

GOVERNMENT OF INDIA
OFFICE OF THE
DIRECTOR GENERAL OF CIVIL
AVIATION
OPP. SAFDARJUNG AIRPORT,
NEW DELHI – 110 003



भारत सरकार
महानिदेशक नागर विमानन
का कार्यालय
सफदरजंग एरपोर्ट के सामने
नई दिल्ली - ११० ००३

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Reference No./ संख्या: DGCA-27041/1/2024-AED-DGCA
Dated/ दिनांक: २९ April , 2025

विमान अभियांत्रिकी निदेशालय

To,
Sri Guru Ram Dass Jee International Airport
Amritsar, Punjab 143101,
India.

(Kind Attention: Shri. S. K. Kapahi, Airport Director, AAI, Amritsar)

Subject: Approval of Airport Noise Zone developed by Sri Guru Ram Dass Jee International Airport, Amritsar

Sir,

Reference is invited to the G.S.R 568(E) dated 18/06/2018, on Airport Noise Zone area at Airports to define Noise Contour for day and night period, considering all approach and departure funnels and Instrument Flight Procedures in consultation with airports Air Navigation Service Provider as per the Master Plan of the Airport.

In this regard, Sri Guru Ram Dass Jee International Airport, Amritsar has carried out the study in consultation with M/s. Structural Solutions Pvt. Ltd. and developed the Airport Noise Zone, document no.: 044-Rev.02 dated March 2025. The submitted document has been examined in accordance with G.S.R 568(E) issued by Ministry of Environment, Forest and Climate Change (MoEFCC) dated 18/06/2018 and found satisfactory.

DGCA shall review the noise contour of Sri Guru Ram Dass Jee International Airport, Amritsar after three years and based on the satisfactory evaluation the approval will be renewed further for another three years.

This approval shall remain valid for a period three years from the date of issue unless suspended/revoked/cancelled. The airport operator shall display the approved noise zone on their official website.

Yours faithfully

(Rohit Thakur)
Deputy Director (AE)
for Director General of Civil Aviation

Copy to:-

- 1) The Chairman, Airports Authority of India, Block -C, Rajiv Gandhi Bhawan, Safdarjung Airport, New Delhi - 110003
- 2) Director, Directorate of Aerodrome Standards, DGCA HQs, opposite Safdarjung Airport , New Delhi- 110003



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Report no 044 - Revision 2

Sri Guru Ram Dass Jee International Airport Amritsar, India Report for Noise Mapping Study and Zone Declaration Study 2024 Contract No: GEMC-511687779954930



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1. Introduction

Contract No: GEMC-511687779954930

Custom Bid for Services Noise mapping and declaration of Airport Noise zones at Amritsar Airport

The following report describes the study carried out for the civil airport of Amritsar, based in north India, to understand the noise impact generated by its flight activity.

This study complies with the Indian regulations about airport noise, as described in the following pages.

The study shows the results of a noise model made from 2023 flights data.

The noise model has been processed by a specific software worldwide used that let users to calculate noise contours.

Noise contours are helpful to study the current noise impact of planes flying away and toward to a specific airport. Furthermore, they can be generated taking into account future flight traffic evolutions to understand previously how this will affect the surrounding areas and to calculate exposed population to noise levels.



2. Regulations

The following table shows regulations, guidelines and technical reports concerning the following study.

Regulations	Title
Aviation Environment Circular 01 of 2024 (Noise management at Airports) issued by Director General of Civil Aviation (DGCA) dated 2nd July 2024	<i>"Noise management of Aircraft Operations at Airports"</i>
Ministry of Environnement, Forest and Climat change notification, 18 June 2018	<i>"CENTRAL Pollution Control Board (CPCB), MoEF gazette notification G.S.R. 568(E) Dated 18.06.2018. – Airport Zone"</i>

Tabel 1: Regulations.



3. Airport features

The airport, called Sri Guru Ram Dass Jee International Airport, is located in the North of India in state of Punjab close to the international borders. It was built in 1930 and since its establishment it owns only a runway. Its flight traffic is made by both local and international flights.

Features	
Name	Sri Guru Ram Dass Jee International Airport
ICAO code	VIAR
IATA code	ATQ
ARP coordinates	31°42'38" N 74°48'01" E
Altitude	≈ 231 (760ft) m
Runways	1
Runways type	16-34
Helipad	NO
Operator	Airports Authority of India - NR

Tabel 2: Airport features.

The following table shows approximate airport traffic data of the last years¹.

Year	Flights
2019	17,082
2020	8,016
2021	13,504
2022	19,522
2023	21,726

Tabel 3: Airport traffic.

As the aircraft movements for Sri Guru Ram Dass Jee International Airport were **21,276** in 2023, this airport is cateregaries as **Other Airport**

¹ Source: Airports Economic Regulatory Authority of India - IN THE MATTER OF DETERMINATION OF TARIFF FOR GROUND HANDLING SERVICES FOR M/s INDOTHAI AMRITSAR PRIVATE LIMITED (ITAPL) AT SRI GURU RAM DAS JEE INTERNATIONAL AIRPORT, AMRITSAR FOR THE FIRST CONTROL PERIOD (FY 2022-23 TO FY 2026-27) – 06/09/2023.

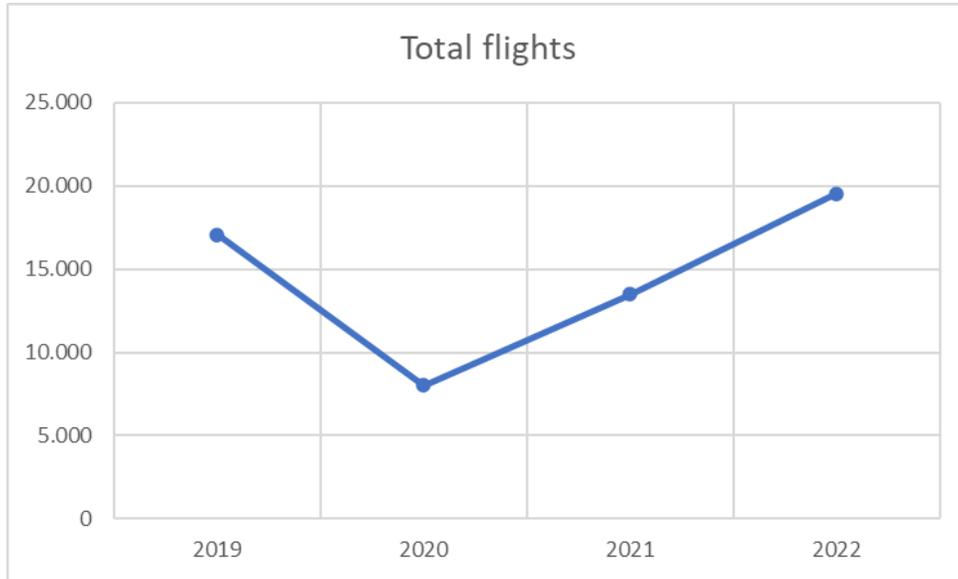


Image 1: Evolution of flights over the time period 2019-2022.

The following table shows the declared distances of the runway.

Runway	TORA	TODA	ASDA	LDA
16	3.658	3.658	3.658	3.658
34	3.658	3.658	3.658	3.658

Tabel 4: Declared distances.

The 16-34 runway width is 45 meters.

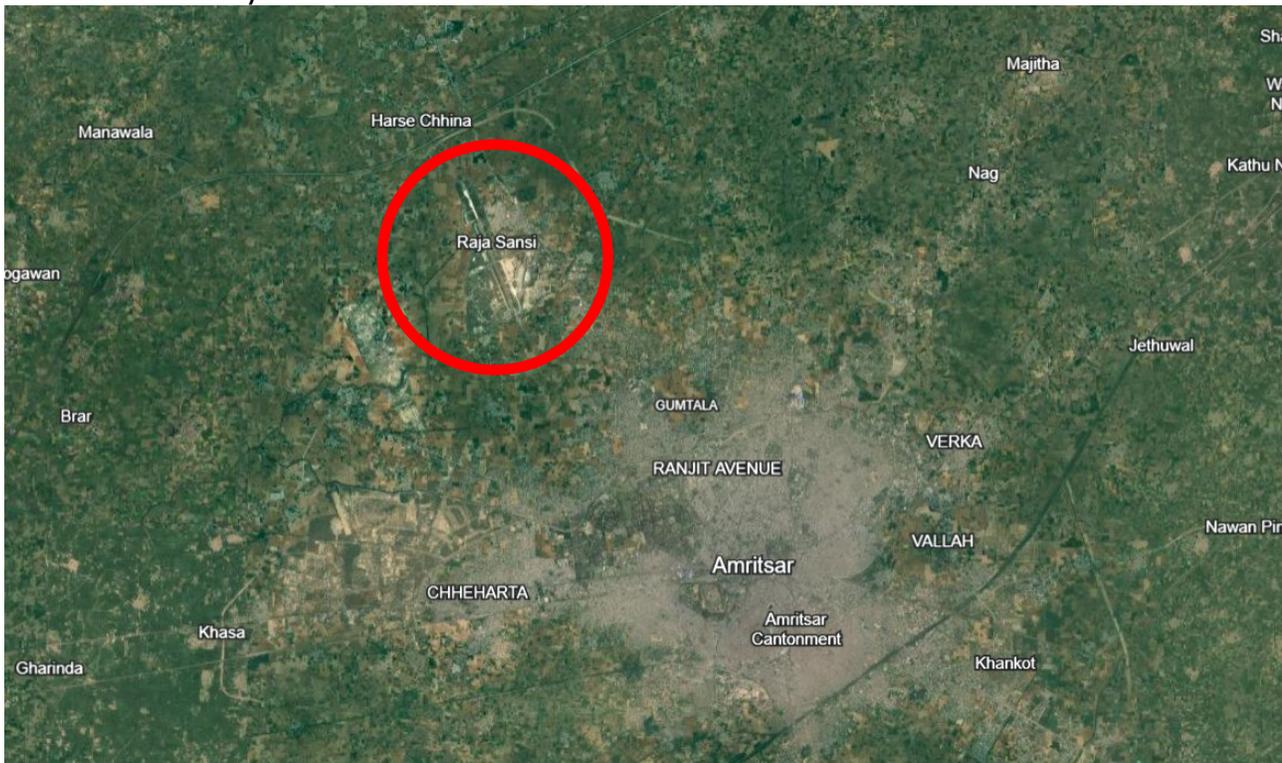


Image 2: Airport location.



Image 3: airport borders.



4. Simulation

The noise study has been developed using the software named Aviation Environmental Design Tool (AEDT) developed by the Federal Aviation Administration (FAA).

The AEDT is the new generation software to predict noise made by aircrafts. Before AEDT, Integrated Noise Model (INM), developed by FAA, was used.

4.1 INM software

INM is a software based on the following standards:

- SAE-AIR-1845 "Procedure for the calculation of airplane noise in the vicinity of airports";
- SAE-AIR-5662 "Method for predicting lateral attenuation of airplane noise"
- SAE-ARP-866 "Standard values of atmospheric absorption as a function of temperature and humidity for use in evaluating aircraft flyover noise"
- ECAC Doc.29 4th edition "Report on Standard Method of Computing Noise Contours around Civil Airports";
- Circular ICAO 205 "Recommended method for computing noise contours around airports".

INM is not designed to calculate noise made by a single aeronautic movement and its algorithm is made to evaluate long term average noise. In this way it is not necessary to input flights for each 365 days of the year. INM works with the "yearly average day" which is made by the average use of the airport (average aircraft types, tracks, procedures, weather).

The software is able to model noise coming only from departures and approaches within specific altitude limits of the aircrafts (noise calculation made by approaches starts from 6,000 ft while noise calculation made by departures cut is not performed over 10,000 ft).

Noise made by APU and from taxiing is not calculated but usually this is a neglectable energetic contribution comparing to sound energy of departures and landings.

A built-in option let the user to model noise from run ups.

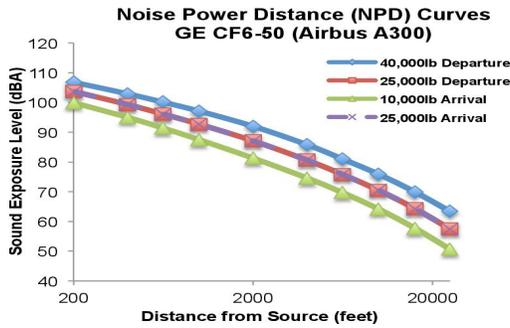


Image 4: NPD set example².

To calculate noise at receiver points INM uses the segmentation process. This method takes into account the NPD (Noise – Power – Distance) data. NPD curves provide noise data for a specific plane in a specific condition and the noise can be modify using correction factors such as air pressure or flight angles.

The software analyses horizontal track projections (on the ground) and using flight procedures and motion equations it starts to draw a 3D flying path. The 3D flying path is then divided in several segments and for each segment INM calculates noise made by a specific plane taking into account correction coefficients.

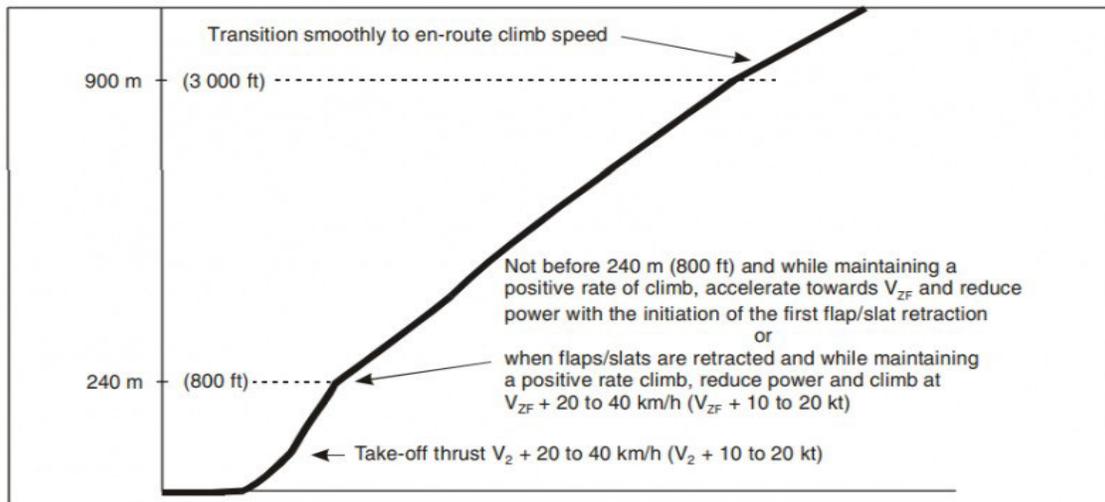


Image 5: Flight procedure – NADP 2 – ICAO³.

² <https://www.semanticscholar.org/paper/Modeling-Performance-and-Noise-of-Advanced-for-and-Thomas-Hansman/72742faab9409f888186261c456e32079cb01dd3>

³ <https://mediawiki.ivao.aero/index.php?title=File:NADP-2.png>



4.2 Aviation Environmental Design Tool (AEDT)

AEDT is able to model both noise and emission (air pollution). It is a complete software that let users to study several scenarios and environmental pollutants such as noise, fuel burn and emissions.

AEDT comes from the join of several calculation cores such as INM, Magenta, EDMS and SAGE.

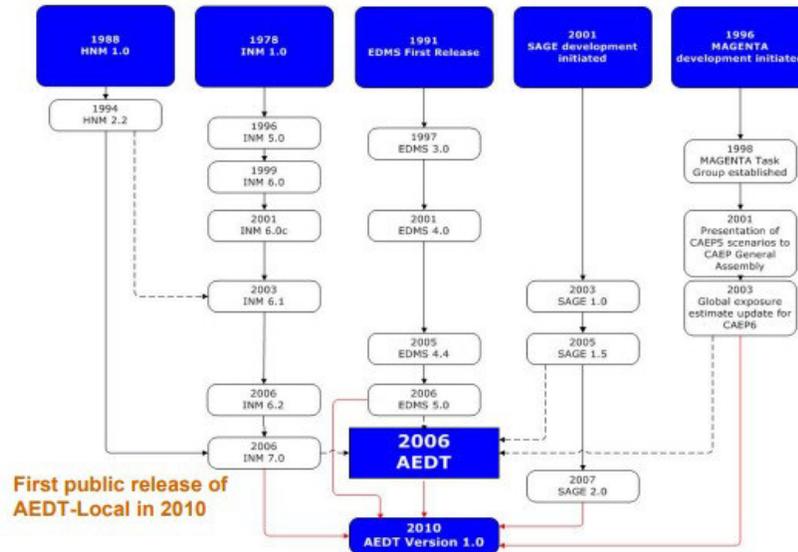


Image 6: AEDT origins⁴.

Concerning noise modelling AEDT uses the same algorithm of INM with few implementations such as a better resolution into the segmentation process.

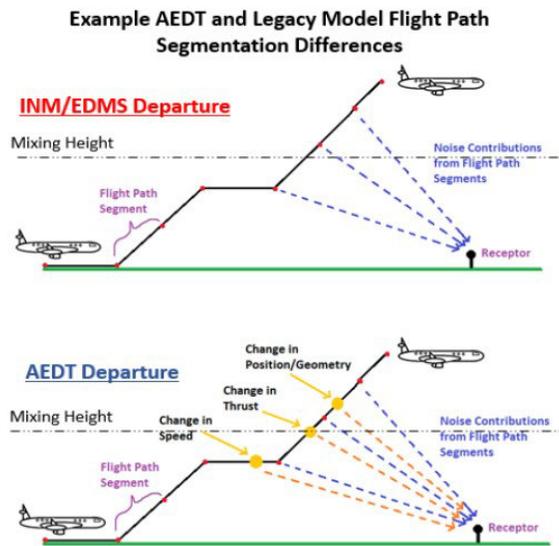


Image 7: Segmentation process comparison⁵.

⁴ https://onlinepubs.trb.org/onlinepubs/archive/conferences/aedt-apmt/04_gf_overview-aedt_2006-11-28_final.pdf

⁵ https://aedt.faa.gov/Documents/Comparison_AEDT_Legacy_Summary.pdf



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AEDT has an SQL server architecture that let the user to operate on databases. Furthermore, it uses also database from EUROCONTROL such as the BADA (Base of Aircraft Data).



4.3 Input Data

Input data have been calculated starting from the total scheduled air traffic for 2023 released by the Sri Guru Ram Dass Jee International Airport as shown from the following tables .

ATO DOMESTIC DEPARTURE FLIGHT SCHEDULE				
AIRLINES	FLIGHT NO.	DEP TO	DEP Time	FREQUENCY
INDIGO	6E6129	Pune	0005	DAILY
INDIGO	6E2342	New Delhi	0605	DAILY
AIR INDIA	AH54	New Delhi	0650	DAILY
INDIGO	6E357	Goa	0700	DAILY
INDIGO	6E2221	New Delhi	0730	DAILY
VISTARA	UK696	Mumbai	0840	DAILY
AIR INDIA	AI1650	Mumbai	0900	DAILY
INDIGO	6E6164	Srinagar	0925	DAILY
ALLIANCE AIR	91808	Kuala Lumpur	0955	Mon, Wed, Fri
VISTARA	UK696	New Delhi	1005	DAILY
INDIGO	6E 5192	Mumbai	1015	DAILY
AIR INDIA EXPRESS	IX953	Hyderabad	1100	DAILY
INDIGO	6E6165	Lucknow	1215	DAILY
INDIGO	6E3366	New Delhi	1230	DAILY
AIR INDIA	AI492	New Delhi	1300	DAILY
INDIGO	6E6288	Srinagar	1330	DAILY
INDIGO	6E6344	Kolkata	1400	DAILY
VISTARA	UK692	New Delhi	1525	DAILY
INDIGO	6E2748	New Delhi	1555	SUN
INDIGO	6E478	Bangalore	1610	DAILY
AIR INDIA	AH462	New Delhi	1615	DAILY
INDIGO	6E2577	New Delhi	2200	DAILY
INDIGO	6E 127	Ahmedabad	2210	DAILY
AIR INDIA	AH80	New Delhi	2300	DAILY
INDIGO	6E5179	Mumbai	2310	DAILY

ATO INTERNATIONAL DEPARTURE FLIGHT SCHEDULE					EFFECTIVENESS
AIRLINES	FLIGHT NO.	DEP TO	DEP Time	FREQUENCY	
AIR ASIA	D7189	Kuala Lumpur	0030	THU,SAT	
NEOS S.P.A	NO535	Milan	0200	FRI	
NEOS S.P.A	NO325	Rome	0230	THU	02 NOV TO 07 DEC
	MH207	Kuala Lumpur	0320	TUE,SAT	
QATAR	QR549	Doha	0410	DAILY	
NEOS S.P.A	NO535	Milan	0640	FRI	
AIR INDIA EXPRESS	IX137	Sharjah	0750	MON,WED,THU,FRI,SUN	
SPICEJET	SG55	Dubai	0840	DAILY	
UZBEKISTAN AIRWAYS	HY442	Tashkent	0935	TUE,FRI,SUN	04 JAN TO 14JAN
SCOOT	TR505	Singapore	1030	MON,WED,THU,FRI,SUN	13 DEC TO 24 JAN
NEOS S.P.A	NO325	Rome	1150	WED	
INDIGO	6E1427	Sharjah	1200	DAILY	
MALINDO	D7189	Kuala Lumpur	1230	MON,SUN	
AIR INDIA	AI169	London Gatwick	1415	WED,FRI,SUN	
AIR INDIA	AI117	Birmingham	1415	MON,THU,SAT	
AIR INDIA EXPRESS	IX191	Dubai	1625	DAILY	1 NOV-27 MAR
NEOS S.P.A	NO277	TBS	1535	WED	25 DEC TO 01 JAN
NEOS S.P.A	NO735	Rome	1535	MON	
MALINDO	OD272	Kuala Lumpur	1835	MON,WED,FRI,SUN	
MALINDO	OD272	Kuala Lumpur	2200	MON,WED,FRI,SUN	2 FEB TO 29 MAR
NEOS S.P.A	NO535	Milan	2325	FRI	
MALAYSIAN AIRLINES	MH119	Kuala Lumpur	2325	WED,SAT	

Image 8: Scheduled departures winter 2023-24.



ATQ DOMESTIC ARRIVAL FLIGHT SCHEDULE				
AIRLINES	FLIGHT NO.	ARR FROM	ARR Time	FREQUENCY
INDIGO	6E721	Pune	0515	DAILY
AIR INDIA	A1453	New Delhi	0610	DAILY
INDIGO	6E241	New Delhi	0650	DAILY
VISTARA	UK695	Mumbai	0750	DAILY
AIR INDIA	A11649	Mumbai	0820	DAILY
INDIGO	6E 272	Mumbai	0840	DAILY
INDIGO	6E6164	Lucknow	0850	DAILY
VISTARA	UK697	New Delhi	0930	DAILY
ALLIANCE AIR	91807	Kuala Lumpur	0930	Mon, Wed, Fri
AIR INDIA EXPRESS	IX954	Hyderabad	1015	DAILY
INDIGO	6E 106	Ahmedabad	1055	DAILY
INDIGO	6E6165	Srinagar	1145	DAILY
INDIGO	6E6557	New Delhi	1200	DAILY
AIR INDIA	A1491	New Delhi	1225	DAILY
INDIGO	6E 201	Kolkata	1240	DAILY
INDIGO	6E6288	Bangalore	1300	DAILY
VISTARA	UK 691	New Delhi	1450	DAILY
INDIGO	6E2747	New Delhi	1510	SUN
AIR INDIA	A1461	New Delhi	1530	DAILY
INDIGO	6E 478	Srinagar	1540	DAILY
INDIGO	6E2045	New Delhi	2120	DAILY
AIR INDIA	A1479	New Delhi	2210	DAILY
INDIGO	6E5256	Mumbai	2335	DAILY
INDIGO	6E6307	New Delhi	2310	DAILY
INDIGO	6E 362	Goa	2330	DAILY

ATQ INTERNATIONAL ARRIVAL FLIGHT SCHEDULE					EFFECTIVENESS
AIRLINES	FLIGHT NO.	ARR FROM	ARR Time	FREQUENCY	
NEOS S.P.A	N0324	Milan	0100	THU	02 NOV TO 07 DEC
	MH206	Kuala Lumpur	0220	TUE,SAT	
QATAR	QR548	Doha	0240	DAILY	04 JAN TO 14JAN
UZBEKISTAN AIRWAYS	HY441	Tashkent	0830	TUE,FRI,SUN	
NEOS S.P.A	N0534	Milan	0525	FRI	13 DEC TO 24 JAN
NEOS S.P.A	N0534	Rome	0525	FRI	
AIR INDIA EXPRESS	IX138	Sharjah	0650	MON,WED,THU,FRI,SAT	1 NOV-27 MAR
SPICEJET	SG56	Dubai	0730	DAILY	
SCOOT	TR504	Singapore	0905	MON,WED,THU,FRI,SUN	25 DEC TO 01 JAN
AIR INDIA	A1170	London Gatwick	1005	WED,FRI,SUN	
AIR INDIA	A1118	Birmingham	1010	MON,THU,SAT	2 FEB TO 29 MAR
NEOS S.P.A	N0324	Milan	1030	WED	
MALINDO	D7188	Kuala Lumpur	1100	MON,SUN	1 NOV-27 MAR
NEOS S.P.A	N0276	TBS	1355	WED	
NEOS S.P.A	N0734	Milan	1355	MON	25 DEC TO 01 JAN
AIR INDIA EXPRESS	IX192	Dubai	1440	DAILY	
MALINDO	OD271	Kuala Lumpur	1620	MON,WED,FRI,SUN	2 FEB TO 29 MAR
INDIGO	6E1428	Sharjah	2015	DAILY	
MALINDO	OD271	Kuala Lumpur	2115	MON,WED,FRI,SUN	2 FEB TO 29 MAR
NEOS S.P.A	N0534	Rome	2205	FRI	
MALAYSIAN AIRLINES	MH118	Kuala Lumpur	2210	WED,SAT	2 FEB TO 29 MAR
AIR ASIA	D7188	Kuala Lumpur	2300	WED,FRI	

Image 9: Scheduled landings – winter 2023-24.

ATQ DOMESTIC DEPARTURE FLIGHT SCHEDULE				
AIRLINES	Flight No	Departure To	Departure Time	frequency
AIR INDIA	A1650	BOMBAY	855	DAILY
INDIGO	6E5279	BOMBAY	530	DAILY
INDIGO	6E5182	DELHI	545	DAILY
AIR INDIA	A1454	DELHI	650	DAILY
INDIGO	6E2034	DELHI	920	DAILY
INDIGO	6E6193	SRINAGAR	925	DAILY EXCEPT WED
INDIGO	6E6193	SRI NAGAR	950	WED
VISTARA	UK694	DELHI	1015	DAILY
INDIGO	6E 307	LUCKNOW	1250	DAILY
INDIGO	6E 797	SRI NAGAR	1300	DAILY
AIR INDIA	A1464	DELHI	1310	TUE & SAT
AIR INDIA	A1464	DELHI	1335	SAT
SPICEJET	SG2942	PATNA	1115	DAILY
VISTARA	UK692	DELHI	1525	DAILY
INDIGO	6E 478	BANGALURU	1605	DAILY
INDIGO	6E2124	DELHI	1610	WED
AIR INDIA	A1462	DELHI	1620	DAILY
INDIGO	6E2527	DELHI	1945	WED
INDIGO	6E5202	DELHI	2100	DAILY
INDIGO	6E 645	AHMEDABAD	2000	TUE, THU & SAT
INDIGO	6E9526	CALCUTTA	2140	DAILY
INDIGO	6E 157	BOMBAY	2145	DAILY
AIR INDIA	A1480	DELHI	2310	DAILY
INDIGO	6E 951	PUNE	2320	DAILY

ATQ INTERNATIONAL DEP' FLIGHT SCHEDULE				
AIRLINES	FLIGHT NO.	TO	DEP (STA)	frequency
NEOS	N05249	MILAN	145	FRI,SAT
QATAR	QR549	DOHA	335	DAILY
NEOS	N03249	MILAN	430	THU
AIR INDIA EXPRESS	IX137	SHARJAH	900	MON,WED,THU,FRI,SUN
SPICEJET	SG55	DUBAI	915	DAILY
INDIGO	6E1427	SHARJAH	1245	DAILY
AIR INDIA	A1169	GETWICK	1400	MON, THU & SAT
AIR INDIA	A1117	BIRMINGHAM	1430	MON, THU & SAT
AIR INDIA EXPRESS	IX191	DUBAI	1625	DAILY
SCOOT	TR509	SINGAPORE	1940	MON,WED,THU,FRI,SUN
SCOOT	TR509	SINGAPORE	2240	THU
MALINDO	OD272	KUALA LUMPUR	2230	MON, WED, FRI & SUN

Image 10: Scheduled departures – summer 2023-24.



4.3.1 Flight traffic

Flight data have been elaborate calculating daily average operations. This has been done taking into account aircraft types, runway percentage usage, flight time distribution and trip distance (Stage).

Runway percentage usage has been calculated from the following data.

Arrival		Departure	
Total	10864	Total	10863
From RWY 34	From RWY 16	From RWY 34	From RWY 16
8691	2172	7604	3259

Image 12: Runway usage.

Runway	Usage percentage
34-16	75%
16-34	25%

Tabel 5: Calculated runway percentage usage.

The following table shows the calculation of the total operations for the average day.

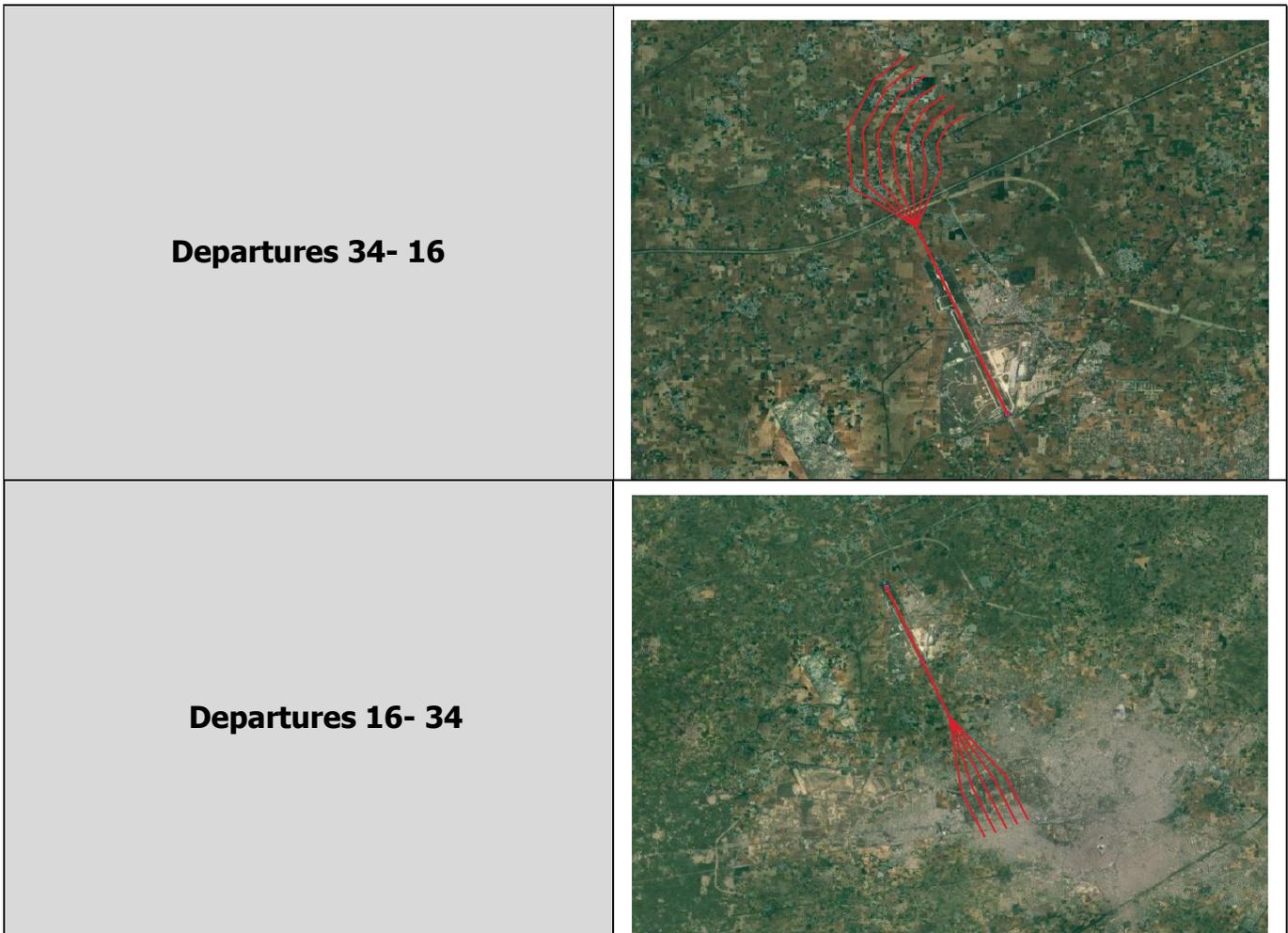
Average daily operations	59.52877	60
Departures	50%	30
Landings	50%	30
Departures 34-16	22.5	
Landings 34-16	22.5	
Departures 16-34	7.5	
Landings 16-34	7.5	

Tabel 6: Total operations – Average day.



4.3.2 Flying tracks

Tracks have been drawn following Customer information and real ADSB flight tracks. It is good to underline that since the aircraft traffic featuring Amritsar airport is not high there is no need to model with high accuracy a track because the high acoustic energy comes during the straight segment for both departures and landings. To simulate deviation from SID, tracks dispersion has been settled up on departures tracks.





<p>Landings 34- 16</p>	
<p>Landings 16 - 34</p>	

Tabel 7: Input tracks.

4.3.3 Aircrafts

The following list shows the aircrafts featuring the average day:

- Airbus A320;
- Boeing B737-800;
- Boeing B787-800;
- Boeing B787-900.

Note that military flights and helicopters have been neglected.

4.3.4 Flight profiles

Each aircraft can be modelled with different flying profiles. AEDT allows users to choose from many profiles (also ICAO A and B procedures) but since no information have been received all the flights have been modelled with standard profiles.



About departure profiles, these are divided by stage values. Stage is a noise related parameter which is connected with MTOW. Since is easier to manage distances than MTOW then stage depends on the trip distance as shown in the following image.

Stage Number	Trip Length (nmi)
1	0-500
2	500-1,000
3	1,000-1,500
4	1,500-2,500
5	2,500-3,500
6	3,500-4,500
7	4,500-5,500
8	5,500-6,500
9	6,500-11,000
M	Maximum range at maximum takeoff weight

Image 13: Stage meaning.

About landing usually there is only one profile featured by stage 1. That’s why usually during the approach planes are in idle position or the thrust is limited and used just to contrast wind effects.

4.3.5 Weather

AEDT databases store local weather information. For the current study an average based on the period 2012-2021 have been used. Data comes from ISD (Integrated Surface Database).

Temperature (°F)	73.33
(°C)	22.96
Pressure [millibars]	937.4
Wind speed (knt)	2.64

Tabel 8: Weather input data.

4.3.6 Final input data

The following tables show the flights featuring the average day calculated as above. These are the input flights in AEDT software.



DAY	Stage					
A320	1.00	2.00	3.00	4.00	5.00	6.00
Take-off 34-16	7.4	2.3	1.0	0.0	0.0	0.0
Landing 34-16	10.7	0.0	0.0	0.0	0.0	0.0
Take-off 16-34	2.5	0.8	0.3	0.0	0.0	0.0
Landing 16-34	3.6	0.0	0.0	0.0	0.0	0.0
B789	1.00	2.00	3.00	4.00	5.00	6.00
Take-off 34-16	0.0	0.0	0.0	0.0	0.0	0.0
Landing 34-16	0.0	0.0	0.0	0.0	0.0	0.0
Take-off 16-34	0.0	0.0	0.0	0.0	0.0	0.0
Landing 16-34	0.0	0.0	0.0	0.0	0.0	0.0
B738	1.00	2.00	3.00	4.00	5.00	6.00
Take-off 34-16	0.0	0.0	2.3	0.0	0.0	0.0
Landing 34-16	0.0	0.0	2.3	0.0	0.0	0.0
Take-off 16-34	0.0	0.0	0.8	0.0	0.0	0.0
Landing 16-34	0.0	0.0	0.8	0.0	0.0	0.0
B788	1.00	2.00	3.00	4.00	5.00	6.00
Take-off 34-16	0.0	0.0	0.0	0.0	0.2	0.5
Landing 34-16	0.7	0.0	0.0	0.0	0.0	0.0
Take-off 16-34	0.0	0.0	0.0	0.0	0.1	0.2
Landing 16-34	0.3	0.0	0.0	0.0	0.0	0.0

Tabel 9: Input data – day.



EVENING	Stage					
A320	1.00	2.00	3.00	4.00	5.00	6.00
Take-off 34-16	1.2	2.6	0.0	0.0	0.0	0.0
Landing 34-16	2.8	0.0	0.0	0.0	0.0	0.0
Take-off 16-34	0.4	0.9	0.0	0.0	0.0	0.0
Landing 16-34	1.3	0.0	0.0	0.0	0.0	0.0
B789	1.00	2.00	3.00	4.00	5.00	6.00
Take-off 34-16	0.0	0.0	0.0	0.0	0.0	0.0
Landing 34-16	0.0	0.0	0.0	0.0	0.0	0.0
Take-off 16-34	0.0	0.0	0.0	0.0	0.0	0.0
Landing 16-34	0.0	0.0	0.0	0.0	0.0	0.0
B738	1.00	2.00	3.00	4.00	5.00	6.00
Take-off 34-16	0.0	0.0	0.1	0.1	0.0	0.0
Landing 34-16	0.2	0.0	0.0	0.0	0.0	0.0
Take-off 16-34	0.0	0.0	0.0	0.0	0.0	0.0
Landing 16-34	0.0	0.0	0.0	0.0	0.0	0.0
B788	1.00	2.00	3.00	4.00	5.00	6.00
Take-off 34-16	0.0	0.0	0.0	0.0	0.7	0.0
Landing 34-16	0.7	0.0	0.0	0.0	0.0	0.0
Take-off 16-34	0.0	0.0	0.0	0.0	0.2	0.0
Landing 16-34	0.2	0.0	0.0	0.0	0.0	0.0

Tabel 10: Input data – evening.

NIGHT	Stage					
A320	1.00	2.00	3.00	4.00	5.00	6.00
Take-off 34-16	1.5	1.1	0.8	0.0	0.0	0.0
Landing 34-16	3.4	0.0	0.0	0.0	0.0	0.0
Take-off 16-34	0.5	0.4	0.3	0.0	0.0	0.0
Landing 16-34	1.2	0.0	0.0	0.0	0.0	0.0
B789	1.00	2.00	3.00	4.00	5.00	6.00
Take-off 34-16	0.0	0.0	0.0	0.0	0.2	0.0
Landing 34-16	0.0	0.0	0.0	0.0	0.2	0.0
Take-off 16-34	0.0	0.0	0.0	0.0	0.1	0.0
Landing 16-34	0.0	0.0	0.0	0.0	0.1	0.0
B738	1.00	2.00	3.00	4.00	5.00	6.00
Take-off 34-16	0.0	0.0	0.0	1.0	0.0	0.0
Landing 34-16	0.0	0.0	0.0	1.0	0.0	0.0
Take-off 16-34	0.0	0.0	0.0	0.3	0.0	0.0



Landing 16-34	0.0	0.0	0.0	0.3	0.0	0.0
B788	1.00	2.00	3.00	4.00	5.00	6.00
Take-off 34-16	0.0	0.0	0.0	0.0	0.1	0.0
Landing 34-16	0.0	0.0	0.0	0.0	0.1	0.0
Take-off 16-34	0.0	0.0	0.0	0.0	0.0	0.0
Landing 16-34	0.0	0.0	0.0	0.0	0.0	0.0

Tabel 11: Input data – night.



4.4 Metrics

Indian regulation uses different kind of noise metrics such as Lden, Ld, Le, Ln, Lde, DNL, LAeq_day, LAeq_night_Lamax.

Lden is a daily long term average calculated splitting time as the following table (Indian time periods).

Day	06:00 – 18:00
Evening	18:00 – 22:00
Night	22:00 – 06:00

Tabel 12: Reference times.

Lden is then calculated with the following equation with a 5 dBA penalty for levels during the evening time and a 10 dBA penalty for the night period.

$$L_{den} = 10 \log_{10} \left[\frac{12}{24} \left(10^{L_{day}/10} \right) + \frac{4}{24} \left(10^{(L_{evening}+5)/10} \right) + \frac{8}{24} \left(10^{(L_{night}+10)/10} \right) \right]$$

Equation 1: Lden.

Lden is an A frequency weighted sound level.

Ld, Le and Ln are daily long term average calculated respectively on the day, evening and night period.

Lde is the daily long term average calculated on the day and evening period with no penalty associated to it.

$$L_{de} = 10 \log_{10} \left[\frac{12}{16} \left(10^{L_{day}/10} \right) + \frac{4}{16} \left(10^{(L_{evening})/10} \right) \right]$$

Equation 2: Lde.

DNL is the acronym of Day and Night level, commonly used in the United States of America to evaluate airport noise. It is the daily long term average calculated on the day and night period, setting up the time period from 06:00 to 22:00.

$$DNL = 10 \log_{10} \left[\frac{16}{24} \left(10^{L_{day}/10} \right) + \frac{8}{24} \left(10^{(L_{night}+10)/10} \right) \right]$$

Equation 3: DNL.

LAeq,T is the the constant noise level that would result in the same total sound energy being produced over a given period. Indian regulation gives two periods: day (from 06:00-22:00) and night (from 22:00-06:00).

$$L_{Aeq,T} = 10 \log_{10} \left(\frac{1}{T} \int_0^T \frac{p_t^2}{p_0^2} dt \right)$$

Equation 4: LAeq.

LAmix is the maximum sound level recorderd over a given period, in this case during the whole average day.



4.5 Noise Contours Generation

Noise contours generation have been performed for all the noise metrics required by Indian Regulations starting from 45 dBA to 75 dBA with 5 dBA increment, beside Lamax which was drawn from 65 dBA to 90 dBA. Noise contours are attached at the end of the report. The following table shows Lden value calculated in the same points where noise measurements were performed.

Point	Lden
Location 1	60.5 dBA
Location 2	65.4 dBA
Location 3	55.1 dBA
Location 4	55.2 dBA
Location 5	51.3 dBA

Tabel 13: Lden calculated values.



Image 14: Lden map.



5. Noise Measurements

During the month of April 2024, Team of SSPL performed environmental noise measurements to evaluate the real impact of Amritsar flights activity and to better investigate where to install permanent noise measurement system.

Measurements points were as close as possible to the tracks ground projections or to sensitive receptors such as schools.

The following table shows the measurements points.

Name	Coordinates	Receptor
Location 1	31°43'22.7"N 74°47'46.7"E	Bethel House of Fellowship Church - Raj Sansi
Location 2	31°44'07.5"N 74°47'06.0"E	Golden planet resort
Location 3	31°43'12.8"N 74°48'04.0"E	Baba Deep Singh Public School - Raj Sansi
Location 4	31°41'36.8"N 74°48'40.4"E	Khalsa Collage Public School – Heir
Location 5	31°41'26.1"N 74°47'43.5"E	Civil Veterinary Dispensary – Rudala

Tabel 14: Noise measurement points.



Image 15: Noise measurement points.

Noise measurements were carried out continuously for at least 24 hours for each measurement point, using a class 1 sound level meter with a free field microphone suited for outdoor measurements. Sound level meter was calibrated before to start each measurement session and microphone were pointed towards the sky.

Name	Starting time	End time
Location 1	19 April 2024 – 15:00	20 April 2024 – 15:30
Location 2	17 April 2024 – 10:45	18 April 2024 – 10:55
Location 3	21 April 2024 – 18:00	22 April 2024 – 18:30
Location 4	20 April 2024 – 16:30	21 April 2024 – 17:00
Location 5	18 April 2024 – 12:30	19 April 2024 – 13:00

Tabel 15: Measurement times.



Image 16: Location 1.



Image 17: Location 2.



Image 18: Location 3.



Image 19: Location 4.

Noise measurements were analyzed using the software SARA (Sistema Acquisizione Rumore Aeroportuale). SARA calculated noise events and then it correlated these events to flight activities. The following images show few noise events made mostly by departures.

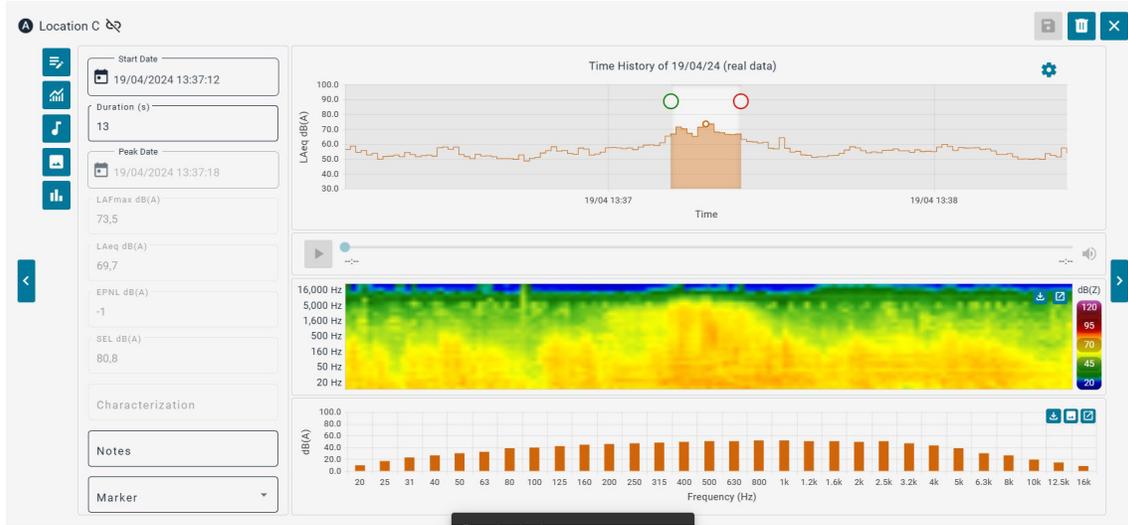


Image 20: A320 departure from runway 34-16 – Location 1.

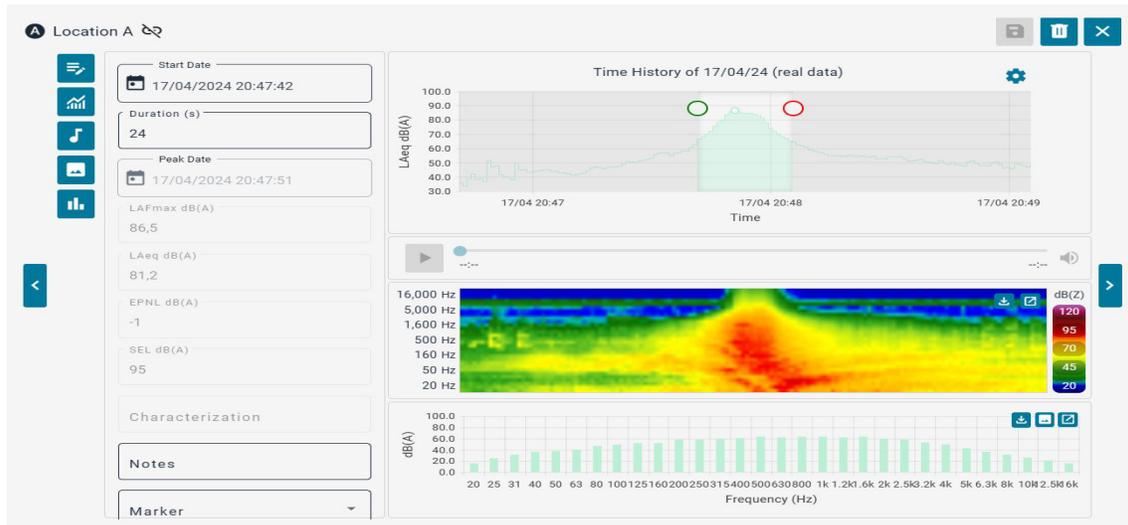


Image 21: A330 departure from runway 34-16 – Location 2.



Image 22: B737-8 departure from runway 34-16 – Location 4.

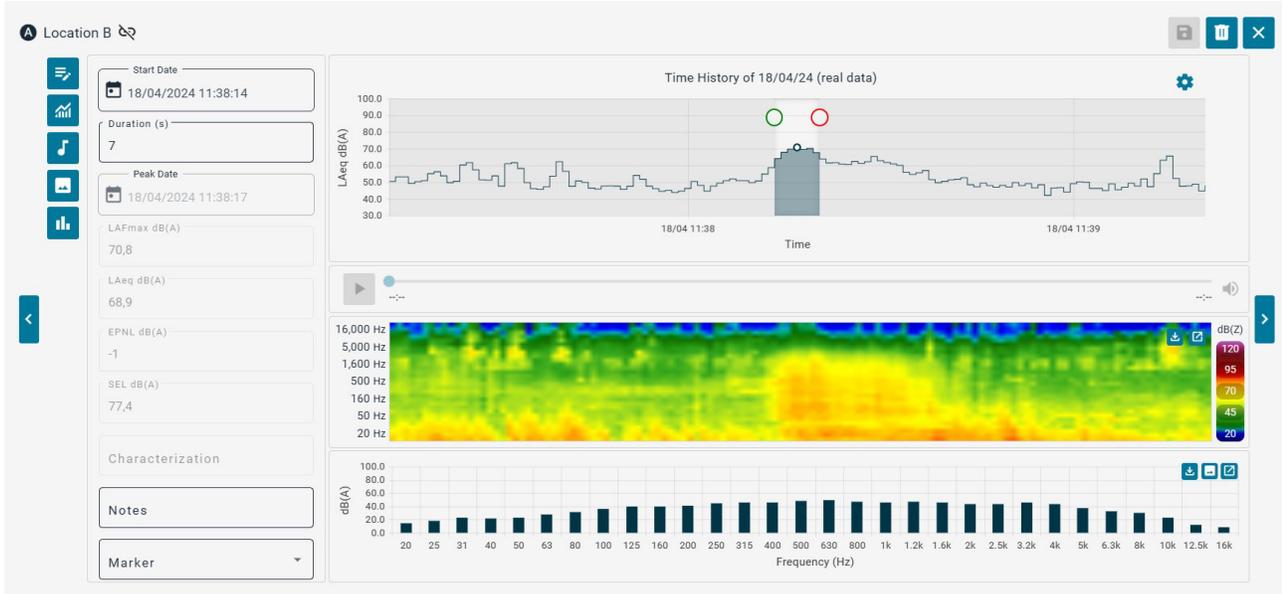


Image 23: B787-800 departure from runway 34-16 – Location 5.

Automatic noise event correlation was manually corrected when needed and after that SARA calculated Lden as shown in the next table.

Name	Lden
Location 1	56.6
Location 2	63.0
Location 3	50.1
Location 4	53.2
Location 5	51.0

Tabel 16: Calculated Lden.



6. Noise Model Validation

Lden values coming from noise measurements cannot be compared with those coming from the model for several reasons such as:

- Different year and probably different scheduled flights (aircraft types and flight frequencies);
- Short time measurements cannot be compared with results coming from a model with long term average input data.

For these reasons model validation was performed modelling each day and comparing noise levels with those measured. In this way several input data such as flying tracks and flying procedures can be validated.

It is necessary to underline that noise models were made taking into account only those flights that generated noise events. Furthermore, untypical noise events were not taken into account.

The following table shows calculated levels and the comparison with measured levels.

Location	Validation noise model	Difference
1	58.0 dBA	1.4 dBA
2	63.5 dBA	0.5 dBA
3	55.2 dBA	0.7 dBA
4	53.2 dBA	0.0 dBA
5	49.0 dBA	2.0 dBA

Tabel 17: Comparison – model validation.

Usually, noise model uncertainty is at least 3 dBA but, in this case, uncertainty could be at least 4 dBA counting uncertainty coming from noise measurements also. So, since the greatest difference is 2.0 dBA the noise model can be validated.



7. Noise Zones Definition

Indian regulation states that noise standards within the overall boundary of airports shall be applicable as Industrial Areas i.e. day time 75 dB (A) Leq and night time 70 dB (A) Leq. Outside the airport borders noise limits in existing zones such as silence zones, residential zones and commercial areas shall be replaced by the following noise limits depending on the airport dimensions.

Airport	LAeq, day (06:00-22:00)	LAeq,night (22:00-06:00)
Busy airport ⁶	70.0 dBA	65.0 dBA
All other airport excluding proposed airports	65.0 dBA	60.0 dBA

Tabel 18: Noise limits outside the airport borders.

Starting from this requirement noise zone has been generated following the airport borders. In this area noise limit should be 75 dBA during the night period and 70 dBA during the day period.

As stated in the Indian regulation on airport noise “*the above specified limits shall have a tolerance limit of 10dB (A) Leq.*”⁷.

⁶ More than 50.000 aircraft movements for year.

⁷ Ministry of environment, forest and climate change notification, 18 June 2018



Tabel 19: Noise zone.

Since Sri Guru Das Jee airport is **not a busy airport** as defined by Indian regulation then outside the airport borders noise limits should comply with those for "All other airport excluding proposed airports" shown into the above table.

Because of this no Lmax limit is needed.

To verify compliance with noise limits, noise zones have been overlaid on the LAeq noise maps, for both day and night period.

This check has shown compliance with noise limits.

To better assess compliance with noise limits, points have been generated approximately every 300 meters along the noise zone boundary. The following table shows the calculated points.

Name	Longitude WGS84 – EPSG 4326	Latitude WGS84 – EPSG 4326
NZ0	74.78632722	31.73021872
NZ1	74.78834673	31.72974872
NZ2	74.79022637	31.72897341
NZ3	74.79175811	31.72722402
NZ4	74.79301961	31.72484256
NZ5	74.79428111	31.7224611
NZ6	74.79554262	31.72007964
NZ7	74.79680412	31.71769818
NZ8	74.79785882	31.71562883
NZ9	74.79922623	31.71394512
NZ10	74.80192009	31.7138686



NZ11	74.80461395	31.71379208
NZ12	74.80730781	31.71371556
NZ13	74.80925538	31.71301808
NZ14	74.80881916	31.71036301
NZ15	74.80827365	31.70772531
NZ16	74.80806238	31.70522236
NZ17	74.8068957	31.70320975
NZ18	74.80630796	31.70063286
NZ19	74.80579241	31.69799721
NZ20	74.80538428	31.69553591
NZ21	74.80584622	31.69336587
NZ22	74.80702598	31.69094287
NZ23	74.80820574	31.68851988
NZ24	74.80784017	31.68676673
NZ25	74.80650408	31.68866478
NZ26	74.80543223	31.69113741
NZ27	74.80436039	31.69361004
NZ28	74.80252763	31.69450465
NZ29	74.79984741	31.69436814
NZ30	74.79732813	31.69359688
NZ31	74.79544812	31.69178975
NZ32	74.79288395	31.6911086
NZ33	74.79026819	31.69160978
NZ34	74.78936044	31.69358742
NZ35	74.78930111	31.69621569
NZ36	74.78933574	31.69891041
NZ37	74.78857733	31.70123072
NZ38	74.78918926	31.70385527
NZ39	74.7898012	31.70647983
NZ40	74.79041313	31.70910438
NZ41	74.79102506	31.71172893
NZ42	74.79150709	31.71435238
NZ43	74.79085065	31.71696615
NZ44	74.78903959	31.71809948
NZ45	74.78816551	31.72033537
NZ46	74.78862608	31.72207241
NZ47	74.78734458	31.72444298
NZ48	74.7861448	31.72685571
NZ49	74.78636163	31.72871179

Table 1: Point position and naming.

Day and night noise levels have been calculated on those points.



NZ	LAeq_day [dBA]	LAeq_night [dBA]
0	58.9	56.7
1	59.4	57.1
2	58.6	56.5
3	59.9	57.8
4	59.5	57.2
5	59.2	56.8
6	59.2	56.6
7	59.2	56.3
8	59.4	56.2
9	58.2	54.7
10	52.7	49.3
11	48.4	45.2
12	45.5	42.4
13	44.0	41.0
14	45.3	42.4
15	47.2	44.4
16	49.0	46.4
17	52.2	49.8
18	50.3	47.6
19	62.3	60.0
20	66.7	64.4
21	62.2	59.4
22	62.4	59.7
23	61.9	59.2
24	60.4	57.8
25	53.7	51.4
26	60.1	57.4
27	61.8	59.0
28	64.5	62.2
29	56.1	53.9
30	50.8	48.6
31	47.1	44.9
32	44.7	42.4
33	42.9	40.6
34	43.1	40.7
35	43.9	41.4
36	44.7	42.1
37	44.8	42.0
38	46.3	43.2
39	48.6	45.3
40	52.0	48.6
41	55.8	52.5
42	59.5	56.4



43	60.3	57.8
44	58.0	55.3
45	58.2	55.7
46	60.3	58.1
47	60.7	58.5
48	59.4	57.2
49	58.0	55.9

Table 2: Calculated noise levels on points.

As stated in the Indian regulation on airport noise “ *The noise standards...shall be measured at different points of airport boundary and then averaged*”⁸.

The following table presents the average noise levels along the airport boundary and their comparison with noise limits.

DAY	LAeq_day [dBA]	LAeq_day LIMIT inside borders [dBA]	Compliance with day noise limits	LAeq_day LIMIT outside borders [dBA]	Compliance with night noise limits
Average noise along airport boundary line	58.5	75.0	YES	65.0	YES

Table 3: Day average noise level and comparison with noise limits.

⁸ Ministry of environment, forest and climate change notification, 18 june 2018



NIGHT	LAeq_night [dBA]	LAeq_night LIMIT inside borders [dBA]	Compliance with day noise limits	LAeq_night LIMIT outside borders [dBA]	Compliance with night noise limits
Average noise along airport boundary line	56.0	7.,0	YES	60.0	YES

Table 4: Night average noise level and comparison with noise limits.

The defined noise zones shall be approved by Airport Operator on the basis of existing GSR 751 (E), issued by the Ministry of Civil Aviation (Height Restrictions for Safeguarding of Aircraft Operations) Rules, 2015 published on 30th September, 2015.



8. Noise Measurement System

We used Larsen Davis USA make model no NMS044 - PORTABLE NOISE MONITORING System. The SoundAdvisor™ Portable Noise Monitoring System Model NMS044 is a completely wireless solution designed to run indefinitely on solar power, allowing you to both take measurements and view them 24 hours a day, seven days a week.





9. Long Term Noise Contours Calculation

A long term noise assessment calculation has been performed. The Customer estimated flights for 2033-2034 year.

The following table shows estimated air traffic for next years.

Expansion Plan for next 10 years				
F.Y.	Domestic		International	
	Arrival	Departure	Arrival	Departure
2023-24	7937	7942	2761	2788
2024-25	8333	8339	2899	2927
2025-26	8750	8756	3044	3073
2026-27	9188	9193	3196	3227
2027-28	9647	9653	3356	3388
2028-29	10129	10136	3523	3558
2029-30	10636	10643	3700	3736
2030-31	11168	11175	3885	3922
2031-32	11726	11733	4079	4119
2032-33	12312	12320	4283	4325
2033-34	12928	12936	4497	4541

Figure 1: Estimated future air traffic.

Noise calculation has been performed using the software feature called "annualization" and setting up a multiplier of 1,62 which expresses the ratio between total future flights (2033-2034) and nowadays total flights (2023-2024).



10. Conclusions

The present report describes the study carried out for the civil airport of Amritsar, based in north India, to understand the noise impact generated by aircraft movements.

A noise model, starting from 2023 flight data, was processed by a specific software worldwide used, called AEDT, that let users to calculate noise contours.

Afterwards noise measurements were performed to evaluate the real noise impact of Amritsar flights activity and to better investigate where to instal permanent noise measurement system.

Noise data were analyzed by SARA software which was able to correlate noise events to aircraft movements and then to calculate Lden and other noise indicators.

Comparisons between measured noise values and simulations were carried out to validate the noise model.

Starting from the validated noise model, noise maps were generated for all noise indicators required by indian regulation.

Furthermore exposed people to noise were calculated and noise zone were defined. To verify compliance with noise limits, noise zones have been overlaid on the LAeq noise maps, for both day and night period.

This check has shown compliance with noise limits.

The defined noise zones shall be approved by Airport Operator on the basis of existing GSR 751 (E), issued by the Ministry of Civil Aviation (Height Restrictions for Safeguarding of Aircraft Operations) Rules, 2015 published on 30th September, 2015.

Lastly positions to instal permanent noise measurement system were investigated and suggested.

Lastly a long term noise assessment calculation has been performed taking into account estimated air traffic for 2033-2034.

The study is valid under the assumptions made and the information received by the Customer. Any change into the assumptions (such as number of flights, type of aircraft, flying tracks used etc) could change the results of the present study.



Attachments:

1. DNL map 2023-24;
2. LAeq day map 2023-24;
3. LAeq night map 2023-24;
4. LAmax map 2023-24;
5. Lden map 2023-24;
6. Lde map 2023-24;
7. Ld map 2023-24;
8. Le map 2023-24;
9. Ln map 2023-24;
10. Noise zones definition map 2023-24;
11. Noise zones vs LAeq day map 2023-24;
12. Noise zones vs LAeq night map 2023-24;
13. Instruments calibration charts;
14. DNL map 2033-34;
15. LAeq day map 2033-34;
16. LAeq night map 2033-34;
17. LAmax map 2033-34;
18. Lden map 2033-34;
19. Lde map 2033-34;
20. Ld map 2033-34;
21. Le map 2033-34;
22. Ln map 2033-34;
23. Noise zones definition map 2033-34;
24. Noise zones vs LAeq day map 2033-34;
25. Noise zones vs LAeq night map 2033-34.