The sonic public realm – chances for improving the sound quality of the everyday city

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ABSTRACT
Sound quality affects a place’s popularity, the user’s well-being, and how long people stay. Simply put, urban sound quality is key for a successful city. The building facades, roofs, the city floor surfaces and the natural terrain interact acoustically with their reflective surfaces, masses, and voids and generate the audible acoustic space. Any building, any building’s facades and surrounding floors is responsible for the acoustic quality of the public realm. Any change in the building materials and the buildings’ shape and placement provides chances to improve this quality. On behalf of the cantonal noise authorities of Zurich and Basel, our team has collected principle-led design tools and examples in a user’s guide by which architects, planners, and public realm designers can improve the everyday city’s sound quality. The guide assumes that small achievable steps that are coordinated between different levels have a big impact and contribute to a better acoustic environment. In exemplary master plans for large areas in the city of Basel, we suggest such steps to gradually interweave individual, acoustically loose projects into a connected public urban space with differentiated sound qualities. Citizens’ participation and involvement are most welcome but also necessary to make these qualities audible.

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1. URBAN COEXISTENCE IN BOTH ACCELERATING AND DECELERATING CONDITIONS

European cities show a very eccentric and dynamic tendency which is characterised by high velocity and permanent acceleration. Spectacular buildings, high-capacity infrastructures for ubiquitous and super-fast mobility, as well as stunning cultural and sporting events are important for cities to successfully compete against each other for attracting highly skilled professionals, tourists, students, residents with high incomes, creative minds, and businesses with high economic benefits. However, a decelerating and stabilizing counter-tendency in European cities can be observed as well. Because living in the city is very much in demand, so as living in the countryside, cities are increasingly forced to provide housing developments, public services, and public spaces which match with people’s needs for family life, leisure and recreation. Both «green» spaces and the «landscape» are symbols for quiet and well-being and are considered worthwhile preserving. Public transportation systems and green

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structures for slow moving people, such as tramways, pedestrian connections and bicycle paths, also provide access to the city’s eccentric areas (1).

Cities underlie permanent change which is driven by diverse forces. They are «arenas» in where private, public, and semi-public players sometimes compete against each other and sometimes cooperate with each other. Depending on the objectives and on the local context, the involved players participate within dynamic constellations, whose actions and thinking are influenced by socio-economic, political and cultural factors, cf. (2). As a result of this complex interplay, a city shows numerous qualities and sometimes ambivalent features, cf. (3, 4). However, differentiated qualities and varied features are decisive for cities. Variety and differentiation of urban spaces are essential for coexistence between diverse people. Such urban spaces also improve a city’s resilience against upcoming challenges like climate change and internal urban development.

2. URBAN SOUND FROM AN URBANIST’S PERSPECTIVE

Urban sound can be understood as the audible result of people’s coexistence. It is the audible sum of all qualities and features which cities represent. It is the immediate expression of people’s presence and activities. From an urbanist’s perspective, cities are enormous «musical instruments», say, giant drums, on which the protagonists are simultaneously pounding but without listening to each other. In the city everybody is an acoustic protagonist. The protagonists are not only unconscious «musicians» who apparently produce a chaotic audible result. They are also unwanted «listeners» and random «musical instrument makers». Whether as planners, designers, politicians, tourists, or residents, everybody plays at least one if not several roles. From this metaphor the following questions arise:

– How can the city be planned and designed so its audible outcome becomes projectable?
– How can urban spaces such as streets, parks, squares and housing developments be realised so that the resulting audible interplay between sound sources and building materials supports people’s coexistence and encourages them to get involved and interact with their surroundings?

The aforementioned questions turn out to become a communication issue with a few tough nuts to crack. First, it is a substantive issue because the «instrument makers» (architects, planners, authorities, etc.) need to have an idea about the sounds they want to realise, so as to build a «musical instrument» (the city) with good sound quality. Second, it is an interdisciplinary issue because «listeners», «musicians» and «instrument makers» have to cooperate to realise such an instrument and for that reason a «language» everybody understands is necessary. Third, it is a professional issue because most «instrument makers» are specialised in reading figures and working with plans while a «listener» immediately hears if a plan’s audible outcome sounds pleasantly or boring. And fourth, it is a communication issue. Because sounds are invisible and intangible they are difficult to quantify and describe, nor can a place’s sound be showed in plans and mock-ups, nor can it be reproduced.

3. A COMMUNICATION TOOL FOR CITY SOUND QUALITY

The cantonal noise authorities of Zurich and Basel aim to raise public awareness for city sound quality. The target audience are people involved and interested in the city’s planning and design process. The authors support this process on several occasions with soundwalks, case studies, lectures and workshops to initiate a public dialogue on urban sound and to gain and share experiences between architects, planners, landscape designers and other experts and «non-experts» on soundscape, acoustics and noise control. So far the process has resulted in a user’s guide (5) on the urban sound realm by which professionals can improve their projects. The guide contains principle-led design tools which show the effect of designing specific parameters of the everyday public space such as floors, walls and
buildings on the city’s sound quality. Model cases and reference examples demonstrate the principles’ audible effects and how these principles may turn out in a site-specific context.

The guide takes the AUDIBLE characteristics and opportunities of the city seriously. It is aimed at those people who are interested in a city’s sound quality and supports those architects, urban planners, landscape architects, planners, community officials and individuals who would like to actively change that quality. It is the beginning of a process which starts by knowing the acoustic characteristics of building materials and the parameters for sound quality and successively involving these skills in the planning and design process of the city. This because the quality of the urban sound realm makes a decisive contribution for people’s well-being in cities. Sound quality also affects a place’s popularity and how long people stay. It is therefore reflected, e.g., in land price and in rent prices for housing.

Sound quality is a local sound experience perceived by the listeners. It is a perception, and not a measurement, cf. (6). Sound quality can be experienced in the characteristics of urban places which mainly concern all material properties such as the material’s density and composition, nature and shape of the surfaces, size and scale, as well as distance and position to adjacent materials that have a favourable effect on the acoustic perception and are able to create a clear contrast to the present listening situation. This notion of sound quality requires to carefully consider all decisive parameters which are related to planning, realisation and maintenance of cities. Thereby the focus lies on skills for building materials and their acoustic properties.

The guide therefore emphasises sound quality which is based on a combination of architectural, designing and urban planning considerations. These considerations are not intended as building codes nor mandatory requirements. They rather aim to ensure sound quality in the long run and to go hand in hand with ongoing individual projects and future urban development steps. The considerations take into account in particular small and quickly realisable measures which efficiently support this process. They particularly assume that small and achievable steps, which can be coordinated on different levels, have a big impact and are expected to contribute to the sonic environment.

In architecture, urban planning and landscape architecture, sound quality can be supported using various parameters. Any floor, any facade, any building can either be built right from the start or re-designed later on so that qualities become audible. This is the guide’s starting point to contribute to sound quality which is realised step by step and on different levels, in particular

- to recognise the effect of building materials and design elements on city sound quality;
- to lead a discourse on city sound between builders, planners, architects, designers, community officials and users;
- to determine measures, interventions and planning steps on the basis of acoustic considerations;
- and finally to revitalise acoustic wastelands and give these areas back to the city as future living environments.

This integral approach results in a gradually grown sound quality which provides good conditions and synergies in the city for achieving environmental objectives such as city climate and biodiversity, keeping and improving the value of public spaces and ensuring a high living quality.

4. URBAN FLOORS AND THEIR CHANCES FOR THE CITY’S SOUND QUALITY (EXAMPLE PRINCIPLES)

The guide suggests in total 13 principles of which the first three principles are dedicated to the floor and its contribution to the audible environments of cities. The other principles concern the chances for sound quality which are related to city furniture and other small objects (principle 4), newsstands, bus shelters and other big objects (principle 5), walls and building facades (principles 6, 7 and 8), public realm design (principle 9), public art (principle 10), and design of pedestrian paths
The variety of floor materials is a precondition for sound quality in cities (figure 1). Differentiated floor materials influence the floor’s diffusion and absorption behaviour. Material variety supports the diversity of audible reflections and, thus, counteracts with monotonously sounding environments. The acoustic effect is dependent on the difference between the acoustically relevant characteristics of the floor materials used. For example, the material’s porosity is one parameter of the floor which immediately influences the floor’s acoustic reflection. The more differentiated the urban spaces’ floors and the respective characteristics, the better for the people.

Figure 1 – In the variety of floor materials lies a first chance to obtain favourable conditions for city sound quality.

The floor is an «acoustic actor» who generates sounds when people walk and drive on it. Imagine the city as a big vinyl record and the pedestrians as sound pickups reading the songs. The material’s density and its resonance characteristics become very noticeable for people. Loose and porous materials such as sand and gravel are softer than sealed and solid materials such as concrete and asphalt. They have a more sound-absorbing surface, which is acoustically less reflective, than asphalt surfaces. Highly reflective and weakly absorbing surfaces such as asphalt spread traffic noise better through urban spaces.

If the major part of the city floor is covered with the same asphalt, e.g., urban spaces sound monotonous and unbalanced. The material variety of the city floor can be improved by

- providing areas for pedestrians and cyclists which don’t have the same materials as the roads do, but differ in material properties;
- designing public urban spaces with plantings, hard gravel floors and soft, loose and porous floor materials such as gravel and marl. This reduces the proportion of asphalt and unwanted amplification of traffic noise. Also one’s own steps become better audible. Being able to hear oneself in the city is an important quality of the public space;
- leaving natural floors as they are.

The edges between the city floor and the building facades cause disturbing reflections particularly if the materials are highly reflective such as glass and steel. Especially the edges along long buildings...
influence the sound of the adjacent public spaces. Therefore, floors should never be directly connected to the facades, but rather joined up with stairs, terraces, pilasters and cornices. Sound scattering and absorbing materials are particularly important where floors meet walls. Such materials should also be pulled out to the streets so as to additionally break, scatter and soften the urban sound.

Figure 2 – In the city people experience porous and soft floors such as gravel with leaves as pleasant. In the example, an enclosing hedge and a group of about 15 trees additionally contribute to this quality. Together with the floor they have acoustic properties which a listener perceives as an ear-catching audible space, which is a welcoming break.

4.2 STRUCTURE FLOOR SURFACES (PRINCIPLE 2)

The acoustic variety of materials in the public realm is achieved by structuring and distributing floor materials over the whole surface (figure 3). The size proportion of the considered floors determines the acoustic effect of the floor and therefore its sound quality.

Figure 3 – A second chance for differentiated audible spaces is achieved by structuring large floor surfaces into areas of different sizes and varied materials.
Large areas which show the same materials in repeating patterns everywhere may at first glance appear tidy and visually convincing. However, people also hear the same patterns and after a while they experience monotonous floors without any change in material as stressful and unpleasant. Large squares, parks, streets and open spaces should therefore be structured into floor areas of different sizes and materials. Thereby, the traffic area should be reduced to the minimum of asphalt necessary. The more areas for pedestrians and cyclists differ from the ordinary road surface, the better for the ear. The result of that is an audible improvement in public urban space. Because people associate asphalt with traffic, they additionally see more positive qualities in areas which are visually not «occupied» by asphalt and, consequently, like these areas better.

Structured floor surfaces result in an acoustically differentiated design and can be achieved by
- designing large city areas with diverse processed and structured stone floors, concrete surfaces, wooden floors, steel panels and rubber sheets;
- dividing large city areas into user-specific areas;
- structuring large parks in varied areas with grass, sand, gravel, water and natural stone;
- using recycled plastics, shredded tires and wood chips for paths and public spaces of pedestrians;
- structuring large urban roads in differentiated sections using existing cross-passages, squares and public transport stops;
- greening up existing tram lanes and, by doing so, soften sound reflections of trams and cars. Street traffic becomes more quiet and its noises are not unnecessarily increased.

Because of the floor’s reflective properties large squares close to roads transfer low-frequency sounds from cars and trucks, which people experience as very unpleasant. A good choice of diverse materials (principle 1) and a well structured area (principle 2) improve the near audible space of the listener, but can not reduce nor prevent that low frequencies and loud traffic noises spread. The city floor should therefore also be modelled in its height profile (principle 3).

Figure 4 – Different processed floor materials made of wood, steel, stone, concrete and rubber are used for the design of this large inner city square. The surprising combination of materials counteracts the acoustic monotony. It produces a better sound quality than a sealed asphalt surface ever could in this place.
4.3 MODEL THE TERRAIN (PRINCIPLE 3)

Slopes and height differences in the terrain can acoustically be effective when modelling the terrain (figure 5). When the modulation of floors is used to screen off sound, filter or reflect it, people present in that space can directly feel it physically as well as spatially. People experience the space as hearing niche or hearing «view» point, depending on if they are standing on top or at the bottom of a modulation. The listener can repeat this hearing experience whenever he or she wants. This creates a repeatable audible difference. These hearing experience differences give variations in a monotonous space and can be accounted for as a measure for sound quality.

Figure 5 – A floor’s elevations and depressions offer a third chance for changing the city sound quality. By modelling the city floor in its height slopes and height differences become acoustically effective and audibly differentiate the space.

When elevating the terrain, surfaces on different height levels can be generated so as a large audible space is divided into individual, mutually coupled audible spaces. Additionally, sounds from streets and noisy usages are filtered and screened off. In parks with little background noise and open spaces far away from buildings these effects can be achieved by:
- modelling the terrain with up to head-high height differences;
- creating surfaces at different height levels and vary the elevations;
- shaping the niches like enclosing arenas and, by doing so, creating audible spaces which can additionally be supported by trees and running water;
- creating high-lying areas with plantings, elevated gardens, as well as seating facilities from where the listener can audibly «overlook» the environment from an increased listening position.

Depressions and sunken areas lead listeners into a space surrounded by mass. Mass keeps low frequencies away and thus influences the space’s sound quality. Surrounding mass makes the listener experience a quiet and more peaceful space. In parks and open spaces with a lot of background noise at least waist-high sunken areas of varying size and depth are necessary to become perceivable. A waist-high wall considerably reduces the physically perceptible attacks from pressure waves, vibrations and deep sound waves. The relief is influenced and can additionally be increased by the wall’s density and its mass as well as the vibration reducing properties of the building materials used. Thus, in urban spaces depressions like streams, ponds, biotopes and water channels are most suitable acoustic design elements for terrain modelling. Their vegetation also generates lively and pleasant listening niches with unique sounds.

In noisy environments the terrain should ideally have a lot of elevations and depressions. The rougher and more varied a terrain’s surface, the more efficient low frequencies are broken, scattered
and reduced. The wider the depression, the deeper the surface structure has to be. Particularly attractive for the ear are depressions which are at least as deep as a man and may reach several meters depth in large areas. In urban spaces this can be achieved by

- using rainwater reservoirs, basins, water channels, depressed playgrounds and sunken gardens, for example, as part of a flood protections system;
- transforming a city park along a main road into a large-scale «land art park» with a broken, farmland like surface structure.

Figure 6 – The terrain of this city park is modulated in such a way as to achieve optimal sound quality and to experience different audible spaces. Together with the impressive tree cluster, the up to 2 meter level differences in the sloping terrain create individual sound niches and give the park its acoustic structure.

5. **SOUNDWALKS AND SOUND MASTER PLANS**

Urban sound is a quality feature for the city. All buildings and surfaces are acoustic actors responsible for that quality. Acoustic effects, where they occur and why, immediately become ear-catching when listening on the spot. Favourable characteristics and relationships can be distinguished from big contradictions within a short time and provide first guidance on how and by what means audible changes could be possible. Repeated listening on site develops specific knowledge and shows relevant and realistic measures for improving the sound quality, cf. (7). Interdisciplinary groups are in particular appropriate to contribute to the success of translating these listening experiences into real planning steps. The guide suggests that planners and architects perform soundwalks so that

- the site-specific parameters for sound quality can be determined;
- the professionals involved clarify and sync the ideas about a place, (audible) problems and opportunities to improve sound quality;
- persons concerned such as local residents may be involved at an early stage of the planning and designing process.

The presence of the participants of a soundwalk also makes a first contribution to a place’s design and regeneration. People get involved in their environment and can spread the idea of a place so as its (audible) qualities are additionally supported.
A soundwalk-based case study (8) on the urban sound realm in Basel Breite points out three conflicting qualities. The acoustically dominant traffic axes are characterised by fast movements and very high utilisation. In contrast, the river Rhine seems like a peaceful haven, whose acoustic potential completely lies bare. A green network made of separate courtyards and loosely connected parks and green areas is, to some extent, slowly growing together. The study shows that the public spaces are acoustically fragmented due to the heavy traffic infrastructures. Because of diverse private and public landowners, investors with different interests, several municipalities involved and a wide variety of uses the urban sound realm can not be «repaired» within one single planning step, but rather requires a step-by-step approach. A fixed plan cannot determine the final result, but sound quality should site-specifically be developed according to the places’ existing qualities and weak points. With the help of the listening experience of the actors involved, necessary acoustic changes can be designed, planned, re-designed and finally realised.

For that purpose the study presents an exemplary sound master plan (figure 7) which aims to activate the river’s potential and improve the amenities of the yet disconnected and dull public spaces by doing so. The sound master plan connects the modest green network with the Rhine and transforms the fragmented parks and courtyards into a coherent riverpark. It suggests the necessary steps to gradually link together and interweave individual, acoustically loose fragments of public space like green areas, parks, residential streets, and squares into a coherent public urban space with differentiated sound qualities. Citizens’ participation and involvement of community groups are most welcome but also necessary to make these qualities audible. Therein lies a chance to realise further solutions, for example a city lido as proposed in the study, and to open dimensions that become audible for the entire city in the long run.

Figure 7 – The sound master plan for the Breite area in Basel suggests necessary steps to connect the modest green network with the river Rhine and transform the fragmented parks and courtyards into a coherent and easily accessible riverpark with differentiated sound qualities.

6. CONCLUSIONS FOR URBAN SOUND PLANNING

The cantonal noise authorities of Zurich and Basel pay more attention to communication actions to make people become more aware for their sonic environments and understand themselves as acoustic actors for city sound quality. In cooperation with the noise authorities the authors have published...
an experience-based user’s guide which is aimed at architects, urban planners, landscape architects, planners, community officials and individuals who would like to actively change and improve the urban sound realm.

The guide emphasises principles from architecture, design and urban planning, and shows the audible benefits for the city in using these principles. The principles are outlined with the help of model cases and reference examples. The guide is a communication tool and does not replace laws nor methods, but rather gets integrated into the existing design and planning process of cities in strengthening the different professionals’ skills on sound quality.

The guide’s key objective is not primarily to handle noise problems. Places don’t necessary become more quiet in the short term. However, the guide’s long-term perspective in particular includes achievable steps which gradually contribute to sonic environments. It enables people, who often are not experts in noise, acoustics nor soundscape, to site-specifically moderate their analysis, concepts, designs, and projects in order to judge the need for action, recognise options for action and determine appropriate measures. This approach highly depends on an established and interdisciplinary planning culture within the city, including participation processes so as small measures and big projects are backed and coordinated on different levels, from local people to professional experts. Herein lies the weak spot of the approach because the audible quality of cities lies in cooperation, moderation and negotiation between different actors.

The guide therefore suggests to always use soundwalks as a tool to support the design process. Listening on site, in comparison to study plans and mock-ups, gives an immediate idea of a place’s audible problems and in particularly shows the key parameters for turning the existing sound qualities on a higher level. The authors’ hypothesis and experience is that the results of site-specific soundwalks complement common plans and mock-ups and contribute to analyse, plan, and design places. In particular, soundwalks allow local people to get involved in the design process and to support site-specific knowledge. The professionals involved get a clear chance to synchronise their ideas and sound quality judgements about a specific place. Finally, a soundwalk is always a step of «citymaking» because the soundwalk’s participants spread the idea of a place’s existing and future qualities to other acoustic actors of the everyday city.

REFERENCES