Elements of Temporal Design Approach in Soundscape Based Planning of Urban Quiet Areas

Sergio Luzzi[a] , Rossella Natale[a]
[a] Vie En.Ro.Se. Ingegneria, via Stradivari 19 - 50127 Firenze, ITALY,

A methodology based on integration of urban plans and participation of stakeholders has been applied by the authors in the development of EU LIFE+ HUSH (Harmonization of Urban noise reduction Strategies for Homogeneous action plans) project and in the Strategic Action Plan provided for the Florence City agglomeration. In two case studies noise sources and perception of noise have been considered and relative actions planned according to a Participatory Design approach. The idea moves from the multi-sensorial conception of landscape and its perception and defines a process that attempts to actively involve all the real or potential stakeholders. The Temporal Design approach, considering time and space entities as matter of realizing human scaled and people-friendly environments dominated by new rules aiming to design harmonious and comfortable places, has been considered as source of inspiration for the soundscape based actions definition. The combination of ideas given by casual web, burden of disease and temporal design theories has resulted in a significant added value to the system of design methods used in Florence city Strategic Action Plan and Noise Reduction Plan development.

1. INTRODUCTION

Somewhere, the main goal of design is comfort. Somewhere the consideration of subjective sensation and perception as a contribution for approaching the urban planning is possible.

The idea of soundscape sensible urban design, considering correlation with Temporal Design theory, moves from the multi-sensorial conception of landscape and its perception and defines a process that attempts to actively involve all the real or potential stakeholders.

The authors have proposed an approach to urban design of quiet areas that consist in developing a theoretical system and testing it in some pilot cases, selected by the city of Florence: a square, the external courtyard of a primary School located in a noisy area and a whole peripheral urban area. The preliminary assumption for such a kind of comfort oriented design, from the acoustic side consists in collecting data regarding noise and sounds perception of citizens as well as defining their levels of noise annoyance in combination with their subjective sensations of comfort and discomfort related to other environmental and social factors.

Social surveys, carried out in situations where noise pollution related to traffic noise (road traffic, railway traffic, overflights, etc…) was a serious problem, demonstrated the importance that the noise climate and the soundscape in urban areas plays in social life and daily attendance of public spaces. Such problems, in addition to the intrinsic strong dynamism of cities urban structure, seem seriously compromise the sociability role of these spaces [2]. In the authors experience of noise mitigation action designers, these approach has resulted crucial for the right choice of solutions in most sensitive areas such as schools and urban green spaces. A new challenge is now represented by the recently adoption of pedestrian zones in most of the historic centre of Florence.

Hence, the need to experiment a different approach, involving people in acoustic design of “their spaces” arises besides the traditional one, based only on quantitative noise measurement results.

In each selected area considered as pilot case of project HUSH, a qualitative

analysis has been carried out, by means of surveys on sensitive areas, hotspots and quiet areas, as well as trough inquiries about people's opinion regarding the noise disturb perception.

A methodological approach for the collection of non-acoustic data, including procedures adopted for sample selection, methods for questionnaires structuring and analysing, in the frame of a participatory planning approach, are described. The results of non-acoustic surveys, carried out on significant samples of people, consists in a collection of information for planning global comfort.

From the applicative side, global comfort can be defined as a particular condition of well-being in a space (indoor or open space), according to the sensorial perceptions determined by several factors as temperature, humidity, acoustics and brightness. This condition of wellness, however, depends on the relations between the subjective (perceptive) variables and objective (environmental) variables. So, global comfort is directly connected to psychological and physical aspects. Designers have the responsibility to create highly comfortable spaces following users' expectations.

In the following of this article three examples of urban design based on the integration of urban plans in the city of Florence and the participation of stakeholders are described and some ideas for the acoustic design of the pedestrian areas, freshly established in Florence city centre are presented. In all these scenarios, elements of temporal design approach have been implemented in soundscape based planning according to a Participatory Design approach.

2. METHODOLOGY

The sources of inspiration of the proposed methodology are: causal web design, burden of disease, polycentric urban planning and temporal design.

The causal web design theory is based on a network of cause-effect relations where each graph connection can be read in both senses. The burden of disease method is a evidence based method, that consider individual experiences assessment and external evidence of a given factor of disease represented by BDI (Burden of Disease Index). Polycentrism is a urban planning theory that considers macroareas as functional centres.

In the specific context of acoustic comfort, the temporal design approach aims to create an environment on a human scale, dominated by the laws of harmony, using a mathematical model based on processing signals received by both the left and the right ear through operations of auto-correlation and cross-correlation. On the other hand, the soundscape approach helps and forces designers in considering human perception as a contribution. These two theories can be integrated in a project for the requalification of a indoor or confined outdoor place, such as an urban quiet area.

The common features between Temporal Design and Soundscape Approach are linked to the concept of "wellness", contextualized within the different phases of architectural design and urban planning. The optimization of environmental quality in a living space can be considered as the full compliance of the environmental system to the users' health requirements (temperature, humidity, visual, noise, respiratory-olfactory). During the process of designing of the recovery and requalification actions and interventions, urban spaces have to be conceived not as a set of independent and passive elements but as real entities interacting actively with users.

In European cities, a unique policy for quality of life, in terms of overall comfort each significant city space, is lacking. One of the reasons is that not all city plans and relative projects involve a simultaneous evaluation of multiple aspects of comfort, even if they are closely related and interdependent. The author's designing procedure considers subjective parameters

and assesses the degree of comfort perceived by users as a measure of the overall environmental acceptability. The acoustic design of a square and, in the frame of HUSH project, the requalification of two sites (a school courtyard and a suburban area, identified as acoustic hotspot), have followed the planning and designing approach that considers the effects of the evaluation of global comfort, based on soundscape analysis and on the principles of temporal design in architecture.

The methodology has been developed on the basis of following steps:

1. preliminary investigation phase (site description, analysis of the urban characteristics, materials, orientation, vegetation, predominant colours, sound sources, etc…);
2. measurement phase (physical measurements of temperature, humidity, brightness sound pressure level, binaural measurements etc…);
3. multilayer mapping phase;
4. psychological and social analysis (interviews and questionnaires to users about all the aspects of the comfort according to the principles of Participatory Design);
5. design phase based on the results developed in previous phases;
6. confirmation of the results (through users interviews and questionnaires).

In the frame of the definition of the methodology, the authors have been looking for possible extensions of UNI EN ISO 7730 standard to external quiet and confined areas. A draft application has been found, identifying the two indicators that express the relationships between the activity of the human body and the sensation of thermal comfort, in a statistical reference to the results of the surveys.

As proposed by the standard the *Predicted Mean Vote* PMV has been considered as a parameter that assess the wellbeing of an individual, according to subjective preferences and environmental variables. It is a mathematical function that express in a numerical value on a scale from -3 (index of feeling too cold) to +3 (index sensation of too hot) the state of thermal comfort (0 is neutral). Similarly, the *Predicted Percentage of Dissatisfied* PPD which expresses the percentage of dissatisfied people in a space, has been calculated, starting from a weighted equivalent level of dissatisfaction derived by measurements and answer to questionnaires.

In fact, being the case studies located in open outdoor spaces, not particularly significant values of some direct environmental parameters have been found. Measured levels of temperature, humidity, thermal resistance of clothing, lighting level, have been included in the algorithm for the assessment of global (thermal, visual, acoustic) comfort but the levels of perceived comfort, derived by social data collections have gained more relative importance than the measured ones, in particular for those primary factors like visibility that can generate discomfort in terms of safety or security. For what concerns noise pollution, mainly caused by road traffic, the measured levels has been considered as important objective factor of discomfort, but the perception of annoyance has got a relevant position as well.

In analogy with the above mentioned relationships, the same scale of values in the post-implementation phase of the interventions regarding visual comfort, air quality and global evaluation of the environments has been considered. The subjective method suggests using a questionnaire for the assessment of global wellness.

The subjective data collection has been developed on the basis of:

a) references to design methodologies;
b) specific structure of questionnaires;
c) interviews with a representative sample of subjects
d) statistical elaboration and sociological analysis of collected data;

e) report detailing results to support the requalification actions.

Questionnaires have been divided in three sections:

I. general data of interviewed people (in order to assess sample's heterogeneity) and about mode and timing of attendance of investigated area;
II. perception of the area quality level, referring to six general aspects (facilities, air quality, cleanliness, security, green, soundscape);
III. annoyance assessment relative to several specific noise sources (voices, road traffic, railway traffic, natural sources as twittering, etc.)

The interviewed have been requested to indicate favorite sub-area, expressing reasons, and to give some suggestions to improve the general comfort of the space.

The questionnaire investigates the reactions of people who use the space. Questions relating to each aspect of the environment have been reported and quantified as level assumed by variables. Some examples: perceived noise, acoustic comfort, acoustic preference, noise tolerability, visual perception, visual preference, visual tolerance, air quality tolerance, environmental impact.

3. CASE STUDIES

Three categories of urban scenario have been considered: squares, schools with external areas, suburban areas. In the following, one case for each category is reported.

In all the cases the three steps of the methodology: identification, characterization, design has been implemented.

3.1 Squares

The strategic choice to re-design some squares of the city of Florence was a part of the Strategic Action Plan provided by 2002/49/CE Directive, the Environmental Noise Directive (END). Such a choice moves from the consideration that many squares are located in proximity of transport infrastructures with great transit of vehicles, so in these areas it is sure that it will have need to interventions for noise reduction.

Piazza della Vittoria is located where a railway station was expected to be set up in late 19th century, according to the project presented to Public Administration of Florence by Giuseppe Poggi, a famous Italian architect of the time, in 1856. It is a site beloved by people for some reasons included the trees that gives it the aspect of a garden.

The square is delimited by four streets with important traffic flows and next to the square there are two relevant sensible receivers: the High School "Dante" and a Nursing Home. For long time this square has been an important meeting point for people of the district. Now it is frequented by students, street-football players, young and old people, reading the newspaper and mothers and baby sitters with children.

However, the square is in bad condition of urban blight, improperly used as a parking the days of streets cleaning. Because of this improper use, the grass lawn doesn't grow up, cleanliness and urban furniture are insufficient, there is not a playground and the few existng garden seats are broken and located in the paved central part of the square.

The idea of the requalification of the square as a participative design process has been implemented. The designers have been able to transform each situation perceived as a discomfort as a matter of designing. This kind of work will continue also after the project is done and the requalification realized.

In the case of Piazza della Vittoria, a listening campaign has been organized for six categories of square users:

- students of high school "Dante"
- commercial activities facing the square
- old people
- residents
- mums and children
- teen-agers

Four sub-areas have been individuated according to urban function, typology of urban furniture and noise and,

above all, to social fruition, as derived by the listening campaign.

In all the sub-areas soundwalks with binaural recording have been made to study the soundscapes characterizing daytime acoustic climate. In the same time periods and in each sub-area Sound pressure levels have been measured with microphone positioned at a height of 1,5 mt. from the ground. A specific acoustic map has been derived giving a quantitative survey of all typologies of sonorous sources.

The subdivision in sub-areas, each helps fruition by several categories of users with different needs.

In the case study the square is organized in 4 sectors, according to several categories of users individuated (old people, adults, teen-agers, babies), each sector being a sort of "squares in a square" that can be distinguished functionally, but also acoustically.

So we have : *the square of Dante*, dedicated to students of "Dante" Secondary School, the *square for sound and games*, with sonorous installation, the *square for babies* whit a sound based playground and *the square for relax*, a relaxing area where it is possible to rest, read, etc.

Figure 1. Piazza della Vittoria: the four squares in the square – plan

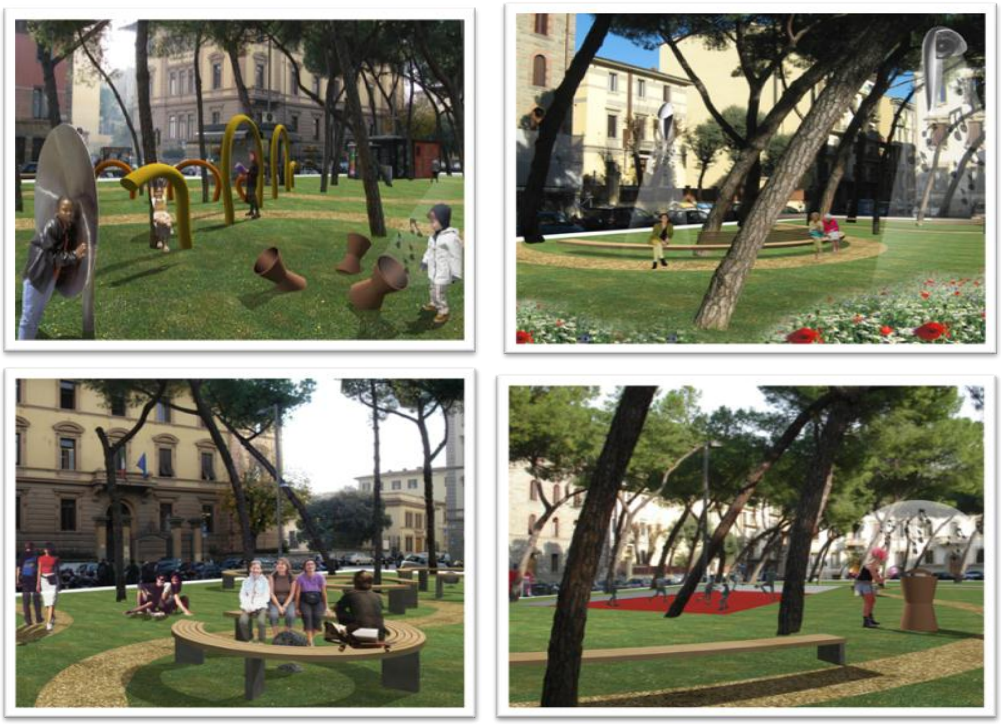

Figure 2. Piazza della Vittoria: the four squares in the square - rendering

3.2 Schools

Schools have been located by Florence administration at the highest priorities in the Noise Mitigation City Plan.

Don Minzoni is a Primary School located in close proximity to a noisy suburbian road, identified the Florence Strategic Action Plan as an acoustic hotspot.

The courtyard of the school is paved in the central part and presents two large flower beds with firs and pines. On the east side of the school there is another green area more protect by the noise. The garden is not equipped with games for children. The garden is enjoyed by children of elementary school during playtime.

The Results of questionnaires (proposed to pupils, families, teachers) show a general but clear overview about the school garden perceived environmental quality. Children contributed to the survey with illustrations about their ideal new garden. Their drawings show how much they would like a garden with pleasant soundscape and a well equipped with games.

A specific section of the questionnaire shows questions aiming to evaluate the sensibility of people towards comfort perception (equipment, air quality, cleaning, security, green and soundscape). The first phase of application applicatiop of the firstmethodology (individuation) carried to four sub areas.

Issues evaluated as more critical, with reference to areas are: soundscape, considered positively by only 13% of respondents, and equipment, considered adequate by only 12%. The sample was sufficiently and fairly satisfied with safety, air quality, cleanliness and presence of vegetation. Sounds that cause more annoyance derives from traffic (cars, buses and motorbikes). The perception of discomfort related to road traffic noise is also evident in the preference of the sub-area facing the heavy traffic road if compared to the other more proteceted ones.

Also in the participatory planning and design have been conducted. A very special design team has been established, consisting of children from different classrooms, co-operating with their teachers as well as with other adults (parents, architects, engineers).

The main users of the garden are definitely children. From survey emerges the request to dispose of game-furnishing and to make noise decrease. General need expressed to include playground equipment is justified by the fact that playing is a fundamental need for growth and a key factor in education and learning process of children. Great appreciation expressed towards the proposal of building up a noise barrier to protect the area from the Via Reginaldo Giuliani traffic noise, is an important signal that improving the soundscape of the area is a needing of children too. In particular a green barrier, although it was not technically the best solution for noise reduction, it is preferred. So designers final choice has been oriented towards an embankment, that guarantees noise reduction effect and is not visually intrusive, being itself a fun element for playing.

The collection of subjective data has been directly used by designers, trying as far ass possible to respect the level of originality and creativity of the children, taking care of selecting the most appropriate materials and solutions and taking into account the regulatory constraints for school buildings.

The project for the garden of the school combines noise mitigation goals with the needs emerged in subjective survey. At the end, this project consist of:

a non intrusive barrier, for reducing noise in a visually pleasant way, well integrated with the space and, above all, enjoyed by the children during playtime;

- wooden playground with educational games;

- wooden mobile amphitheatre to give lesson in the garden;
- soundwalks in the homegrown vegetables garden.

In the definition of layout, orientation, dimension of passive and active mitigation system, and in of the other elements (playground, amphiteatre), the second phase of the methodology (characterizarion) have been based on the integrated Soundscape and Temporal Design approaches.

3.3 Neighbourhood

In the surroundings of Florence there are some areas where residents are many and there is no confortable public place to stay.

The area of Brozzi-Quaracchi includes two historical quarters in the north-west of Florence. The area is delimited by two major roads, connecting Florence to Pistoia and Prato. There are high density of population and presence of a community deeply rooted in its territory. Noise annoyance to the population, is mainly caused by the flow of vehicles crossing the area between the two main roads using local streets rather than the road system outside the quarter. In this urban area five green areas are present but, due to their condition, not properly used, or used without satisfaction, by citizens.

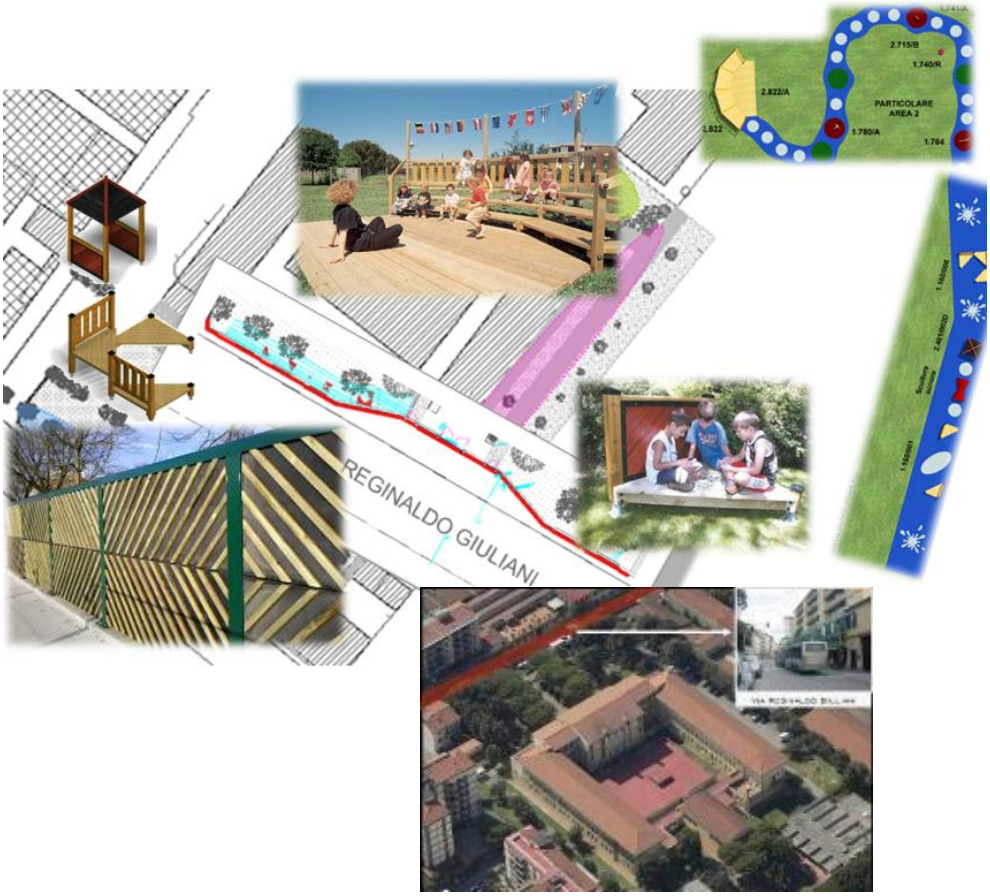

Figure 3. Don Minzoni School case study

Non-acoustic data collection for Brozzi-Quaracchi urban area was focused on people perception acquisition about two distinct aspects: one being the investigation on traffic related problems in such busy sub-urban areas; the other being the satisfaction rating on green areas. Looking at questionnaire results, a huge percentage (about 60%) of respondents, consider road traffic as a very annoying noise and only 21% consider it tolerable. Among noise reduction interventions suggested in the questionnaire, the respondents expressed favorable opinions towards changing the

viability and creating low-speed zones (30 km/h). In the following figures, some graphs representing surveys results are reported.

The data also show that the areas are frequented every days generally for more than 2 hours

despite the overall level of satisfaction about the comfort is not so good for all examined areas.

In the development of the project of this case study, the concept of multi-sensory landscape (perceived in all its aspects and not only in the visual one) has resulted very important. In fact, the pilot case data analysis demonstrates that non-acoustical data results converge on the suggestion of changing the traffic system.

Proposed interventions for improving overall green areas conditions can be summarized in:

- viability variation and creation of a zone 30 Km/h to discourage traffic crossing area, to favor pedestrian path and/or bicycle lane to connect green areas;

- protection against noise by means of embankment and green barriers for the most critical green area;

- introduction in some green areas, of pleasant sounds, like music, composed soundscapes as a mix of natural sound and artificial sounds typical of the area, can make these areas more interesting and attractive creating a path among flowers and music. In this choice the principles of Temporal Design have been applied as far as possible.

4. FURTHER DEVELOPMENT

To preserve quiet areas from noise should be one of the priorities in city action plans.

The approach based on the soundscape can be a good solution for designing quiet areas, considering not only the numerical constraints of legislation, but also the acoustic comfort of the place.

The authors' intention is to go further in this process, raising the attention of urban planners and landscape architects, towards a participatory planning approach, for requalification of urban squares, green areas, urban parks, improving their soundscapes as a vehicle for socialization, so the sound urban spaces can be central elements of social quality and aesthetics of our cities.

Architecture of urban space concerns the wide concept of landscape architecture. Every human intervention, in urban scale, must be designed considering the landscape as a part and a parcel. The concept of landscape is continuously evolving because the way of sensing it is evolving too.

Designing urban space today, can't leave aside topics as multi-sensorial perception of landscape (in its several aspects not only linked to the visual one, and the awareness that landscape belongs to people who live it as active part of project itself.

Design has to involve directly the users of the place, through a process of participation and communication, for qualifying the place through knowledge of inhabitants in their living contest. This process of designing increase the sense of belonging to place, reinforcing the idea of "community". The real transformation of the city often doesn't go on with the evolution of its perception, but it is sure that its perception is often more actual than tangible city. In the twentieth century cities achieve a lot of transformations on sensorial side rather than urban side. It is possible referring to sensorial qualities of building spaces, qualities that overcome the predominant visual channel to include a multi-sensation approach.

Sound designer and music sociologists underlined that in the last years the request of sonorous design of public areas has become relevant. And that a conscious sound design, aimed and functional can use sound as a vector of comfort and social usefulness. The sonorous dimension in urban spaces has reached a high level of attention, rigour and functionality.

5. CONCLUSIONS

The acoustic design should be included in a more general approach to integrated management of urban design.

The trend of protecting urban spaces using barriers against noise sometimes generates a sort of "physical" and/or "psychological" cage. The proposed methodology uses alternative and strategic systems that can, in active mode, preserve the quiet acoustic climate.

In such a way the city re-conquer its urban space and urban role. The interventions on quiet areas can be, in this way, adapted to different cities, architectures and users. The comfort comes from visual and soundscape, designed to be close to people needs, to reality.

A lot of studies about psycho-acoustic have demonstrated that noise test also our social sense so it is time to re-discover the urban space, with its characteristic of pleasant place.

The first case study presented here shows how a square can be rediscovered: the"squares in the square"

The second and third cases, part of Florence city Strategic Action Plan and of EU funded project HUSH, are based on Soundscape Analysis applied to participatory design of urban areas.

The theory of Temporal Design has been considered as source of inspiration in the definition of the methodology used in all the presented cases and in other urban scenarios, particularly in the definition of parameters used in the process of intervention design.

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