very honored to be friends with Yasu Toyota. We have had several unbelievable, unforgettable experiences together building several halls in St. Petersburg and a hall in Moscow, but even his halls in Japan, Hamburg, Paris, and the United States happen to be a part of my life story. When I am brought to a hall with Yasu's name attached, the typical characteristics of the sound are recognizable immediately. We are all lucky that the greatest acousticians of all time did not live 350 years ago. Some of them are living now.

St. Petersburg, June 2019 *Valery Gergiev (transcribed)*

デジタライズしてしまった現代の音響理論がまだ到達できていない演奏空間を、交響するひとつの楽器に組みあげる永田音響理論。それは、究極の完成型としての、京都コンサートホールである。
Nagata Acoustics has achieved a method of creating performing arts spaces which resonate like a musical instrument, a feat which is still not possible through modern, digitalized acoustical technology. The ultimate expression of this theory is our collaboration on Kyoto Concert Hall. (*translation by book authors*)

Oita, April 2019 *Arata Isozaki*

Yasuhisa Toyota has a unique combination of talents as he is not only a master of the acoustical science but also a profound music lover with great knowledge of the various choirs of the orchestra.

I have had only the most wonderful experiences with him in Israel where he not only created the acoustics of our new chamber music hall but also completely revived the acoustic and therefore the sound in the Charles Bronfamn Auditorium.

Mr. Toyota has designed so many halls all over the world that, as we say, he needs no introduction. I wish him the best on all his future projects.

Los Angeles, December 2019 *Zubin Mehta*

Pleasures Declared and Shared

Among the greatest pleasures, the most amazing hallucinatory experiences that this discipline made for mad perfectionists—architecture—can offer, there are the encounters with the great, the indispensable, specialists who come with, change and strengthen the architectural work. These people are artists of precision, inventors of details that turn out to be essential within the complementary dimensions made up of structures, landscapes, scenographies, sounds, music… Among all such sorcerers, I've been particularly fascinated by one who works on the depth and subtlety of sound, a certain Yasuhisa Toyota. For a long while I dreamed of taking him with me on a great architectural and musical adventure, but there was a hitch: he was always booked up exclusively by one of my great architect friends… Finally, in 2002, I succeeded in getting him to embark with me on the Copenhagen concert hall… a hall that looks like a 'meteorite' that's fallen from the sky into a blue cube on a brand new polder, where Danish Radio was having its new buildings erected on a slab of concrete, without realizing what was about to happen later… much later. To cut a long story short, the brief involved an internal structure, tucked in behind blue screens, with a concert hall and three other auditoriums. That's where I saw Yasu the sorcerer at work, with his miniature of the hall, an acoustic model in which, on every one of the 1,850 seats, a quietly concentrating audience member was sitting. The whole thing was on a scale of 10cm to a metre, though every now and then there would be a notable exception to this, in the area of the stage: Yasu would suddenly be sitting there, on stage, in the flesh! Japanese sized, he'd managed to put himself in the audience's place to actually listen to real musical pieces, look at the balconies at eye level, and assess the slope of the handrails, striking them to assess the way they reverberated… Those sessions have stayed with me and with my team. Those images have become cult images, so many proofs of the said sorcerer's commitment, his ability to look ahead, to hear sound before it's actually made. This alertness to a preconceived reality has made his reputation and that of Nagata and Motoo Komoda. Each of the four halls is an instrument to be listened to and that has been produced in the same spirit.

With Yasu we studied five projects; the second of these, one we worked on in 2006, was an island music hub, in the middle of the river in Seoul, that had a concert hall and an opera auditorium… a golden mass emerging from the rocks and trees, with the whole thing reflected in the water. It was the winning project, but… once the Mayor of Seoul became the President of the Republic, he forgot all about his Opera House… causing me extreme frustration, as I would so love to have heard Yasu's acoustics resonate there and see him sitting once more in the middle of the new rocky model…

Then it was the Philharmonie de Paris, a winning project, a built project. Nagata was already under contract to an architect friend of mine… So I designed the concert hall with Harold Marshall as an auditorium, conjuring up ethereal layered expanses of music and light and leaving listeners-spectators suspended, giving them the impression of being surrounded by, and immersed in, the music and the light. But the client wanted to have his own consultant acoustician, in the presence of Eckhard Kahle, whom I'd got to know with Russ (Russell Johnson) in the 1990s, when I was building the concert hall in Lucerne. This situation meant I could have Yasuhisa Toyota, whom my client greatly admired, as my personal consultant on the development of the hall. My design for having the music envelop the audience was challenged by a few grumpy

bureaucrats, so I asked Yasu what he thought of it, and he told me it didn't serve any purpose but that it could be done, and... he went back to his model, to test it – he's forever testing in a bid to improve! The point of the story is that, as far as acoustics go, the complementary nature of the Marshall-Toyota duo was what really enabled the hall to see the light of day and to be recognized as being unique.

Then it was the turn of Germany and the Kronberg project, a modest musical ensemble integrated into a small town, a simple jewel in a room made of wood, with a roof over it... Eternal regrets.

Finally, there was the competition for the Munich concert hall, a precious composition that was misunderstood... Lost illusions.

But thank you, Mr. Yasuhisa Toyota, for being with me in the days of glory and in the days of oblivion...

We will carry on, in complete complicity, and once again try to force them (the clients, the music-lovers) to see and hear because, Yasu, as you've told me clearly enough, we can also see with our ears.

Paris, March 2020 *Jean Nouvel*

Concert halls are instruments. Whatever we all do, however excellently we perform, we are nothing without the space into which the music travels. I really believe that the general public has no idea what an astonishing difference great acoustic can make to a performance, particularly in emotional terms. Yasu has long been the Stradivarius of concert hall design, and in his spaces we no longer have any excuse, we simply HAVE to perform at our highest level. It is not only like a mega instrument but also a vessel which transports us on our journey, enabling music in a profound sense. My dear Yasu, we are, as we sometimes say in English, pathetically grateful for the chance to play as we would wish, not an everyday experience for musicians! So we all wish you more power to your elbow, your ears, and the unusual sensitivity of yourself and your magnificent team.

London, September 2019 *Sir Simon Rattle*

During my forty years of performing around the world I've learned to assign the experience of acoustics to one of the four categories below:

1. Musicians on stage perceive the acoustical properties of the hall as an obstacle, something between the music and the audience. I often think of a membrane as a metaphor. Intuitively we feel that somehow we have to get through it to get to the other side, to pierce it to reach out to the listeners.
2. The music has presence in the space, but there is no focus. The layering and balancing of complex scores is difficult or impossible. I happen to believe that true expression in music is impossible without clarity, balance and focus.
3. The experience on stage is neutral. The strangest category. The hall doesn't distort the musical thought, but it doesn't add anything either. We don't feel inspired or supported by the acoustics, but we can do a professional job, rarely anything more than that.
4. The best category: we experience the hall as a high quality instrument which the orchestra plays. The acoustics not only reproduce, but support and inspire. Over time, we learn to trust the hall. Instead of fighting it, we achieve a perfect symbiosis: the expression itself is been amplified in the space. The music, the orchestra and the audience become one. This kind of magic (I've no better word for it) happens often in spaces designed by Nagata Acoustics.

The design and building process of the Walt Disney Concert Hall in Los Angeles led by Frank Gehry and Yasuhisa Toyota has been one of the most exciting and joyous projects in my entire life. It certainly changed the fate of the LA Philharmonic and classical music generally in the city. Now, one-and-a-half decade later, it can be concluded that the hall also changed the fate of the entire Downtown of LA.

In the superb acoustics of the Walt Disney Concert Hall, music can go beyond a mere aesthetical experience into the realm of a powerful psychophysical/emotional phenomenon. Warmth and transparency. Body and soul. Yin and Yang. Yasuhisa Toyota and Nagata Acoustics have created a masterpiece.

Helsinki, May 2019 *Esa-Pekka Salonen*

Introduction

I learned acoustics and acoustic design at the Kyushu Institute of Design (KID, now a department of Kyushu University). After I graduated in 1977, I joined Nagata Acoustics. KID was a unique college where I could learn two different aspects of acoustics: acoustics as engineering and music as art. I was an enthusiastic classical music lover when I was a high school student, playing saxophone in junior high band and oboe in high school orchestra. My goal was to work close to classical music, possibly as a recording engineer for classical music or as an acoustician who designs the acoustics of concert halls.

I decided to join Nagata Acoustics, which had been established only a few years prior by Dr. Minoru Nagata. Dr. Nagata had been working as an acoustics researcher at NHK (Nippon Hoso Kyokai, the Japanese National Broadcasting Company similar to BBC in the UK), in a technical laboratory under the chief acoustic researcher Mr. Yasuo Makita. Makita had been in charge of the acoustic design of Tokyo Bunka Kaikan (1963), the most important concert hall in Tokyo before the opening of Suntory Hall in 1986. After retiring from NHK, Makita became a professor in the acoustic design department at KID.

My first few years at Nagata Acoustics were quite busy with noise measurements and noise control projects, for road traffic noise, train and subway noise and vibration, aircraft noise, and so on. Noise pollution was growing constantly, together with Japan's economic growth. This was a good opportunity for me to learn the fundamentals of sound engineering, since noise control uses physical thought processes and mathematical calculations, which are also important for the acoustic design of concert halls.

In the 1980s, there was a boom in building multipurpose halls in Japan. Nagata Acoustics was in charge of acoustic design of many halls, probably more than one hundred publicly funded cultural centers. This prepared us for the boom in concert halls which accompanied the economic bubble in the second half of the 1980s.

Suntory Hall in Tokyo opened in 1986. Many concert halls dedicated to classical music, using natural acoustics, followed Suntory Hall one after another for the next decade, in all parts of Japan. Fortunately, the other concert halls built in Tokyo after Suntory Hall were in many different styles, such as shoebox, fan shape, and of many different sizes. We were very lucky to be in Tokyo as acoustical consultants, since we could experience many different concerts by many different performers—not only from Tokyo but also from foreign countries. Listening to those many different performers in different concert halls helped greatly in developing our acoustic knowledge and skill.

I worked closely with Dr. Minoru Nagata for these important two decades, 1980s and 1990s, before moving to Los Angeles to open a new office of Nagata Acoustics. Dr. Nagata was my boss in the company and a mentor for me in my life. He was not only an excellent acoustic engineer with a rigorous scientific background but he was also a wonderful music lover. He always suggested that I go out of the office where we do desk work every day, out into the field and listen to concerts in concert halls. He valued hearing actual concerts and communicating with musicians. What I learned through these experiences is a treasure. This book is an homage to Dr. Minoru Nagata who passed away in the summer of 2018 while this book was being written.

After moving to Los Angeles in 2000, the first important project was Walt Disney Concert Hall. We had started working on Disney Hall already in 1989, which was even before the start of the design of Sapporo Concert Hall in 1993. The two concert halls, Disney and Sapporo, are related to each other, a relation that benefited both projects. When Sapporo started design work in 1993, the Disney project had already completed the schematic design phase as well as a 1:10 scale model acoustic test. But, Sapporo opened first, in 1997. When Disney started construction in 1999, Sapporo had already been open for 2 years, and Disney would open in 2003. Sapporo learned many lessons from Disney, and Disney learned many lessons from Sapporo.

After Disney, we have been very lucky and happy with many high-profile concert hall projects around the world: Mariinsky Theatre Concert Hall (St. Petersburg, Russia 2006), Danish Radio Concert Hall (Copenhagen, Denmark 2009), New World Center (Miami, USA 2011), Helsinki Music Centre (Helsinki, Finland 2011), Shanghai Symphony Hall (Shanghai, China 2014), Philharmonie de Paris (Paris, France 2015), Elbphilharmonie (Hamburg, Germany 2017), and Pierre Boulez Saal (Berlin, Germany 2017). The list continues, with more than 30 halls in total. Many of the concert halls we worked on belong to the so-called vineyard typology, where the stage is surrounded by the audience, and the audience is divided into several

groups. These groups are configured at different levels, so that small wall surfaces among the audience groups can provide acoustically effective reflections. The most important aspect of the vineyard-style concert hall is its visual, architectural intimacy, coupled with the acoustical intimacy, created between the stage and each audience member and also among the audience members: they can see and feel each other's faces over the stage. This is why many modern concert halls take the vineyard-style hall shape and seating configuration.

In this book, we list 32 concert hall projects of our office, with physical data, drawings, photos, and essays for each. Following the projects descriptions are some topics on acoustics we learned by working on the projects, which help us consider design directions for concert hall projects in the future.

Los Angeles, CA, USA Yasuhisa Toyota

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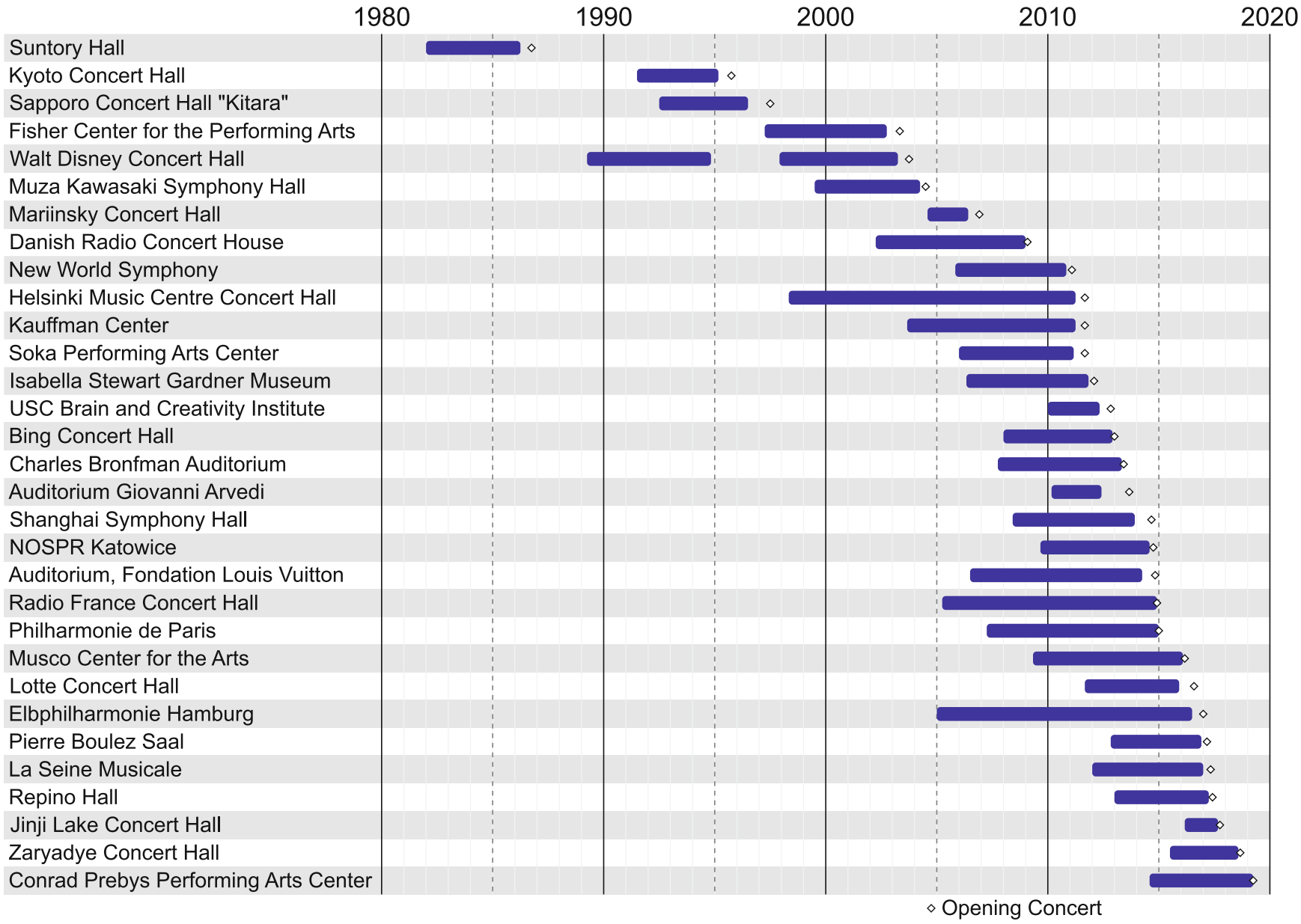
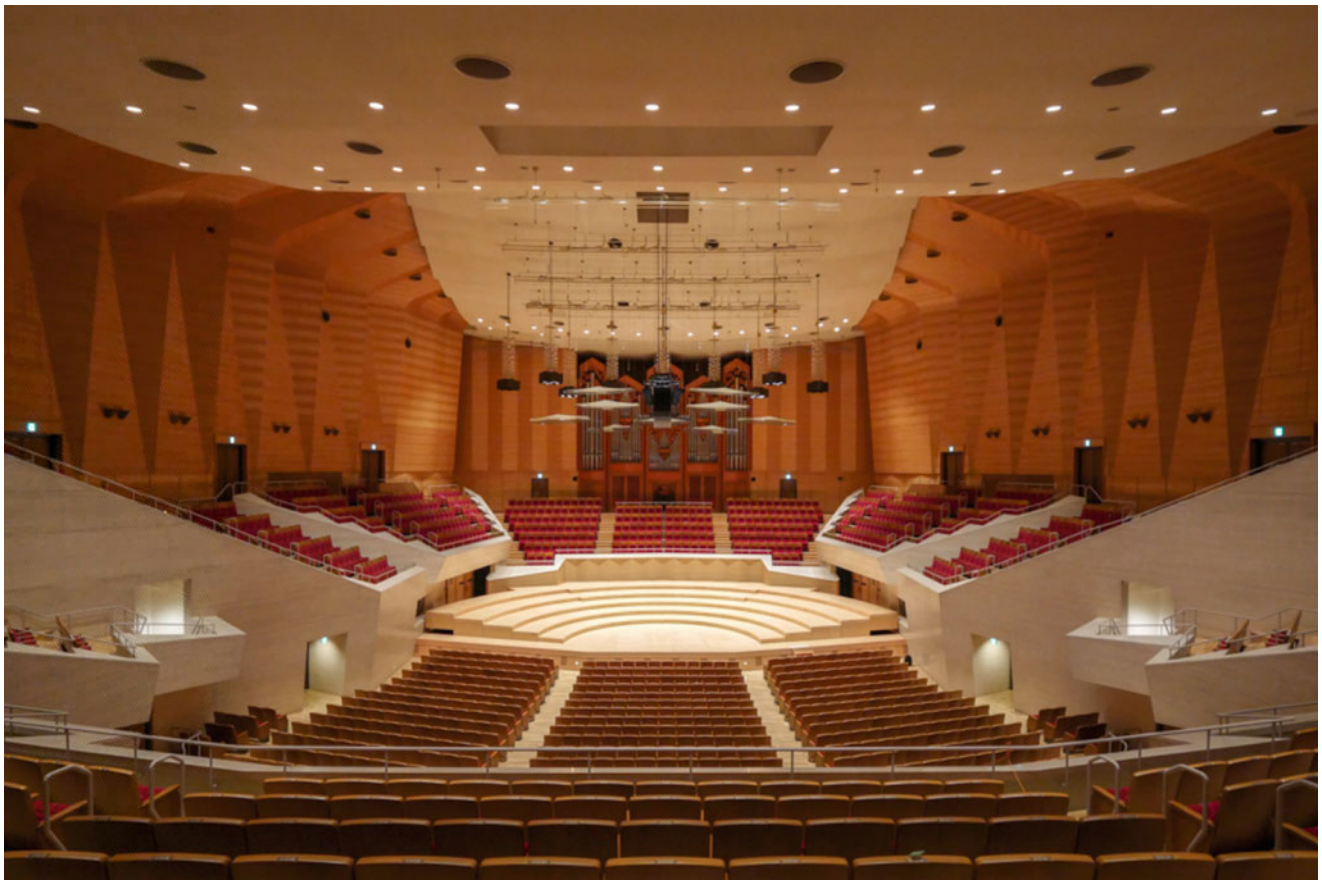

1980
1990
2000
2010
2020
Suntory Hall
Kyoto Concert Hall
Sapporo Concert Hall "Kitara"
Fisher Center for the Performing Arts
Walt Disney Concert Hall
Muza Kawasaki Symphony Hall
Mariinsky Concert Hall
Danish Radio Concert House
New World Symphony
Helsinki Music Centre Concert Hall
Kauffman Center
Soka Performing Arts Center
Isabella Stewart Gardner Museum
USC Brain and Creativity Institute
Bing Concert Hall
Charles Bronfman Auditorium
Auditorium Giovanni Arvedi
Shanghai Symphony Hall
NOSPR Katowice
Auditorium, Fondation Louis Vuitton
Radio France Concert Hall
Philharmonie de Paris
Musco Center for the Arts
Lotte Concert Hall
Elbphilharmonie Hamburg
Pierre Boulez Saal
La Seine Musicale
Repino Hall
Jinji Lake Concert Hall
Zaryadye Concert Hall
Conrad Prebys Performing Arts Center
Opening Concert

Part I

Project Anthology

1. Suntory Hall



View from center balcony. Inspired by the Berlin Philharmonie, the stage is placed at the center of the audience seating

Y. Toyota et al., *Concert Halls by Nagata Acoustics*, https://doi.org/10.1007/978-3-030-42450-3_1

Suntory Hall is the brainchild of the late Suntory president and owner, Keizō Saji. Known for his pioneering attitude and following the Suntory slogan "Yatte Minahare," translated roughly as "just try it" without overthinking, Saji decided to build the first single purpose concert hall in Tokyo. To this end Saji created the Suntory Music Foundation in 1969 to nurture classical music in Japan and retained Yasui Architects to begin design work in 1982. Maestro Herbert von Karajan, a personal friend of Saji, acted as an advisor for the project.

The hall is nestled in a commercial development which was constructed as a part of the revitalization of the Akasaka-Roppongi district in central Tokyo. A sunken courtyard, aptly named Herbert von Karajan Platz, leads to the hall lobby complete with marble walls and a 30-sided chandelier. To the left, the small, "Blue Rose" hall has a system of floor lifts that can reconfigure the space for chamber concerts and banquets alike. Continuing ahead past the café leads to the main hall.

Free from the restrictions of public projects, there was considerable latitude to experiment with the form of the hall. The vineyard-style typology was decided from the start, strongly influenced by von Karajan and the Berlin Philharmonie. The new hall would feature terraced seating areas surrounding the stage and the orchestra would sit on curved stage risers made of resonant wood.

Some vestiges of the historical seating layout remain, such as the expansive main floor seating with a gentle rake seating 870. A single small wall divides the seating areas and provides space for circulation. A minimal number of seats were placed under the balcony near the control room. The balcony, side, and chorus seating areas form eleven distinct terraces which hold the remainder of the 2,006 viewer-listeners. The balcony fronts are angled downwards to provide the audience with early reflections that would come from narrow sidewalls in a shoebox hall. Balcony fronts and terrace walls are covered in smooth sheets of ivory colored marble which complement the clean, crisp lines of the walls. Subtle reflections off the polished stone create the impression that the stage glows in the spotlight, focusing our attention to the center of the space.

At the time of design, studies showed that lateral reflections were particularly important in achieving good acoustics. For the seating areas flanking the stage, there are no sidewalls to provide early reflections of any kind. The issue was the source of much consternation as the acoustical success and larger viability of the vineyard layout was at stake. The design solution was to accordion fold the walls to send incoming reflections from the ceiling sideways. The wood finished walls are largely featureless save for this pleated profile in plan.

In another inspiration from the Berlin Philharmonie, nine plexiglass ensemble reflectors are suspended above stage. While one of the local orchestras chooses to perform with the panels raised all the way to the main ceiling, the general consensus is that the stage acoustics are difficult unless the reflectors are lowered to an elevation approximately 12 m above stage. Since the panels are clear and have minimal thickness, they do not impede the view of the ceiling, thereby preserving the impression of a singular, unified volume. A tented ceiling profile is created by gypsum board segments which comes to its apex directly above the front edge of the stage, another influence from Berlin Philharmonie.

Suntory Hall was the first case where we used a 1:10 scale model to investigate the acoustical properties. Before computer modeling was available, reflective paper, laser pointers, and measuring tape were used to map reflection delay times throughout the hall. Upon completion of the hall, the differences in acoustical character between various seating areas became a case study that has become the foundation of our design process.

Today, Suntory Hall is one of the most popular venues in Tokyo. While there is no resident orchestra, the hall hosts more than 400 concerts each year. There is some perception that the hall has matured as it aged, but in reality the local orchestras have improved in quality, giving the impression that the hall has changed. Since the exceptional clarity of the hall tends to leave the ensemble somewhat exposed, the orchestras must improve the quality and balance of their sound.

After 30 years, the hall was refurbished in 2016. Care was taken not to change any of the interior materials in order to preserve the visual and acoustical impression that Tokyo audiences have come to love. Notably, the stage risers were extended and the thickness of the stage floor decking was decreased to improve resonance, changes which have been well received by musicians. An updated, line array sound system was installed in the main hall for lectures and other educational programming.

Erik Bergal

View from side terrace. The ceiling is composed of overlapping plates of gypsum which meet at their highest point just in front of the stage edge. This point is much higher than the elevation of the suspended, plexiglass ensemble reflectors

View from upstage terrace. While the main floor seating is relatively flat, reminiscent of historical halls, the terraced seating is arranged in blocks with a steep rake

Suntory Hall	
Location	Tokyo, Japan
Owner	Suntory Limited
Architect	Yasui Architects
Acoustical consultant	Nagata Acoustics
	Minoru Nagata, Yasuhisa Toyota, Akira Ono
Design start	1982
Construction start	Q3 1983
Construction end	Q2 1986
Opening date	October 12, 1986
Building size	12,000 m^2
Main hall	
Seating capacity	2,006
Room volume	21,000 m^3
Surface area	6,700 m^2
Volume/seat	10.5 m^3/seat
Volume/surface area	3.1 m
Finish material	
Ceiling	Gypsum board
Ensemble reflectors	Plexiglass
Walls	Wood veneer on gypsum board on concrete
Audience floor	Wood board on concrete
Stage floor	Pine
Seat manufacturer	Kotobuki Seating
Organ builder	Rieger Orgelbau
Model scale	1:10

Table 1.1 Suntory Hall—acoustical metrics at 500 Hz

RT unoccupied	2.6 s
RT occupied	2.1 s
EDT	2.5 s
C_{80}	−1.4 dB
D_{50}	27%

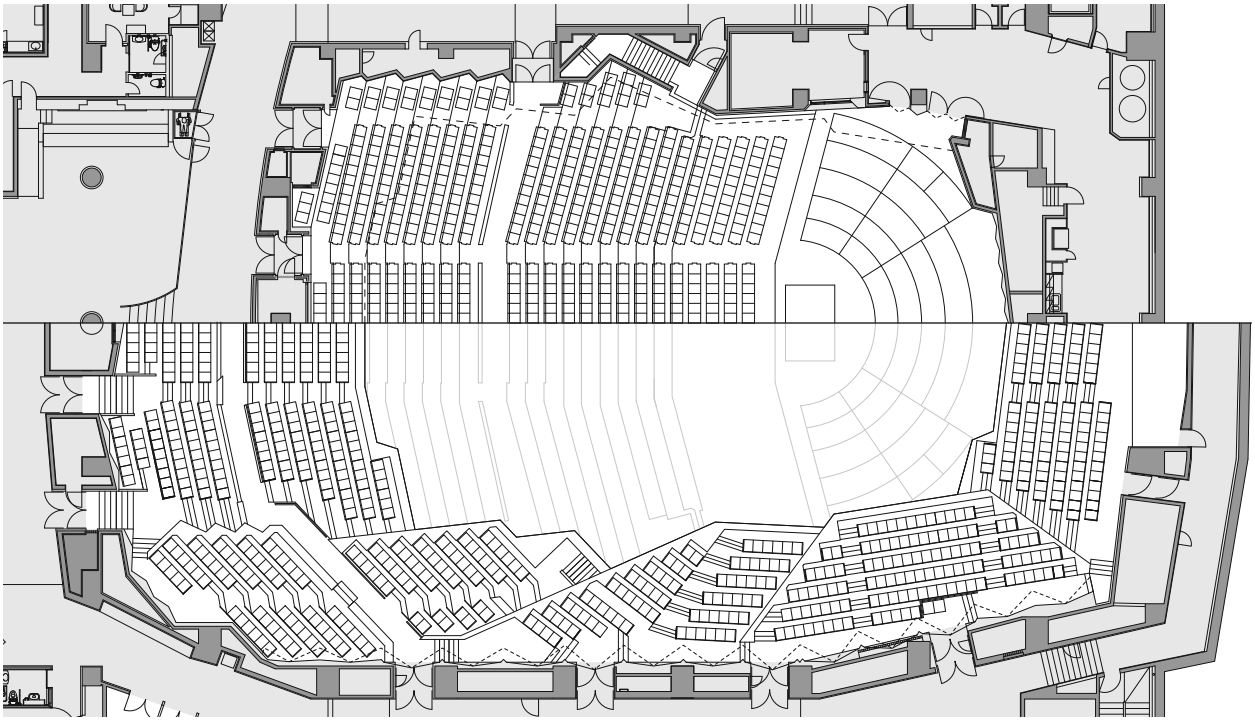


Fig. 1.1 Stage and terrace levels plan
Courtesy of Yasui Architects

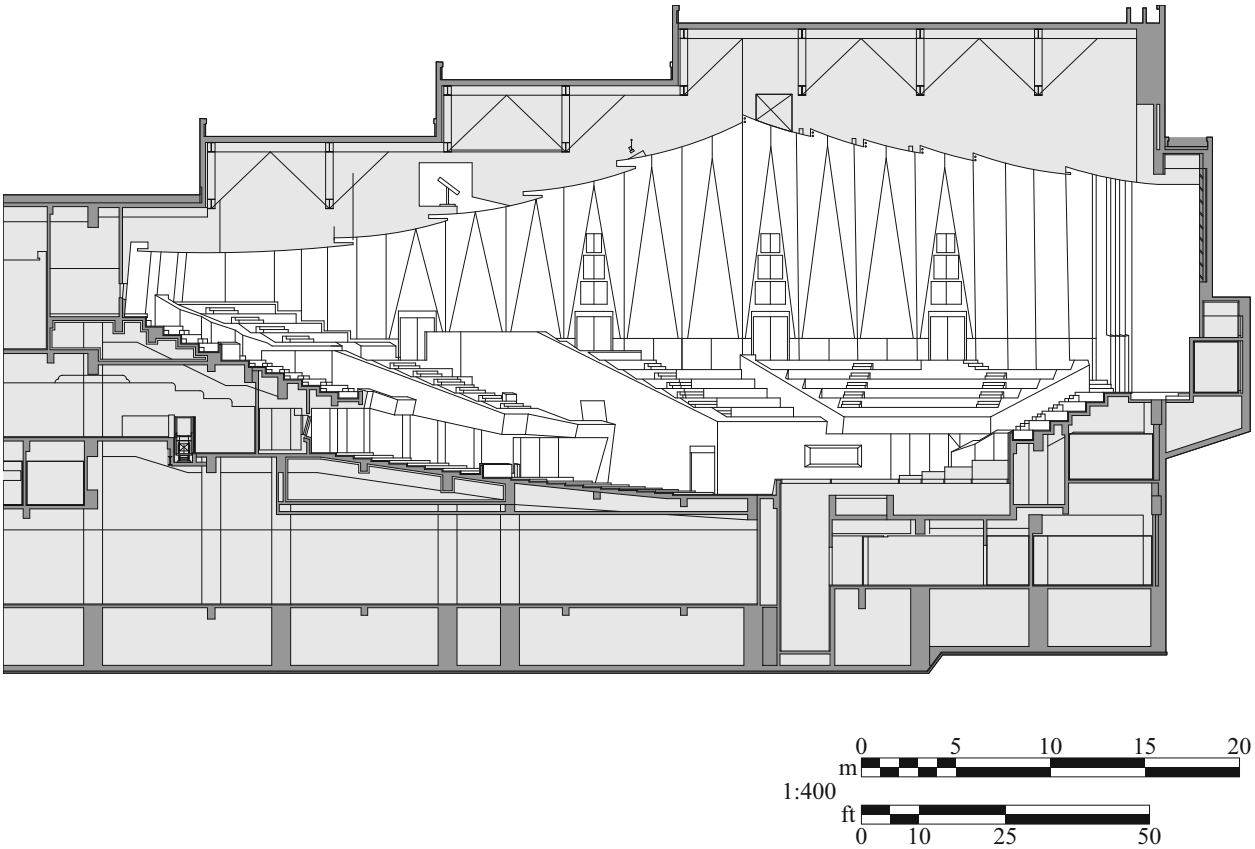


Fig. 1.2 Longitudinal section
Courtesy of Yasui Architects

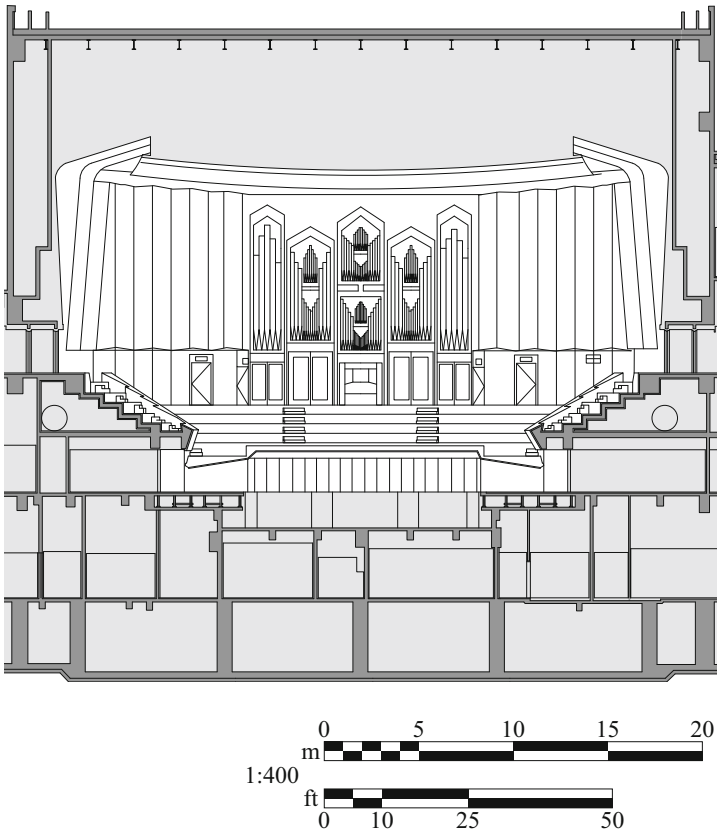
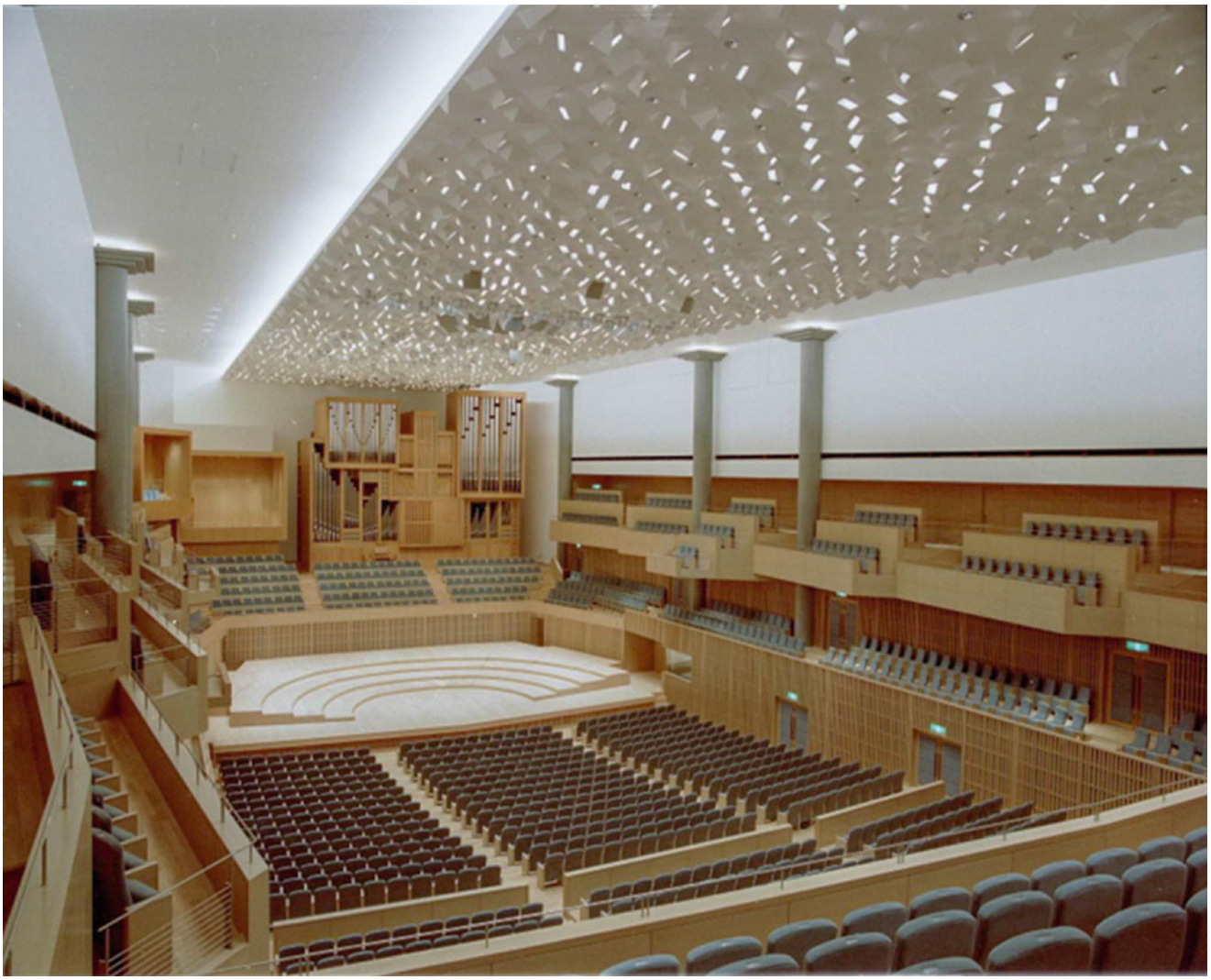


Fig. 1.3 Cross section
Courtesy of Yasui Architects

2. Kyoto Concert Hall



View from balcony. The axial ceiling panel contains an array of lights amid pyramidal acoustical diffusion. The rest of the ceiling and walls are left intentionally clean and stark in contrast

Y. Toyota et al., *Concert Halls by Nagata Acoustics*, https://doi.org/10.1007/978-3-030-42450-3_2

The Kyoto Symphony Orchestra holds a unique position as an official part of the city government, making its musicians truly public servants. The construction of a new concert hall was planned for the orchestra as part of the celebrations surrounding the 1,200th anniversary of establishing the city—then known as Heian-kyō—as the capital of Japan in 794. The new hall opened on October 12, 1995 with a 1 year delay. The venue is easily reached by subway in the north of Kyoto at the edge of a large botanical garden. Upon entering the building, a large spiral ramp leads up to the concert hall lobby.

The city of Kyoto was interested in a traditional, shoebox style concert hall and wrote their design competition accordingly. At the time, Suntory Hall in Tokyo was still under construction meaning that there were no nearby vineyard style halls to use as references. Arata Isozaki was already acknowledged as a talented architect and chose to break from the project brief as much as possible since he found the limitations constricting. Audience seating is arranged on three levels familiar from the historical shoebox layout: the main floor, a parterre, and a balcony broken up into loges. Seating areas were added around the stage. A rake was added to the main audience floor and balcony loges were rotated to improve sightlines. While the plan mostly follows a shoebox scheme, the visual impression is distinctly contemporary compared to the shoeboxes of antiquity. Seats are upholstered with iridescent blue velvet that shift from lavender, through teal, to mint depending on the viewing angle.

The most striking architectural feature of the hall is the highly diffuse ceiling texture on a band running down the center of the hall. The field of pyramids jutting down serve double duty as acoustic diffusion and disguise for the theatrical components. When viewed from stage, loudspeakers and swiveling theatrical lights can be found scattered among the chaos. On either side of this strip are stark, white surfaces that prevent the ceiling from becoming too visually cluttered. Movable panels at the corner with the walls can reveal additional theatrical lighting when necessary. A handful of large, decorative columns give the impression of supporting the ceiling.

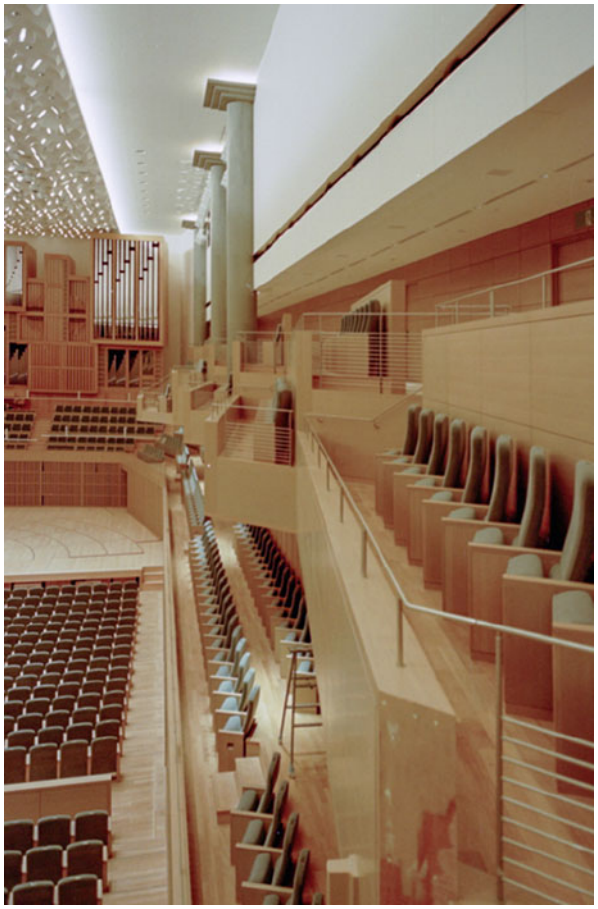
Retractable lighting rigs. At the corner of the walls and ceiling, retractable lighting can be used for specialized performances. When not in use, the white walls are left clean. Spherical lights embedded in the central ceiling panel are used for everyday performances

Late in design, the location of the organ was offset to the stage left to further break from the usual symmetry of traditional halls. Isozaki sat in the acoustical scale model and sketched the design for the boxes that make up the organ. Aside from the visual impression, this change afforded space to add a gallery for off-stage musicians.

Kyoto Concert Hall was a turning point in the design of stage construction. In an effort to optimize the resonance achieved by the stage structure itself, several mockups were evaluated by the acoustic team and musicians. Fourteen podiums were constructed from a variety of wood types. Each podium was evaluated both while a cellist and a bassist sat on the podium and played. The results favored the Japanese cypress, Hinoki, that had been used for traditional Japanese construction for centuries. The acoustical benefits of this species was confirmed in a similar test years later in Los Angeles as part of the design of Walt Disney Concert Hall design.

The acoustics in Kyoto Concert Hall are well balanced and have a more subdued impression than other halls. Because of their sister city relationship, the inaugural concert was performed by Orchestre de Paris on October 12, 1995, although the Kyoto Symphony Orchestra did have a ceremonial concert a few days earlier. Following the inauguration, the Kyoto Symphony Orchestra began the first concert series in their new hall. As one of those first regular concerts, Mahler's Symphony No. 8 was chosen due to its commanding presence but was logistically challenging. The short rehearsal time and difficulty in securing enough professional chorus members led to a slightly muddled concert that did not allow the acoustics of the hall to shine. As always, as the orchestra has spent more time in the space, the performance quality has improved dramatically.

Erik Bergal



Balcony loges. The blocks of balcony seats are broken into groups and angled towards the stage. This improves sightlines and provides visual interest to the otherwise rectangular plan

Rehearsal seen from main floor. The early rehearsals are especially exciting and tense moments in the birth of a new hall as everyone experiences the acoustics for the first time. From centerline, the asymmetry of the organ position is highlighted. The boxes on the upper left can be used for the occasional off-stage ensemble

Kyoto Concert Hall	
Location	Kyoto, Japan
Owner	City of Kyoto
User	Kyoto Symphony Orchestra
Architect	Arata Isozaki & Associates
Acoustical consultant	Nagata Acoustics
	Yasuhisa Toyota, Keiji Oguchi
Theater consultant	Jukoh Sato, Celebration of the lights
Construction cost	JPY 16.7 billion
Design start	July 1991
Construction start	October 1992
Construction end	March 1995
Opening date	October 12, 1995
Main hall	
Seating capacity	1,833
Room volume	20,000 m^3
Surface area	6,300 m^2
Volume/seat	10.9 m^3/seat
Volume/surface area	3.2 m
Finish material	
Ceiling	Concrete, fiberglass reinforced concrete
Wall	Wood veneer on gypsum board on concrete, fiberglass reinforced concrete
Stage floor	Hinoki
Seat manufacturer	Kotobuki Seating
Organ builder	Klais Orgelbau
Model scale	1:10

Table 2.1 Kyoto Concert Hall—acoustical metrics at 500 Hz

RT unoccupied	2.2 s
RT occupied	2.0 s

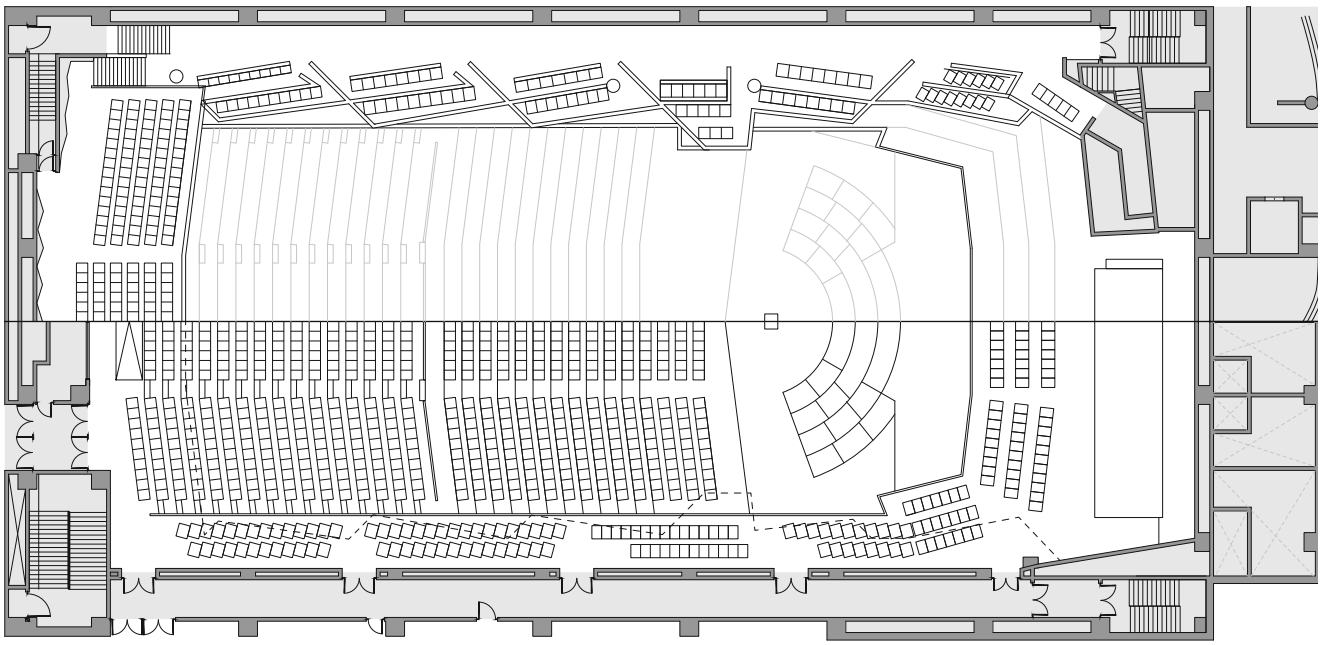


Fig. 2.1 Stage and balcony levels plan
Courtesy of Arata Isozaki & Associates

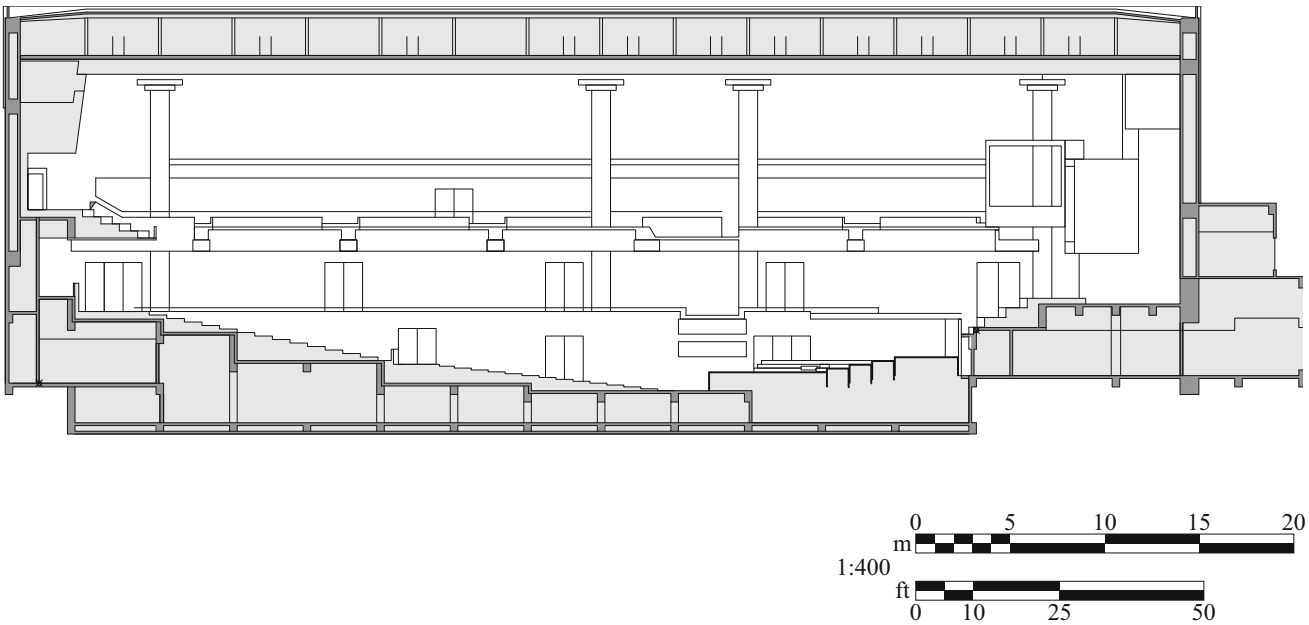


Fig. 2.2 Section
Courtesy of Arata Isozaki & Associates

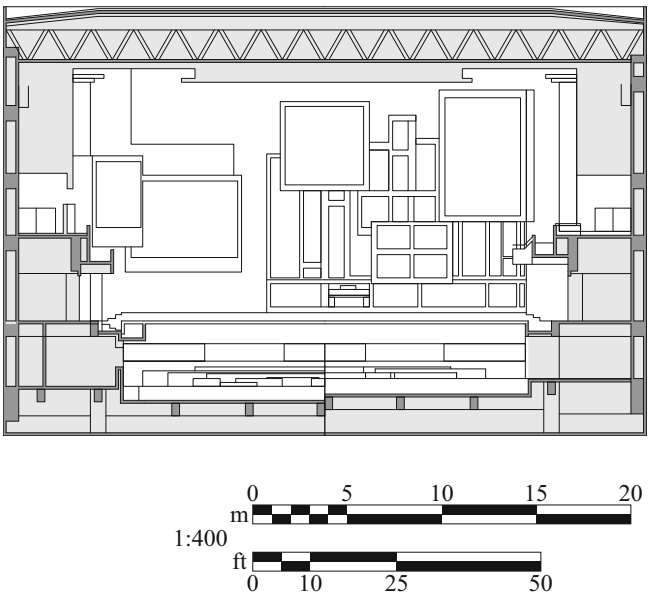


Fig. 2.3 Cross section
Courtesy of Arata Isozaki & Associates

3. Sapporo Concert Hall “Kitara”

View from rear seats. Seating terraces give a variety of views towards the stage and fellow audience viewer-listeners. The tent-like ceiling has a suspended ensemble reflector at the middle of the tallest area

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