

Other Waves: The Acoustics of Alvar Aalto

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Does the work of a mature architect have an acoustic signature? Specifically, would a study of the architecture of Alvar Aalto reveal a recognizable and definable sound quality present in spaces intended for listening? Aalto had a remarkably productive career in which he designed numerous spaces for music and public speaking. The architecture is distinguished in its integration of nature and site, recollection of classical program, and development of a characteristic vocabulary of elements and spaces.

This study concludes that Aalto did not attempt to define one "right" sound. Just as each built space has a specific physical site and context, it also has an identifiable sound context. For Aalto this sound context was fundamental, and linked to the program for the space. His development of a qualitative program for sound in space effectively pushed beyond contemporary limits of acoustic culture.

Several methods were used to uncover patterns and ideas about sound in Aalto's spaces, in particular in rooms designed for assembly, spaces for lectures, music, and prayer. Traditional acoustic analysis techniques such as reverberation time and transmission loss calculations, along with light study models, ripple tank, and ray diagram drawings were used to measure sound in the auditorium space of the Kulttuuritalo, and the sanctuary of the church at Iimatra.

Drawings, including process drawings of plans and sections, ray diagrams and light study models, and correspondence with acoustical consultants were studied at the Alvar Aalto Foundation Archives. Interviews with acousticians and architects directly involved with the Kulttuuritalo, Finlandia Hall, and Essen Opera House provided insight into Aalto's design intentions.^{2,3}

Perhaps the most unconventional method for discovery was the use of poetic metaphor. Metaphor is a tool used in many fields of thought to reach a new understanding of an existing condition. The use of metaphor to interpret acoustic conditions seemed particularly appropriate to Aalto's design methodology.

Thus, the following conditions and case studies are the result of the synthesis of this information.

The isolated room is defined when there is total isolation of the assembly space from all external spaces. It is a planning strategy in which early on the spaces are grouped by the level of sound associated with their program. The Vuoksenniska church at Iimatra, and the main auditorium space at the Kulttuuritalo are planned with in this way. The enclosing walls of the listening rooms are massive. These rooms are insular and self-contained, with emphasis on sound generated from within; no sounds are transmitted through the skin. Their walls, like walls of snow, contain pockets of air which insulate and protect.

Drawings of the wall sections of the Church of the Three Crosses at Iimatra recall microscopic views of a plant; the wall is a structure which contains smaller cells of space. The splayed wall alters sound and light. The surface articulation provides for early sound reflections and its interior is a space in which music resonates. Sound is isolated, generated and held within, while light filters through glass into the contemplative space. Irregular shapes of the windows allow for glimpses to the exterior, to sky and trees, but always through the double walls of the cells. Distance from the outside is emphasized, which further isolates and concentrates the sounds of music and prayer heard within the room.

Inside, the white plaster surface can be warm and snug, or icy and distant. The interior surfaces are hard, heavy and massive, with little absorptive material, to produce a brilliant sound. The wall surface behind the speaker's platform curves down to form a reflective surface. With no sound but the spoken voice, words reverberate but are intelligible as they move towards the listeners. A large organ covers the wall by the pulpit, becoming articulated surface decoration and a source of music. When the two concrete sliding door panels are open the entire room feels intimate and unified as the space reverberates with the sound of organ music. Were the heavy sliding concrete walls to close, the cavernous room would subdivide again, and then again, into three low and more mysterious caves, smaller self contained spaces for simultaneous, ever more isolated activities.

Aalto's stated interest in the eccentric curved volume of space was its acoustic performance. Light study models and ray diagrams were used to study not only the path of sound, but also the time it took for sound reflections to reach the designated points in the room. The sectional light drawing shows a density of light at the farthest reach of the room. In the church, the speaker's words must be understood clearly by every listener. Music would also fill the space, and so simple curves which might focus sound were avoided. The test confirms the way the innovative form would carry sound to the back of the room, and indicates that the speaker's voice would reach the "cave". Later, additional plan and section drawings of the church, colored with precisely drawn ray diagrams, trace path and time as sound reflections arrive point to point. A small key to the drawings describes each colored line as a timed reflection, based on the speed of sound through air.

Models for the church study the acoustics of the listening room in isolation, without the entry sequence. The entry sequence is direct and functional, and not held in the memory once the main space is experienced. In an isolated country, in an isolated town, in an isolated clearing, inside an isolated church, in an isolated room: sounds of prayer.

The Inside/Outside Theater occurs where an important event is heard on either side of the wall. While the physical boundary between natural setting and building envelope are always solid and clear, this is a somewhat permeable condition. The knowledge of the dual nature of the enclosing wall as a piece which has an interior and an exterior function *opens* the sound of each space to the other. In the rural setting at Otaniemi, separate theaters are located on the exterior and the interior of the same insulating wall. The wall is like the surface of the lake as it melts, from ice to water, a shifting physical boundary which allows light and sound to pass through.

In the rural, university context of Otaniemi the main auditoria stand out clearly as the essential space of the school. On the campus this important space for presentation and dialogue is linked directly to an amphitheater in the landscape.

At Otaniemi, The Aula Magna is a tall room. The back wall curves up to become the ceiling high above the seats of the listeners in the hall. In a tall room, some sound is lost in the "sky"; the ceiling is so very tall that it does not provide sound reflections back towards the listeners. The spacious sound allowed by the height and volume of the lecture theater is related to the sound of the amphitheater directly outside. For the duration of the relentless dark winter months, when outside gathering is not a possibility, the Aula Magna provides a sound connection to the original space of gathering. Outside this room, the steep amphitheater is focused on the open campus lawn. Outdoor seating is provided by a curved, stepped wall. As the wall steps up towards the sky it opens to let light down inside the rooms it encloses. It continues up, to become the deep coffered ceiling of the rooms inside, and folds down to become the back wall, a concrete structure infilled with wood panels. This is the most permeable condition of enclosure, as light enters the room through the articulated surface of the continuous wall-ceiling-wall. In sharp contrast

to this plastic surface which shapes both sound and light, are the flat side walls. In this room for speech, articulation of the side wall is not critical to the sound. A small wood sculpture, an experimental piece of wood, animates the wall. Later, in the concert halls, this sculptural screen element seems to expand, to provide surfaces for lateral sound reflection.

The Amphitheater Enclosed: A Remembered Theater is a room which is physically enclosed, isolated and insulated from the exterior. The interior space captures an exterior space, both visually, and, because of the capacity for adjustable sound environments, aurally. Aalto first experiments with this concept at Finlandia Hall, and it is realized more fully at the Essen Opera House. In these urban theaters, there is no actual outside theater on the site. The interior theater *contains* the exterior theater. The sound is physically contained by a room which can simulate space, and so becomes seemingly boundless. The sound of the space allows for the memory of infinite cyclical change, like winter, spring, summer, fall, in which the memory of the past and future season is ever present

The remembered theater: Finlandia Hall and Essen Opera House

A material, a surface, or a condition is said to be acoustically transparent when it has no effect on the sound in a space. The visible ceiling of Finlandia hall was designed by Aalto to be "acoustically transparent". Sound from the stage would rise up through transparent screen elements, mix and blend above, and return to the listener's ears. For performance, it was conceived as a completely adaptable space, so the sound reflections and reverberation time of the hall would be adjusted to the particular piece played. In a concert hall, sound reflections from the ceiling add to the direct sound from the stage, and provide a sense of clarity. Against the recommendations of acoustic consultants, the ceiling was built high, and was not closed off to sound. Sound moved up through the transparent ceiling, continued up into the permeable sky. Since the hall has been completed numerous adjustments have been made to achieve a satisfactory sound. The stage has been raised, and the ceiling has been closed off with reflecting surfaces behind the slats to turn the sound back towards the audience.

But could the sound in the room have been heard and adjusted in another way? Is there another understanding of Aalto's desire for the transparent ceiling? Might this particular experiment with acoustic transparency have allowed for a sound memory, a situation of repeated sounds layered and compressed in the listener's mind to recall an earlier place, through sound? Before the renovation, was there the potential for the sound in this hall to evoke a collective memory, of music played in other times, the mythic sound of the outdoor amphitheater?

Even before Finlandia, Aalto had proposed new acoustic spaces; potential for new sound is evident in the earliest 1959 competition drawings for the Essen Opera House. The set of

drawings reveals several experimental conditions. On the first page of the set, a perspective view of a stepped landscape appears to be an outdoor amphitheater, but actually represents the interior theater space for the Opera house proposal. Exterior recreated inside, all processional drawings which appear to be describing the world outside are actually views inside the lobby and the concert hall. In this urban theater, the simulation of the exterior will be visual and aural.

The simple theater in the woods, like the outdoor theater at Turku, has a back wall and is open to the sides. Certainly the undulating balcony element is taken from the outside field and woods and enclosed by the opera house. The white balcony forms the back reflective wall inside the theater, which stops short of wrapping the sides. The high relief of the decorative indigo wooden slats are the forest, as dark blue curved wooden pieces fall back visually and give the impression of forest depth on every side. Hidden behind the slats will be the curved and adjustable "elephant ears", acoustic elements designed to adjust and provide as little or as much lateral reflection as needed. With balcony enclosed and side walls and ceiling available for adjustable sound, the exterior sound world may be recalled within the theater.

The bold balcony element is itself double sided, seemingly freestanding, a balcony for listening and viewing in the lobby as well as inside the theater. As part of the tiered lobby, the wall provides a space for congregation and viewing, to celebrate the spectacle of entry into the theater. Inside the hall the balcony provides seating and surface for sound reflections.

The main building section shows the ceiling as a curved form, continuous from inside the hall out into the lobby,

Divided only by the double sided balcony element, the volume of the hall engages the lobby and hints at another acoustic opportunity. The volume of the upper lobby can be considered as part of the hall. If constructed of massive material, the space has the potential to act as a reverberation chamber for the hall. Long reverberation time and sound envelopment are desirable in a concert hall. The room behind the hall, the entrance and lobby, becomes one instrument with the hall, and has the potential to enhance the quality of sound. The lobby becomes an insulating space against the outside, but also a space to fill with sound which extends the reverberance of the of the hall.

NOTES

¹The Alvar Aalto Archives in Helsinki has hundreds of drawings available to interested students of Aalto's work. Mia Hepelli showed me the drawings of Imatra, which are in the process of being catalogued.

²Aalto hired Paavo Arni to consult on the acoustics of the Kuulturitalo and later on Finlandia Hall. Correspondence between Aalto and Arni reveals that Aalto followed some but not all of Arni's recommendations. In the 1950s, acoustician Alpo Halme was an associate in Arni's office. In May 1998, Mr. Halme generously offered to give a tour of the Kuulturitalo and Finlandia Hall and to provide recollections of his encounters with Alvar Aalto.

³In the late 1960's and early 70's architect Mikko Merklng was an associate in the office of Alvar Aalto, and in Mat 1998 shared his knowledge and experience, in particular on the Essen Opera House. He was a designer for the "elephant ears" in the Essen Opera house.