

RESEARCH OF NOISE EMISSION OF SELECTED AIRPORTS AND THE INFLUENCE OF METEOROLOGICAL CONDITIONS ON THE NOISE EMISSION

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The present article deals with the noise sources of aircraft noise, research of noise emission and the influence loads of relevant meteorological conditions such as sound propagation above ground and temperature inversions. Attention is focused on assessment and analysis of aircraft noise at airports Kosice and Bratislava and its associated road solutions.

K e y w o r d s : noise, noise emission, meteorological conditions, temperature inversion

1 INTRODUCTION

By definition, noise is an unpleasant, unwanted sound which can damage health of the hearer. Noise can be steady, intermittent, fluctuating and impulsive. With its harmful effects, noise is recognized as special danger for life environment. The growth of noise intensity, as a result of industrialization, urbanization and development of transportation, creates various degrees of noise. This trend is mostly visible in industrial agglomerations with a huge density of inhabitants and has negative effects on the wealth of exposed population. Analysis of the noise environment must consider not only physical impact of noise on health, but also psychosocial impact, such as harassment. [1]

2 GENERAL INFORMATION

2.1 Sources of aviation noise

Between aircraft noise sources are:

- a.) Airplane engine
- b.) Turbulent flow of air flowing around the airplane
- c.) Radio Correspondence
- d.) Air Condition
- e.) Supersonic boom

Passengers and airport employees find the airplane engine as the most significant source. Constructors are trying to avoid this problem by a design of more quiet engines. The impact of airplane noise is lowered by the usage of quiet engines and by gradual application of internationally recognised treaties concerning

noise of new airplanes. Workers working in noisy environments are protected by various safety regulations. Among these are noise attenuation of rooms and ear protecting devices.

Inhabitants living near airports are constantly exposed to unwanted noises of airplanes and air transportation. Noise can cause various health defects; among the most frequent are hearing impairment, sleep disorders and impaired mental balance. Aviation noise bothers a person a waking state and lowers the concentration of children. Surveys focusing on the highly sensible children population proved the negative impact of noise on children while learning, reading, impact on the quality and quantity of sleep and the rise of blood pressure and hormone level. In the Slovak republic, the noise limitations are set to 50dB for day, and 40dB for night. As the greatest sources of noise are considered road, railway and air transport, not only in SR, but in the whole European continent. Approximately 30% of the EU population is exposed to a transportation noise greater than 55dB. [2]

2.2 Noise analysis as an environmental burden and the impact of relevant meteorological components

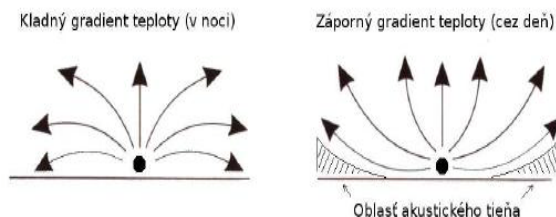
Meteorological components and phenomena near surface strongly influence distribution of sound waves for great ranges. This is caused mainly by acoustic refraction (impact of vertical temperature gradients, wind gradients and atmospheric absorption).

Vertical, temperature and wind gradients are always present in open space. Temperature gradients come to existence by means of heat

transfer from earth surface into the atmosphere. Wind gradients are a result of friction between moving parts of air and earth surface. At a certain meteorological situation areas of acoustic shadow may appear. Those areas are not clearly bordered because acoustic energy is broken into shadow areas by an atmospheric turbulence.

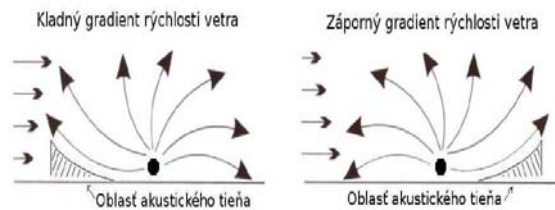
2.3 Sound transmission above earth surface

Speed of sound increases with temperature and therefore with a positive temperature gradient (usually at night, if the temperature in the higher sections of atmosphere is higher than temperature on the earth surface) sound waves are bending towards the earth surface. At this point, transmission of sound may increase. Otherwise, if the temperature gradient is negative (during the day) the warmer air sections are lower, near the earth surface and sound waves are bending away from earth surface, creating acoustic (sound) shadow. Impact of Temperature gradients on sound transmission during a steady, calm situation is shown in Picture 1.



Picture 1 Impact of positive (left) and negative (right) temperature gradients on sound transmission during calm

If the wind gradient is positive (when the speed in the higher sections of atmosphere is higher) sound waves are bending against the wind from the earth surface in a way that just above surface acoustic shadow comes to existence. According to the way of the wind sound ways are bending towards earth surface, what causes increase of sound transmission or vice versa if the gradient is negative. Picture 2 shows the impact of wind gradient on sound transmission.



Picture 2 Impact of positive (left) and negative (right) wind gradients on sound transmission

As pictures above show, it is clear that curve radius of a sound beam above earth surface (up to approx. 30m) can show the impact of meteorological conditions on the transmission of sound waves in an open space without obstructions.[3]

2.4 Temperature Inversion

Main characteristics of air temperature are: the greater, the high, the lower the temperature. Layers of such air are called inversion layers, usually found just above the surface. Acoustic importance of those layers lies in the fact, that the speed of sound is greater in higher temperatures. This means that in inversion layers the speed of sound is greatest in the top layer, and the lowest speed in the bottom layer.

Temperature inversions are quite regular. They appear during almost all quiet and still nights and under certain circumstances also during day. Main mechanism, which comes to existence at night, is the transport of heat from earth surface and infrared shining. Such shining of inversion quickly disappears with sunshine. During winter when radiation inversion comes to existence at night, it is most intense just before sunrise. This is the reason why the outer level of noise in metropolitan areas is above average before and after sunrise, after a quiet and still night. Clear conditions may cause inversion in the hours of sunset. A very intense ground inversion is created usually in the season of cold nights.

Emissions from distant commercial airplanes (during take-off) are also increased during temperature inversion. Someone, who hadn't thought about this phenomenon suddenly, tries to imagine if it is really possible. Everything one has to do is to listen to the background sounds created

by faraway planes during takeoff after sunset or shortly before or after sunrise. From all atmospheric conditions, only the wind is not relevant. [4]

3 Analysis of aviation noise at selected airports

Planes making takeoff or landing are the main source of noise. Mainly the landing noise is the major cause of various complaints. People who live near airports have experience with ground noises produced by rolling of airplanes, engine testing, also power generators, transit and car transportation. Transportation routes to the airport, mainly private vehicles and public buses also contribute to the general noise surrounding airports.

3.1 Aviation Noise at the Bratislava airport

In recent years, the number of international flights, provided mainly from the international airport in Bratislava, has increased. The airport Milana Rastislava Štefánika transported 1 585 064 passengers in 2011.

In order to follow the limits, it is necessary to pay attention to the noise, which is in Bratislava airport proceed, as follows:

- 24 hour noise monitoring since 1994
- on-line radar system connected with the monitoring (in cooperation with LPS SR, š.p.;
- continuous processing of noise data and corrections of flight trajectories;
- Communication with involved villages and suburbs.

In the field of environmental politics the Bratislava airport annually cooperates with specialised companies in order to create a noise map. This map is a relevant document for approving and reviewing further re-building of the airport.

Occurrence of increased aviation noise at the Bratislava airport is annual, because of the maintenance of take-off runway RWY 04-22, which takes 21 days. To insure uninterrupted run

of the airport during these days, only the runway RWY 13-31 is operating with take-off over the suburbs Rača , Vajnory and the village Most pri Bratislave.

Maintenance of the RWY 13-31 take-off runway is planed annually every 20 days, when all flights are re-located towards Vrakuňa, Podunajské Biskupice, Dlhé Hony and Ivanka pri Dunaji.

Maintenance of those runways takes place after winter season in order to prepare the runways for the next season and for the most important season time-summer.

In 2011, the company EUROAKUSTIK, s.r.o secured the monitoring of noise at the Bratislava airport and summarized data from three various monitoring devices performing continuous measuring of noise in the outer environment. The company also secured documents and gathered data about continuous noise situation of places where monitoring devices were installed. [5]

3.1 Aviation noise at Košice airport

Air transportation is not a serious problem for the inhabitants of Kosice from the viewpoint of noise. The area surrounding the Kosice airport has a noise of equivalent noise of 65dB and the maximum threshold at 85dB, concerning southern part of the city and villages like Veľká Ida, Haniska and Sokol'any. [6]

Airplanes at other airports, for instance at the Bratislava airport take –off against the wind, because less noise is created while doing so. One of the reasons why airplanes at Košice airport take-off according to wind may lie in the fact, that behind the airport there is the suburb Železníky, and the noise does not affect this part. At the Košice airport the planes land from the south against the wind because the city lies to the north. South from the airport there is the U.S.S factory and the impact of the noise on the factory is not so obvious.

If aviation will improve, we may expect the growth in flights. For this reason, the company NORSONIC Slovensko, s.r.o prepared noise maps for the Košice airport recently.

4 NOISE LOAD SURVEYS AT THE KOŠICE AND BRATISLAVA AIRPORTS

Intense growth of in transportation and the occurrence of new forms of noise in the last decades gave impetus to deal with the situation. Government branches are trying to reduce the negative impact of aviation noise to minimum in order to protect the inhabitants.

One of the ways how to keep track with the new trends, state priorities and come up with possible solutions of the problem is a questionnaire for the general public.

5 QUESTIONNAIRE RESULTS

In my questionnaire I have focused on how aviation noise affects inhabitants who live near airports near Košice and Bratislava. Questionnaires were filled via internet or via personal contact altogether 120 respondents, 29 women and 31 men in Košice. 28 women and 32 men responded in Bratislava.

My research revealed the following:

-age of the respondents had an average of 37 years;

-most respondents are bothered by the household noise, approximately one third of the respondents are bothered by the street noise;

-noise bothers Košice inhabitants mainly in household environment while relaxing and sleeping. Bratislava respondents were bothered, mainly men, while working and relaxing, women were distracted mainly while sleeping and relaxing;

-house ventilation through windows is not preferred because of the street noise by 11 women and 10 men;

-most of the respondents work mainly manually, 25 respondents are students and 7 respondents are unemployed;

-according to time, most respondents claimed that noise bothers them the whole day, 11 respondents are not bothered by the noise at all;

-results of the questionnaire showed, that women living/working near Košice and Bratislava airports are bothered by aviation noise and industrial factory noise. Men are clearly bothered

by road transportation, aviation transportation and by noises produced while building construction. Aviation is not considered as a source of the greatest amount of noise by any women in Košice, but in Bratislava 3 women thought otherwise.

6 POSSIBLE SOLUTIONS

Airports are cornerstones of air transportation, and as this kind of transportation is expanding, the noise is expanding gradually with it. Airports ought to be built with sound proof barriers and far away from suburbs or villages. Air aviation should become more nature friendly, with low emission and noise levels. We have to come up with solutions in the fields of alternative fuel, airplane design and airports management in order to improve the general situation.

We can decrease the aviation noise if we lower the number of night flights a restrict engine testing at night. Regular revision of sound barriers and flight trajectories is also very important (usage of modernised monitoring devices). Another step is the actualisation of economic tools (less noisy airplanes) and sound barriers. Installation of sound isolating devices on particularly sensitive buildings is also important. Communication between airport executives and city inhabitants may not solve the problem, but can be helpful.

7 CONCLUSION

The present article shows the influence of meteorological parameters on the noise burden from which the wind speed and direction of the greatest propagator of sound effects, which depend on thermal stratification and wind profile with height.

Research of noise load around airports Kosice and Bratislava brought interesting results and also that most people around the airport noise interferes at the home of mental activity. The most annoying noise source respondents considered air. Because abusive noise limited ventilation 21 residents living near the airport Kosice and Bratislava. Noise greatest burden on respondents throughout the day as the second time interval said

residents near the airport Košice range between 12.00 and 18.00 hours, residents living near the airport in Bratislava indicate the time interval between 22.00 and 6.00.

These results can be used as the basis for these airports, which are concerned about the quality of life of people living in their neighbourhood.

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