MADRID
inter.noise 2019
June 16 - 19
NOISE CONTROL FOR A BETTER ENVIRONMENT

Acoustics in global comfort design of restaurants

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ABSTRACT

The paper reports some experiences of acoustic design inspired by global comfort theories and approach.
The methodology has been defined and applied by authors in some case studies including high rated restaurants, requiring top comfort quotes as well as popular "trattorias" serving typical food in a friendly, crowded, noisy atmosphere, aiming to reduce the background noise.
The sound and noise characterization of eating rooms and dining areas in open spaces, based on room acoustics principles are presented by the authors in terms of values given to acoustics variables that are combined with other variables representing different factors of perceived comfort.
Indicators of global comfort for guests are generated by combined variables and used for the definition of solutions characterized by the aim of optimizing both the perceived quality of place enriching the food experience.

Keywords: Noise, restaurants, comfort, acoustic quality
I-INCE Classification of Subject Number: 52

1. INTRODUCTION

Noise produces auditory and extra-auditory effects on humans, affecting the hearing organ and other organs and systems. The categories that represent the effects of noise on health, however, are subjected to redefinition at both the scientific and applicative level, including in addition to the pathologies of the auditory system and other systems and organs, also problems related to the multisensory perception of discomfort, which fall into the categories of noise and annoyance disorder.

In the construction and architectural design of living places and workplaces, there are many spaces with structural and furnishing characteristics that are not suitable for the correct propagation and listening of sounds that result in the aforementioned problems.

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In this work, starting from the authors' experience, an approach to designing the acoustic quality of restaurants is proposed.

The holistic approach to global comfort solution can be referred to the acoustic design of buildings: it is based on the principle of maximizing the pleasantness of places and the global satisfaction of people, considering sustainability like a positive karma that can stop the planet's degradation and the discomfort of its inhabitants.

Designers of buildings, and interior designers of public spaces in particular, are facing the need of considering acoustic quality as a fundamental element of global comfort. New theories and methodologies are diffusing among researchers and policy makers, regarding holistic approaches. In this developing scenario the contribution of acousticians can be relevant. A possible combination of what is reported and recommended in the recently published new WHO guidelines [1] with the more general global comfort index-based design method is presented.

Leisure noise, the noise produced by recreational activities: discos, bars, concerts and the so-called "movida" that characterizes the sound landscape of the urban centers where the coexistence between the right to engage in noisy commercial activities and the right to rest has been considered in the WHO review of evidences, alongside the transport infrastructures (air, rail and road traffic).

Despite this new sensitivity to the problem, restaurants are often characterized by a bad acoustics and a poor multi-sensory perceived comfort

2. GLOBAL COMFORT IN RESTAURANTS

The perception of comfort is multisensory and individuals often present different sensitivities in each of the five senses: psychoacoustics is exploring important aspects of psychological factors deriving from acoustic discomfort, also in consideration of individual neurophysiological aspects of the exposed.

The full consideration of the comfort and the acoustic quality of habitat is the new frontier of the design of the working and living environments, including leisure ones. Noise mitigation inside and outside the workplace is increasingly linked to new design approaches based on the principles of occupational hygiene and health promotion [1].

The methods and algorithms of Global Comfort Design, with their relative indicators, are well applied to a field of specialized design, like the acoustic improvement of restaurants. Figure 1 shows an example of cataloging the comfort indicators that can be connected to acoustics and of implementing a procedure for the holistic design of restaurants. For each comfort indicator, a set of variables can be defined that represent the different physical or subjective, measurable or perceived aspects of the quality of the environment that can be connected, directly or indirectly, to the acoustic design [2].

Global comfort in restaurant design requires a specific evaluation based on the intended use of the buildings. From this point of view, it is possible to divide the performance groups on the basis of the functions that take place in the buildings.

The main acoustic parameter to be considered is the reverberation time. The relevance of the Lambert effect in restaurants is clear: the higher the background noise, the louder the internal noise due to people talking.

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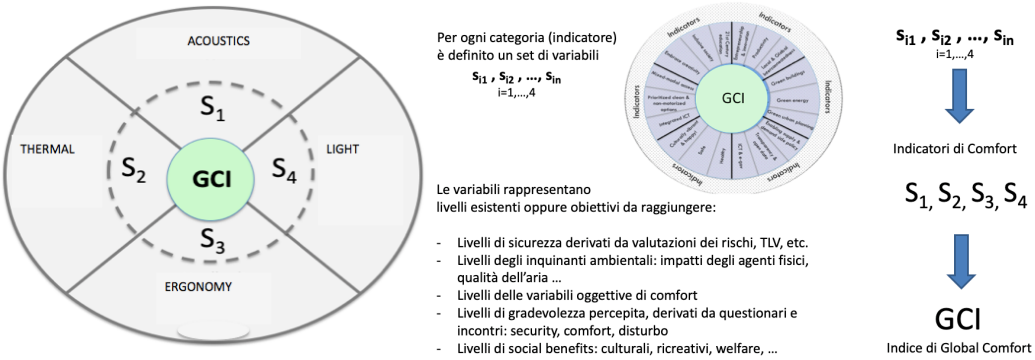

Figure 1: Examples of comfort indicators that can be connected to acoustics implementing the holistic design of restaurants

Several studies have been carried out in Italy in recent years, with the aim of assessing the interaction between different parameters that affect the environmental comfort (thermal control, air quality, illuminance and noise), also with questionnaires designed by psychologists and statisticians, reporting the perceived sense of comfort and pleasantness in the restaurant experience.

In figure 1 the Comfort S_1, S_2, ... indicators are calculated as:

$$S_i = F_i\,(s_{i1}, s_{i2}, \ldots, s_{im}) \tag{1}$$

where s_{i1}, s_{i2}, ..., s_{im} are specific variables that represent the sub-categories of each indicator. It is thus possible to define an index of the overall comfort of a design action or of an entire project, as a linear combination of the values of the comfort indicators.

$$GCI = \Sigma_{j\,=\,1,\,m}\; k_j\, S_j \tag{2}$$

where the value of the k_j constants derives from constraints or priority choices made by the designer.

Considering the C_s Cost, as a weighted average that considers the real costs, the social costs and the costs induced by secondary variables and, similarly, the benefit B_s as a weighted average that considers the primary benefit and the added values of quantifiable secondary and serendipic variables (objective and subjective), it is possible to define a global GI index that allows to evaluate the project (or the single project action) according to the comfort (represented by the GCI index), the cost and the benefit:

$$GI = F\,(GCI, C_s, B_s) = F\,(S_1, S_2, \ldots, C_s, B_s) \tag{3}$$

3. ACOUSTIC DESIGN OF RESTAURANTS

The requirements for restaurant room acoustics design are based essentially on the reverberation time. The acoustic quality in commercial or leisure buildings, such as restaurants, shopping centers, etc., given the vagueness of the functions and activities that take place there, is mainly assigned to the control of reverberation time by means of sound-absorbing materials. The sound-absorbing materials have the function of "retaining" the noise, eliminating or reducing the reflected waves that cause

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reverberation and make the acoustic climate of the interior unpleasant: think for example the restaurants, where the sound atmosphere often characterized by reverberant spaces , is unbearable: the background noise determines the need to raise the voice that determines the rise in background noise and the deterioration of the sound atmosphere.

The sound-absorbing materials are classified primarily as porous and fibrous materials. These are joined by acoustic resonators, vibrating panels, mixed systems. They are part of sound-absorbing materials, natural organic materials such as cork and natural fibers (wood, hemp, linen, cotton), synthetic organic materials such as polystyrene, polyurethane and inorganic materials such as glass and rock wool, vermiculite and expanded clay. We are also affirming "green" materials such as planting lichens with good acoustic performance and low maintenance requirements. Each of these materials has its own absorption characteristics represented by a very precise coefficient.

With the porous and fibrous materials that absorb sound waves, sound-absorbing systems of various shapes and sizes can be created: panels to be applied to the walls or baffles to hang from the ceiling. And they can also be used as furnishing elements: the experience of some important architects and interior designers, think for example of the restaurants designed by Studio Ab Rogers of London, teaches us that we can consider sound-absorbing solutions as part of the acoustic design of a space. The noise mitigation thus becomes a strength of the redevelopment of buildings making the design readable and pleasant, "proudly showing - to use the words of Rogers - an acoustic treatment, rather than hiding it, relying on its striking visual appearance".

In figure 2 two significant examples of acoustic improvement in two restaurants, located in London and Florence, are shown. In both the rooms the main intervention consists in the reduction of reverberation, optimizing the intelligibility of speech, by means of sound-absorbing materials integrated in a comfortable and stylish interior design.

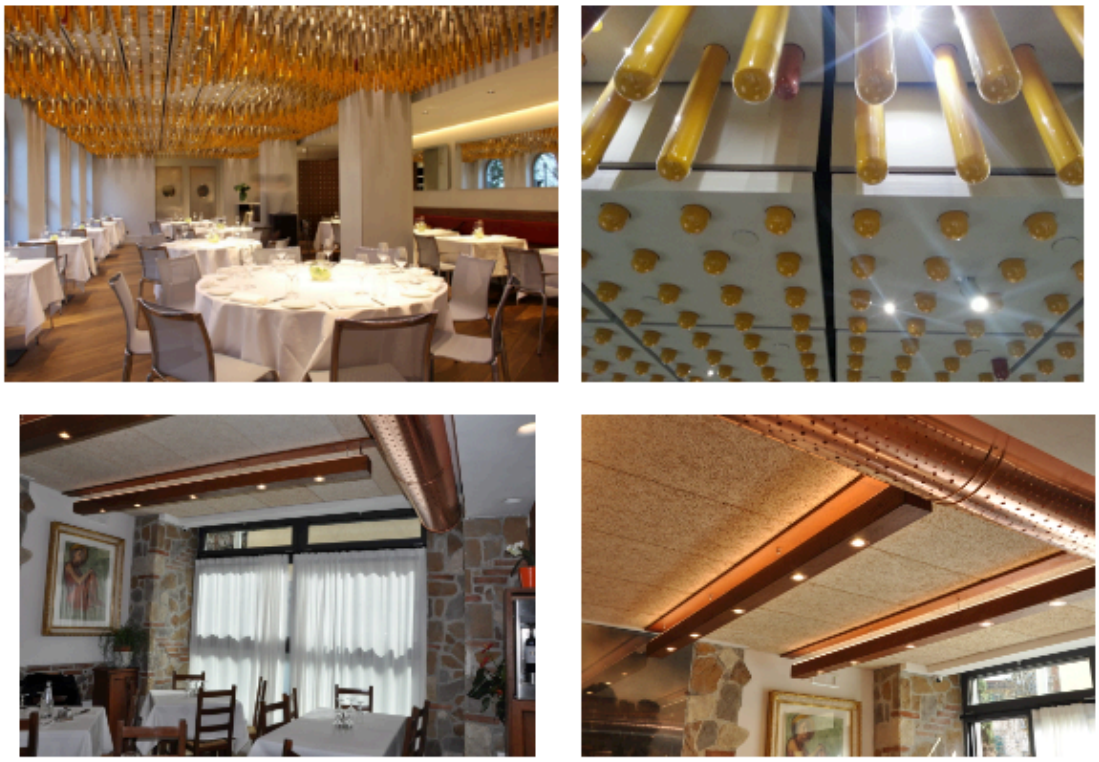

Figure 2: Examples of interventions implemented as part of the restyling of restaurants applying global comfort approaches.

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Figure 3 shows a summary of the design documents relative to the global comfort design of a company canteen. Canteens and refectories are particularly delicate environments from the point of view of acoustics and global comfort: they represent a good example of space where the problems deriving from discomfort factors are more evident and where some important variables that represent these factors (measurable and perceived) can be identified and inserted in the algorithm described above.

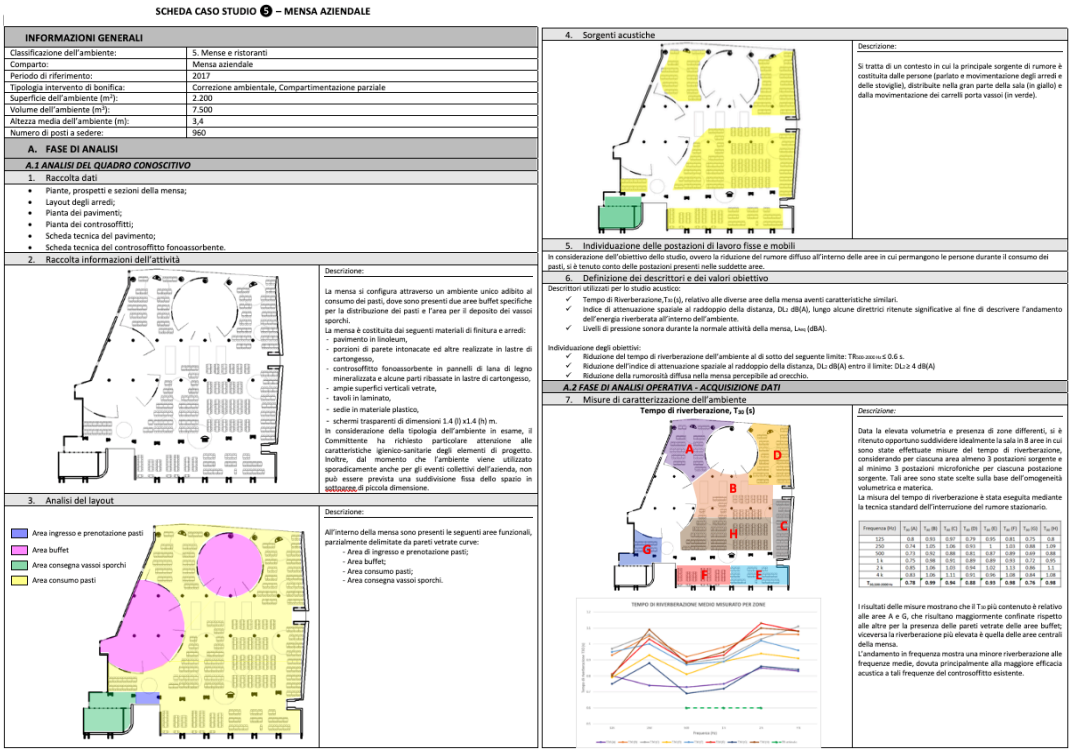

Figure 3: Global confort approach applied to the design of a canteen

4. CONCLUSIONS

In this memory, the principles of global comfort applied to the design of restaurants, considered as spaces indirectly intended for speech and listening, have been summarized. The importance of the perception of comfort and acoustic quality has been underlined, considering how the low acoustic quality of the leisure places can determine discomfort and unpleasantness conditions that make difficult the enjoyment.

5. REFERENCES

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