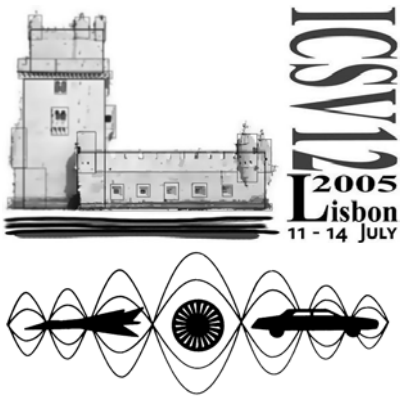

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THEORIES AND METHODS ADAPTABLE TO ACOUSTIC AND ARCHITECTURAL DESIGN OF RAILWAY STATIONS

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Abstract

This paper presents and discusses theories and methods of acoustic design of railway stations, in regard to architectural practice. It emanates from an ongoing project of two railway stations in Stockholm, although the subject matter may be applicable to any railway station. While most recent projects in the field adopt a defensive attitude by seeking to protect people from noise, this project aims at developing principles, methods and models for sounds from a constructive and creative perspective. To be more precise, it is a matter of managing sounds as mediators of qualitative information, e.g., design principles regarding perception, spatial orientation and aesthetics. Hence it deals with the design of sound qualities in regard to the actual situation, which is analogous to the design process when deciding the range of colours for a place or for a building. In this respect, sounds are also part of the social, cultural and aesthetic processes. Today digital technology has made it possible to store, manipulate and distribute sounds in a way that until recently was impossible even to imagine. This has resulted in a renewed interest in acoustic design, especially among disciplines that cross room acoustics with aesthetic fields such as architecture, music and art. Therefore, one main question discussed in this paper is: How can relationships between traffic, sounds, social life and physical space be analysed and designed?

INTRODUCTION – ACOUSTIC DESIGN

The interest for acoustic design has increased in the last few years, both in the building process and in town planning. Considering the popularity and application of the design concept, this is not surprising, but rather a logical consequence in that design theory and design methodologies gradually are becoming an integrated part within research. A prerequisite for integrating acoustic design in practice is that sound criteria are take into account in the introductory phase of a project, and in concordance with the architectural design. One problem, however, is the lack of examples of acoustic design in the built environment, which may serve as models; architecture as well as acoustic design is to a great extent based on practices and models.

This paper is closely connected to the submitted paper *Application of Acoustic and Architectural Design of Two Railway Stations in Stockholm*, which specifically presents design proposals of the two stations.

What is Acoustic Design?

The design concept is synonymous with quality assessment and modelling. In brief, design theory deals with development of methods that aim at constructing models for simulation of processes and prototypes, which in the last stage may result in an abstract or concrete artefact. In other words, design is a tool to help a future user to manage certain problems; bringing into play the close connection between analysis and creation in design.

So, acoustic design deals with development of concepts and methods applicable to analysis and modelling of the acoustic environment. The 'acoustic environment' embraces the whole sound spectrum, from discrete signals to the sound environment in the built space. Acoustic design is – like all design processes – an uncertain process in that there exists no definite manual; the work differs from case to case.

One common problem is that the acoustician very seldom is involved in the initial design phase – the architect or building contractor usually engages the acoustician in the concluding phase, in most cases regarding sound-absorbing installations. This situation is to some extent self-caused since acoustic research and acousticians focus on the measurability of sounds but tend to ignore the descriptive dimensions. This means that acousticians lack a qualitative vocabulary that would be beneficial when communicating with architects and others in the design process. A typical example is the concept of space, which for the acoustician implies volume, resonance, absorption and to some extent geometry. But from the architect's point of view, the concept of space contains a series of nuances that also encompass spatial, aesthetic, perceptual, social and cultural significations (Hellström).

Within the architectural discipline, researchers have long been studying the interplay between perceived space and built space, especially regarding the dimensions of light and colour. But today one may add the dimension of sound as an important building block for architectural research in its entirety. It is important, though, to stress that this is not a matter of audibility in concert halls, or of sound-

absorbing measures, but rather about qualitative criteria on the whole, which is crucial concerning our experiences and understanding of the built space. Hence it deals with the design of sound qualities in regard to the actual situation, which is analogous to the design process when deciding the range of colours for a place or for a building.

Acoustic Design and Railway Stations

The current methods regarding design of sounds in public space can, to some extent, be described as defensive in that they primarily aim at protecting from annoying sounds. But in the last few years strategies for offensive methods have been developed – emphasising the qualitative dimensions of sounds – and how they may be modelled; i.e., acoustic design (AD). A keyword is, thus, 'quality' in that a certain place – indoors or outdoors – has a characteristic sonic identity. To picture the sonic identity one must take the given acoustics, the action and perception into consideration, which means that one has to integrate different knowledge fields when decoding the quality of sounds; mainly acoustics and architecture, but also to some extent sociology, psychology, ethnogeography, music and art (Augoyard, Amphoux). Sounds are seldom perceived as isolated phenomena, but are interpreted in a context, in relation to situation and place. Therefore, AD deals with the adjustment of sound sources, and in regard to the design of the built space. In other words, the function of sounds is to support the activities at a place. A certain place that "sounds good" must not necessarily be quiet, but is established in regard to the whole situation; how sounds are articulated and perceived, how they activate people, how they are related to the built space as well as cultural and aesthetical connections (Hellström).

Railway stations are of a particular interest for AD. Unlike public urban places – like squares and traffic interchanges – the activities at railway stations are more limited and predictable, which make them relatively easy to handle. Yet, the sounds in such milieus are very often neglected. Verbal messages via speakers are diffuse, it is problematic to orientate oneself and to communicate, the milieus cause stress etcetera. One major reason is the lack of AD. This paper focuses on four methodological and theoretical design principles, which are crucial when planning and designing railway stations:

- Perceptive criteria;
- Spatial orientation and design;
- Aesthetical criteria;
- Verbal messages, jingles and signals via speakers.

ACOUSTIC DESIGN – PRINCIPLES

Principles for Perceptive Criteria

A dimensional factor when planning stations deals with how travellers perceive sounds. Since sound perception is crucial for spatial orientation as well as how people

act, interact and communicate, it is necessary to clarify what types of perceptive criteria that are suitable within the different spaces (entrance, passage and platform). The researcher Pascal Amphoux has defined three different types of perceptive criteria: *listening*, *hearing* and *attending* (Amphoux).

Listening deals with the mediation and the event that caused the sound. The category correlates to 'sonic signals" – the signals, literally speaking, grabs our attention; they suddenly appear in our mind unexpectedly – we do not have to listen, but the signal will always call for our attention. From a temporal viewpoint, the signal is always a discontinuity; it is a sonic event that makes us listen. E.g. a verbal message via a speaker or an incoming train on the platform evokes a 'listening' mode.

Hearing refers to an order that one does not pay attention to. The category correlates to 'sonic background' – yet the sounds are clearly audible from the moment one starts to listen actively. From a temporal perspective, sonic background can be outlined in terms of continuity or duration i.e. it is an ongoing stream – a continuum – of sounds.

Attending deals with a perceptual field when we do not search for the sound's derivation and origin. The category correlates to 'sonic ambience' – our perception operates on a selective level; we search for the specific qualities of a certain sound and/or a sonic ambience. Thus the sounds themselves are in focus and not their physical context. From a temporal viewpoint, this perceptive criterion can be characterised through its dynamics – it is the mobility, the movement, the rhythm and alteration of the sonic units of a cohesive ensemble that constitutes the sonic ambience of a place, like the 'pub', 'café' and 'station'.

Principles for Spatial Orientation and Design

Sound is a dimensional factor for spatial orientation. AD makes it possible to enhance the awareness of the physical space and also to make its spatial form clearer. These aspects are essential for the traveller regarding comfort as well as from a security perspective. The consequences might be serious if it is not possible to locate the sounds on a platform; sometimes visually handicapped fall down on the track. This is often due to insufficient acoustics and lack of supportive auditory information. Therefore in such cases, the physical space should correlate with the sonic space; or more clearly – in order to orientate on platforms, people need to know where the sounds derive.

Since sounds constitute spatial formations, AD makes it practically possible to create sonic spaces with different qualities within the one and the same room. In such a way one may differentiate a room. An essential difference between auditory and visual perception is that one may "listen behind the corner", which makes it possible to announce spaces that are situated beyond the visual field.

Nodes where different spaces converge are of particular interest, for instance entrance/passage and passage/platform. And there are three basic sonic spatial principles that deal with design of such nodes:

- An abrupt sonic change between two spaces;

- A smooth passage, where the sounds of two sonic spaces partially overlap each other;
- A sharply marked sonic space that is put inside another sonic space.

These principles possess specific qualities, which have an effect on how we perceive, interact and communicate in the intersection between different types of sonic spaces. In such a way the spatial atmosphere at a station may be given a characteristic architectonic expression and identity, and – in consequence – a place where the traveller feels comfortable and secure.

Principles for Aesthetical Criteria

The aesthetics of sounds may be discussed from different perspectives, but is mainly connected to auditory supplements like music and sound-art installations. It is preferable to plan such supplements in concordance with architectural and artistic group of themes and design.

Research findings point out that aesthetical installations – via speakers – should be applied with caution. In most cases these are interesting at the beginning, but over time the effect is the opposite (Delage). There is an abundance of possibilities. Site-specific installations are preferable; the composer/artist cultivates and experiments with the local sounds in the surroundings. The effect is that the traveller gets into contact with the urban life, supporting the transportation between the underground and the street. Since sound-art installations as isolated phenomena might confuse the traveller, it is preferable to complement the installations with visual effects, especially lighting design. Cafés and waiting rooms are propitious milieus for music and sound-art installations. But also monotonous milieus like long passageways are suitable for design of qualitative listening spaces.

A new international tendency is to play music at railway stations for the purpose of preventing crime. The idea is to distribute music – above all classical music, especially Mozart – in order to deter "unwanted people" like youngsters and drug addicts. This method becomes more and more accepted, and is to be found in, e.g., Stockholm, London, Hamburg, Copenhagen, Brussels and Vienna. In London Underground one has tested this during 18 months at four stations. As a result, the intention is now to install equipment for playing recordings of classical music at 35 other stations.

This is a quite odd and unsound method since it is just a matter of moving people. Responsible persons at the London Underground claim that the reason why playing classical music is that most of the "unwanted people" do not like such music; the music is "uncool" (Shoesmith). So, it is also an expression of social and cultural marking; a highbrow culture that uses music as a sonic virus to combat new target groups. In other words, the music is not aimed for aesthetical purposes but for protective ditto. For that reason, we must hope that this method will soon pass.

On the other hand, it would be more appropriate and demanding to make the opposite, i.e., to create a sonic environment that makes people listen, evoking a sentiment of comfort. Such an environment should comprise private spaces where the

passengers feel safe and undisturbed, and at the same time as they are a part of the public space. Thus, a key concept in regard to this is *sound perception*, since it is a basic qualitative tool for the acoustic designer when exploring the relation between sound and the user's space.

We could learn a lot about the relations between sound perception, environmental sounds and music by studying the 'Sony Walkman movement' that come up in the 1980s, which today has turned over to an 'mp3 and iPod movement'; music becomes a substitute for urban sounds (Bull). This is an expression for a slowly break up of ingrained opinions of musical and sonic environmental representation. One may therefore ask – Why avoid stimulation from outside? What does this mean to urban culture and social life? What is the effect of disconnecting visual information from auditory information? Could such auditory spaces be understood in terms of 'personal soundtracks of urban life'? Etcetera. So, instead of installing equipment for playing recordings of classical music in 35 stations in London, such investigation would probably in the long term be more fruitful and praiseworthy.

[Design issues in regard to this are also discussed in the paper *Application of Acoustic and Architectural Design of Two Railway Stations in Stockholm* – section heading *Sonic Aesthetical Additions*].

Principles for Verbal Messages, Jingles and Signals via Speakers

Design and installation of messages, jingles and signals via speakers are highly relevant for AD since these aspects have an effect on issues like information, communication, orientation, spatial design and aesthetics. Messages, jingles and signals are frequently applied in different types of technical installations at railway and underground stations. For instance, warning signals, electronic displays for information, turnstiles, verbal announcements, train arriving and doors closing. However, these systems are often under dimensioned and do not work properly; it is problematic to catch the different types of messages, which especially make things difficult for visually handicapped. The following criteria should be taken into consideration:

- *Information – audibility*. Sounds must be articulated and distinct. Therefore, the sound equipment must be of high quality. Jingles announcing verbal messages are very important in order to make people conscious of the ongoing activities. The room acoustics is a basic dimensional factor.
- *Orientation – location*. The sonic information is important regarding these aspects.
- *Synchronisation*. All different types of signals and jingles should be systemised and co-ordinated. For that reason, it is important to formulate an overall strategy, in the same way as composing music.
- *Aesthetics*. The aesthetical qualities of signals and jingles are central, especially in regard to aspects of comfort, and should therefore be performed by a composer.

These criteria may be improved by making the jingles and signals distinct in terms of, e.g., articulation of timbre, pitch, harmonics, transient, counterpoint and rhythm. All

jingles and signals should be short since it minimizes the risk of masking effects, as well as it sharpens people's attention (Rubin).

Summing up, a sonic environment that "sounds good" may be created by synchronized, distinct and homogenous sounds and systems; the sounds should be as intelligible as possible since their main task is to inform people (Delage).

Another common problem regarding information via speakers may be discussed in terms of the concept of 'schizophonia', introduced by R. Murray Schafer. The concept concerns the effect when isolating the sound from its original context and reproducing it into another. The consequence is that the listener is situated between two acoustic spaces of which the sonic climates are radically different (Schafer). Therefore, cutting a sound from a certain environment and inserting it into another is not unproblematic since it can disrupt our perception and behaviour when acting in the environment. One may ask: What are the spatial consequences when the sound is detached from its context and reproduced through loudspeakers? And what do the sources represent from environmental, cultural, social and aesthetic points of view?

The composer and music theorist Trevor Wishart uses the concept of 'formalised acoustic space' to distinguish it from 'real acoustic space'. The formalisation of acoustic spaces is to be found in all kinds of music. For instance, in a rock music production the voice might be simulated as coming from a telephone, and simultaneously it is rebalanced to have the same intensity as the amplified rock band. Hence, with sound effects such as reverberation, echo, phase shifting, compression and harmonisation etc., it is possible to manipulate an acoustic space (Wishart).

The concepts of formalised acoustic space and real acoustic space are crucial. Briefly, these two concepts are not only spatial phenomena to be discussed within the musical field, but the concepts might also be applied into an acoustic and architectural context. Since the formalised acoustic space becomes more and more common in everyday life – muzak in elevators, signals or jingles in metros, amplified street music etc. – it is important to investigate the interaction between built form and the acoustic space, and to examine what effects this mix of different acoustic entities have on people's behaviour when acting in public space. For example, how might one describe the acoustic interaction between the formalised acoustic space of the information distributed through loudspeakers at a metro station – e.g., the kind of melodic jingle and pre-recorded voice that is heard at the metro stations in Paris and Stockholm – and the natural acoustic space at the same station? Does this type of acoustic interaction represent a real acoustic space or a formalised acoustic space?

SUMMARY

This paper has dealt with a structural approach to sound issues in general and more particularly to acoustic design of railway stations. The ambition has been to present theories and methods that aim at bridge the gap between acoustics and architecture, and so be useful within both fields of research and practice. In most cases, sound research focuses on developing methods that aim at the measurable dimensions of sounds i.e. defining and encapsulating the sound world in quantifiable systems and

units. This concerns not only the technical dimensions of sounds (physical acoustics) but also perceptual criteria (psycho-acoustics). Though this paper does not oppose these fields of research, the intention has instead been to extend the subject by investigating theories and methods concerning the qualitative nature of sounds. This might seem self evident, but it is nonetheless crucial since the majority of sonic environmental research today is concerned with protecting people from sounds. The opposite attitude promotes supportive and creative approaches to sounds. That is to say, by entering deeply into the very complexity of the sound world, we pursue knowledge that does not hide our relation to the sound world, but rather reveals its riches.

Concluding remarks

This paper is a result of an ongoing project at the acoustic consultancy company *Ingemansson Technology AB*, Sweden. The title of the project is City Line, Stockholm, and concerns the design of two stations. Design proposals are presented in the paper *Application of Acoustic and Architectural Design of Two Railway Stations in Stockholm*.

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