The Sound-absorbing City – New Ideas for Living Environments around Airports

Juergen Bauer – jbauer@wit.ie
Waterford Institute of Technology
Department of Architecture
Cork Road
Waterford, Ireland.

Summarized version of paper 2aNS4
Presented Tuesday morning, October 23, 2012
164th ASA Meeting, Kansas City

About two years ago, the “Berliner Morgenpost”, a Berlin-based newspaper, featured an article entitled “Living around airports to be a new trend” with regard to the brand new Berlin airport that is proposed to open in October 2013. This new airport will replace two other existing airports in Berlin and it is to be located south of the city, in a neighbourhood, which up to now, was rather rural and residential in character. The article refers to an estate agency that expects huge demand for high quality accommodation for people who work at the airport, in the industries related to its operations, or those who would use the airport region as a private hub.
With all respect to the decent idea of bringing living and working environments together, the reality of an airport environment is different: Who really wants to live around an airport, dealing with air traffic noise day after day, or even worse: night after night, bearing in mind the condition that it is predicted that international air traffic volume is due to increase within the next few years? Normally people do not move to airport regions - the airport (or the airport extension) is moving to them and generally very much so against their will.

In the light of noise awareness and anti-noise-policy, it is surely fair to say that great efforts and progress have been made to provide noise protection measures in urban, suburban and rural environments. Regional and local noise action plans have been implemented in many countries that address the issues and outline specific requirements to reduce noise, including air traffic noise.
Air traffic noise action plans, in cooperation with airport companies, mainly focus on the development of aircraft technologies and the optimization of flight routing i.e. the routes of aircraft leaving and approaching runways. These action plans may also include programmes for compensational measures for the built environment around airports, such as highly sound-insulating windows / air exchangers, or, although to a much lesser extent, conservatories and buffer zones. While these measures will considerably improve in-house-life quality, they will, however, not improve or contribute to the external life quality of the human habitat around airports, e.g., the deck, the balcony, the garden, the street, the playground or the park. Despite the measures that have been put in place, the problem of exposure to aircraft noise externally around airports still remains a dilemma.

Local urban planning guidelines and anti-noise-manuals provide experienced and practical advice to reduce noise. Most of the anticipated solutions such as noise-protection-walls, fences, planted mounds etc. will address most issues caused by

land traffic.
Basically, these anti-noise-manuals show how the modeling of the landscape, the position of buildings and the texture of surfaces can help to absorb or to diffract noise. This approach obviously works well in relation to land-borne noise, but how could it work with air-borne noise from aircraft, which, trickily enough, travels like a “flying carpet”, as the noise source comes from above and therefore cannot be reduced by noise-protection walls or fences on the ground?

This paper aims to explore how the principles of acoustic design, used in architecture to design the inside of a building, can be translated to inform the acoustic design of external spaces in urban planning. The experience of practicing architecture and urban planning would suggest that the following basic principles of acoustic design should be considered:
1. the manipulation of surface materials, in order to increase or to decrease the absorption
2. the installation of acoustic barriers, such as walls or objects, which would deflect or diffract the immitted noise,
and, finally, deriving from the concept of diffraction:
3. the creation of areas where noise imission is diffracted, i.e., in the lee of the noise, where an “acoustical shade” is formed.

The first principle is the concept of absorption. Will a considerable reduction of hard surfaces around airports reduce the perceived noise level? It would be intriguing to see whether the incorporation of a higher percentage of green roofs, green facades and softly landscaped road surfaces around airports would lead to a relevant reduction in perceived air-borne noise immission and changes to its audible qualities.
While the reduction will obviously be greater in an urban context, where more hard surfaces are present than in suburban or rural settings, it is still believed advantageous to incorporate an overall strategy where noise reduction improvement by ground surface absorption is incorporated as part of noise action plans.

The second principle is the idea of diffraction. This occurs where the excess noise imissions, which have not been absorbed by surfaces, are deliberately diffracted away from the human habitat. In this context, it is crucial to assess and consider both the (man-made) natural landscape and the building fabric which forms part of the topography. The topography can then be designed in response to the sound propagation. Buildings should be considered not as additions or obstructions within the landscape, but as part of the landscape.
A Student group from Tsinghua University in Beijing demonstrated at the last ASA meeting in Hong Kong (May 2012) how this can be done. The young architects had to design a school project on an urban site that was framed at an angle by a highway. Although the project does not explicitly deal with air craft noise, it shows how initial acoustical factors can contribute to a design idea:
Instead of building up a wall (or a building as a wall) against the noisy roads, they proposed a city park rising from the road level towards the rear of the site. This “sound-absorbing architectural hill” not only deflected noise, but it also

accommodated a complex and innovative school layout beneath its surface. Due to its gradient, it would also diffract the road noise away from the neighbourhood and the housing estates further beyond.

The idea of creating a protected area from noise by means of diffracting the noise leads to the third principle: creating an (urban) acoustical shade in the lee of the noise.
Research was carried out by Simon Gehrmann at Darmstadt University in Germany which analysed the main incidence angles of noise caused by landing aircraft around Dortmund Airport (Germany).
The research defined a grid of coordinates around a flight corridor and it identified, relative to the grid, the individual incidence angles of noise caused by landing aircraft at different heights and positions, which then led to a pattern of acoustical shade.
The research suggested that acoustical shade from aircraft noise can be clearly simulated and identified to inform design decisions that improve living conditions of buildings exposed to air traffic.

In conclusion, while it is not proposed that the environment around airports will be converted into havens of silence, it is suggested that there is further scope for research to develop the principles of sound absorption, sound diffraction or sound shading in the design of buildings around airports. These principles combined with innovative architectural acoustic design approaches have the potential to create a better quality of life within these environments.
“Living around airports to be a new trend” may have appeared to be a vision far away from the current reality, this paper would rather argue that this vision could become a reality sooner than is generally assumed.

Credits:

The design of the Chinese Student team was awarded in a student competition sponsored by Armstrong (China) Ltd and the paper presented in Hong Kong can be found on the CD of the Conference Journal (ASA meeting Hongkong, paper 2aAAa5).

An extract of Simon Gehrmann's urban design thesis, which is based on this research, received the German Building Young Academics Research Award 2011 and can currently be viewed at www.einwohnschneise.de (September 2012, German only).