Sound Space –
How is Hearing heard in 2nd Year Architectural Design Education?

By Jürgen Bauer, Architect, Tramore, Ireland

This paper is a revised version of:
J. Bauer: How is hearing heard in second year architectural design education? J. Acoust. Soc. Am. 123 , 3807 (2008)

Architects are often accused of "not being interested in acoustics because it is invisible".
Architectural design, particularly at the preliminary stage, has always been developed visually. Traditionally, as a result of their training, architects develop a project visually rather than aurally.
However, designing architects have also to deal creatively with more or less invisible parameters such as: socio-cultural demands, climatic aspects or even daylight, which can be considered to be visible but certainly is everything but constant.
If an architect's design ability is about observation and awareness and if light is considered to be much more than just being bright or dark, how then could we implement early awareness that sound is much more than noise or silence, and that sound planning is much more than just using anti-noise-panels?
We asked 2nd year architecture students at Waterford Institute of Technology to (re-)think sound and to question the sound qualities of their own projects. Thus sound experience is integrated into the basic design and not just considered specialist knowledge for specific projects.

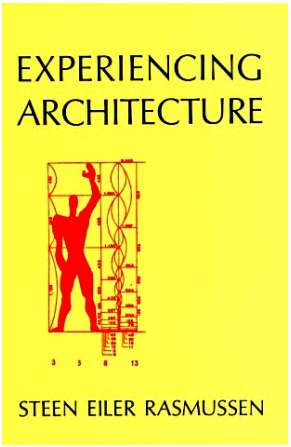
Soundtrack

The Third Man (1949) [1]

Do you recognize this picture? As you may know, this is a scene from the famous motion picture "The Third Man" (1949). The final scenes of this film are set in the underground tunnels of the sewage system of the city of Vienna. The spectator witnesses a gangster chase, entirely without music (in contrast to the rest of the film), just amplifying the spatial sound of the tunnel.
If you have ever seen this film, you will surely remember this setting: the sound of the tunnel system, the echoing voices of the police, the splashing water and the men's footsteps. Can you even experience the cold and the smell?
Would you agree that a sewage tunnel system is not necessarily a sophisticated Architectural design and yet that it still possesses its own unique sound?

Sound Awareness

"Can Architecture be heard?" This question was asked by the Danish Architect Steen Eiler Rasmussen [2] in his small, but most substantial, book "Experiencing Architecture" [3], This is a treasure of a book and still worth reading today for everybody who is interested in Architecture. It is also one we highly recommend to our students.



Experiencing Architecture [4]

Mr. Rasmussen dedicates a whole chapter to "Hearing Architecture" and answers his own question as follows:
"Most people would probably say that as architecture does not produce sound, it cannot be heard. But neither does it radiate light and yet can it be seen. We see the light it reflects and thereby gain an impression of form and material. In the same way we hear the sounds it reflects and they, too, give us an impression of form and material. Differently shaped rooms and different materials reverberate differently.

We are seldom aware of how much we can hear. We receive a total impression of the thing we are looking at and give no thought to the various senses that have contributed to that impression. For instance, when we say of a room that it is cold and formal, we seldom mean that the temperature in it is low. The reaction probably arises from a natural antipathy to forms and materials found in the room – in other words, something we *feel*. Or it may be that the colours are cold, in which case it is something we *see*. Or, finally, it may be that the acoustics are hard so that sound – especially high tones – reverberate in it; something we *hear*. If the same room were given warm colours or furnished with rugs and draperies to soften the acoustics, we would probably find it warm and cosy even though the temperature was the same as before. (….)"

Rasmussen makes many inspiring points in his introduction to "Hearing Architecture". I would like to outline two of them:
First, he creates a link between light and sound: Architecture can both be seen and be heard, even though it neither radiates light nor produces sound.
And secondly, is it not remarkable that Rasmussen does not once use a term like silence, loudness, noise, volume or pitch etc?
Instead, he interestingly speaks about "cold and formal" or "warm and cosy": his approach is about feeling, atmosphere and comfort [5]; it is not about decibels, or quantity by calculation, but it is about quality by description. It is less about "How much" and it is more about "How good".

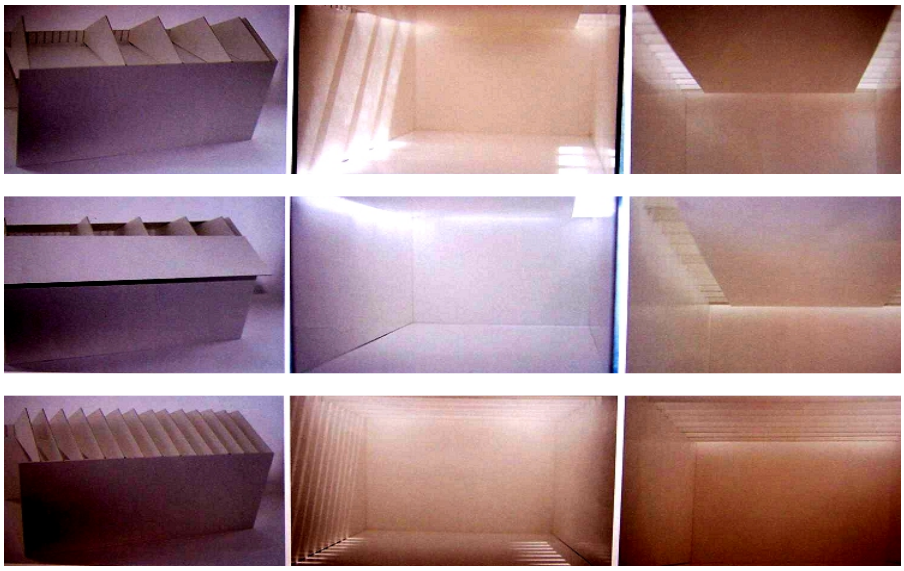
Light and Sound Education

Learning to design a building and to develop a built environment step by step is anything but easy. No wonder Architectural studies usually take at least five years. Basic learning steps about understanding space will neither start with sound nor with social, sustainable or any other complex issues.
In 2nd year Architecture however, we found it appropriate to place an emphasis on aspects of light - and, subsequently, on matters of sound. An introduction to (day-) light as a visible phenomenon would be easily understood by the students, and we hoped that students would appreciate sound matters much more after their first experiences with light studies.
Sound is not light, of course; we all would have learned about the distinction between waves and rays. We would know that sound waves are much slower than light rays, or we would have heard that sound is able to bend around small objects relative to wavelength, whereas light with its extremely small wavelength hardly bends around any obstacle.
However, by looking at these phenomena we have the opportunity to introduce our students to more intangible aspects such as reflection, absorption and diffusion.
We would also know from good practice that light models can help to get a basic understanding of sound waves in architectural design. Furthermore, we can refer to the fact that "the earliest investigations of sound in three-dimensional models were done using light as a proxy for sound." [6]

Light Studies

In the first semester of the second year, students were to design a "House in a courtyard with a studio".
How did we introduce light? We did not ask for lumen or candela. In this tutorial we placed the emphasis on the quality of light rather than on the quantity of light.
We limited the investigation to daylight and discussed distinctive characteristics of daylight with the students such as "reflecting light, breaking light, floating light, localising light, scattering light, soft light, hard light, side light, intersecting light, shade casting light" – in other words: we wanted the students to interpret daylight as an "intangible" building material [7].

The students were then asked to implement their observations and conclusions in their own schemes deliberately rather than by coincidence. They were encouraged to work on physical working models instead of using daylight simulation software.
The following images show some of the results:



Daylight study by Barry Walsh, light is sliced by the louvers in the ceiling and floods the walls.

Daylight study by Sean Kehoe, exploring light distributors in the ceiling and considering the "colours" of light

Daylight study by Gary Nash: Simulating daylight and its different qualities throughout the seasons

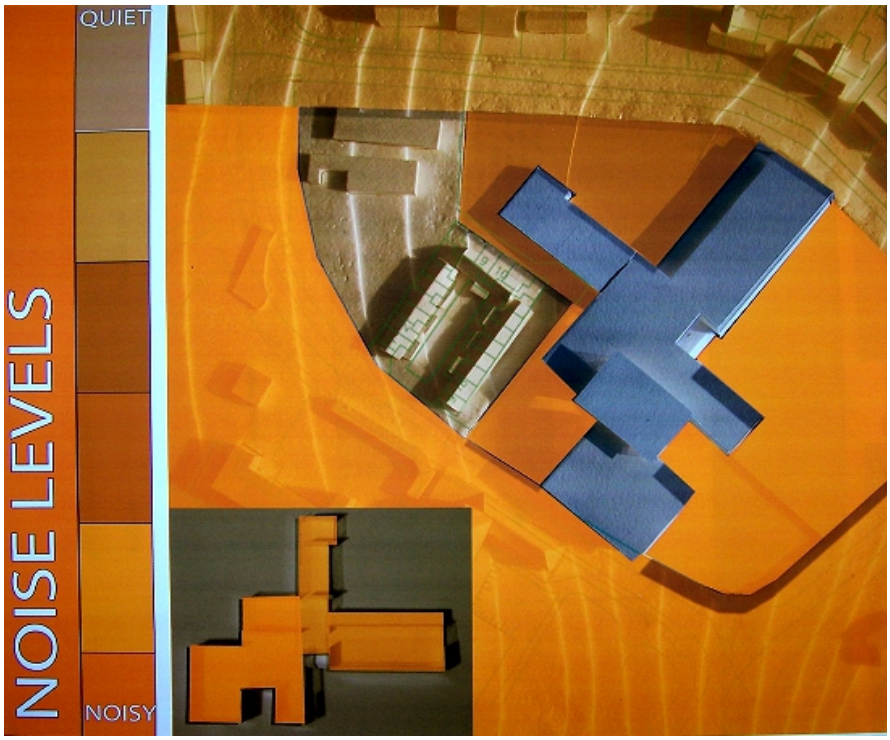
Sound Studies

In the second semester of the second year, students were to design a school project.
With the light experience in mind, how did we introduce sound? We did not ask for sound pressures and decibels, and we did not consider any amplified sound systems. Students were invited to listen to audio samples of different class rooms [8] and were asked to identify the differences between each one – and indeed they were able to do that.
After this class, students realized that acoustic sound qualities were not just about quantity or volume - they were able to make a distinction between sound qualities like soft, hard, warm, cold, dry, boomy etc.

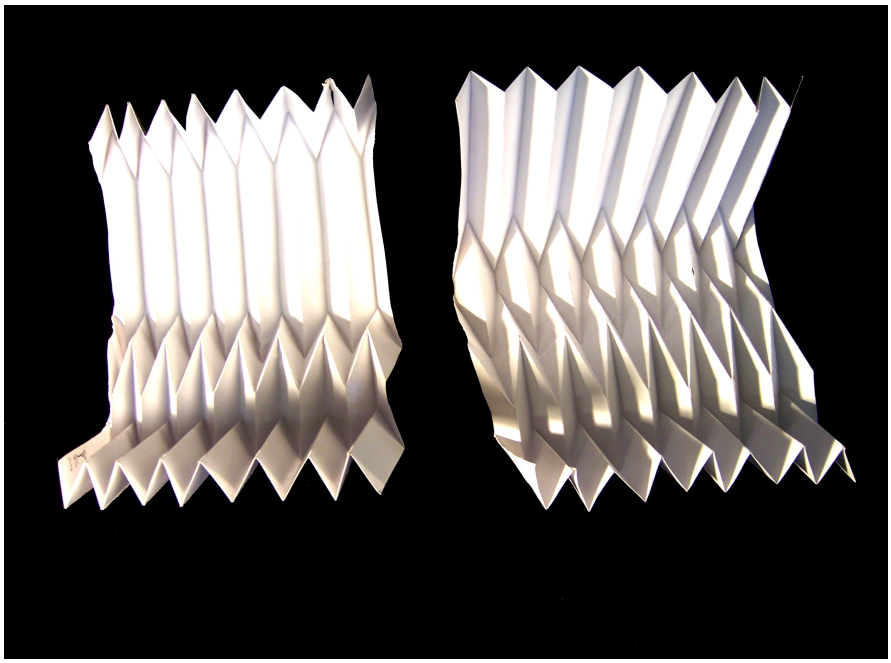
Finally they were introduced to two specific terms: “Reverberation” and “Speech Intelligibility”[9].

For the rest of the semester, students were simply and regularly asked in their tutorials: “How is your project going to sound?”
We used this question to provoke the students to keep thinking about sound in the overall design process. The specific outcome or format of their sound ideas was left entirely open to their creativity.

The following images show some individual approaches in dealing with sound issues:



Sound approach by Barry Walsh: Location Plan as a Noise Map. The term “Noise Mapping” had not been introduced before.



Sound approach by Danilo Suhrweier: Developing folded ceiling elements for Sound distribution. Is this element sound absorbing, sound diffusing or sound reflecting? The learning outcome of this design exercise is to create an open mind for an early dialogue with the specific consultant.

Sound approach by Rachel Farrell: Differentiating soft and hard surfaces in a lecture hall. Acoustically active building elements (which ones are actually not?) become part of the main design intentions.

Light and Sound Design

In 2nd Year of Architectural studies, we thought that a holistic design process should implement light and sound strategies as soon as possible into a project. Architecture is a sensual experience. Light and Sound are two of these experiences.

Light and Sound are not merely coincidental phenomena, they should be understood as design tools and used as building materials.
We were thrilled by the experimental interest of the students. We think it was crucial not to overload the issue with too much complexity, so students were more driven by curiosity than loaded by information.
Students should understand light and sound as an inspiration, not as an encumbrance during their design exploration.

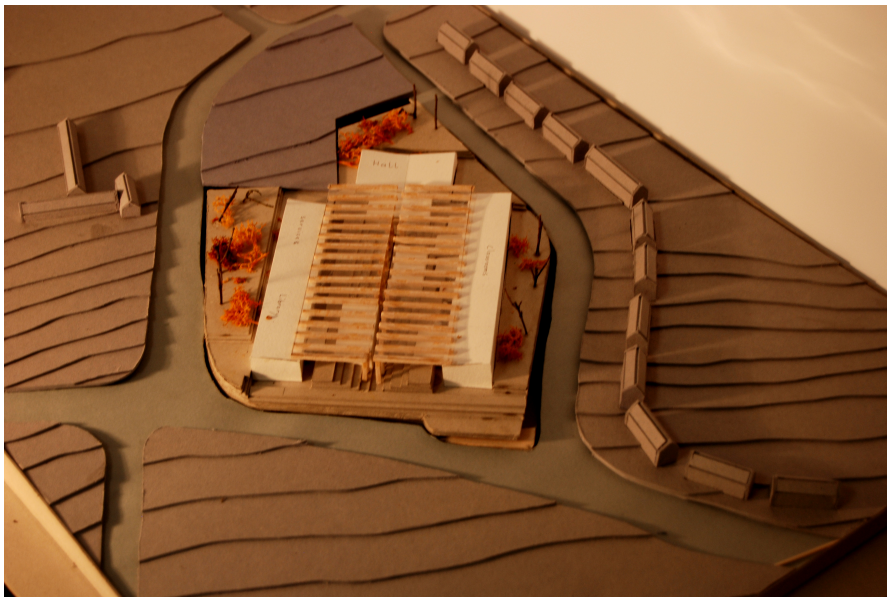
The audio experience proved to be most efficient for the students' stimulation but this needs to be developed, both in terms of good listening samples and in terms of on-site-experience at real locations. Background noise issues should be included in this hearing experience.
We also learnt that there is a slight danger of mixing up building and room acoustics. A clearer distinction between both is essential.

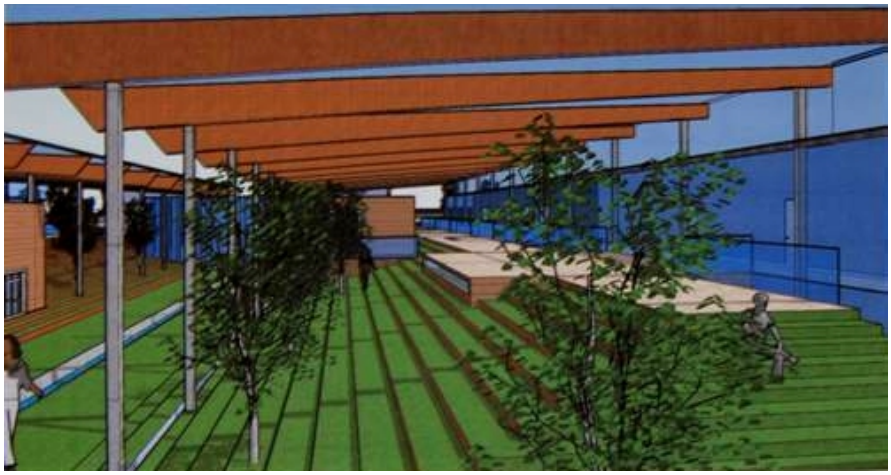
To sum up, there is one main lesson which is crucial for every design process: that curiosity and experimentation come first, and only then reading and research. For the design approach, imagination is much more important than specification, a clear notion of sound quality is more relevant than its calculation.

Sound Space and Soundscape

What has that all to do with the topic of this session "Soundscape and Community Noise"?
We were very impressed with one student who – as shown earlier – had developed the location plan around his school project as a noise map. He apparently had never heard of noise mapping before. From what he did, it is a small step towards a statement of community noise, and to express it more positively: towards a vision of community sound.

Another student went even one step further: James Nally created an open school project with a glass-roofed public garden in the middle, and I assume he could easily develop this approach into a "Soundscape" concept.





Was James thinking of playing children, raindrops falling onto the glass roof or the gales of wind from the near sea front when developing the project? We thought hearing had definitely arrived in his design approach: he has a vision of sound, and hopefully a sustainable appreciation for soundscapes.

The author is lecturer for Architecture in Waterford Institute of Technology, Ireland; he would like to thank all 2nd Year Studio Students of the Academic Year 2007/08 in W.I.T. for their creativity and their contributions.

This paper was first presented in the session: "Soundscape and Community Noise" at Acoustics 08, the 2nd joint conference of the Acoustical Society of America and the European Acoustics Association on 4th July 2008 in Paris, France. A german version of it was published in Zeitschrift fuer Laermbekaempfung (Duesseldorf, Germany, 2009), pp171.

[1] Scene from the motion picture "The Third Man" (1949)
(Photo downloaded on 27th March 2008 from
http://www.dvdtimes.co.uk/images/thirdmanr24.jpg)

[2] "Steen Eiler Rasmussen (1898-1990) was a Danish architect and town-planner, professor at the Royal Danish Academy of Fine Arts, and a prolific writer of books and poetry. (…) His bibliography (1973) lists 536 items. One of his most important books was "London". It was first published in Danish in 1934, in English (as "London, the Unique City") in 1937. When this edition was re-issued in 1948, Rasmussen had added two Postscripts: "For English readers only", and "For American readers only". A shorter version was published as a paperback in 1960. Other influential books by Rasmussen are "Towns and Buildings" (1951), and "Experiencing Architecture" (1959). (…). In 1942 Rasmussen (together with his colleague Kay Fisker) educated Jørn Utzon, the world-renowned architect and creator of the Sydney Opera House. (…)"
(Reference downloaded on 27th March 2008 from Wikipedia:
http://en.wikipedia.org/wiki/Steen_Eiler_Rasmussen)

[3] Steen Eiler Rasmussen: "Hearing Architecture" in: Experiencing Architecture. Cambridge U.S.A. 1959, reprint 1989, pp 225.
On page 226, Rasmussen refers to the motion picture "The Third Man".

[4] Experiencing Architecture. Cover of the 1989 edition.

[5] See also Leo Beranek: The Language of Acoustics, in: Concert Halls and Opera Houses, New York 1996, pp 30. Beranek introduces terms as „Warmth" and „Acoustical Glare" for describing sound qualities.

[6] Christopher N. Brooks: Architectural Acoustics, Jefferson U.S.A., 2003, pp 50:
"Sound-reflecting surfaces are modelled by light-reflecting materials. A model can be built of light-reflecting material, such as polished aluminium, or the surfaces of an existing model can be coved with a light-reflecting material. A lamp or laser is used to model the sound source. (…)"

[7] Merete Madsen and Peter Thule Kristensen: Daylight as a Building Material.
In: Detail Practice (Christina Augustesen and others): Lighting Design, Munich 2006, pp 92.

[8] The audio samples were retrieved from www.wilhelmi.de in March 2008 (Lahnau Akustik GmbH, Germany).

[9] In 2000, the Technical Committee on Architectural Acoustics of the Acoustical Society of America published a very helpful guideline on classroom acoustics which was used in our tutorials.
"Classroom Acoustics" can be downloaded free from the ASA's website
http://asa.aip.org/