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Towards a classification of the "sonic character" of the architectural space

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Today it is well-known that an architectural space can be compared with a musical instrument. One of the main characteristics of a musical instrument is its timbre, which makes unique the sound produced by it. We can understand this timbre as the sound quality of the instrument that is produced due to the specific physical characteristics of the instrument. In an architectural space these concepts of timbre and sound quality could be applied through the concept of “sonic character” of the space. The “sonic character” of the architectural space is the sound personality of the space due to the specific physical or architectural characteristics of it. Understanding this concept in architecture could be of great importance to architectural design purposes since this could be the way by which sound can be embodied in an integral way of designing architectural spaces. This paper presents a proposal for the classification of the “sonic character” of the architectural space as an important step of a research towards a better understanding of the need of taking into account the sound as an essential component of the architectural space. The presentation includes also some architectural space examples to improve the understanding of this important concept.

1 Introduction

This paper takes an important step as a spark towards an essential way of thinking in architectural design. It is dedicated to those architects that are trying to develop today a new way of doing architecture: a sensory architecture, which is taking day by day more followers. Now we can say that there is a light at the end of the road which gives us the hope that the problem of sound in architectural space is going to be approached; it is, however, to some extent strange that even today most architects have only very few ideas about the meaning of sound in architectural design and research. The sonic experience in architectural space, although it's great deal of subjectivity no doubt, it is the key factor for an integral perception of the architectural space. Even though light and vision are apparently the most important aspects of space perception we cannot conceive a space without our auditory system. Normally, people perceive sound rather unconsciously, even though they are part of the experience in an architectural space. Sound describes the space and helps both placing and feeling it. Understanding the architectural space by means of sound helps architects in designing better spaces and buildings, by applying an integral way of conceiving them. This paper describes the kind of research that the author is currently doing, in search of a closer relation between architecture and sound, by describing the natural relationship between them and the new and unexpected opportunities for design when sound takes part in it.

One of the things a designer needs when addressing something he does not know, is a kind of guide that will take him through the world he is trying to understand. Because it is most likely that sound has been the field of least architectural interest in history, architects do not have the theory and the tools to handle it, and even less if it comes to design. Some tools are common and are available for the architect. Design tools, in the sensorial way, like day lighting design and others are part of the design tool box of the architect, but for sound design there are only some very technical and complex tools. A simplified tool for understanding sound is needed for architects. Since the only way to feel the space through sound is to use our auditory system we have to talk about the “method” we can take to understand it and to turn it into a design language.

As well as with light, sound has a definitive presence in space; we can try to understand it from the scientific point of view and having as a result a wide collection of numbers, coefficients, factors and mathematical equations. Architecture has often been compared with science trying

to make its design methods more scientific. But we have to understand that the essence of architecture is the creation of space, far away from science and scientific methods. Architectural spaces have their own personality and this is the key factor to reach a better understanding of this concept and its interpretation in a proper design language. Space, function, place and art are the main concepts of architecture and they will guide our thoughts towards the development and classification of the concept: The *sonic character* of space.

2 The experience of space

When an architect comes into a space he perceives and judges usually its visual appearance. As we know architecture has been taken for centuries as being part of the Fine Arts and, consequently, beauty has been its main line of reasoning. This way of thinking has influenced things in such a way that visualization has been and is almost the only approach to judge architecture.

The experience of space goes beyond this visualization approach since we experience the architectural space with our senses and due to the reflections of light we perceive colour, shape and volume. The same phenomenon applies to sound since due to sound reflections we perceive size, volume and the nearness of many elements like walls and other kind of boundaries.

The idea of space is derived from sensory perception and thus from experience [1]. We can say that a space is much more than just only words; it is a “whole” giving us its presence which represents the meaning and the experience by itself.

The experience of space is possible through geometry, form, function, structure, dimension, volume, surface, material, shape, texture, light, colour, temperature, odour and sound, and all of them may affect the sensory system of humans and therefore may have also an effect on people. The behaviour of space depends on the way we perceive them as well as from its architectural configuration.

Space conceived as “place”, could be handled as a term that is related to the environment and as “an integral part of existence”. In this way of thinking a place is more than a simple location, it is a whole that comprises such attributes, like those mentioned in the former paragraph, and in the opinion of Christian Norberg-Schulz, it determines an “environmental character” that is, not simple quantitative, but qualitative giving us an idea of the “spirit of place” [2].

Light and sound are the main attributes of space; vision and hearing are thus our space perception tools. In fact we need

both senses for having a true space experience. Other minor senses like smell and the sense of touch participate in this experience but not as deep as the eye and the ear.

3 The sound experience in architectural space

We have talk about the pre-eminence of sight in architectural perception. It is very likely that vision is more effective than ear to gather information. The visual space has a completely different character than the auditory, however blind people have developed tools and parameters to perceive space as if they were actually seeing it, and this is mostly due to their auditory system.

Blind people perceive boundaries, echoes, reverberation, pitch and noise in such a way that they know where they are in space. Materials, textures and volume are the elements that contribute to a good control of their space. The human ear is enabled to recognize elements of space like bats do, as an extension of his essential skills [3].

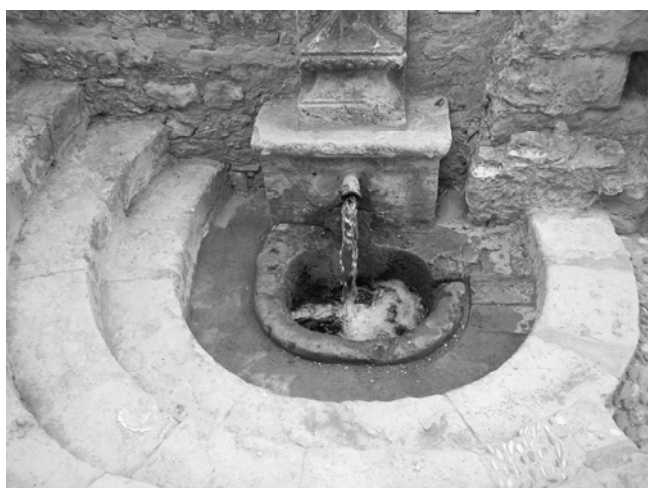


Fig. 1 The sound experience
(Alcazar Gardens. Cordoba, Spain)

Rasmussen [4] analyzes the qualities of daylight, colour and sound in space and architecture. The chapter on sound is named “Hearing architecture” and it begins with the question: Can architecture be heard? And from this point onwards he develops the notion of the sound experience of the architectural space (Fig. 1).

J. Pallasmaa in his extraordinary essay [5] affirms that “Sight isolates whereas sound incorporates; vision is directional, whereas sound is omni-directional. The sense of sight implies exteriority, but sound creates an experience of interiority. I regard an object, but sound approaches me; the eye reaches but the ear receives. Buildings do not react to our gaze, but they do return our sounds back to our ears”.

What should be the meaning of sound for architects? An architect should answer that sound is one of the key elements of the architectural character of space and this sonic character depends on its architectural configuration. In this way of thinking we could say that a sound experience depends on the architectural or urban configuration of space. But there are other elements in this

play, one is the sound source(s) and the other is the sound receiver(s). Other things to consider are time, activity and the specific type of space [1].

The architectural space as a manmade object modifies the natural environment, producing new ambiances. Architecture modifies the natural paths of sound by its mere presence, and the manner in which space modifies a path depends of its architectural configuration. People hear spaces in spite that most of the time they are not conscious of it.

A space creates sound by the combination of at least one sound source, a path defined by the configuration of the space, and at least one receiver. Sound sources are all those objects and subjects that produce sound. Music, speech and noise are the main type of sounds generated by specific sound sources.

Pathways of sound are traced by the ways sound can disseminate through space to reach the receiver’s ears. This propagation of sound is determined by many factors where the main ones being: Geometry, size, volume and materials. Geometry is one of the issues by means of which the architect expresses his design ideas, and therefore a natural way towards a sonic design. Geometry defines shape and order in space, and these concepts have to be crossed with reflections and scattering of sound in space to describe the way sound travels through it.

The geometry of space is critical because sound does not move in a straight line but tangentially. Therefore, regular space geometries are more predictable than complex ones. In a complex geometry, sound travels dynamically with fuses and flows in many possible forms, generating an environment of continuous change of sound. Geometry generates also many possibilities of sound reflection and diffusion to produce one or another type of sonic environment. We know today that fractal geometries are very valuable elements for the generation of very high sound quality environments due to sound diffusion.

Size and volume describe the amount of space that we have to fill with sound. We know also that size and volume are main factors in defining reverberation, which is the main parameter in room acoustics that describes and characterizes the quality of sound in space.

Materials are intrinsically the main ingredient to obtain sound quality in space. Their shape and acoustical properties allow sound to be reflected, absorbed and/or diffused to various extents. A wrong mixture of geometry, size, volume and materials can derive into a chaotic sound environment; on the contrary, if there is a good mixture of chosen materials, then it will be almost certain that the acoustical environment will be acceptable. Materials allow spaces to be closer or away from sound by isolating them from unwanted or aggressive noise sources, and by conditioning them for a satisfactory internal acoustical environment [6].

4 Space as a musical instrument?

The idea about the relation between architecture and music is probably as old as them. Paul Valery affirms that “music and architecture differ from the other arts in their capacity of surrounding man entirely [7]. In his very interesting article architect Daniel Libeskind [8] establishes that, “As

an architect . . . I have been keenly aware of the intense and often reciprocal dialogue between the audible and the visible. Buildings provide spaces for living, but are also de facto instruments, giving shape to the sound of the world. Music and architecture are related not only by metaphor, but also through concrete space. . . In the Imperial War Museum North in Trafford, Manchester, I have created a relationship between the atmosphere of the various components of the building and a particular "soundscape". The composition of the building is a four-movement experience. . . Architecture can only be appreciated by transforming size into scale, matter into light, and time into rhythm, colour and key. . . Without music, architecture would disappear altogether. Reducing architecture to a material reality only is to create a city of noise." As we can see those architects who love music are potentially architectural composers as Libeskind is (Fig. 2).

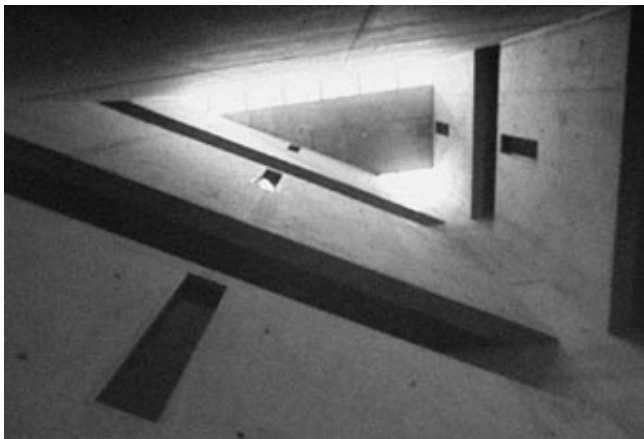


Fig. 2 Buildings are also instruments
(Jewish Museum, Berlin. Daniel Libeskind)

The true musical architectural type is the concert hall, spaces that have been developed from the experience of music in churches and theatres. The concert hall is the place for music and in the last years there is something like a "boom" of new concert halls around the world, and they all want to have the best acoustics. This fact triggered a more architecturally research towards a good acoustics architecture, new forms and surfaces emerge as a result of it (Fig. 3).

If we make a deep analysis of what space means to music we can establish that:

- All music needs a space to be expressed
- Any sound has its own expression at any space
- Same sounds do not have the same presence at different spaces

The architectural space defines how a sound, musical or not is going to be heard. We can then address the issue of the "sonic character" of space, beginning with the notion of space as a musical instrument.

In musical acoustics the concept of timbre refers to the characterization of a tone in terms of pitch and loudness. Timbre is mainly determined by the harmonic content of a sound and the dynamic characteristics of the sound such as vibrato and the attack-decay envelope of the sound. Timbre refers also to sound quality and it describes those

characteristics of sound which allow the ear to distinguish sounds which have the same pitch and loudness [9].



Fig. 3 . . . new forms and surfaces emerge
(Elbe Concert Hall, Hamburg. Herzog & De Meuron)
Techniques & Architecture Journal

In a direct comparison with a musical instrument e.g. a violin, an architectural space has as well a resonance response to sound as the instrument and therefore harmonics are going to establish its own timbre. If a sound is played in a space and then in another, we will perceive this timbre and this is the timbre of space. Probably it would be a good idea to study the architectural space from the musical acoustics point of view, I still do not know if there is any. Surface reflections and diffusion together with the concepts of resonance and reverberation are with no doubt the main factors affecting the sound quality of an architectural space, and they contribute to develop the sonic character of space.

5 The "sonic character" of space

At the beginning of this paper it was mentioned that space, function, place and art are the main concepts of architecture, and that they will guide our approach towards the concept of "sonic" character of the architectural space. On the other hand we have established that sight is the main sense used by architects when perceiving a space. If we try to combine all these concepts we find that it is possible to establish a model to help us to understand in a better way how sound interacts with space in architecture. From this point of view we can make this division:

- The functional approach
- The "Place" approach
- The expressive approach

At the end a model is proposed about the relation of all these aspects of the "sonic" character of space, with the intention of searching a way for a classification.

5.1 The functional approach

The functional approach of a space refers to functionalism, a basic concept of the pioneer architectural movement of the early twenty century lead basically by Walter Gropius and Le Corbusier, and its basic statement was “form follows function”. Deeply the fundamental principles of this movement are the need to address the core functions of the building to translate then this concept into space. From this point of view, the main tasks and activities of the space are the key elements to discover its “sonic” character. We have to remember that architecture covers and serves all the fields of human activity, therefore the “sonic” character of this type of spaces is the expression of any of them

This approach is the more technical of all here proposed, and its character is dominated by the concepts of noise and reverberation control since the main acoustic problem of this kind of spaces is to address the specific needs inherent to each activity.

5.2 The “place” approach

The “spirit of place” as stated by Norberg-Schulz [2] has mainly an “environmental character” which is qualitative. The notion of place comes from thinker Martin Heidegger who makes a distinction between space and place, where “spaces” gain authority not from “space” appreciated mathematically but “place” appreciated through human experience [10].



Fig. 4 An atmosphere

(Casa Galvez, Mexico City, Luis Barragán)

<http://id2124cl.wikispaces.com/space/showimage/20061229091106-barragan.jpg>

A place is strongly related to the concept of quality of life and in this way of thinking it has to do with the quality of

architecture. Peter Zumthor establishes the term “Atmosphere” [11], where architectural quality is a must and we can understand it better through the following question: “How can things be designed with such a presence, beautiful and natural things that move and touch me over and over again?” He tells us also that when entering a building he looks at a space and perceives an atmosphere having in just one tenth of a second a true feeling of what it is.

The term “Atmosphere” can interact directly with the term of “Place”. It implies an emotional sensitivity which is a true human feeling. A “Place” is wholeness and an “Atmosphere” is wholeness too and because of it they imply sound (Fig. 4). From this point of view we can say that a “Space”, a “Place” and an “Atmosphere” can serve as a great musical instrument that mix, amplify and propagate sounds.

This kind of “Atmosphere” character of space will depend as a rule on the reverberation time of the room; a “sonic atmosphere” is something that we perceive regardless of its noisy environment. It is also an undeniable truth that an “Atmosphere” is highly dependent on vision and therefore we have to take into account an “Atmosphere” as a sensorial wholeness.

5.3 The expressive approach

“Sound art” and “Soundscape” are emerging disciplines related with art and environment that are gaining day by day more followers around the world. The first one refers to a group of activities whose main objective is to consider sound and hearing as a raw material to express art generally combined with architectural or urban spaces. The second is more involved with the natural or urban environments where the term of acoustic ecology has been wide used in the last years. Acoustic ecology is the relation between sound and living beings to create a “Soundscape” with a natural value. “Soundscape” can also refer to a musical performance to create the sensation of experiencing a particular acoustic environment, and even more there is the possibility to create a sound composition by means of natural, urban or interior sounds no matter if they come from traffic noises, machine noises or even shouts.

This particular sonic character as an art activity is at the other extreme of the functional one. It only has as its main objective to create a sound environment probably from scratch. Its function is to express art, feelings and ways of thinking, its personality is more related with sound transmission, reverberation and even vibration. Much of these works are involved with audio projects and very few are the result of a research in natural acoustics.

5.4 The model

A proposal for a model towards a classification of the “sonic” character of the architectural space (Fig. 5) is here presented; it is the result of a deep investigation of how architects can understand sound in their terms.

The main characteristics of this model are that it contains all the concepts here mentioned and that are involved with architectural design. The relation between the main concepts is established as: Function – Place – Art with a

relation with the Visual factor at the central point of the model.

The logic of the model is to localize a specific space according to the limits that are suggested by the model. Concepts as noise and reverberation control, emotional sensitivity, Atmosphere, Soundscape and sound expression are guides of the kind of space which is expected to be located there or the kind of acoustic design it is expected.

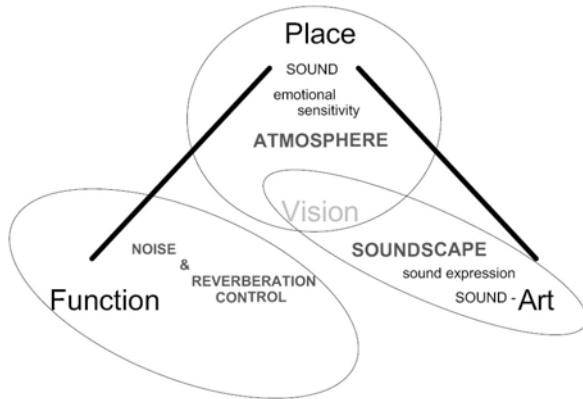


Fig. 5 The model

The circle and ellipses signify the sphere of action of each concept where “Place” is the widest covering up to the visual factor because it is highly dependent on him. Then the two other fields come where the functional has no necessarily a link with the vision; however to the artistic field it is not required but generally the visual factor is present.

The straight lines signify the relation between the major fields. “Function” and “Place” have a direct relation as well as “Place” and “Art” but “Function” and “Art” have a minor relation because apparently are opposites.

To locate a specific space it can be structured along the following criteria:

- Between the main fields as it is perceived closer to one another.
- Nearer or not from the visual factor as it is perceived dependent from it.
- In the middle between fields if place is related to all of them.

The model has also a dynamic purpose; where you can establish a “sonic” character route in a building going from function to place and even to art when walking from one space to another.

6 Conclusions

A model towards a classification of the “sonic” character of the architectural space is here proposed. It is expected to be a simplified tool to help architects to understand the kind of “sonic” character a space has. This is also a tool that will help in the selection or differentiation of the desired “sonic” character for a space not yet designed. This means that every space, inside or outside can be designed from the “sonic” character point of view.

This is a first step in trying to define how acoustics will be useful for design purposes. More work and research has to be done to improve the model here proposed and to expand the number of tools than an architect can have on hand.

Architects have the responsibility of taking sound into account for the design of a better world for the human beings.

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