

Sound Influence on Spa Park Perception in Feelings of Visitors

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Abstract. Noise can have many harmful effects on the recipients, however people exposed to noise on a long-term and regular basis can get used to it, even if the permissible levels are exceeded. In cities, green areas and park systems are provided to create a climate for rest and relaxation. Spa parks are a special kind of such park systems, which – in addition to the above-mentioned features – support therapies offered by spa facilities located there. On the one hand, patients and visitors appreciate various social and entertainment events held there, but – on the other – a multitude of sounds associated with them may reduce the comfort of their stay.

The aim of this paper is to analyse the relationship between the results of noise measurements and the human perception of noise within the impact zone. The examined area is a spa park in the health resort district of Inowrocław, where seasonal measurements (taken in summer and winter) provided a basis for the determination of the connection between the measured values of equivalent sound level and the noise level perceived by surveyed people. A statistical analysis was performed to take into account the correlation between the obtained measurement results and the human perception of noise. It shows some differences in the perception of heard sounds. The results allow an evaluation of the soundscape of the analysed area.

Keywords: acoustic climate, green area, noise, soundscape, spa park.

Conference topic: Environmental protection.

Introduction

City residents are exposed to various stimuli, whether they are aware of them or not, and noise is one of the most discomforting of these. Continuous exceeding of the permissible levels of noise may lead to the development of various disorders and illnesses. The subjective perception and sensitivity to noise depend on the individual's physiological predisposition and the nature of the noise itself. Certain noises may be both pleasing to our ears and cause nuisance. This depends on the individual's personality, age, state of health, mood, sensitivity and immunity to noise. The notion of 'noise sensitivity' is a unique, increased perception of noise as unpleasant (Shepherd *et al.* 2010; Sellenrich 2014; Aletta *et al.* 2016). City parks are the main environmental resources for modern urban areas. They are valuable because of their recreational, leisure and health-promoting functions. Attention to the problem of acoustic climate of such areas has been increasingly drawn by different authors. Spa parks located in health resorts play a particularly important role in the shaping of the space intended to support therapies. The term 'health resort' applies to an area which combines therapeutic and leisure functions (The law of 28th July 2005). Their fundamental principle is to maintain a balance between natural and cultural environmental factors (Węclawowicz-Bilska 2010; Sztubecka, Skiba 2016). Modern health resorts, being health-promoting centres, should be distinguished by their unpolluted natural environment and appropriate climate to enhance the beneficial effect. They are often treated as tourism and recreation areas offering board and accommodation, and featuring sports and cultural facilities. Population ageing and the increasing health awareness make spa tourism a dynamically growing sector in a lot countries. The management of such areas should, however, make sure that the health resort assets are not lost as a result of unrestricted public access (Liu *et al.* 2013; Liu, Kang 2015). Acoustic landscaping involves the creation of such acoustic conditions that would prevent sound stimuli from exceeding established limit values and keep them at optimum levels from the point of view of human health and activities. The conditions should also facilitate the maintenance of the so-called acoustic comfort (Baltrenas *et al.* 2010; Orozco, Aguilar 2016), which depends on the approach and materials selected, but may also largely depend on the sources of sound emissions in the given area and on the sensitivity of the recipients. Therefore, the purpose of this study is to analyse the correlations between the results of noise measurements and the its perceived nuisance expressed by people exposed to the noise.

Materials

Inowrocław is a town in the Kujawsko-Pomorskie Province, founded near the historical settlement of Askaukalis, a Roman era trade emporium situated on the Amber Road. At present, the town serves the following functions:

- A large residential community,
- An industrial, economic and commercial centre of the region,
- An important road and rail transportation hub,
- A health resort with an established spa district.

The spa district of the town is located in its western part. It features a spa park (*Park Solankowy*) with brine graduation towers and sport and recreation facilities. The health spa centre was founded there in 1875. At first, the spa gardens (*Ogród Zdrojowy*) covered 5 ha but has been stretched to the west and expanded to approx. 85 ha. The complex is functionally developed and adapted to serve both therapeutic and leisure purposes (Fig. 1).



Fig. 1. The location of spa park – Park Solankowy (Source: own elaboration)

The park has been developed to cater for health spa patients and visitors, enabling them to stroll along the alleys and promenades and relax at the brine graduation towers, gazebos, mineral water pump rooms, spa houses, natural therapy centres and other public buildings available in the area (Fig. 2, Fig. 3).

The SPA Park scheme - Inowrocław



legend



Fig. 2. Spa park with sources of sound (Source: own elaboration)



Fig. 3. Spa park "Solanki" (Source: own elaboration)

The principal purpose of the spa park was to create a climate which would support therapies administered to the health spa patients. However, its social and entertainment functions are perhaps now equally important. The emission

of music out of the ballrooms and restaurants affects the comfort of a substantial number of patients and visitors staying or passing nearby. Other sources of noise are playgrounds, alleys and other facilities and installations in the park. This shows that most of the noise in this kind of areas comes originates from the manner of use of their facilities.

Methoda and results

Considering the subject of this study, it is interesting to look at the issue of noise present in the spa park in connection with the impression of people exposed to it. To this end, two contrasting measurement seasons were selected in which the park is used differently: the summer and the winter. In order to relate the recorded impressions to the conditions which actually prevailed in the park, the equivalent sound levels were measured. These measurements provided a basis for the analysis of four ranges which came between the minimum and the maximum values of the noise (Table 1).

Table 1. Noise level ranges (Source: own elaboration)

Classes of noise nuisance in the park	Values in decibels [dB]
low noise nuisance	42.9–46.5
moderate noise nuisance	46.5–50.1
substantial noise nuisance	50.1–53.7
severe noise nuisance	53.7–57.3

Mean reference values were then determined for the assumed ranges shown in Table 1 (Table 2).

Table 2. Reference value (Source: own elaboration)

Classes of noise nuisance in the park	Mean values [dB]
low noise nuisance	45.1
moderate noise nuisance	48.7
substantial noise nuisance	52.3
severe noise nuisance	55.9

The mean values calculated from the measured sound levels for the two selected seasons are shown in Table 3 below.

Table 3. Mean sound levels in the park by seasons (Source: own elaboration)

Seasons	Mean values of equivalent sound level [dB]
summer	50.3
winter	46.4

The differences between the measured noise and the perceived noise make the output data for subsequent analysis (Fig. 4).

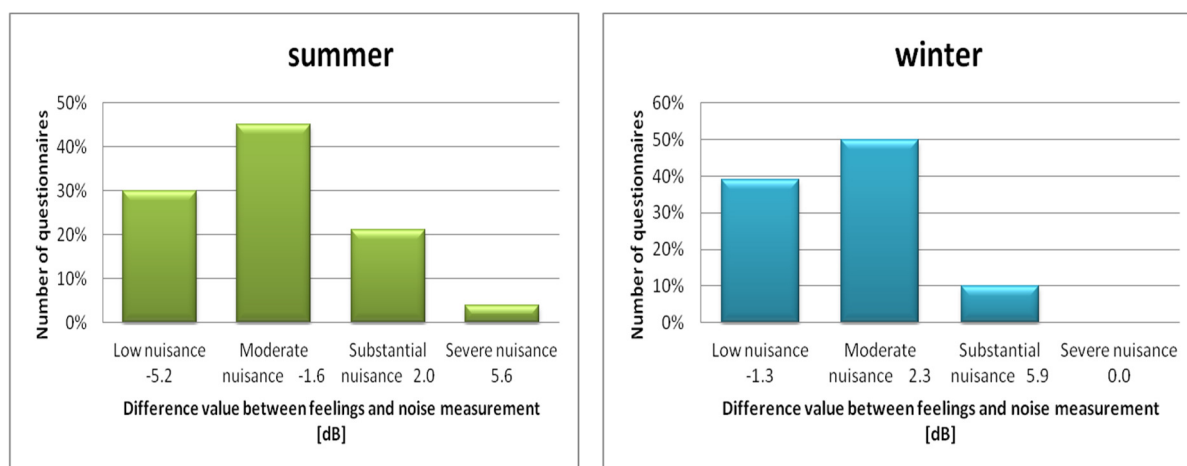


Fig. 4. Differences in noise perception with reference classes in summer and winter (Source: own elaboration)

Where the noise came from a few different sources at the same time, the loudest sound was considered as it was the main constituent of the impression of nuisance (the least pleasant aspect affects the general perception of a situation). Ultimately, the analysis of perceived noise used the responses concerning the most annoying sounds. Based on the assumptions, differences between the value of perceived noise and measured noise were calculated (Table 4).

Table 4. Difference value between feelings and noise measurement (Source: own elaboration)

Seasons	The statistical mean value [dB]	Mean values of equivalent sound level [dB]	Difference value [dB]
summer	48.6	50.3	-1.7
winter	47.6	46.4	+1.2

The obtained differences indicate that both in the summer season and in winter the levels of perceived noise were different than the measured values. The summer season shows a greater tolerance of the respondents to noise, whereas in winter they seem to be more sensitive to it. The respondents described the noise as louder than the measured levels. In order to verify that the analyses were correct, the Student's t-statistic was applied. The following null hypothesis was assumed:

- H_0 – the respondents' sensations are consistent with the measurements (mean difference equals zero).
- To confirm or reject the null hypothesis, a Student's t-test was performed. The results are collected in Table 5.

Table 5. Student's t-distribution (Source: own elaboration)

Seasons	Student's t-test	Degrees of freedom (n-1) df
summer	-8.260	199
winter	5.518	109

Where the assumed statistical significance is 0.05, the values of t-statistic in the summer and winter seasons allow for rejection of H_0 . Thus, there is a difference in the level of perceived audible noises, possibly dependent on the season as the summer is a more dynamic season than winter.

Conclusions

Recreational and leisure grounds have always been treated as an essential component of residential areas, improving the standard of living. Today, traffic noise is considered as the most annoying. The selected park is protected from

excessive noise due to its location in the health resort district and related functions. The objective here was to analyse the correlation between the measured noise levels and the levels perceived by people exposed to the noise.

The obtained results indicate that traffic is not a prevailing source of noise in this kind of areas. The soundscape of the park is shaped by sources related to the utilisation of the park functions according to its purposes. It should be mentioned that the perceived noise nuisance does not have to correspond to the distribution of noise determined on the basis of the measurements. People in the park may pay attention to the noise which is not considered excessive by applicable regulations. The results of the questionnaire are significant as the differences found in the perceived noise in summer and winter confirm the divergence in perception. In the summer season the abundance of sounds 'muffles' the ambient noise in the park, despite the higher measured values. In the winter season, on the other hand, separate sound events cause negative sensations in the absence of coexisting noise and the perceived noise level increases as compared to the measured values. A conclusion may be attempted that visitors to the park tend to get used to excessive noise. This is an alarming phenomenon, mainly associated with the development of cities. In summer, people find urban areas attractive in spite of the increased noise nuisance. The results of this study indicate a need for individual approach to the shaping of such areas with regard to noise emissions. Referring to permissible levels is important, however human sensitivity to noise should also be taken into account. In the case of newly-planned parks and leisure grounds quiet zones can be easily separated from louder areas at the design phase. In existing areas, often protected (listed), it is a challenge and may involve re-development and application of materials with better sound insulation properties.

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