Capri Island Heliport noise control

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Summary
The helicopter noise is produced by various and complex contributions, which is a mechanical aerodynamic Therefore, a proper assessment of the noise, in the environmental impact study of "Airports, Airfields and Heliports", plays an important role because the perception by the exposed population is also influenced by subjective parameters. The sound level meter is set in trigger mode level with 70 dBA threshold to start events measurement.
The measurement campaign has allowed while monitoring lasted 20 days, to identify the total number of 220 events, attributable to takeoffs and landings.
We evaluated the time history and the spectral components of the events landings and takeoffs. The values obtained were compared with the limits of judicial practice.

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1. Generality about helicopter noise

There are many sound contributions associated with the noise of the helicopters, and their importance depends on the type of helicopter involved. Predominant in the generation of noise is the tail rotor, but also the engine produces noise of various types, then there is the product inlet into the turbine, the compressor, the turbine itself, combustion and aerodynamic noise.

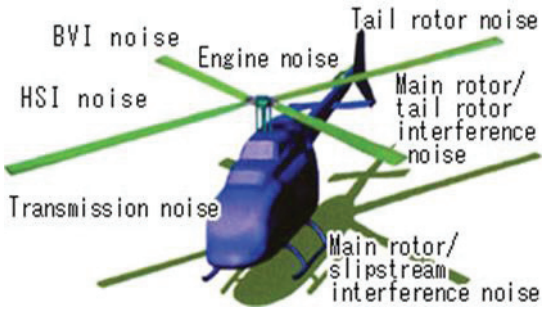

Figure 1. Various contributions of the noise of a helicopter.

All efforts to mitigate the noise, however, are limited by the fact that this has originated for the most part, by the flow of air that the rotor head shoots on the cell (cab-body) and on the tail of the helicopter, in order to keep in high and go in all directions.

The tail rotor is a technology component specifically used in the helicopter. Placed at the end of the tail boom is formed by a rotor generally of small diameter, mounted on one side as close as possible to the perpendicular of the main rotor.
Can say that the tail rotor is a thruster that pushes the body of the helicopter in the opposite direction to that due to the main rotor in order to avoid loss of control.
Large part of the helicopters carries the tail rotor located below the circle of the rotor head: the air flow is thus broken continuously, and in this position is to occur the noise.
In fact, to pay attention, when you hear a helicopter passes over the pace of the airflow fragmented that the noise of the engines (almost always the noisy turbines which notes, however, the classic whistle generally only when the helicopter is in few tens of meters). The propagation of the noise of a helicopter is very peculiar: In fact, the presence of natural obstacles (helicopter at low altitude, wind and / or woods or hills between the listener and the helicopter) you cannot notice the same until the middle does not arrive just a few hundred meters; while in the countryside for the listener to the ground and the helicopter is low-flying with no wind (or in area with low background noise) you can hear the helicopter also to several kilometers away.

2. LIQC DAMECUTA Capri Heliport

Is defined heliport, an area that includes structures, geometries and technical requirements which enable the landing and takeoff of aircraft to launch vertically .

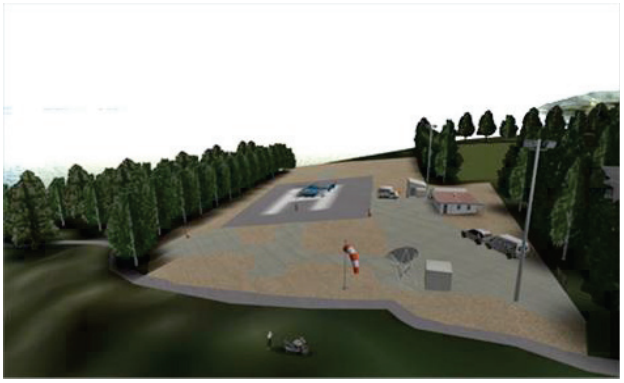

Figure 2. Rendering LIQC DAMECUTA Heliport 40°33'30.95" N 014°12'04.76" E

A heliport generally includes one or more landing points (helipad) and contains, usually of limited facilities such as fuel, lighting, a windsock for measuring the strength of the wind (often coupled to a weather control unit).

The Management Airport Campania ENAC National Civil Aviation Authority, reports that the site DAMECUTA is considered only a military helipad, open to civilian traffic.

The civilian traffic concerns transfers by helicopter operated by companies and by private helicopter, for various routes including those frequently round trip: Ravello (0h.20'), Naples Capodichino (0h.17'), Rome Fiumicino (1h .20').

2.1. Noise Classification area

Table I. Provisional zoning limits.

Provisional zone	*day 6-22*	*night 22-6*
Entire national territory (hospitals, schools, parks, resting places)	70	60
Zona A – D.M. n. 1444/1968 art. 2 (urban areas which are relevant historical, artistic of particular pregio)	65	55
Zona B –D.M. n. 1444/1968 art. 2 (the parts of territory totally or partially built, other than Zone A)	60	50
Exclusively industrial area	70	70

Waiting for the drafting and approval of the acoustics zoning plan of the City of Anacapri, are valid the limits related to "the entire national territory" equal to 70 dBA daytime and 60 dBA night as in the table of provisional zoning (tab. I).

2.2. Receptors

The receptor is the most exposed building nearest the heliport. Its distance from the heliport is variable between 64 and 104 meters.

Figure 3. Extract cadastral document: receptor and heliport

3. Phonometrics measurements

The noise from helicopters is mechanical and aerodynamic, is not constant, and also presents different characteristics in frequency, including the generation of infrasound.

Therefore, a proper study, aimed at identifying the phenomenon, which can not be done by a complex monitoring over a long period. Therefore, landings and takeoffs were acquired for 20 continuous days, in three weeks of heavy traffic in the year.

3.1. Sampling modes

To assess the actual amount of sound output noise complained, monitoring, in order to correctly identify and clear events, was preceded by appropriate sampling able to allow the characterization of the trigger thresholds, for the automatic recording of phenomenon, and choose the most appropriate monitoring locations.

The Trigger functionality, allows the sound acquisition to passing a set threshold level. Following the setting of these analysis parameters, better described later, is carried out a continuous acoustic monitoring for 24 hours in twenty (20) consecutive days.

To check the weather and climate condition, it is used a monitoring station Babuc A with related probes, at a height microphone near the window, so as not to affect the sound field.
The weather control unit has verified the absence of rain, snow and wind (less than 5 m/s^2).

3.2. Monitoring stations

The point most disturbed and appropriate for the measurements has been identified in the nearest building, following the inspection, were chosen for the measurement stations and data acquisition, both for the acoustic monitoring of the video that the overflight.
The instrumentation was placed in front of the room window on the first floor near the square of the heliport. The microphone was positioned at the height of 1.5 meters, and more than one meter away from reflective surfaces, as required by law (DM March 16, 1998 "Techniques for detecting and measuring noise pollution") and were carried out all the calibration procedures of the instrumentation, without significant deviations of the measurement parameters.

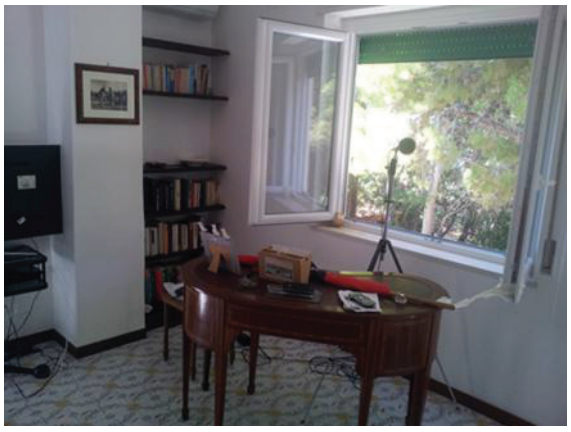

Figure 4. Measurement point in the nearest building

Has been used a stand-alone video monitoring system.
The system consists of a laptop with software Sentry Vision Security 3.2 on Win XP operating system, multiple webcams support, and video generated in WMV format.
The Computer placed in a protective carrying case, inside a tin-plated cabin in the building garden, is connected to the web-cam fixed on the cabin roof, in the direction of the expected route of the helicopters in approach or departure from the heliport

Figure 5. Video station

Figure 6. Video sequence of a approaching helicopter.

3.3. Instruments setting

The sound level meter analyzer integrator Brüel & Kjær model 2260 Investigator, used in the monitoring, complies with IEC 651ed IEC 804 Type 1, IEC 61672 Class 1 comes with valid calibration certificate issued by European accredited laboratory.
The residual noise level (LR) is the equivalent continuous A-weighted sound pressure "A", which

Table II. Surveys carried out in the three weeks of the month of August 2014

date	*Aug 8*	*Aug 9*	*Aug 10*	*Aug 11*	*Aug 12*	*Aug 13*	*Aug 14*	*Aug 15*	*Aug 16*	*Aug 17*
events n.	7	12	16	15	11	9	9	6	15	3
date	*Aug 18*	*Aug 19*	*Aug 20*	*Aug 21*	*Aug 22*	*Aug 23*	*Aug 24*	*Aug 25*	*Aug 26*	*Aug 27*
events n.	10	12	8	12	18	11	13	5	10	18

detects when you not include the specific disturbing source.
LR does not contain any atypical sound events, was measured on equal terms used for the measurement of environmental noise LA, but with different sampling rate (only every 5/10 min)
Therefore the background noise (LF), is represented, by way of precaution, by 95 percentile, not of the parameter LAf, but of the parameter LAf_{max} of residual noise level (LR) obtained the entire reference period day (excluding the events attributable to the source heliport).
The trigger level is activated when Laf (ist) exceeds the level set in the "start" field for a time higher than the "time duration" set. The event stops when Laf (ist) falls below the level set in the "stop" field in excess of the "time duration". The LAf parameter is sampled 10 times per second. Trigger instrument settings are shown in Table. III.

Table III. Trigger instrument settings.

START		*STOP*	
Pre-trigger	07 sec	Post-trigger	02 sec
Level	77 dBA	Level	70 dBA
Duration	06 sec	Duration	05 sec

Have been used pre and post trigger times. These function use the instrument computing capacity to store a total of up to 15 seconds before or after the event, allowing a complete event recording.

3.4. Measurement results analysis

From the analysis of LAf time history events, is clear the distinction between the takeoff and landing of helicopters.
In fact, the trend of the parameter laf (instantaneous sound level) shows two mirror images, with the laf that takeoff grows fast up to 90 dBA, then stabilized to 80 dBA and decreases moving away, and vice versa in landing (fig. 7).

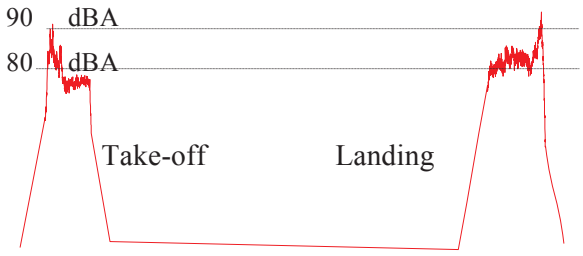

Figure 7. Laf event time history

The measurement campaign has allowed, in total, to identify 220 events, attributable to the takeoffs and landings of helicopters. The events number are reported, divided according to the day of occurrence, in the table II.
The duration of the events measured with trigger mode, excluding helicopters with the engine running, after landing and until the next takeoff (fig. 10), ranging from 20 seconds up to a minute and a half. The helicopters events seen as "the start and end of the perception of the noise", is greater, being more than 2 minutes.

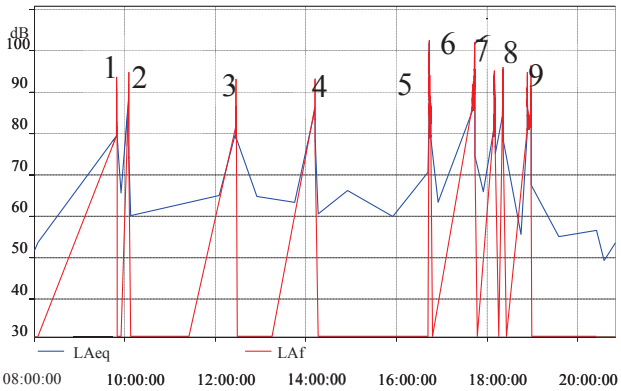

Figure 8. Day time history typical events

The study of sound spectrums shows, as might be expected, the evidence of predominant in low frequency bands, in particular that of 25Hz, that without distinction between the process of landing and take-off.

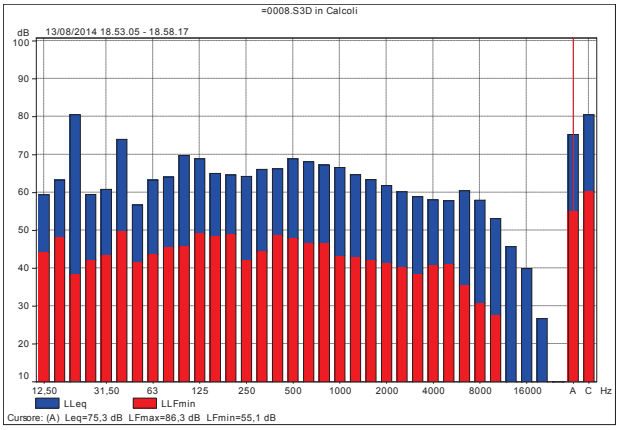

Figure 9. Sound spectrums events – Lafmin e Leaq

By comparison with the equal loudness contour (ISO 266), there are no present, in the measurements, steady tonal components.

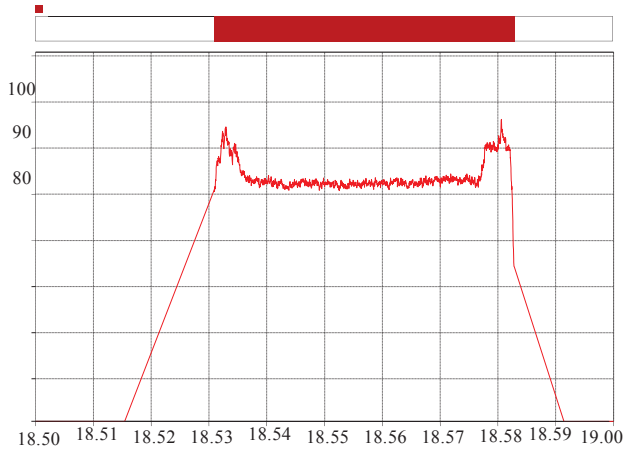

Figure 10. Undue exposure: helicopters Laf time history with the engine running, after landing and until the next takeoff.

4. Normal tolerance Criterion (art. 844 civil code)

This criterion called "comparative" defines intolerable noise when the comparison between Leaq LA (environmental noise) and the LAf L_{95} percentile of LR (residual noise level), exceeds 3 dBA.
Because of the infrequent sampling of residual noise level LR than environmental LA, to correctly apply the criterion of normal tolerance, has been used as a conservative condition, the 95 percentile, calculated on LAFmax and not on instant lAf.

Table IV. Normal tolerance Criterion typical results

R	*Time*	*Duration*	*LA LeAQ*	*LF: LAf95max LR*	*LA – LF > 3*
1	09.41.00	02.43	75,6	53,3	**22,3**
2	10.00.01	01.20	80,9		**27,6**
3	10.48.40	00.51	76,8		**23,5**
4	10.54.31	00.28	81,3		**28,0**
5	12.58.49	01.46	79,5		**26,2**
6	13.17.43	00.29	79,6		**26,3**
7	13.49.39	00.27	80,0		**26,7**
8	15.18.04	01.05	75,2		**21,9**
9	15.55.08	00.46	78,7		**25,4**
10	16.10.44	00.27	81,3		**28,0**

5. Conclusions

This study was aimed at evaluation of the disturbance in an apartment, located in Anacapri, attributable to the source: heliport LIQC Capri / Anacapri DAMECUTA. Subjects exposed, complain, all day, in their homes, the disturbance from noise connected to the overflight, landing and take-off of helicopters. The receptors exposed to noise, are located in the Municipality of Anacapri with noise limits transients related to "the entire national territory" of 70 dBA day and 60 dBA night. From surveys carried out in the building closest, during the three weeks of heavy traffic of the year, it appears that:

1) there was critical situations such as the practice of the landing and take-off, leaving the engine running;

2) the criterion of absolute ceiling, depending on the class of the destination of use is not respected as for all events are found values up to more than 10 dBA above the limits.

3) the limit "comparative" criterion of normal tolerance of noise is exceeded, because in each single event the value LA acquired exceeds considerably (even 10 times) the limit of 3 dB maximum allowed.

References

[1] Night Noise Guidelines for Europe Organizzazione Mondiale della Sanità Ed. 2009;
[2] A.R. Geroge Helicopter Noise state-of-the-Art, AIAAA 4th Aeroacoustic Conference, Atlanta, june 20 1978.