Brief encounter

The acoustic requirements for the new Philharmonie de Paris were carefully specified to ensure the venue's exceptional acoustic quality, yet leave the freedom for innovation

The inaugural concert at the new Philharmonie de Paris hall, which opened its doors on January 14, 2015, featured the Orchestre de Paris, and was attended by both the President of France and the Mayor of Paris. While there are still some ongoing debates as to whether the hall opened too early (before the completion of all works), and surrounding the construction cost (which officially currently stands at US$436m), the praise is unanimous for the acoustic quality of this highly innovative concert hall.

Kahle Acoustics from Brussels, working in collaboration with Paris-based company Altia Acoustique, joined the project as the client-side acousticians, beginning work prior to the architectural competition and continuing on the project during all the planning and construction phases, right the way up to the opening. The first (and possibly most important) part of Kahle's appointment was to write the acoustic brief for the concert hall. There were some assumptions by some parties that the client acoustician would be fixing the basic design shape of the concert hall by limiting the design possibilities to well-established shapes, such as shoebox or vineyard. To the team at Kahle, however, it was clear from the onset that this was neither possible nor a good starting point. The client brief asked for a "high-quality acoustic concert hall, comparable in acoustic quality to the best recent realizations" and "an innovative architectural concept", therefore the brief had to ensure acoustic quality while defining the framework within which the project's architectural creativity could be fully developed – an acoustician cannot design an innovative architectural concept without an architect around the table.

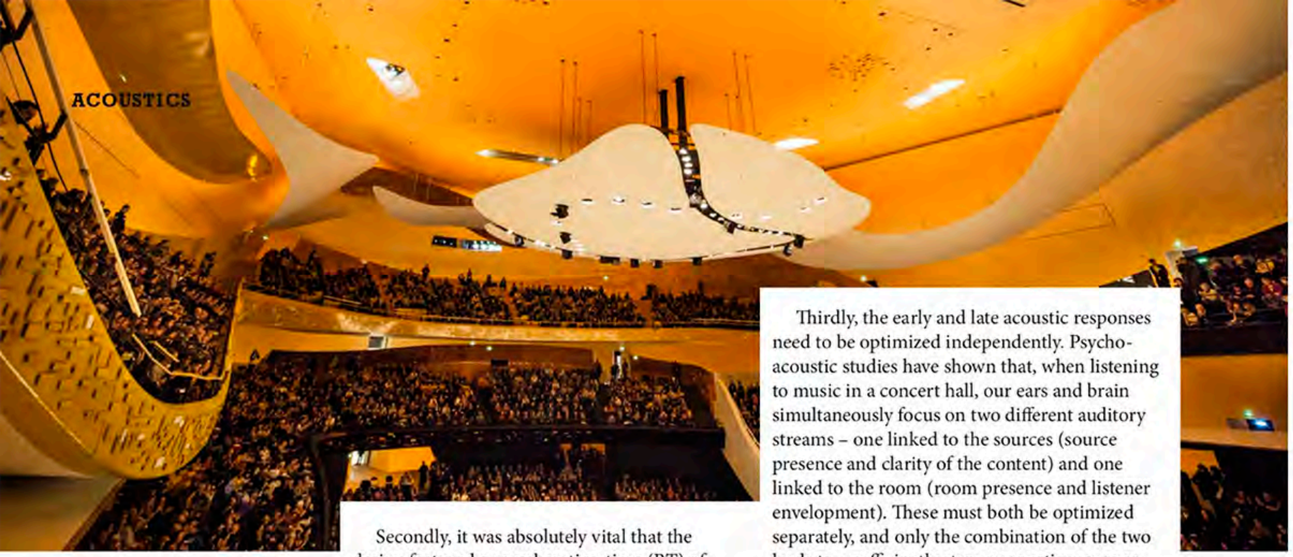
The architectural competition was won by lead architect Ateliers Jean Nouvel, which teamed up with Brigitte Métra Associés for the design of the concert hall. Marshall Day Acoustics (Harold Marshall and collaborators) was the design team acoustician, with Yasuhisa Toyota (Nagata Acoustics) taking the role of special advisor to Jean Nouvel. Studio DAP (Federico Cruz Barney) from Paris also joined the team, and was responsible for all rooms other than the concert hall (including the seven large-scale rehearsal rooms and the pôle éducatif reserved for musical training and education) and for building acoustics. Later, Jean-Paul Lamoureux and ASC worked on the project as acousticians for the contractors. Ducks Scéno of Lyon, a regular collaborator with Jean Nouvel on performing arts projects, was responsible for theater planning and theater equipment.

Challenges and innovations

The client brief called for a 2,400-seat concert hall; a new typology providing a central stage for classical music concerts and a frontal stage for amplified concerts and events; high-quality acoustics; and innovative architecture. And, of course, ideal acoustic conditions for the musicians on stage.

Detailed studies of reference projects and research into different room typologies – and their connection with objective acoustic criteria and subjective acoustical qualities – led to a number of the main recommendations and elements in the acoustic brief.

Firstly, avoid a shoebox hall design. For a seat count significantly above 2,000, and with contemporary seat spacing and aisle widths, shoebox halls will either be too long or too wide to ensure intimacy and good acoustics. While there are indeed issues with seats behind the orchestra, placing the stage toward the middle of the hall enables a significant reduction of the average distance from the musicians to the listeners. Furthermore, it was suggested that the hall – contrary to the Berlin Philharmonie and most other vineyard halls – should have balconies, further reducing the distances and increasing the feeling of intimacy. In the final hall, no seat is more than 32m (105ft) away from the stage edge. At the same time, maintaining some beneficial acoustic elements of the shoebox design (including reflection coverage from balcony soffits and lateral reflections) was recommended.



The acoustic brief set out during the development of the Philharmonie de Paris was key to the positive reaction to the venue's sound quality

Secondly, it was absolutely vital that the design featured a reverberation time (RT) of more than 2.0 seconds. Even though an RT of 2.0 seconds is often quoted as being ideal for symphony concerts, more detailed research demonstrates that this is no longer true for a contemporary concert hall with a seat count of more than 2,000. For optimal presence and source definition, a significant amount of early reflections has to be designed and created. To balance this strong early response, a longer reverberation time is required to optimize both early and late responses. Furthermore, the larger the volume of the room, the weaker the energy of the late reverberation, and for equal audibility of the late response, the reverberation time needs to be increased for larger rooms. In the final room, at opening (prior to the installation of acoustic curtains around the back of the stage) the occupied reverberation time was significantly above 2.5 seconds – deemed by some to be perfect, and by others as being slightly excessive. The occupied reverberation time is now just under 2.5 seconds, with both musicians and critical listeners judging it to be ideal. The long reverberation time is required to balance the very strong early presence and reflections, allowing for maximum clarity and reverberance.

Thirdly, the early and late acoustic responses need to be optimized independently. Psycho-acoustic studies have shown that, when listening to music in a concert hall, our ears and brain simultaneously focus on two different auditory streams – one linked to the sources (source presence and clarity of the content) and one linked to the room (room presence and listener envelopment). These must both be optimized separately, and only the combination of the two leads to a sufficiently strong acoustic response, an especially important issue for concert halls with more than 2,000 seats. In the acoustic brief, this separation of early room response and late room response was clearly explained and indicated – and for both responses, optimization possibilities are given that can be accommodated within different architectural concepts.

Going the distance

Also highlighted in the brief was the decoupling of acoustic volume and the distance to acoustic reflectors. When concert halls grow bigger in order to accommodate larger audiences and/or more comfortable seats, the walls and all of the boundary surfaces are moving further away from the sources and receivers. As a consequence, not only are the acoustic reflections getting weaker, but they are also arriving later. The human ear has fixed time constants – explained simply, all reflections arriving within 80ms of the direct sound are integrated into the source presence, while all reflections arriving later than 80ms are integrated into the room response – irrespective of room size. The danger is that, the bigger the room is, the less reflections are integrated into the source presence. In order to counteract this effect, a minimum early reflection surface (in square meters) was specified in the brief and it was suggested that those surfaces might be others than the boundary surfaces of the room, so that they can be closer to the sound sources and listeners. The idea is that reflection surfaces (which need to be sufficiently close, even in a room for 2,400 audience members) can be different from the boundary surfaces that create the acoustic volume (which needs to be large for sufficient reverberation). It is interesting to note that, prior to the Philharmonie, two different concepts already existed that allow this decoupling of reflection surfaces and acoustic volume. The first is the concept of reverberation chambers, which provides a more intimate room (for reflections) surrounded by an additional volume (for reverberation), and often with the coupling between the inner and outer volume being variable (KKL Luzern, for example). The second concept involves the placement of large suspended reflectors inside a bigger volume, oriented to send energy from the stage to audience areas (as seen in Christchurch Town Hall). Acoustically, both concepts are similar and can in fact be generalized into the notion of early room response and late room response.

Finally, there was a project requirement for strong lateral reflections, more so than in the Berlin Philharmonie and most other vineyard concert halls. Vineyard concert halls can have many acoustic qualities, but a detailed comparison of available acoustic data for both shoebox and vineyard concert halls shows that, on average,

vineyard concert halls have fewer (and/or less strong) lateral reflections, leading to reduced listener envelopment. While this shortcoming is, to a certain degree, intrinsic to the hall shape, it can be compensated for by adequate acoustic design features, some of which were discussed in the acoustic brief. It is interesting to note that it was Harold Marshall – acoustic designer of the Philharmonie de Paris – who established the importance of lateral reflections in the late 1960s, following the opening of the Berlin Philharmonie.

The acoustic-architectural design proposed by the architects and their acousticians – including free-floating balconies in a bigger acoustic volume, with clouds and ribbons providing early reflection surfaces and a freeform yet optimized shape – is a highly creative and pertinent response to the requirements and requests formulated in the brief. ■

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