

THE NOISE AS A REGIONAL PLANNING VARIABLE. THE CASE OF MADRID-BARAJAS AND BARCELONA- EL PRAT AIRPORTS

Jaume Torán Ibáñez
University of Barcelona
jaumetoran@gmail.com

ABSTRACT

In the regional planning some negative environmental variables are considered, such as atmospheric, water and soil contamination. However, noise impact, derived mainly from the industrial and transport sector, is not very often introduced.

The strong growth of air transport has led to the creation of mega airports, which recorded a large number of takeoffs and landings, day and night. These facilities are not only large consumers of space, but also great noise generators. Therefore, noise contamination is one of the many negative impacts derived from the airports infrastructures, affecting both in a cultural and economical sphere, but mainly, over the territory.

This essay attempt to elaborate a comparative analysis about the noise influence of the two largest Spanish airports, the Madrid-Barajas and Barcelona-El Prat, over their closest territory. However, before starting to talk about noise it is convenient to take a glimpse about the existent noise legislation and planning regarding the noise. Therefore, that essay appears divided in three different sections. The first one will analyze the noise legislation over territory from an inductive perspective, starting from the International legislation to the local laws. The second one intends to make a similar type of analysis from the current planning. And the last one aim to analyze the noise impact of both airports and its consequent impact over the territory and its population.

From the data obtained, it is intended to detect the present weaknesses in the Spanish territorial organization in terms of the legislative implementation of noise on a given territory. Keeping this on mind, we will try to propose a solution, followed by a compilation of the existent noise mitigation proposals.

KEYWORDS

Noise impact, noise legislation, regional planning, airport planning, noise mitigation, noise contour maps.

1. INTRODUCTION TO THE PROBLEM. AIRPORT'S NOISE IMPACTS IMPORTANCE

It is well known that negative consequences derived from the airports and its activities are many, being environmental impact one of the more important (P. Morrell and C. H. Y. Lu, 2000). In this paper, however, it is intended to analyze those outcomes that have a greater effect on society, in other words, the noise impact, since it is the one that affects a greater number of people because of their greater sensitivity. Although it is noteworthy that the damage to society is related to its proximity to the infrastructure, since a closer proximity to the airport generally means a greater affection, thus, as J. M. Seguí (2004) indicates, 7% of the population exposed to noise impacts lives in airport environments.

This negative consequence on the local population is contrasted with the benefits brought in by airports, which, apart from local, are also distributed throughout the region or nation where the airport is located (J. Tompkins et al, 1998).

It should be noted that in addition to the effects on quality of life and health caused on the population, there are many problems that arise in other activity branches, mainly focused on those activities related to the airport industry and other derivate services connected to the air transport. In this sense, it is possible to mention the restrictions of flight operations or the "curfew" for night flights, factors that lead to a reduction of operational flexibility and the income of airport operators as well as companies. This, in turn, has negative implications for employment and tax revenues which in turn could have a negative effect on the surrounding communities (S. Zass, 2006). Finally, it should not be forgotten the impact of noise on the price of houses. Several studies show that relationship, such as document Noise versus Access (J. Tompkins et al, 1998), which shows the great price difference that exists between those houses near the airport but not affected by noise and those who might be found in more remote areas but have a great affection because of the airplane routes and therefore have less value. Another study, The Impact of Airport Noise and Proximity on Residential Property Values (M. Espey and H. Lopez, 2000), examines the immediate reduction of value suffered by homes with the announcement of the expansion of airports¹ and their possible future paths.

As European Commission DG Environment reminds us, currently², the annually economic losses in the European Union due to noise impact are

1. In this case, the document discusses the effects caused by the airport in Reno-Sparks in Nevada, USA.

2. The statement was prepared in early 2001.

between 13,000 and 38,000 million euros. It is worth mentioning that this study takes into account issues such as the reduction of house value, reducing the possibilities of land use, the cost of days of work abstention caused by noise pollution and health care costs.

Exposure to sound pressure above certain thresholds could generate very negative effects on the human body, not only causing alterations in the auditory system, but also of the nervous system, causing at times situations of a high health risk (J. M. Seguí. et al, 2004). But these are not the only important effects on population, there are also some important social consequences, since high levels of sound pressure can also cause disruptions in communication, privacy and social relations in general.

Being fully aware of this problem, the main regulator of health topics, the World Health Organization (WHO), established in 1999 the noise levels and impact on health (Fig. 1).

Figure 1: WHO guideline values for community noise.

Environment	Critical health effect	Sound level dB(A)*	Time hours
Outdoor living areas	Annoyance	50 - 55	16
Indoor dwellings	Speech intelligibility	35	16
Bedrooms	Sleep disturbance	30	8
School classrooms	Disturbance of communication	35	During class
Industrial, commercial and traffic areas	Hearing impairment	70	24
Music through earphones	Hearing impairment	85	1
Ceremonies and entertainment	Hearing impairment	100	4

*"A weighting": Low and very high frequencies are eliminated to retain only those frequencies most damaging to hearing.

Source: World Health Organization.

Apart from setting these levels, the World Health Organization also drew up recommendations for guidance on maximum acceptable for health, setting a limit of 50 dB(A)³ daytime and 30 dB(A) night both inside the houses, nonetheless, aircraft landing and taking off exceed the level of 100

3. The Decibel A sound filters, eliminating the low and very high frequencies, to retain only those most damaging to hearing. Due to this filtering, this unit is a good indicator of risk hearing.

dB, expanding such pressure along kilometers along their routes to the nearest airport.

So far those major negative impacts originated by airports over the territory, people and economy, with particular reference to the topic at hand, i.e. the noise, have been considered. However, it is obvious that airports also generate many positive impacts on the territory on a scale both local and regional. Nevertheless, many of these impacts are kept at the economic level, strengthening the regional economy with new workplaces and improving its communication.

2. THE NOISE LAWS. FROM THE INTERNATIONAL PROPOSALS TO THE LOCAL LAWS

Hereafter, regulations, laws and directives according to the noise that have a direct influence over the two territories considered, i.e. Madrid and Barcelona, will be analyzed. To make it more comprehensive, the following examination will follow an inductive process starting by the European laws and ending with the autonomous regions in which there are the two airports considered for the study. The local level is ignored in this case due to its absence. As J. Celma and M. A. Luzon (2006) suggest, is that absence of legislation and lack of municipal resources to fight against noise which gives a character of great complexity to the matter, with quite hopeless foresights.

It is important to remember that this compilation will only be centered in those laws, or directives, that have a direct relation with both airports, despite the fact that there are specific laws against noise in other countries such as Belgium, France, Italy, Portugal and Switzerland⁴, also addressing the issue of noise from airports or aircraft propulsion.

2.1. International proposals

Starting with the international level, it is transcendental to highlight the International Civil Aviation Organization (ICAO) as the highest representative in terms of regulations against noise emitted by aircraft and airports. The bureau of the air transport of that organization held in 2001 the report called “balanced approach to the management of noise “, more commonly known as

4. Following the same order we can find the: Legislation relative au bruit (Belgium), Loi 92-1444 contre le bruit (France), Legge “Rumore Ambiente” (Italy), Decreto-Lei n.º 292/2000 de 14-11-2000 (Portugal) «Regulamento Geral do Ruído» (portugal), Loi fédérale sur la protection de l’environnement (Suiza).

the Resolution 31 / 7 of the 33rd Assembly of ICAO. That document suggests four key proposals that have the intention of achieving a reduction of the noise caused by airports and airplanes. First proposals are linked to the technological renovation and more precisely to the reduction of aircraft noise at source. To carry out such regulations, all planes and helicopters built today have to pass the certificates noise standards adopted by the council of the ICAO. The second kind of suggestion considers measures of management, planning and management of land, which seek to ensure that the activities near airports are compatible and, in turn, seek to affect the minimum possible number of people. The third suggestion considers the approach of the operating procedures of noise reduction, made in the context of aviation operations, trying to achieve noise reduction through processes that can be comparatively cheap, for instance, by choosing the more optimal routes. Finally, the operational restrictions are considered, through the application of laws and policies in force. These proposals are taken as mandatory in those countries that joined the ICAO (J. M. Seguí et al, 2004).

A similar concept to that established by ICAO and its regulations is the one mentioned before from the World Health Organization (WHO) and its guidelines for limiting noise pollution. However, these indications are in no case compulsory, despite the fact that are commonly used and referenced by a great variety of documents.

2.2. European legislation

At the European level it is noteworthy the Green Paper of 1996 “on the future political noise in the European Community”. Despite the fact that this document is no longer in force, its importance lies in the fact that it represents a great new policy related to the impairment acoustics and served as the basis for future European directives.

The Green Paper of the Commission focused on two aspects: first, on the presence of noise on the population, and secondly, the levels of noise pollution at the time. Nonetheless, it is interesting to note that the law itself did not give much importance to current situations because these ones were virtually lost. In fact, all the propositions were planned with a future point of view. Thus, the measures proposed in relation to the noise impact caused by the airport infrastructures were on the one hand, regulate the construction of residential areas and other facilities when they are located near airports that already exist, and on the other hand, the construction of the airports. This led to a division into zones, which would be designed in order to distinguish land use. This delineation was made after the mapping of noise and linking land use permitted with the levels of ambient noise. In addition to the zones a noise control resulting in air traffic was

also proposed. Such control included the imposition of emission values and the development of local measures that affected on territorial planning.

Undoubtedly, the Green Paper was a major breakthrough on legislation related to noise impacts, and many of its guidelines have persisted over time and can be found in other legislation, such as the currently legislation in force in relation to noise impact on European territory, the directive 2002/49/EC on Environmental Noise.

This directive aims to lay the foundation skills to face the future with appropriate treatment to the problem, both by two clear goals: to harmonize the evaluation methods of noise exposure and promote the mutual exchange of information. This strategy is on two specific recommendations, the first in the mapping of noise, and the second in providing information to the public on noise exposure.

To get to achieve that goal, that directive establish rules and procedures for the introduction of related operating restrictions at Community airports, picking up the principles contained in Resolution 31 / 7 of the 33rd Assembly of ICAO, i.e. the measures previously discussed.

2.3. The noise legislation in Spain

Focusing in the Spanish case, all the noise regulations at the state level are represented today by law 37/2003 more commonly known as the Law on Noise, developed from the Royal Decree 1367/2007, adopted on 19 October 2007 by the Government of Spain. This is a law that covers cross the whole issue of noise and control of their emission sources, through the continued development of an intended target, as indicated by law, prevent, monitor and reduce noise pollution to avoid the risks and reduce the damage they can cause in people's health or the environment, in addition to ensuring the welfare and quality of life of citizens. (J. M. Sanz, 2007)

Concerning this point, and more specifically to achieve the reduction of airport noise, the law proposes a restriction on the reception of noise from measures such as the need to establish some noise limit values. Therefore, states such as acoustic quality objective that the sound levels are kept below 60 dB(A) during the day and evening periods and 50 dB(A) during the night and that they try to preserve the best sound quality that is consistent with sustainable development.

Other measures include the requirement that all subsonic jet aircraft must first obtain a noise certification for the standards set by ICAO, the anticipation of a series of plans for soundproofing of homes and facilities, or the ability to expropriate or prohibit construction in those cases where the problem is uncontrollable with the other mitigation measures.

However, this law has distinguished itself for its territorial incidence and the difficulty for its proper implementation at different administrative levels, introducing, for example, the concept of bonded area of an airport noise, clearly limiting the expansion of urban areas directly affected by the airport infrastructure, and limiting the municipal autonomy in the areas of urban planning (J. M. Seguí et al, 2004).

This limitation is regulated by zoning to delineate land use, depending on the intensity of noise pollution from the limit values. The delimitation of degraded areas acoustically and knowledge of the situation will be given by the mapping of noise, using evaluation indicators, methodologies and procedures consistent and comparable with those established by the European Union (J. M. Sanz, 2007).

The temporary nature of the law set a series of stages of development and implementation. The first phase is centered on the noise contour maps development, which must be reviewed every five years. Once made, the law stipulates the development of the criteria used for zoning the territory in acoustic areas, the application of objectives to improve the quality of these areas plus the acoustic space inside the buildings susceptible to noise pollution, and the limitation of the emissions generated by transport infrastructure and the linked activities that generate noise and vibration (J. M. Sanz, 2007).

Returning to their territorial nature, the law sets out the adjustments that must be carried out by local and regional authorities in the management and spatial planning. Thus, municipal ordinances should be approved in relation to the matters covered by the law, while the existing ordinances should be adapted to the provisions of this law and its implementing rules. In the case of territorial planning, both local and regional competition, which affects land management should contemplate the forecasts established by the law, while, the existing plans must be adapted (J. M. Sanz, 2007).

2.4. Madrid and Catalonia noise legislation

Once analyzed the Spanish law of noise, it is time to analyze the present legislation from the Madrid and Barcelona Autonomous Regions, nonetheless, it is important to remember that airports are competence of the Spanish State; therefore, all administrative actions from a lower level are very limited.

Catalonian noise legislation is the most developed one in comparison with the Madrid autonomous region one.

At Catalan level, in relation to the environmental matter, stands out the law 3/1998, of 27 of February, on the integral intervention of the environmental administration, and the decree 136/1999 that develops it. This law aims for the protection, the conservation and the improvement of the environment to

guarantee the quality of life and the sustainable development of the Catalan territory, according to the treaty of the European Union and the text of the Spanish Constitution.

In spite of its importance, this law only makes a reference on a small aspect of the acoustic contamination, the emission levels; however, these are not limited normatively but instead these are only recommended values in terms of the location, the hour period and the acoustic sensitivity of the areas.

Another important document is the law 16/2002, of June 28th, of protection against the acoustic contamination. Again, this document exemplifies the difficulties that the Catalan administration confronts to delimit aspects regarding the legislative competitions of the State. In result, part of the measures that displays to fight against the noise and to favor his diminution are an adaptation of the measures commented in 37/2003 Spanish Noise Law.

Finally, it is also necessary to mention law 19/2000, of December 29th, known as the "Airports law of Catalonia". This law is framed within the present jurisdictional frame; therefore, it will only be applicable to those private airports that are not of general interest, i.e. not under the State jurisdiction.

In the case of the Community of Madrid shall be mentioned the decree 78/1999, of May 27th, of "protection against the acoustic contamination". This decree includes all the sources of noise with the exception of the airports, again, because of the state competition.

This decree, on the contrary that the decree applied in the Catalan territory, limits the acoustic levels of the areas, delimiting at the same time the land pressure by types. It is possible to find those zones that are considered as quiet areas (including in this type of areas the Hospitals), which only allows from 25 to 30 db(A), and the slightly noisy areas, with limits between 45 and 55 db(A), where the educative and cultural centers and private houses are built.

Other Madrid laws and decrees mention the airports, but in no case make reference to problems related to the acoustic contamination. It is the case of the law 8/1993, of June 22nd, of Promotion of the Accessibility and Suppression of Architectonic Barriers, which insist on the problems of accessibility to such infrastructures, and Decree 116/2004, of July 29th, of the Council of Transports and Infrastructures. The rest of decrees that mention the airports always does it at the expense of the State norms and making clear that in the case of a possible management, it will always be subdued to the State legislation.

Another example is the Decree 78/1999, of May 27, by which the regime of protection against the acoustic contamination of the Community of Madrid is regulated. This decree is even more specific that the others and make very clear that "*the arranged thing in this Decree will not be of application to airport infrastructures of state competition, unless its own norm or other specific norms allow it*".

3. AIRPORT NOISE PLANNING

Whereas in the matter of legislation it has been possible to establish a clear hierarchical structure from the superiors levels to the inferiors, in the case of planning this is not so evident since it only has two levels: the State level, that will play a role as a adviser rather than a regulator, and the one of the autonomous regions.

3.1. The Spanish planning and the airport noise

At the Spanish level it seems appropriate to emphasize the Strategic Infrastructure and Transports Plan (PEIT) 2005-2020, assumed by the Ministry of Public Works and the Economy. This Plan has the objective to approach the challenges to which at the moment it has to face up the Spanish transport system and to offer the measures that can contribute to improve the economic competitiveness, the territorial and social cohesion, and the security and quality of the service. Hence, this plan is the one in charge of the Spanish airport development and for it, it suggest a total of eleven proposals. Nevertheless, none of the proposals contemplate the noise problem, not even the environmental issues concerning the airports. Almost all of the PEIT proposals are related to the economic development of airports. Nevertheless, it can be highlighted one of the proposals, which, plead for the participation of the autonomic and local authorities for the management from the airports. Such proposal might mean a major participation of the regional and local authorities bringing the possibility to carry through some kind of environmental management.

Another important item is the Director Plan of the Spanish airports, understood as an instrument of strictly airport planning and, in no case, city-planning, as AENA reminds. These plans have the objective to provide solution to those problems derived from the complexity of the airports. Probably, their most significant functions are the setting of the airport boundary and the servitude zone of the airports of general interest as well as the determination of the airports activities to develop within their own enclosure and its servitude zone.

The elaboration of these plans is responsibility of AENA, in agreement with the directives established by the General Secretary of Transports of the Ministry of Public Works and the Economy. The approval, on the other hand, is responsibility of the same Ministry.

AENA, as a state owned company, and the works settled by their Director Plans within the airports cannot be interfered by the local authorities, even if the airport is within the municipality limit, however, local authorities must include the airport area and its servitude zones inside their “General Plan of Urban Management” according to the Spanish legislation.

3.2. The autonomous communities planning

Within the Catalan territorial planning there are two key documents that affects over the territory and their transport system.

First of them it is General Territorial Plan of Catalonia (GTPC). This Plan was approved in 1995 and since then it has been contemplated like the instrument that define the objectives of the territorial balance of Catalonia, to fomentation of the economic attractiveness of the Catalan territory and the promotion of the life quality of the Catalans. Nevertheless, it is necessary to emphasize that this plan never has been applied, despite the fact that several authors and notable politics use it as a source.

In this document, the airports appear classified as “great transport infrastructure centers”, the same way that the rest of transport infrastructures. The functions of this kind of infrastructures are divided in three sections: canalize the flows, balance the territory in the matter of accessibility and allow the competitiveness of the enterprises. In addition to these functions, the plan proposed an evaluation of the environmental impacts derived from these infrastructures, assuring their permeability over the natural environment.

The GTPC established up to three exclusive objectives for airports; to extend the airport system, to integrate the Catalan airports with its nearer territory and to obtain the interconnection of the same with the rest generating new centers.

In conclusion, this plan presents a serious planning lack in relation to the noises originated by the airports. This null incidence over the acoustic problems is even present in the GTPC section dedicated to the life quality of the Catalan population. In this section, only aspects related with the land conservation are considered.

The second analyzed document is the Plan of Airports, Aerodromes and Heliports of Catalonia 2007 – 2012 (PAAHC). This document persecutes the total development of the airport network of Catalonia.

The PAAHC, possibly due to its up-to-dateness, contemplates the noise problem, nonetheless, in a quite reduced way. Hence, in one of its priorities, the plan pursues the diminution of the contamination and the noise of the airships, guaranteeing this way a sustainable growth.

It is evident that in this document exists a great preoccupation by the noise and a great interest in its reduction and its diminution, however, the noise of the airplanes and the airports are not contemplated, only that noise emitted by helicopters and the heliports. That is, of course, because of the State venue over the airports of general interest.

In the case of Madrid, unlike Catalonia, the territorial planning does not affect in any case the airports. It is completely void. In addition, the

Autonomous Region of Madrid does not have plans that affect the noise emitted by other infrastructures such as heliports. All the actions carried out by Madrid are submitted to the little capacities of management that are not observed state level.

4. THE AIRPORT NOISE CONTOUR MAPS

It has been commented before that some laws, like the Noise Law of Spain, demands the making of the noise contour maps.

Before proceeding with the next section it is important to describe them and to write down some of their strong points that made them so necessary and significant.

4.1. Description and importance of the noise contour maps

The noise contour map is a graphical representation of the significant levels of noise in a given territory, obtained by measuring a set of representative points, over different periods, and its subsequent integration and interpretation. Therefore, the results obtained show the density of the noise emitted in a given location.

The measurement of the noise levels is commonly carried out through electronic monitoring stations, or EMS. These stations record the sound level of each aircraft movement; consequently, the stations are normally located following the takeoff and landing routes of airplanes. The readings obtained by the EMS are averaged to give an “equivalent continuous noise level” or Leq for short. An “A-weighting” is added to the reading to simulate the way in which the human ear responds to a range of sound frequencies.

In discussing pollution, density maps can be very useful in indicating sources and areas of greatest noise contamination. Contour maps are especially useful for diffuse forms or scales of pollution. Therefore, airport noise mapping importance lie in that maps can be used to identify areas where assistance with noise control is needed.

As a result, noise contour maps are envisaged by a great quantity of legal and planning documents.

4.2. Noise contour maps in legislation

Currently, the noise contour maps are attached in the main existent noise laws, both at the European and the Spanish level.

Its origin lies in the Directive 2002/49/EC on the management and assessment of environmental noise. The issues contemplated by the Spanish Noise Law related to the noise-mapping come from the European directive; so, the applied measures concur on both documents.

In legislation, noise-mapping aim to conclude the level of affection of a specific location and its exposure to noise, as well as to provide information to the population about the problem. These specific maps should be used too to facilitate the adoption of action plans based on noise pollution as well as the most appropriate corrective actions. Moreover, laws also lay down the guidelines for drawing up noise contour maps.

Descending to the Spanish level, two types of noise contour maps are established by the Spanish Noise Law: on the one hand, the strategic noise contour maps and on the other, the not strategic noise contour maps. The first will be developed and approved by the competent authorities that have to map, among other things, major airports and cities with populations over 100,000, while the second will be produced in those areas where noise is found in breach of the objectives of sound quality.

Currently AENA, through the Director Plans of the Spanish general interest airports, has made noise maps of the main Spanish airports, namely Alicante, Barcelona, Bilbao, Gran Canaria, Madrid, Malaga, Palma de Mallorca, Tenerife, South Tenerife and Valencia. They all incorporate the description of the noise contour map, divided in three additional maps: the common noise contour maps, the noise exposure maps plus maps of the affected areas.

4.3. Guidelines to the production of a noise contour map

At the moment of making a noise contour map certain tools are required. One of them, perhaps the most important, is a Geographical Information System (GIS).

GIS will be crucial for the elaboration of a noise contour map, however, in addition to this software, some data will be needed to be proceeded.

The data needed for the development of noise contour maps generally is:

- The location of the fixed electronic monitoring stations from the airport in question and its data. Nevertheless, the information can also be taken in person using Sound level meters and clearly indicating the place of measurement.
- Maps of the study area.
- Orthophotos covering the study area and the airport.
- Land use maps of the study area.

And, in the case of intending to observe its impact on the population, can be considered other variables like:

- The coordinates of schools and hospitals that are in the study area.
- The taking off and landing routes from the airports.
- The residential areas.

Evidently, the sound levels monitored by the stations, including the correct indication of its location and the exact moment (day and hour) of the noise recording befall the most important data. Once obtained, it could be treated with a GIS through processes like the one known as the “Natural Neighbor”, however, this process require a lot of recording points.

In relation to the representation of the noise levels, this is usually made trough a hatch map style, with a color spectrum that goes from the purple for the high values to the yellow for those slight levels.

5. THE ACOUSTIC IMPACT IN THE AIRPORTS OF MADRID-BARAJAS AND BARCELONA-EL PRAT

The data analyzed until the moment, that is to say, the legislation and the planning referring to the noise, represent one first stage of the analysis process. With the compiled data, this paper persecutes to analyze the reality of the territories affected directly by the noise emitted by the airports. For it, as it has been mentioned previously, the two major Spanish airports has been selected, namely Madrid-Barajas airport and Barcelona-El Prat airport, and by extension, its nearer territory.

As a way to simplify the direct impact that affects the territory and its population, the present study will consider the same variables for both airports, being in accord with the variables used by AENA noise contour maps. Hence, once analyzed the degree of acoustic affectation for both airports the affectation level of the more vulnerable civil infrastructures will be examined, i.e. schools and hospitals, keeping in mind those noise levels stipulated by the incident legislation over these same infrastructures.

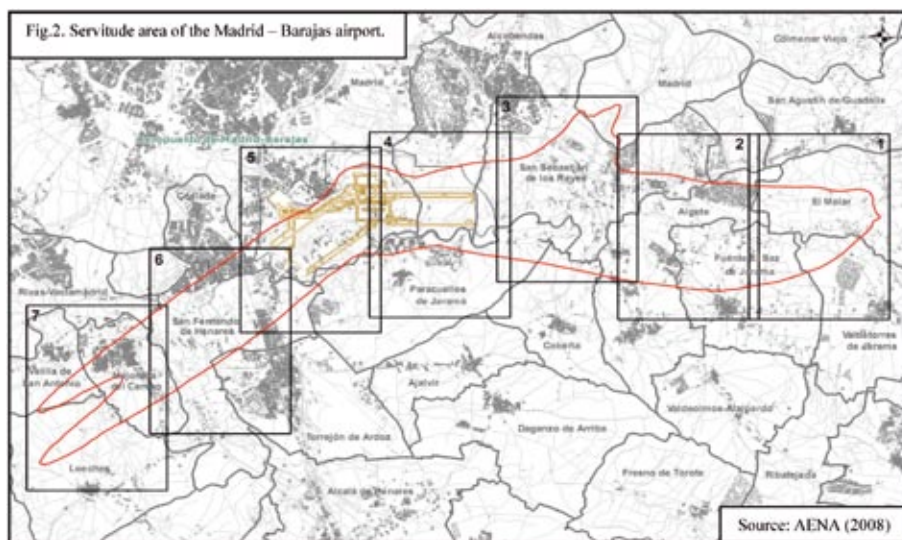
All in all, AENA noise-mapping will be the main data used for the study, concluding its effectiveness and its credibility.

5.1. The case of Madrid

The airport of Madrid - Barajas is in the northeast of Madrid, to about 13 kilometers approximately. A part of being the greatest airport of the State

also it is the Spanish airport with the greater number of passengers, around 50 million in 2007, being placed in the tenth position to world-wide level and the fourth of Europe by number of passengers (AENA.es).

The municipalities directly affected according to the area of servitude established by AENA are 15 (fig.2.). These are Loeches, Velilla de San Antonio, Mejorada del Campo, San Fernando de Henares, Torrejón de Ardoz, Coslada, Madrid, Paracuellos de Jarama, Alcobendas, San Sebastián de los Reyes, Cobeña, Algete, Fuente el Saz de Jarama, el Molar, and Valdetorres de Jarama. It is obvious to think that the affectation level among them is very different, and that the most affected will be those that are closer to the airport. Said this, it is important to emphasize that the own structures of the airport extend on four of the 15 mentioned municipalities: Madrid, Paracuellos de Jarama, Alcobendas and San Sebastián de los Reyes.



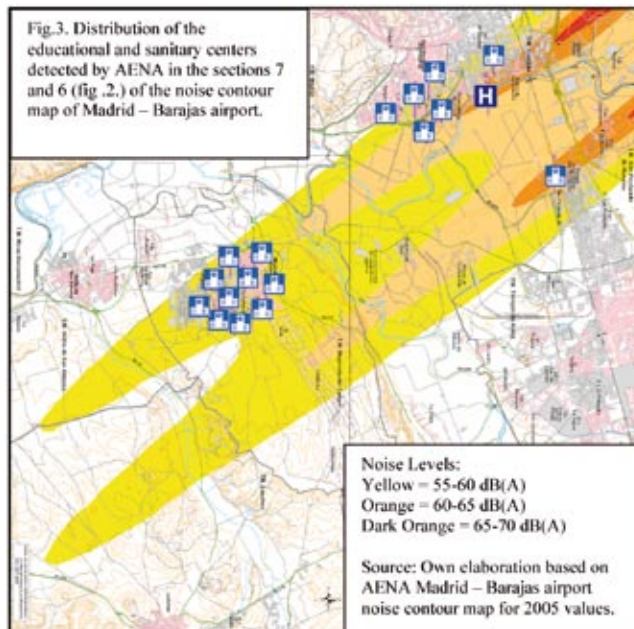
The territory included by the set of these 15 municipalities is of 1,100 kilometers square approximately. The total population of these municipalities, according to the Spanish census of 2001, is of 3,374,343 inhabitants (Institute of Statistic of the Community of Madrid). Unfortunately, the area of servitude established by AENA is very diffuse and it is not well defined, and so it is complicated to establish his surface and the exact population within its limits.

In relation to the schoolhouses, the online searcher of educational centers and services of Madrid has been used to determine the total number of schools located in the 15 affected municipalities. The obtained result was of 1,855 educative centers.

Obviously, the territory affected by the area of servitude of the airport does not occupy the totality of the municipalities; in addition, 1,535 of these centers are in the municipality of Madrid. The rest of municipalities accumulate a total of 320 public and private schools.

Nevertheless, it seems somewhat significant that from the maps of AENA, developed in 2005, 19 centers were only identified, a fairly exaggerated value. It is true that some of the municipalities included in the area of servitude of the airport of Madrid – Barajas are not very affected, but that it is significant that of the 19 centers identified by AENA 10 correspond to the municipality of Mejorada del Campo and 6 to the one of San Fernando de Henares. A simple glance of the affected area shows other urban nuclei very affected, as it is the case of Algete or San Sebastián de los Reyes. The sum of the centers included by these two nuclei, plus the two more significant municipalities for AENA is of 97. Therefore, it might be concluded that the data shown by AENA, of public access and reference for future activities, is rather little trustworthy.

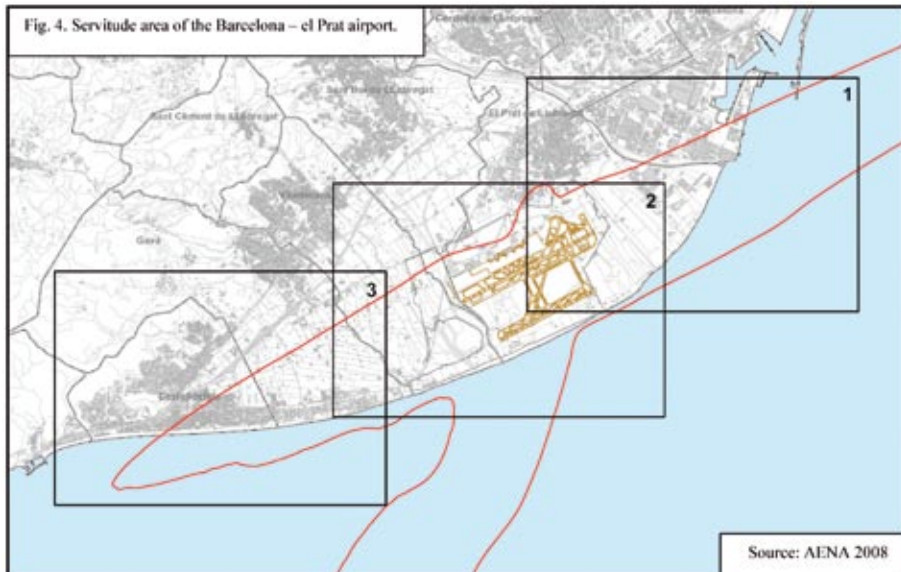
The case of the sanitary centers is not very different. In such case, AENA only identifies a unique hospital, but through the consultation of sanitary centers in the Community of Madrid website, a considerable number of sanitary centers have been located. This is because AENA only identified hospitals, excluding the rest of sanitary centers. As a result, the obtained results have been of 158 centers. Again, 129 of these are located in the municipality of Madrid, very slightly affected municipality.



In conclusion with respect to the Madrilenian territory, it is necessary to emphasize that the little centers contemplated by AENA, as much for the educative centers as the sanitary center, already are a clear reflection of the reality since these are over the levels allowed by the Madrilenian legislation. As it has been observed previously, the Madrilenian legislation with respect to the noise, and more concretely the decree 78/1999, delimits the levels of sound allowed in terms of land use by types. The type 1, in which hospitals are observed, goes from 25 to 30 dB(A), while for the residential areas, where schools are included, the limit is set at 55 dB(A). Since the minimum level considered by AENA noise contour maps is of 55 dB(A) it is easy to conclude that all the centers, both educational and sanitary, are in no case below that limit.

5.2. The case of Barcelona

The airport of Barcelona is located in the municipality of El Prat, at 10 kilometers in southwestern direction from Barcelona. Is the second larger airport in Spain in number of passengers and during the period from 1996 to 2001 it was the second airport in growth of passengers in Europe. If the airport of Madrid is placed near the 50 million passengers in the 2007, the one of Barcelona surpassed 30 million the same year, being placed ninth in the European ranking (P. Suau and M. Pallarés, 2007)



Because it is a smaller dimensions and to their proximity to the sea, the affected territory is relatively smaller than the one of the airport of Madrid – Barajas. In this case, the number of municipalities affected directly by the airport operations descends to six (fig.4.). These are Castelldefels, Gavà, Viladecans, Sant Boi de Llobregat (although it only affects a small sector), El Prat de Llobregat and Barcelona. In this case, a distinction of those affected municipalities will not be made, since the small occupied territory and the operative routes cause that all of them are highly affected.

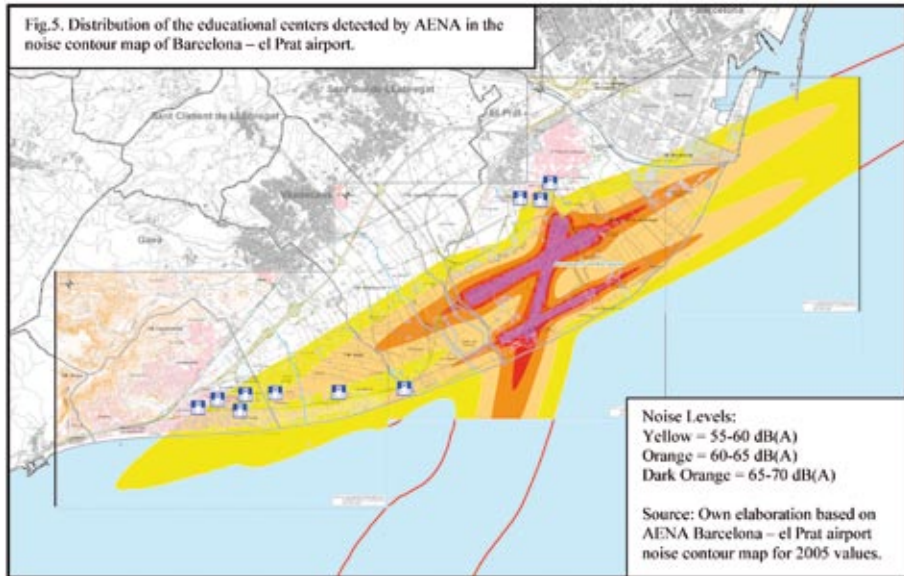
The affected territory is far below from the Madrid airport, which it descends approximately to about 218.5 square kilometers. The resident population to the set of municipalities, according to the register of the 2007, it is of 1,901,600 inhabitants approximately (data collected from the Institute of Statistic of Catalonia).

Through the observation of the AENA noise contour maps, as well as of the reading of its memory, 10 educative centers in the affected area were identified. However, using the educative centers searcher of the Catalan Autonomous Government website, it is possible to obtain a total of 124 centers (this result does not include those centers located in Barcelona or Sant Boi de Llobregat, since the impact area in this municipalities is too reduced and the number of centers that can appear in those zones are expected to be very reduced or null). Therefore, it is observed again a great negligence on the part of AENA on the research of educative centers.

In relation to the hospitals, AENA does not present any center in their studies; however, with an easy observation in the on-line sanitary centers searcher of the Catalan Autonomous Government of Catalonia website it is easy to notice the presence of several sanitary centers. The problem in this point is the difference that exists between the diverse types of sanitary centers. It seems evident that AENA only take into account hospitals; nevertheless, at no moment it is explained in the information the reason of the omission of the Primary Attention Centers (CAP in Catalonia) and other types of clinics.

In the four more affected municipalities (the municipality of Barcelona and the one of Sant Boi de Llobregat have been disregarded again) up to 9 CAP have been founded.

As in the case of Madrid, despite the fact of the omission of centers, it is evident that all the centers selected in the AENA studies are over the 55 diurnal decibels, whereas the levels of malaise mentioned by the WHO are the 50 decibels.



8ONCLUSIONS

The advantages that airports bring to the territory are indisputable. However, like it has been explained at the beginning of the present paper, the negative impacts that they also generate are of great importance and they have a greater affection in its nearer territory and its population. The negative impacts suppose a worsening of the natural qualities of means, favoring their destabilization. The affectionation of the noise of the airports on the territory must be contemplated like a sociocultural impact, that is to say, an impact that is materialized in changes in the framework of the social and economic relations of a community, in their cultural forms, their customs and their scale of human values (M. Bolós, 1992).

According to M. Bolós (1992), it is possible to distinguish up to four different types of impacts: impacts of occupation, resulting impacts of the emission of polluting agents, impacts of diffusion and impacts originated by the extraction of natural resources. It is important to point out that in the case of the airports up to three of these types are located.

First of all, the occupation impacts, since these are those that inevitable are derived from the simple fact of the location of an activity on a land with a different use from a previous one. Normally, they are strongly changing impacts of the previous existing natural conditions, and have in addition a practically irreversible character.

The type of impact of diffusion also does exist. These impacts are generated from the pressure that the location and the development of a human activity, like the one generated by the airports, exert on their surroundings. Obviously, occupation impacts provoke, with major or minor intensity, a diffusion impact. Finally, it is possible to detect in the case of the airports the existence of the resulting impacts of the emission of polluting agents.

Consequently, it is evident that the environmental impact brought by an airport is of great importance and must be well regulated. It is for that reason that strong laws and norms that persecute the best management of these infrastructures are required, as well as a competent strategic planning.

The inadequate planning can incite, in the same way that an incorrect legislation, a degradation of the social and natural conditions (B. Calderón, 2001). That is why applied planning must consider both local and regional demands and needs to makes previous and continued studies throughout their application to avoid possible misunderstandings and brings the possibility to introduce modifications, instead of applying and unsatisfactory plan for a long term.

Unfortunately, the current situation presents a little encouraging panorama. As it has been shown through the paper, nowadays major airports often bring up complicate environmental conflicts that presents a very difficult conciliation with the local population and that does not contemplate any kind of management. And sadly, when some of those problems are analyzed due to a social demand it is common to come upon badly executed studies containing an informative deceit, results falsifications or the omission of values, frequently depending on the interest of the agents that carried out the studies. To this effect AENA noise-mapping can be mentioned.

The infrastructural development to reach a greater level of competitiveness can harm to the environment and the interests of the inhabitants affected by the negative impacts of such development. Organizations as ESPON (European Spatial Planning Observation Network) insist on the importance of transportation networks for the territorial development due to their influence on the structures and the territorial models⁵, harnessing dynamic or contributing to resist territorial imbalances. But the same organization remembers us that the trans-European networks of transport are first of all interregional networks and that therefore is necessary that the territories establish horizontal and vertical networks of territorial collaboration, considering both cooperation simultaneously, since all infrastructure are part of a network, which raises the necessity of the interadministrative cooperation as well (J. Farinós, 2007).

5. For instance, in their study "ESPON Project 2.4.2. Integrated transnational analysis of and national territories".

In the same way that ESPON, the European Conference of Ministers responsible for regional/spatial planning (CEMAT) in their document “The Guiding Principles for Sustainable Spatial Development of the European Continent”, point out, in the 35th recommendation, the importance of one better interconnection between urban nuclei and centers of transport to obtain a policy of balanced territorial arrangement.

Therefore, the lack of integration between the state, the regional and the municipal level in the Spanish case is noteworthy. The state jurisdiction of the major Spanish airports causes a legal loophole with very negative consequences over the airport planning. That is the reason because it is necessary to promote a better interaction among the different levels, since it seems evident that those that have to coexist with the problem are those that possess a superior knowledge on the situation and, therefore, can contribute with more suitable proposals.

At this point, it is interesting to remember that proposal previously commented provided by the PEIN, which proposes the opening of the management from the airports to the participation of the autonomic and local authorities. Without a doubt this could be the key to obtain a more effective management, as long as the local proposals were not downplayed.

Following a similar proposal to the one from PEIN, E. Nieto (2007) proposes to make a reconversion of the management of the airports of general interest to the tendencies of other European countries like the United Kingdom or Germany. This reconversion would be based on the granting of a juristic person to all the major Spanish airports, becoming this way an independent managing organization, the same way the Communitarian Right pleads. Each of these managing organizations would be integrated by representatives of the different public administrations with concurrent interests in the airport territory.

Nevertheless, this proposal seems to remain very far from the present situation. As it has been observed, that proposition contradicts the current situation that it is found in Spain, since the management in this country is made by a unique managing organization, that is to say AENA.

Despite the difficulty of applying such proposition, it is evident that there are other kind of actions that can be executed to fight against the noise emitted by airports and airplanes. Before ending this document, it has been considered of great significance, considering the treated subject, to present a typological generalization of those interventions and applicable measures found in the collection of consulted papers. Despite the fact that all of them are commonly used it is very hard to find a mixture of some of them, so the common use of some of them at a time may lead to a general acoustic reduction, certainly appreciated by the closest inhabitants.

In this way, according to its type of incidence, three great blocks can be distinguished:

- Firstly, economic measures have to be highlighted.

To this effect, two different kinds of measures are founded: the application of taxes or loads to the airports and the economic compensations to the affected ones by the noise.

In the case of the economic loads, some authors points out that they represent one better way to achieve favorable environmental objectives investing a smaller cost than through regulations (P. Morell and C.H. Lu, 2000). The use of this strategy has been remarkably increased in the last years.

On the other hand, the compensations try to fight against the damages brought about on the population near the airport infrastructure. Such compensations can go destined, for example, to the soundproofing of the affected houses or to the construction of barriers or silencers. However, such measurement can be inadequate in certain cases not arriving to absolutely compensate the losses of the inhabitants (E.I. Feitelson Et al, 1996).

However, it is interesting to indicate that both measures do not specifically respond to a palliative measurement but to a derived consequence of a bad management.

- Secondly, the restrictive measures.

Possibly these are the more common type of measures in the current legislations. In this sense it is possible to found measures such as the limitation of sonorous emission, already observed previously in diverse cases. Another type of limitations are the technological ones, forasmuch to obtain an airships acoustic diminution arriving at the indicated standards it is necessary that the airships pass rigorous controls, and that thus, those noisier airships are separated from the operations unless an advisable adaptation is carried out to them (J.M. Seguí et al, 2004). In the European scenario, the acoustic limitations of the airships are collected in the directive 92/14/CEE, of 2 of March of 1992. Another essential restrictive measurement is that one related with the restriction of the operations in certain periods, as it is the case of the nocturne period. This type of restrictions can vary in magnitude of application, from the ones that completely prohibit the operations to the ones that only prohibit them partially; limiting the number of operations by track⁶ for instance.

- Thirdly, the last classes of measures are those ones related with the management, planning and arrangement. To this effect, measures such as the selection of the altitude of the radial flight and the correct election of optimal routes, selecting those take-off runs and landing routes that have a smaller degree of affectation on the population, can be founded. These types of measures are already considered in the Norms of Aerial Discipline in the matter

6. That is the case of the Amsterdam – Schiphol airport.

of Noises of each Spanish airport. Evidently, these norms consider aspects as the geographic location or the structural characteristics of the airport track (J.M. Seguí et al, 2004), with the porpoise of achieving the maximum degree of noise reduction.

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