Urban and architectural heritage; interdisciplinary methods in the evaluation of acoustic design in traditional houses

Debache Samira & Benzagouta Yasser Nassim
Laboratory Villes & Patrimoine
University of Constantine 3/ Faculty of Architecture & Town planning
Cité Gric Bt 01 N° 08 Ain Smara Constantine 25000, ALGERIA.

Abstract: We, unfortunately, notice that most Islamic countries have lost their urban and architectural heritage: they opted for a contemporary urban structure imported from Western countries; and, as a result, they lost their identity and missed the opportunity to preserve their valuable Islamic architectural heritage. Our cities are losing their historic styles and the impact of modernisation has led to a rupture of continuity between the inherited morphology and more recent urban structure.
On the other hand, Western designers are impressed by Medinas and old cities; they are seeking and investigating established techniques and ways of construction which have proved their effectiveness and success.
It seems that we have forgotten that traditional architecture proved its ability in reducing heat, cold, noise, humidity, etc., inside buildings; that is an important message for modern designers. Our architectural heritage is a force that should link and connect past, present and future communities.
This study investigates interdisciplinary methods in the evaluation of acoustic design in the traditional house; it focuses on techniques used for reducing noise in traditional local buildings and identifies how to integrate sonic quality to architectural design. This may provide an alternative approach for designers and developers who are able to create architecture that will be the heritage of tomorrow. Our research emphasizes on objective sound levels, in different indoor and outdoor spaces. In conjunction with these measures, we correlate the use patterns in different zones of the buildings and the effect of noise on the inhabitants. Our intention is to present a multidisciplinary study on sonic quality in traditional housing and public spaces and to promote traditional ways of construction.

Keywords: Architectural heritage, Sonic quality, Living environment, Medina, Identity, design, house

I. INTRODUCTION
Acoustic comfort, considered to be a non-priority topic twenty years ago, is now an important concern for designers and occupants. Indeed, today, noise has become a significant pollution, generating stress, tiredness and irritation. In fact, it is at the top of the harmful effects listed by the inhabitants of cities. Nowadays, whilst architectural design shows considerable respect for norms and regulations concerning thermal insulation procedures there is less concern over sonic quality. Acoustical remedies are often introduced to correct rather than prevent a problem [1]. In this study, we demonstrate how traditional building methods and techniques give beneficial results regarding acoustic comfort and sonic quality in the living environment. The existing sound literature, both in research and in practice, is dominated by a technically-normative approach; one which looks to measurements and regulations rather than human feelings and perceptions. Criteria for assessment of the harmful acoustic effects due to a variety of noise sources inside and outside buildings still remain a mystery and an enigma for many designers [4].
This study addresses the characteristics of the sound environment and demonstrates how the sonic qualities of traditional building environments were much more desirable than in buildings produced by modern construction practices. The results from occupant interviews and measurements, in the Medina, show that traditional techniques are effective in reducing noise transmission from outside to inside buildings.

II. RESEARCH METHODOLOGY
Three traditional houses were selected for this study. Similar investigations, involving noise measurements and qualitative descriptions of complex sound situations were carried out several times a day in order to compare the different houses studied. The relationship between the organisation of space and the effect of this on noise generation by the occupants and subsequent transmission through the spaces was also investigated. In addition, interior and exterior sound environments of the Medina and contemporary areas were compared. Tenants were
surveyed by questionnaire to evaluate noise, its level, times of occurrence, etc., near residential properties. The object was to get a general overview of the most common noise irritations for residents. The information gathered was used to explore the traditional building methods and techniques and their effectiveness in reducing noise inside houses. It was important to understand how the building envelope influenced the practices of comfort and adaptation within the interior environment [3]. For this reason, we:

- established the overall acoustic context of the buildings,
- obtained an assessments of the acoustical environments as perceived by the inhabitants,
- identified specific noise problems and their relationship with building quality and construction method,
- detailed the behaviour of inhabitants vis-a-vis noise issues and noted actions they took towards controlling the noise.

### III. SITE DESCRIPTION

The Medina of Constantine is a very compact site, where houses screen each other from outside noise as shown on Fig.1 and Fig.2. The old parts of the medina are dominated by narrow, winding thoroughfares and traditional buildings. It is surrounded by the modern city, comprising French colonial style buildings, and newer quarters with modern Algerian buildings. The Casbah, a Roman fortress, the 18th century Mosque, the Medersa and the 19th century Bey Palace are Constantine’s most important landmarks. The city thus has a variety of contrasting architectural and urban features. French buildings constitute the facades of main streets hiding the inner original traditional fabric and buildings, Fig 2. The traditional Arab medina has narrow, faceless, unadorned streets with no windows on the street and only small doors that open onto opulently ornamented courtyards. The medina public spaces have been influenced by changes introduced mainly during the colonial period and these European urban styles inside the medina have created differentiated quarters. Measurements were taken in houses with different locations e.g. shopping streets, alleys and dead ends; with an emphasis on capturing the sonic quality of the traditional environment.

**Figure 1: Overall View of the Medina (source, Y.A.Bertrand)**

**Figure 2: French Buildings Sheltering Traditional Houses from Noise (source, author)**

### IV. NEW ACOUSTIC REGULATION

Acoustic regulation (NRA, new acoustic regulation) has been adopted by European countries in 1996; dealing with a range of human activities such as:

- Building acoustics: minimum performance levels for insulation in many types of buildings (Hotels, Schools, Residential Buildings, Industry, Commerce and Services).
- Urban acoustics: definition of quiet and noisy places;
- Traffic: limitations to noise produced by vehicles;
- Environment: limitation of noise levels produced by “noisy activities”.

Generally, European Union Member State regulations define the maximum total sound level due to services and appliances that could be measured in the different spaces of dwellings. Values range from 20 to 30 dB(A) in bedrooms, 25 to 35 dB(A) in living rooms, 30 to 40 dB(A) in kitchens and 35 to 45 dB(A) in other spaces, [12]. These values indicate the maximum total sound level produced by all the services and appliances which generate noise of long duration. For noise of short duration, these values can be increased by 5 dB(A), [9].

Local authorities in Algeria use the same ways of evaluating environments as in France. The measured values (LnAT in the French regulation which means Lp adapted to a standard reverberation time of 0.5 seconds) must not be higher than between 30 dB(A) to 45 dB(A) in the living room and between 35 dB(A) and 50 dB(A) in the kitchen. The minimum values found range from 25 dB to 35 dB depending on the type of building and on the classification of the neighbourhood (ranges from quiet to very noisy) [10].

V. UNDESIRABLE EFFECTS OF NOISE

Noise can be defined for our purposes as intrusive sounds that disrupt, distract, or detract from regular functioning. It has a negative impact on the health and productivity of people. Many studies [2, 3] have looked at the effects of noise on health and wellness, and the results have shown that noise has its main impacts on productivity and health.

- Productivity, because noise can be distracting, [11]. One study [8] examined children exposed to airport noise and found that their reading ability and long-term memory was impaired. Those working in noisy office environments have also been found to be less cognitively motivated, and to have higher stress levels, according to a Cornell University study [8].
- Health, and perhaps the most serious problem created by noise is the impact it has on our health. Because it can trigger the body’s stress response. As a result, noise has also been linked with heart disease, high blood pressure, and stroke. Noise pollution can also impact sleep quality by keeping people awake and disrupting sleep cycles. And, perhaps most significantly, because chronic stress can lower immunity to all disease, noise is a general threat to health and wellness [11].

VI. MEASUREMENTS AND ANALYSIS

The study was initially directed towards discussions on the concept of noise intrusion and its significance for the inhabitants. The first aspect of the research has been to explore the possibilities and the methods of collecting information on the sonic environment. Questionnaires surveys of inhabitants were carried out in order to evaluate their impressions and intuitive approaches and practices for achieving acoustic comfort. In the traditional Medina, measurements were taken in three houses, in different neighbourhoods, where noise intensity varies according to the area (shopping or residential streets).

The living environment of the Medina is characterised by compact houses with typical and very distinctive passageways Figs 3, streets, dead ends Figs 4, skiffas (passages leading to the inside of houses). These architectural and urban elements act as screens and buffer zones against the outside noise. This variation of noise levels and the transition along passages from the outside to courtyards is the result of a hierarchy of passages in the traditional environment; from an open and noisy space, with a diversity of sound sources (mechanical and natural) in the street, to an alley and then to the skiffa, which acts as a real screen against outside noise as shown in Fig 5.

Figures 3: Passageways: Sonic Filters of the Medina of Constantine (source, author)
The results suggest that sonic comfort requires more than usually considered in terms of acoustic insulation. It shows that houses of the medina provide a level of acoustic comfort which can be identified in terms of architectural conception and in terms of criteria determined by those who use the space. Noise intensities recorded are rather uniform and evolve in a dynamics of about 10 dB (A) (between 61 and 71 dB (A)) depending on the source of noise. This reflects an environment in which a whole series of signals (footsteps, voices, etc.) emerge on a constant background noise.
Our research confirms that traditional ways of buildings proves more satisfactory for achieving acoustic comfort. In fact, the design of the traditional house and the role of certain elements in screening and shielding against noise are actions that should be taken into consideration during the design of contemporary residential buildings. This underlines the need for planners and decision-makers to apply such tools which allow them to manage and control the intrusion of external noise into housing better that at present.

VIII. CONCLUSIONS

Nowadays, noise mapping helps in determining issues for preventing disturbance from external noise. However, sonic comfort does not exist in isolation but results from a process. Research shows that this comfort has a much larger significance than what is usually considered in terms of acoustic insulation, and that the occupier is known to be an active participant in this process, [7].

We should take advantage, as planners, of our valuable heritage. An overview of acoustically successful traditional housing methods can serve the contemporary designer who is interested in acoustic comfort [6]. Traditional measures have developed a synergy between the acoustic capabilities of constructions and cultural characteristics depending upon the period in which, and the place where the inhabitants reside.

This research has intended to demonstrate the values of some traditional building forms for contemporary planning and architecture.

REFERENCES