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NOISE EXPOSURE AROUND LYON SATOLAS AIRPORT

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Keywords:**ABSTRACT**

This paper gives the method and the results of a series of acoustic measurements around Lyon-Saint Exupéry airport. The results constitute the initial point to characterize the noise before the development of the airport by the construction under consideration of one or two new runways.

1 - INTRODUCTION

The Airport of Lyon-Saint Exupéry plans an extension by building two new runways, in around 2015, and wish to assess the current sound exposure in the bordering neighbourhoods. The noise may come from various sources: aircraft noise, road noise, railway noise and other noise sources.

The objective is to determine the noise levels existing in the surrounding neighbourhoods, and the contribution of various sources for 1998-1999.

Measurements were taken during landing and take off. Nearly 60 days, 24 hours long, were recorded, which constitutes a solid database to characterize the sound environment in the communes around Lyon-Saint Exupéry in 1998 and 1999. This set of results thus comprises approximately 8 000 aircraft noises described by their total energy (i.e. quantity of noise emitted), their duration, their level maximum and their energy brought back to one second duration (SEL). This set of results allows statistical calculations to characterize the aircrafts: according to their chapter ICAO:

- chapter II: noisy aircrafts, built before 1977;
- chapter III: less noisy, had been constructed conceived according to more severe acoustic standards' and had built after 1977.
- according to their group (French classification finer than the ICAO),
- according to the kind of the aircraft: numbers and site of the engines, numbers propeller engines,
- according to the type of the aircraft: Boeing 737-200, Airbus 320.

Some difficulties appeared in determining the chapter or the class of some, huskities, the registration of the aircrafts not appearing on the strips from control tower. The data base thus acquired in Saint Exupéry will also make it possible to carry out calculations of simulation: for example what would be the impact of the suppression of the use of the aircrafts of chapter II (04 – 2002) on the levels of noise.

2 - METHOD OF MEASUREMENT**2.1 - Conditions of measurement**

For each city at least three sonometers measure simultaneously the noise emitted by the aircrafts, as well as the noise of the city or sometimes the noise of other means of transport (TGV). The conditions of measuring are given by standard NF S 31 110 and appendix 16 of the ICAO.

2.2 - Measuring system

Integrating and averaging sonometer 01DB equipped with an external measuring unit.

- models SIP 95 – class 1;
- dynamic range 30 – 130 dB;
- frequential weighting dB (A).

The duration of acquisition is 24 hours long, with one second duration elementary Leq, that is to say 86 400 values recorded by point. For each measurement, the calibration is recorded at beginning and at the end of the period, in order to ensure that its variation does not exceed 0,5 dB (A). The microphone is in free field. The foot of microphone is positioned on close-cropped grass.

- 2 propellers,
- 4 propellers,
- 2 jet-engines under the wings,
- 4 jet-engines under the wings,
- 2 jet-engines on the fuselage,
- 3 jet-engines on the fuselage,
- 3 jet-engines.

The regional Management of the Civil Aviation authority provides information on the type of aircraft and the phase of procedure, after each series of measuring.

From the file, and existing data, we may calculate:

- Leq, the Leq max 1 s, SEL for each aircraft;
- Leq and SEL for the whole of the aircrafts;
- Leq on various time ranges:
 - 6 am to 10 pm;
 - 10 pm to 6 am.

These time sections are those defined for the calculation of the exposure of local residents living near road. Other time sections were defined, especially those of evenings and morning, example:

- 6 pm to 10 pm; and 6 am to 8 am
- during daylight: from 8 am to 6 pm.

3 - RESULTS

Presentation of the results

- the total energy of the noise coming from all the sources (total Leq) no longer limited to the noises of the aircrafts measured over all the duration of measurement (10 pm-6 am, 6 am-10 pm, etc.),
- the sound energy due to the noise of aircrafts, spread out over all the duration of the period of measurement considered.

3.1 - Table of the results

Example: aircrafts on taking off

Towns to the north of Lyon-Saint Exupéry airport – Results Leq in dB (A)

Towns	Place	<i>6 am – 10 pm</i>		<i>10 pm – 6 am</i>	
		<i>Total</i>	<i>Aircrafts</i>	<i>Total</i>	<i>Aircrafts</i>
Balan 01	Le Plateron	53,6	53,0	50,4	48,6
	Town Hall	53,1	50,0	46,0	43,0
	Château	53,8	50,7	47,0	40,9
Janneyrias 38	Town Hall	58,4	49,9	54,0	46,4
	Saint Ours	56,8	56,5	49,5	49,0
	Champoulet	58,3	57,6	52,6	51,6
Jonage 69	Town Hall	56,5	55,9	48,8	47,6
	Marre	57,5	56,8	51,4	51,2
	Georges Sand	53,0	52,7	45,4	44,9
Jons 69	Town Hall	58,2	56,8	55,9	55,7
	Biane				
	Chemin de Montalet	55,7	55,3	54,9	54,9
Niévroz 01	Centre ville	55,7	55,0	46,9	44,9
Pusignan 69	Town Hall	57,5	56,4	52,7	52,2
	Moifond	61,3	61,1	57,4	57,1
	Coquelicots	60,7	60,5	58,3	58,2
Villette d'Anthon 38	Town Hall	55,3	50,1	45,7	44,8
	Sous l'église	48,1	47,3	40,0	43,4
	Mons	53,4	51,6	44,2	43,7
	Asnière	48,5	48,1	40,7	39,7

Table 1: Take off – aircrafts towards the north of Lyon-Saint Exupéry airport.

Towns to the south of Lyon-Saint Exupéry airport – Results Leq in dB (A)

Towns	Place	<i>6 am – 10 pm</i>		<i>10 pm – 6 am</i>	
		<i>Total</i>	<i>Aircrafts</i>	<i>Total</i>	<i>Aircrafts</i>
Diémoz 38	Chemin de la chapelle	53,6	47,4	43,2	41,7
Heyrieux 38	Le château	49,5	42,7	41,3	32,7
	Les Wégélias	49,0	36,5	40,8	27,1
Grenay 38	Chemin des chapelles	59,0	58,7	58,6	58,5
	Town Hall	56,7	52,9	54,5	51,9
	Clos de la Fontaine	56,6	56,0	55,2	55,0
Saint Laurent de Mure 69	rue des Combattants	50,4	43,0	43,5	38,8
	rue de Caborne	50,4	46,9	43,6	41,2
	Mairie	48,3	39,0	43,3	38,1
Saint Quentin Fallavier 38	Domaine de la Lieuse	54,5	53,0	54,5	53,0
	Town Hall	58,8	52,6	54,2	52,9
	Hameau de Montjay	54,8	54,1	54,6	54,1

Table 2: Take off – aircrafts towards the south of Lyon-Saint Exupéry airport.

Towns to the east of Lyon-Saint Exupéry airport – Results Leq in dB (A)*Aircrafts taking off to north*

Towns	Place	<i>6 am – 10 pm</i>		<i>10 pm – 6 am</i>	
		<i>Total</i>	<i>Aircrafts</i>	<i>Total</i>	<i>Aircrafts</i>
<i>Colombier</i>	Town Hall	60,2	46,3	49,5	43,9
<i>Saugnieu 69</i>	Impasse de la croix	58,2	58,0	54,5	54,3
	Saugnieu	58,9	58,3	56,8	53,9

Table 3: Take off – aircrafts towards the east of Lyon-Saint Exupéry airport.

Other values of Leq were calculated over different periods. They include those of the evening, between 6 pm and 10 pm, as well as the period of the morning between 6 am and 8 am. Aircrafts are very active in these two periods. They correspond to the time when people are at home and do not sleep. The last comparison is made over the duration of measurement, that is to say 24 hours. We can note that in several cities, the Leq of the morning is often, especially on the takeoff, highest. In this time section, many aircrafts of chapter II, mainly Boeing 737-200 are in service.

3.2 - INTERPRETATION

The difference between total Leq and Leq aircraft, for each period of measurement considered, allows to be determinated the impact of the noise of the aircrafts on the sound environment of the point of measurement, according to three criteria: the noise of aircrafts is dominating, the noise of aircrafts is equal to the residual noise, the noise of aircrafts is lower than the residual noise.

First case

The difference between total Leq and Leq aircrafts is very slight, lower than 1 dB (A); the principal component of the total noise is the noise of the aircrafts; example: in Pusignan Moifond (aircrafts on takeoff), this difference is equal to 0,2 dB (A). The residual Leq with a value of 47,6 dB (A), lower by 15,6 dB (A) to the Leq aircraft.

Second case

If the difference between total Leq and Leq aircrafts is 3 dB (A). the value of the Leq residual noise is equal to the value of the Leq noise aircraft. In other words, the other sources of noise have the same importance as the noise of the aircrafts.

Third case

When the difference between global Leq and Leq aircrafts increases beyond 3 dB (A), less the noise of the aircrafts is significant; for example: the for a difference between total Leq and Leq had equal to 10 dB (A), the residual Leq differs from the total Leq only by 0,5 dB (A). The other sources of residual noise are the principal components of the total Leq.

4 - CONCLUSION

Leq 6 am – 10 pm goes from 48,1 to 61,3 dB (A) and the Leq 10 pm – 6 am varies from 40,8 to 58,3 dB (A). The levels Leq max sometimes exceed 85 even 90 dB (A). That presents the problem of the acoustic index to characterize the annoyance. Significant effects are due to the reduction of the noisy aircrafts (chapter II) on the night Leq. The reduction of the noisy aircrafts (chapter II) at night has a significant effect on the reduction of the night Leq. The general withdrawal of these in 2002 will thus have a significant impact on the noise perceived by the residents. The airport intends to install a permanent monitoring system noise, at the end of 2000, which will allow further comparison.

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