

The Study Report
Entitled
Noise Mapping and Declaration of Airport Noise Zones
at

Surat International Airport



भारतीय विमानपत्तन प्राधिकरण
AIRPORTS AUTHORITY OF INDIA

Submitted in partial fulfilment of the requirements

By

Submitted by agency :-



hplj
AN (E-C)
11/07/2024

Unistar Environment and Research Labs Pvt
White House, Near Vapi GIDC Office, Char Rasta, Vapi,
Dist. Valsad - 396 195. Gujarat (India)
Tele: 0260 2433966

Email: unistar.airnoise@uerl.in , response@uerl.in

Web Site: www.uerl.in

Sm
SM (E-C)
सुरज वीर सिंह SURAJ VIBER SINGH
वरिष्ठ प्रबंधक (अभि.-सिविल)
Sr Manager (Engg.-Civil)
भारतीय विमानपत्तन प्राधिकरण
Airports Authority of India
सुरत हवाईअड्डा, सुरत-394 550.
Surat Airport, Surat-394 550.

सुरज
विमानपत्तन निदेशक
AIRPORT DIRECTOR
भा.वि.प्रा./सुरत अंतरराष्ट्रीय हवाईअड्डा, सुरत
AAI, Surat International Airport, Surat

KD
12/7/2024
कृष्ण दत्त वर्मा / Krishna Datta Verma
उप महा प्रबंधक (अभि.-सिविल)
Dy. General Manager (Engg.-Civil)
भारतीय विमानपत्तन प्राधिकरण
AIRPORTS AUTHORITY OF INDIA
सुरत अंतरराष्ट्रीय हवाईअड्डा, सुरत-394 5
Surat International Airport, Surat-394

FOREWORD

The Airport Authority of India, Surat invited tender from environmental agencies to conduct Noise Mapping and Declaration of Airport Noise Zones at Surat Airport and entrusted the work to M/s. UNISTAR ENVIRONMENT AND RESEARCH LABS PVT. LTD., VAPI via work order no. AAI/SRT/DGM(E-C)/Noise Mapping/24-25/113-126, dated 17/04/2024.

A comprehensive study had been planned and successfully executed as per DGCA guidelines. The findings have been presented in this report.

Our sincerely thanks are due to the Airport Authority of India, Surat for awarding this work. Extensive thanks to the authorities for their kind cooperation during the study period.



Place : Vapi

Date: 08/07/2024

For.
**UniStar Environment and
Research Labs Pvt. Ltd.**



**Authorized Signatory.
(Jaivik S. Tandel)**



ACKNOWLEDGEMENT

We sincerely wish to express our heartfelt thanks and a sense of gratitude to Mr. Sunil ^{Kumar} ~~ha~~, Assistant Manager, Airports Authority of India, Surat International Airport for his support without whom we would not have been able to complete this study. We are thankful to Mr. Suraj Veer Singh, Sr. Manager, Airports Authority of India, Surat International Airport who provided us with the facilities during various phases of our work.

We are also thankful to Mr. Krishna Datta Verma, DGM, Airports Authority of India, Surat International Airport for providing necessary data.

We would like to thank God Almighty for giving us the strength, knowledge, ability, and opportunity to undertake this work and to persevere and complete it satisfactorily. Without his blessings, this achievement would not have been possible.

Finally, I acknowledge to all who helped me directly or indirectly in completing the work.

ABSTRACT

Aircraft noise has been recognized as a serious issue that affects the urban regions. Due to urbanization and industrialization, transportation in urban areas has increased. Air traffic density in India and the world at large is growing fast and posing challenging problems. The problems encountered can be parameterized as flight delay, workload of air traffic controllers and noise levels in and around aerodromes. Prediction and quantification of these parameters aid in developing strategies for efficient air traffic management. Noise prediction maps can be used to identify the impact of noise pollution. The objective of the research study is to develop noise maps and declaration of noise zone of Surat International Airport.

Noise monitoring and mapping study has been done for Surat International Airport of India. The noise maps are developed using computer simulation model (SoundPLANnoise 9.0 software). ECAC 4th edition model, which is inbuilt in SoundPLAN software, was used to develop noise prediction contour maps as per DGCA guidelines. Data required to create noise maps, namely number of flights, pattern of flights, schedule of flights, aircraft types & details, runway information, meteorological data, were collected from Surat International Airport Authority. Noise contour maps were validated with actual noise measurements data.

The results of noise monitoring study depicted that the day time & night time noise levels were within the prescribe limit of MOEF&CC, G.S.R 568 (E) dated 18th June 2018. The predicted L_{Aeq} by software were found above the prescribed limit during daytime & nighttime within 4000 meters, parallel to flight path from the airport towards north and south. Surat city is commercial and economic center of South Gujarat and known for its diamond and textile business. Aircraft traffic is increasing every year based on the passenger movement statistics. Therefore, Airport Noise Zone has been declared within 4 kms radius of airport on the basis of existing G.S.R. 751 (E), issued by the Ministry of Civil Aviation (Height Restrictions for Safeguarding of Aircraft Operations) Rules, 2015 published on 30th September, 2015.

Keywords: Aircraft Noise; Airport Noise Zone; ECAC 4th Edition Model; Equivalent Noise Level; Noise Mapping

Name:

Dr. Dipeshkumar R. Sonaviya

Designation:

Noise Mapping & Modelling Expert

CONTENTS

ACKNOWLEDGEMENT	i
ABSTRACT	ii
CONTENTS	iii
LIST OF TABLES	v
LIST OF FIGURES	vi
ABBREVIATIONS	viii
CHAPTER 1 INTRODUCTION	
1.1 GENERAL	1
1.2 IMPACT OF NOISE POLLUTION	1
1.3 NOISE MAPS AND PREDICTION	2
CHAPTER 2 OBJECTIVES	
2.1 GENERAL	4
2.2 PROBLEM STATEMENT	4
2.3 OBJECTIVES	4
CHAPTER 3 METHODOLOGY	
3.1 GENERAL	5
3.2 METHODOLOGY	5
3.2.1 SITE SELECTION CRITERIA	6
3.2.2 NOISE MONITORING	6
3.2.3 TYPE OF MONITORING STATION	6
3.2.4 NUMBER OF MONITORING STATIONS	6
3.2.5 MONITORING TIME	6
3.2.6 MONITORING PARAMETERS	6
3.2.7 METEOROLOGICAL MEASUREMENT	6
3.2.8 AIRPORT NOISE NOTIFICATION DATED 18 TH JUNE 2018	7
3.3 INSTRUMENTS AND SOFTWARE	7
3.3.1 SPOT NOISE MONITORING TERMINAL	7
3.3.2 BEDROCK AM100 CLASS 1 SOUND LEVEL METER	8
3.3.3 <u>SoundPLANnoise 9.0</u>	9
3.3.4 RADAR TRACKING SYSTEM	9
3.4 STUDY AREA PROFILE	9
CHAPTER 4 DATA COLLECTION AND ANALYSIS	
4.1 GENERAL	12

4.2 NOISE MONITORING SURVEY	12
4.3 AIRPORT DETAILED SURVEY	21
4.3.1 AIRPORT/RUNWAY DATA	21
4.3.2 FLIGHT SCHEDULE	22
4.4 TRAFFIC, FLIGHT TRACKS AND CORRIDORS	24
4.5 METEOROLOGICAL DATA	27
CHAPTER 5 NOISE MAPS AND PREDICTION	
5.1 GENERAL	28
5.2 CONCEPT OF NOISE MAPPING	28
5.3 NOISE MAPS AND PREDICTION MODEL	29
CHAPTER 6 DECLARATION OF NOISE ZONE	
6.1 GENERAL	36
6.2 DECLARATION OF NOISE ZONE	36
CHAPTER 7 CONCLUSION & NOISE MANAGEMENT ACTION PLAN	
7.1 CONCLUSIONS	43
7.2 NOISE MANAGEMENT ACTION PLAN	43
ANNEXURE-I REPRESENTATIVE NOISE ANALYSIS REPORT & SITE PHOTOGRAPHS	45
ANNEXURE-II EXAMPLE FILE FOR AIRCRAFT A320-214	48
ANNEXURE-III THE GAZETTE OF INDIA, MOEF&CC NOTIFICATION, G.S.R. 568(E)	52
ANNEXURE-IV MINUTES OF MEETING	59
ANNEXURE-V SURAT AIRPORT NOISE ZONE MAP	62
REFERENCES	63

LIST OF TABLES

Table 3.1: Ambient Air Quality Standards with respect to Noise in Airport Noise Zone.....	7
Table 3.2: Statistics of Passengers	10
Table 3.3: Noise Monitoring Locations	11
Table 4.1: NMT-1_S08_Airport Premises Noise Level Readings	13
Table 4.2: NMT-2_S07_Airport Premises Noise Level Readings	13
Table 4.3: SLM-1_Residential Scatter Noise Level Readings.....	13
Table 4.4: NMT-3_S07_Residential Scatter/School Noise Level Readings	14
Table 4.5: NMT-4_S08_Residential Scatter Noise Level Readings	14
Table 4.6: SLM-2_Residential Scatter/Hospital Noise Level Readings	14
Table 4.7: Schedule Domestic Arrival	22
Table 4.8: Schedule Domestic Departure.....	23
Table 4.9: Schedule International Arrival	23
Table 4.10: Schedule International Departure	23
Table 4.11: Non-Schedule Arrival.....	24
Table 4.12: Non-Schedule Departure.....	24
Table 4.13: Meteorological Data.....	27
Table 5.1: Day Time Measured and Predicted Values	30
Table 5.2: Night Time Measured and Predicted Values	30

LIST OF FIGURES

Figure 3.1: Flow Diagram of Methodology	5
Figure 3.2: Spot Noise Monitoring Terminal.....	8
Figure 3.3: Bedrock AM100 Class 1 Sound Level Meter.....	8
Figure 3.4: Surat International Airport.....	10
Figure 3.5: Map of Surat International Airport with Monitoring Locations.....	11
Figure 4.1: Daytime NMT-1 Noise Indices	15
Figure 4.2: Nighttime NMT-1 Noise Indices	15
Figure 4.3: Daytime NMT-2 Noise Indices	16
Figure 4.4: Nighttime NMT-2 Noise Indices	16
Figure 4.5: Daytime SLM-1 Noise Indices.....	17
Figure 4.6: Nighttime SLM-1 Noise Indices	17
Figure 4.7: Daytime NMT-3 Noise Indices	18
Figure 4.8: Nighttime NMT-3 Noise Indices	18
Figure 4.9: Daytime NMT-4 Noise Indices	19
Figure 4.10: Nighttime NMT-4 Noise Indices	19
Figure 4.11: Daytime SLM-2 Noise Indices.....	20
Figure 4.12: Nighttime SLM-2 Noise Indices	20
Figure 4.13: 3-D Model View Flight Tracks of Surat International Airport.....	25
Figure 4.14: 2-D View Flight Tracks of Surat International Airport	26
Figure 5.1: Day Time Noise Prediction Map	31
Figure 5.2: Night Time Noise Prediction Map.....	32
Figure 5.3: L _{max} Noise Prediction Map.....	33
Figure 5.4: Level-Time Course of Sound Pressure Level Produced by Road Traffic on Highway at Location NMT-4	35
Figure 6.1: Day Time Noise Contour Map	37

Figure 6.2: Methodology for noise mapping	38
Figure 6.3: Colour Coded Zoning Map (CCZM) of Surat International Airport	39
Figure 6.4: Daytime Colour Coded Zoning Map (CCZM) with Noise Contours of Surat International Airport	40
Figure 6.5: Nighttime Colour Coded Zoning Map (CCZM) with Noise Contours of Surat International Airport	41

ABBREVIATIONS

APU	Auxiliary Power Unit
CAR	Civil Aviation Requirements
CCZM	Colour Coded Zoning Map
CPCB	Central Pollution Control Board
CDA	Continuous Descent Approach
CCO	Continuous Climb Operations
DGCA	Directorate General of Civil Aviation
dB	Decibel
dB(A)	Decibel in "A" weighting network
ECAC	European Civil Aviation Conference
GPU	Ground Power Unit
INM	Integrated Noise Model
ICAO	The International Civil Aviation Organization
IATA	International Air Transport Association
L _{Aeq}	A-weighted equivalent noise level in dB(A)
LDN	Day Night Average/ Equivalent Sound Level
MOEF & CC	Ministry of Environment, Forests and Climate Change
NMT	Noise Monitoring Terminal
PTE	Permissible Top Elevation
SLM	Sound Level Meter
TDOA	Time Difference of Arrival

CHAPTER-1

INTRODUCTION

1.1 GENERAL

This chapter deals with basics of noise, noise effects, and impact of noise pollution. This chapter also gives a brief discussion of aircraft noise, noise maps and prediction models. The global concern for public health and earthly biodiversity has always involved various pollutions such as air pollution, noise pollution, water pollution, and soil pollution (Oguntunde et al. 2019). The number of pollutants has increased significantly and has caused serious harm to the quality of the atmosphere. Managing different pollutions is a challenging task. Although different management strategies are available, the environmental pollution issue remains the same. Noise is one of the world's most significant pollution problems (Lavanya et al. 2014). Noise pollution is seen as a growing problem for the societies in large urban areas (Jhanwar 2016; Paszkowski and Sobiech 2019). Recent studies on noise pollution reported that around 20% of the world's population are exposed to excessive noise levels and almost 60% of Europe's population are exposed to elevated noise during day time (Rivas et al. 2003).

Aircraft is leading source of noise pollution in urban areas. Globalization, urbanization, economic growth, and rise in the travel and tourism sector are some of the major drivers of the aviation sector. Over time both the size and operations of airports are rapidly increasing. Noise is almost one of the harmful pollutions to citizens; hence, many nations have introduced emission limits for aircraft noise and legislation to reduce aircraft noise. Over the last few years, new restrictive laws have been implemented in some countries to regulate aircraft noise. In densely populated cities, residents living near aerodromes may experience heightened exposure to aircraft noise (Leng Ang et al. 2024). The ability to measure and represent ambient noise levels on a map can be a powerful tool for defining sources of noise, distributing their impacts, and making control and management decisions (Ko et al. 2011).

1.2 IMPACT OF NOISE POLLUTION

Noise and other forms of pollution have globally become a danger to the quality of human life. High noise levels have adverse effects on human health (Mishra et al. 2008). It may induce hypertension, interrupted sleep, and hampered cognitive development of children (Singh and Davar 2004; Pal and Bhattacharya 2012). The consequences of excessive noise can be so extreme that there is either a permanent memory loss or a psychiatric disorder (Bravo-Moncayo et al. 2019).

Thus, excessive noise and sudden noise exposure have many adverse effects (Kalawapudi et al. 2020). Noise can influence sleep, hearing, mental and physical health, and communication (Agarwal and Swami 2011; Istamto et al. 2014). Noise, regardless of the source, is a pollutant, and in addition to its stress levels, hearing impairments and other body problems, it still remains to be fully understood (Halperin 2014).

Aircraft noise is intermittent in nature and exposure may result in sleep disturbance. Aircraft engines are the major source of noise and can cause hearing impairment, high blood pressure, hypertension, ischemic heart disease, annoyance, and decreased school performance. Elevated noise levels can create stress, increase workplace accident rates, and stimulate aggression and other anti-social behaviors.

1.3 NOISE MAPS AND PREDICTION

With the increasing number of flights and the continuous development of technology, aircraft noise has become a serious problem in terms of environmental protection. It is, therefore, necessary to conduct regular assessments to identify urban areas where there are high noise levels that exceed allowable noise limits (Manojkumar et al. 2019). These assessments can be performed through on-site measurements or through predictions, using specially designed software (Mioduszewski et al. 2011). Noise mapping softwares are a professional tool, widely used by many experts from different backgrounds and with great experience in various applications, data, and software (Sonaviya and Tandel, 2016). The manner of using the software is very important because it can affect the quality of the results in the noise mapping process (Petrovici et al. 2015).

When it comes to the proper interpretation of the noise generated by aircraft, data processing software is very useful. Normally, all the softwares are based either on acoustic measurements or predictions, taking into account in case of aircraft noise, various aspects like aircraft type, time schedule, altitude, flight path, etc. These two ways of analyzing noise can also go together by introducing data about the analyzed area (topographic features, infrastructure, exposed population, etc.) and data concerning the measured noise. The noise map that can be generated after introducing all these parameters can provide later an overview of the analyzed area.

Noise maps are developed by specialized computer simulation model that calculates the noise level in specific areas, showing how noise propagates from the considered sources (Asensio et al. 2011). This software can also consider elements that affect the dispersion of noise like buildings, shape of the land, capacity of an area to absorb noise (cultivated fields) or to reflect noise (concrete areas, or water surface) (Manvell and Banda 2011). They also take into account the obstacles in the area,

which can be: barriers, the shape and the acoustical characteristics of the terrain, meteorological conditions, and more (Sonaviya and Tandel, 2020a).

There are number of computer simulation models (softwares) available to map and model sound (Sonaviya and Tandel, 2019a). These types of softwares support basic environment noise mapping (Karantonis et al. 2010). Tracing polygon on top of a bitmap is a general way of mapping the area. The process is easy for a small area, but it can be time-consuming to do this on a large scale (Hadzi-Nikolova et al. 2012). The modelling process can be simplified to use readily available data and large areas can be mapped as easily and efficiently as the computing power available. Noise modelling can be done using various software available such as INM, LimA, Cadna/A, and SoundPLAN. These noise software models can provide fast and precise noise impact assessment.

The noise maps created by the software show an overview of the explored area from the acoustic perspective (Arana et al. 2013). The noise maps highlight the areas in which noise levels are higher than the maximum allowable limits and provide simulations and animations showing clearly how noise propagates from a mobile noise source (Sonaviya and Tandel, 2020c).

The propagation models and softwares are very useful to analyze the current situation of external noise. The software creates a noise map, which shows the complete information on the distribution of noise in a given area (Sonaviya and Tandel, 2021). Noise can be a combination of point sources and line sources. Thus, the development of noise maps based on measurements requires a large number of measurement data, propagation models, and software.

CHAPTER-2

OBJECTIVES

2.1 GENERAL

According to the scope of work, it is observed that a large number of people can expose to aircraft noise at different locations around the Surat International airport. This chapter deals with problem statement, and objectives of entire study.

2.2 PROBLEM STATEMENT

The noise produced by aircraft during operations around airports represents a serious social, ecological, technical and economic problem. The ability to assess and predict noise exposure accurately is an increasingly important factor in the design and implementation of any airport improvements. Aircraft are complex noise sources. The number and intensity of noise sources vary with the type of the aircraft and, in particular, with the type of engines incorporated in their power plants. Relationships between the acoustic characteristics of the main noise sources and the flight mode parameters (or engine mode parameters) must be known for the best evaluation of noise levels under the flight path for any type of aircraft at any stage of its flight. Therefore, aircraft noise modelling has been carried out to study the propagation of noise from aircraft movement along with field measurements. The noise maps can be developed using computer simulation model (SoundPLANnoise 9.0).

2.3 OBJECTIVES

The objectives of this study are outlined as below:

1. Noise monitoring study on and around Surat International airport
2. Declaration of airport noise zone
3. To develop noise contour maps using computer simulation model (SoundPLANnoise 9.0) for Surat International Airport.

by
AM (E-c)
11/7/2024

CHAPTER-3

METHODOLOGY

3.1 GENERAL

This chapter deals with methodology, instruments and software used for study, site selection criteria, noise monitoring time, noise parameters, noise standards, and study area profile. Noise mapping and declaration of airport noise zones for airport has to be carried out in accordance with latest DGCA CAR Section 10, series A part-1, Central Pollution Control Board (CPCB), MoEF &CC gazette notification G.S.R. 568 (E), dated 18.06.2018.

3.2 METHODOLOGY

Methodology used for performing work is represented in Figure 3.1. Noise survey was carried out and analyzed on and around Surat airport premises. This analysis included noise monitoring on selected locations, aircraft type & aircraft traffic volume, airport details, passenger statistics, and urban land use study. Noise monitoring was carried out continuously for 24 hours for 7 days as per the CPCB guideline. Integration of the exhaustive data was done using a computer simulation model SoundPLANnoise 9.0 software, to develop noise maps.

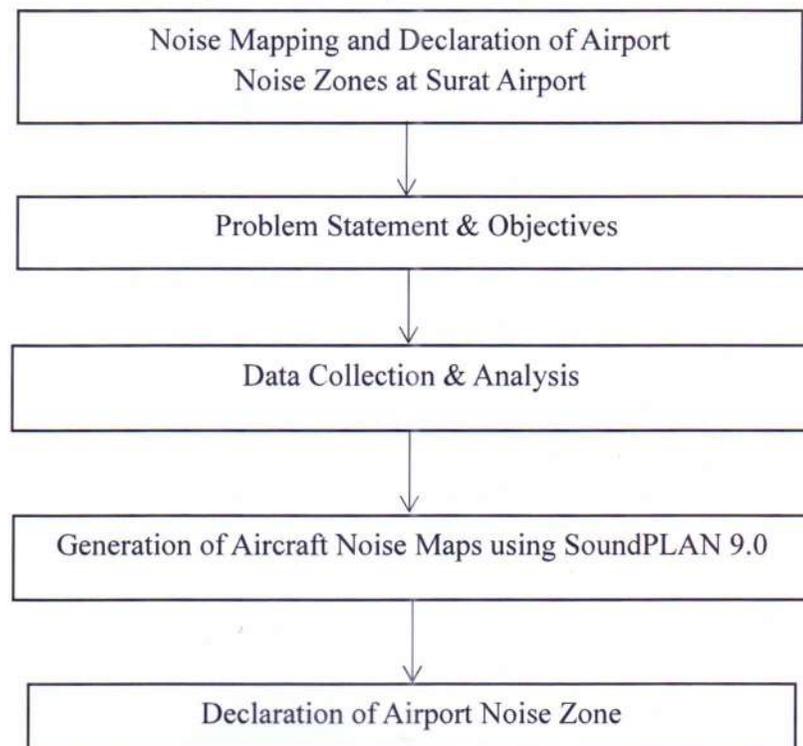


Figure 3.1: Flow Diagram of Methodology

3.2.1 SITE SELECTION CRITERIA

The site was selected to minimize disturbances from other sources for proper event detection. The minimum A-weighted maximum sound pressure level from aircraft movements was at least 15 dB above the background noise level.

3.2.2 NOISE MONITORING

Noise monitoring shall be carried out continuously for 24 hours a day, 365 days a year in permanent stations. In temporary stations, noise shall be monitored continuously for minimum 7 days, as per requirements. The microphone height shall be at least 4 m, preferably 10 m, above the ground level.

3.2.3 TYPE OF MONITORING STATIONS

Monitoring stations should be permanent for all runway approaches. For mobile monitoring it can be either mobile vans mounted or portable noise monitoring terminal can be used as temporary stations.

3.2.4 NUMBER OF MONITORING STATIONS

At least two permanent stations shall be installed per runway. The permanent monitoring stations shall be located on both sides of the runway, at the nearest residential area / silence zone and as far as possible under the flight paths of the aircrafts. In addition, temporary stations shall be used for specific monitoring activity under the flight paths, where noise levels are expected to be higher.

3.2.5 MONITORING TIME

Day time monitoring has been carried out during 6.00 am to 10.00 pm and night time 10.00 pm to 6.00 am.

3.2.6 MONITORING PARAMETERS

During noise survey, various noise indices such as L_{Aeq} , L_{10} , L_{90} , L_{95} , L_{50} , L_{max} , have been recorded.

3.2.7 METEOROLOGICAL MEASUREMENT

Meteorological parameters such as wind speed, wind direction, relative humidity, air temperature and occurrence of rain was recorded.

3.2.8 AIRPORT NOISE NOTIFICATION DATED 18TH JUNE 2018

Standards for noise levels are given in MOEF & CC, G.S.R. 568(E) dated 18th June 2018 for Ambient Air Quality Standards with respect to Noise in Airport Noise Zone and it is given in Table 3.1.

Table 3.1: Ambient Air Quality Standards with respect to Noise in Airport Noise Zone

Sl. No.	Industry	Parameters	Standards	
1	2	3	4	
Ambient Air Quality Standards with respect to Noise in Airport Noise Zone				
112	Airports	Type of Airports	Limits in dB (A) L_{eq}^*	
			Day Time	Night Time
		Busy Airports	70	65
	All other Airports excluding proposed airports	65	60	

3.3 INSTRUMENTS AND SOFTWARE

Instruments and software used for study were class-1 noise monitoring terminal & sound level meter with its kits for measuring noise, and computer simulation model (SoundPLAN noise 9.0 software) for developing noise maps.

Following are the list of equipment/instrument and software used for noise mapping:

3.3.1 SPOT NOISE MONITORING TERMINAL

Spot Noise Monitoring Terminal was used for noise data collection from premises of airport, which is shown in Figure 3.2. The Spot Noise Monitoring Terminal is an acoustic measurement instrument from Slovenia with main features of a conventional and integrating-averaging sound level meter and analyzer with storage. It is available with cloud-based server available in India.

Spot Noise Monitoring Terminal has features like A-C-Z weighted noise level, equivalent continuous level (L_{eq}), peak pressure levels, real time analyzer by octave bands –31.5 Hz to 8 kHz, minimum and maximum noise level values, and statistical distribution of the measured values: L_{01} - L_{10} - L_{50} - L_{90} - L_{95} .



Figure 3.2: Spot Noise Monitoring Terminal

3.3.2 BEDROCK AM100 CLASS 1 SOUND LEVEL METER

The Bedrock AM100 is most advanced class 1 / type 1 acoustic measuring instrument, which is shown in Figure 3.3. The BEDROCK AM100 SLM is an acoustic measurement instrument from Netherland with main features of a conventional and integrating-averaging sound level meter and analyzer with storage.



Figure 3.3: Bedrock AM100 Class 1 Sound Level Meter

3.3.3 COMPUTER SIMULATION MODEL (SoundPLANnoise 9.0)

SoundPLANnoise 9.0 is a software suite created by professionals in noise pollution engineering professionals working with noise scenarios. The software is specially developed for simulations of noise situations. Noise modelling encompasses aircraft noise. This software has more than 10 calculation standards to satisfy the needs of noise control engineers and environmental consultants. In this study, SoundPLANnoise 9.0 was used to develop noise maps. SoundPLANnoise 9.0 has single document application for aircraft noise. It allows standard cases to be processed quickly, efficiently, and inexpensively.

3.3.4 RADAR TRACKING SYSTEM

Flightradar24 was used to avail the flight related data. It is a global flight tracking service that provides you with real-time information about thousands of aircraft around the world. It has largest ADS-B network in the world with over 40,000 connected receivers. Flightradar24's business account was subscribed to collect the radar tracking data.

3.4 STUDY AREA PROFILE

Surat is a city located on the western part of India in the state of Gujarat. It is one of the most dynamic city of India with one of the fastest growth rates due to immigration from various parts of Gujarat and other states of India and famous all over the world for its diamond and textile business. Surat is the second largest city in the state after Ahmedabad. Surat is regarded as 4th fastest developing cities of India with a bustling metropolitan area home to over 6 million people. According to recent Census of India 2011, Surat has recorded a growth of 63.3% in its population from 2001 to 2011. The city plays a key role in the economic development of the nation with its important contribution towards national GDP. Surat is an important hub for diamond cutting and polishing in Gujarat. The city also serves as an administrative capital of the Surat district. Population of Surat has been increasing with an annual growth rate of over 6.3% ([Parking Policy for Surat city 2018](#)).

Surat is well connected with other cities by air, rail, and road. There are several transportation options available for the residents to travel all across the city. In past few years, the city has emerged as an important and well-developed industrial & business center in Gujarat. Thus, transportation and communication system has also developed along with the infrastructure of the city.



Figure 3.4: Surat International Airport

Surat Airport is an international airport serving Surat, Southern Gujarat. It is located in Magdalla, situated 12 km (6.4 mi) from the city center. It has a total area of 770 acres (312 ha), and is the second busiest airport in Gujarat after Ahmedabad, in terms of both aircraft movements and passenger traffic. It was awarded the status of a customs airport on 9th June 2018, and the international status was approved by the cabinet on 15th December 2023.

The statistics of passenger movement from Surat International airport is as follows:

Table 3.2: Statistics of Passengers

Year	Arrival Passenger	Departure Passenger	Total
2021	473735	468878	942613
2022	614438	599686	1214124
2023	664959	640910	1305869



Figure 3.5: Map of Surat International Airport with Monitoring Locations

Fig. 3.5 shows the map of Surat International airport with monitoring locations. Total six locations were selected as per MOEF & CC, G.S.R. 568(E) dated 18th June 2018. These six locations include diversified activities of residence, school, hospital, and village. Different type of land- use pattern has been seen along these locations. All locations are laid under the south-west zone of Surat city.

Table 3.3: Noise Monitoring Locations

Sr. No.	Latitude Longitude	Locations Code	Location Category
1	21° 10' 44.42" N 72° 73' 4.82" E	NMT-1_S07	Airport Premises
2	21° 11' 30.75" N 72° 74' 44.35" E	NMT-2_S08	Airport Premises
3	21° 9' 1.09" N 72° 46' 49.25" E	SLM-1	Resident
4	21° 13' 68.08" N 72° 75' 89.11" E	SLM-2	Resident/Hospital
5	21° 09' 34.65" N 72° 72' 43.09" E	NMT-3_S07	Resident/School
6	21° 11' 46.74" N 72° 77' 27.15" E	NMT-04_S08	Resident/Village

4.1 GENERAL

This chapter deals with data collection work of noise survey, meteorological data, flight scheduled, and aircraft related data. The detailed observation of data collection is incorporated here. Noise data were collected as per MOEF & CC notification G.S.R.568(E), CPCB guideline, and CAR Section 10-Series-A Part-I for aircraft noise monitoring and mapping.

Noise monitoring was done at six different locations which were under the flight path. Residential, school, hospital buildings are located under the flight path and these buildings are of minimum 3 storeys and maximum 13 storeys.

Noise measurements were carried out during 05th June 2024 to 18th June 2024. Field measurements have been taken by using Spot Noise Monitoring Terminal and Bedrock Class-1 Sound Level Meter for 24-hour duration. Monitoring was divided in two parts as per CPCB guidelines, day time 6.00 am to 10.00 pm and night time 10.00 pm to 6.00 am. The noise monitoring terminal & sound level meter is calibrated prior to each measurement using a calibrator. Sound level meter is mounted on height of 4 m above the floor level as per the CPCB guideline.

Noise levels (L_{Aeq}) and other noise indices (L_{10} , L_{50} , L_{90} , L_{95}) stored in the automatic sound level meter and Indian cloud-based server, automatically generates a complete data sheet of all necessary noise data and statistics in a user-friendly way.

4.2 NOISE MONITORING SURVEY

Noise monitoring was conducted between 05th June 2024 to 11th June 2024 in airport premises and between 12th June 2024 to 18th June 2024 around Surat International airport. Monitoring has been done at 6 locations which are laid under the flight path with aircraft traffic volume, meteorological data, and radar tracking data.

Noise monitoring was done on both side of the runway, at the nearest residential/silent zone and far as possible under the flight path of the aircraft using Spot Noise Monitoring Terminal. Other temporary four stations were installed under the flight path where noise levels are expected to be high This instrument was set for A-weighting continuous 24 hours and all the readings were taken

as per CPCB protocol. Noise descriptors like L_{max} , L_{min} , L_{10} , L_{50} , L_{95} , and L_{Aeq} , were assessed and are given in Table 4.1 to 4.6 for all locations. Representative noise analysis reports & site photographs are given in *Annexure-I*.

Table 4.1: NMT-1_S08_Airport Premises Noise Level Readings

Date	Day Time (6.00 AM to 10.00 PM)						Night Time (10.00 PM to 6.00 AM)					
	L_{Aeq}	L_{max}	L_{min}	L_{10}	L_{50}	L_{95}	L_{Aeq}	L_{max}	L_{min}	L_{10}	L_{50}	L_{95}
05-06-2024	56.2	90.7	46.9	58.3	50.1	45.2	48.3	78.3	44.6	50.1	46.2	42
06-06-2024	57.1	108.1	45.8	59.1	50.4	44.6	50.9	88.3	43.9	52.3	46.8	42.9
07-06-2024	56.6	103.8	44.2	58.5	50.8	45.7	51.7	86.6	43.4	53.2	47.1	43.0
08-06-2024	55.9	92.0	43.4	57.6	49.9	46.0	51.3	88.8	47	54.4	47.5	44.5
09-06-2024	57.3	90.5	48.1	59.4	50.2	45.8	49.8	87.7	43.6	52.8	47.2	43.8
10-06-2024	59.4	96.1	47.8	60.8	51.3	43.8	48.8	82.9	44.8	51.9	46.5	42.9
11-06-2024	57.8	91.6	47.5	59.2	50.8	45.7	53.8	77.4	45.4	55.6	48.6	43.3

Table 4.2: NMT-2_S07_Airport Premises Noise Level Readings

Date	Day Time (6.00 AM to 10.00 PM)						Night Time (10.00 PM to 6.00 AM)					
	L_{Aeq}	L_{max}	L_{min}	L_{10}	L_{50}	L_{95}	L_{Aeq}	L_{max}	L_{min}	L_{10}	L_{50}	L_{95}
05-06-2024	54.4	100.5	40.2	56.3	47.2	41.6	46.6	84.3	40.8	47.7	43.5	39.6
06-06-2024	55.6	88.3	40.8	56.9	46.9	41.7	49.8	84.6	41.1	50.9	45.1	38.6
07-06-2024	56.2	94.8	41.9	58.3	46.8	41.5	52.3	88.8	41.8	54.1	45.8	40.7
08-06-2024	54.6	101.2	38.7	55.4	45.6	40.5	49.5	88.4	43.5	50.8	44.5	42.8
09-06-2024	56.6	88.4	43.4	57.2	48.2	43.5	53.0	87.8	40.4	54.4	47.1	40.9
10-06-2024	55.5	94.5	41.3	57.1	44.7	40.8	46.0	76.6	39.8	47.8	46.2	39.7
11-06-2024	57.5	94.9	42.4	58.7	47.1	42.0	54.4	78.7	41.3	56.1	47.1	40.7

Table 4.3: SLM-1_Residential Scatter Noise Level Readings

Date	Day Time (6.00 AM to 10.00 PM)						Night Time (10.00 PM to 6.00 AM)					
	L_{Aeq}	L_{max}	L_{min}	L_{10}	L_{50}	L_{95}	L_{Aeq}	L_{max}	L_{min}	L_{10}	L_{50}	L_{95}
05-06-2024	50.1	77.1	44.3	52.1	48.2	46.2	43.3	74.1	39.4	45.5	41.3	39.2
06-06-2024	53.6	78.4	43.8	54.6	49.3	45.9	44.5	75.4	38.3	46.9	42.1	40.9
07-06-2024	54.5	80.1	42.9	56.2	49.8	45.6	44.9	79.1	38.4	46.1	41.1	39.4
08-06-2024	51.2	81.2	43.2	52.9	48.8	44.7	43.8	77.2	38.6	45.2	41.9	40.1
09-06-2024	52.7	80.9	47.9	54.5	48.6	43.9	43.2	78.9	39.5	45.1	41.3	39.8
10-06-2024	53.8	79.5	45.8	55.2	49.1	45.6	44.7	79.4	38.1	46.3	42.3	40.1
11-06-2024	51.9	80.8	44.9	53.6	47.2	43.8	45.8	80.3	38.1	47.1	42.2	39.5

Table 4.4: NMT-3_S07_Residential Scatter/School Noise Level Readings

Date	Day Time (6.00 AM to 10.00 PM)						Night Time (10.00 PM to 6.00 AM)					
	L _{Aeq}	L _{max}	L _{min}	L ₁₀	L ₅₀	L ₉₅	L _{Aeq}	L _{max}	L _{min}	L ₁₀	L ₅₀	L ₉₅
12-06-2024	58.0	100.5	45.3	59.1	49.5	43.5	57.3	103.5	44.2	58.5	46.8	40.7
13-06-2024	56.5	102.4	46.2	58.1	48.9	43.2	56.8	101.8	44.7	58.3	47.1	40.9
14-06-2024	58.0	106.4	45.4	59.4	48.7	43.5	54.0	91.6	39.8	55.1	45.7	39.0
15-06-2024	55.2	102.0	44.9	56.8	47.8	42.7	54.4	96.0	43.8	56.1	46.9	40.6
16-06-2024	56.2	100.3	44.5	58.4	48.6	43.4	53.0	94.2	42.5	54.7	45.5	37.6
17-06-2024	55.7	102.8	45.3	57.2	47.5	42.8	55.3	99.2	43.4	56.1	46.1	40.5
18-06-2024	56.9	102.8	45.5	58.8	49.1	43.7	53.7	97.6	40.7	54.8	45.6	38.8

Table 4.5: NMT-4_S08_Residential Scatter Noise Level Readings

Date	Day Time (6.00 AM to 10.00 PM)						Night Time (10.00 PM to 6.00 AM)					
	L _{Aeq}	L _{max}	L _{min}	L ₁₀	L ₅₀	L ₉₅	L _{Aeq}	L _{max}	L _{min}	L ₁₀	L ₅₀	L ₉₅
12-06-2024	53.4	86.9	46.4	55.2	47.8	42.5	52.2	79.1	38.8	54.5	45.2	39.1
13-06-2024	56.1	86.7	48.2	58.3	49.8	44.1	53.5	81.1	40.4	55.9	46.7	40.8
14-06-2024	55.2	84.3	45.2	57.4	45.8	40.0	53.2	81.8	39.5	55.4	48.8	42.4
15-06-2024	55.5	82.7	45.3	57.2	50.1	44.5	51.5	79.8	39.4	53.8	43.5	37.2
16-06-2024	54.3	83.3	44.9	56.8	49.4	43.0	51.1	79.7	38.5	53.6	44.21	37.7
17-06-2024	54.7	89.7	46.1	56.9	49.2	43.7	50.7	81.0	39.9	52.9	45.8	40.3
18-06-2024	56.3	85.7	48.6	58.4	51.2	46.6	49.6	79.1	39.9	51.9	47.8	42.7

Table 4.6: SLM-2_Residential Scatter/Hospital Noise Level Readings

Date	Day Time (6.00 AM to 10.00 PM)						Night Time (10.00 PM to 6.00 AM)					
	L _{Aeq}	L _{max}	L _{min}	L ₁₀	L ₅₀	L ₉₅	L _{Aeq}	L _{max}	L _{min}	L ₁₀	L ₅₀	L ₉₅
12-06-2024	59.1	99.8	45.9	61.2	53.1	48.2	47.3	88.9	44.3	49.5	45.3	40.1
13-06-2024	60.8	101.3	45.4	62.3	52.6	47.6	49.3	90.4	44.9	51.2	46.2	41.1
14-06-2024	59.4	102.8	45.7	60.9	52.7	48.7	50.3	88.4	43.6	52.4	44.1	40.3
15-06-2024	58.1	99.7	43.1	60.2	51.9	48.2	50.7	89.2	45.3	51.9	45.5	40.9
16-06-2024	59.9	100.2	47.2	61.8	52.3	47.8	49.7	88.4	44.8	51.7	45.3	41.8
17-06-2024	60.2	100.8	46.8	62.5	53.4	45.6	48.3	86.5	43.1	50.8	45.4	40.3
18-06-2024	59.1	95.6	44.7	62.1	52.9	47.8	48.8	80.5	45.6	49.7	43.6	39.1

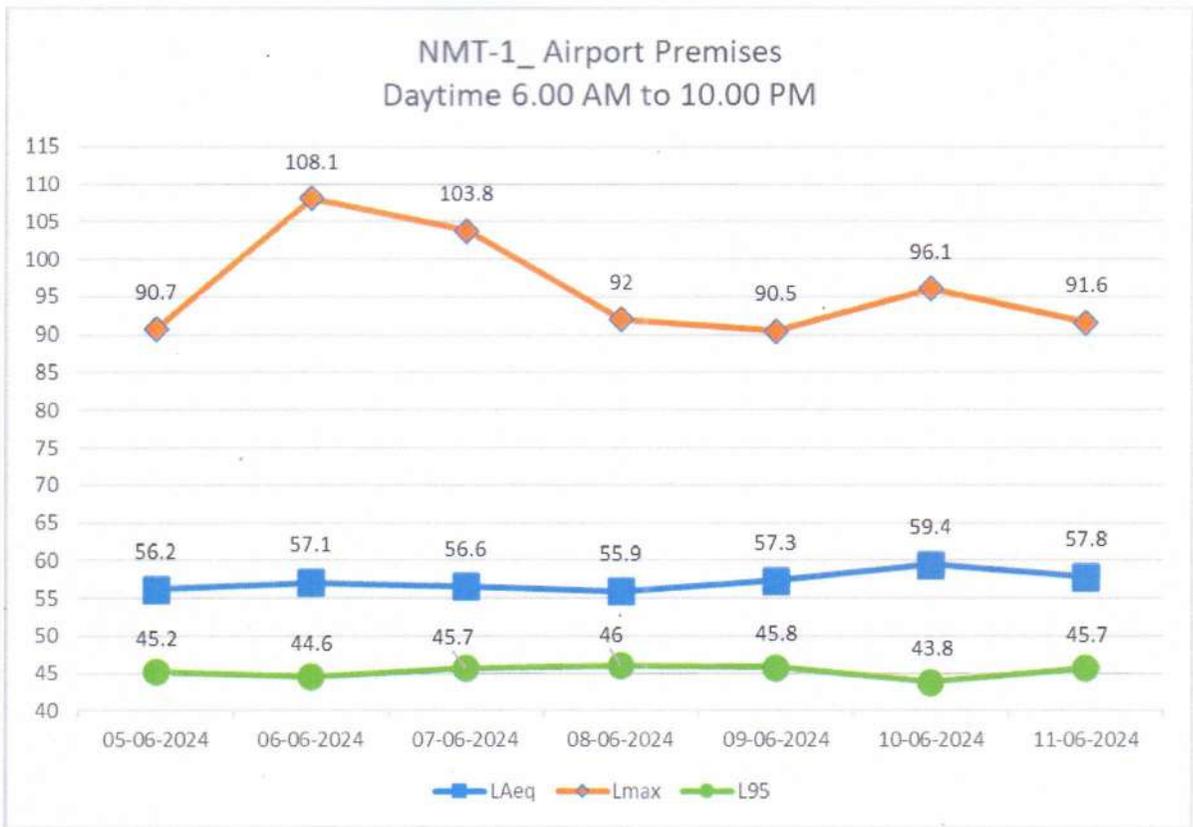


Figure 4.1: Daytime NMT-1 Noise Indices

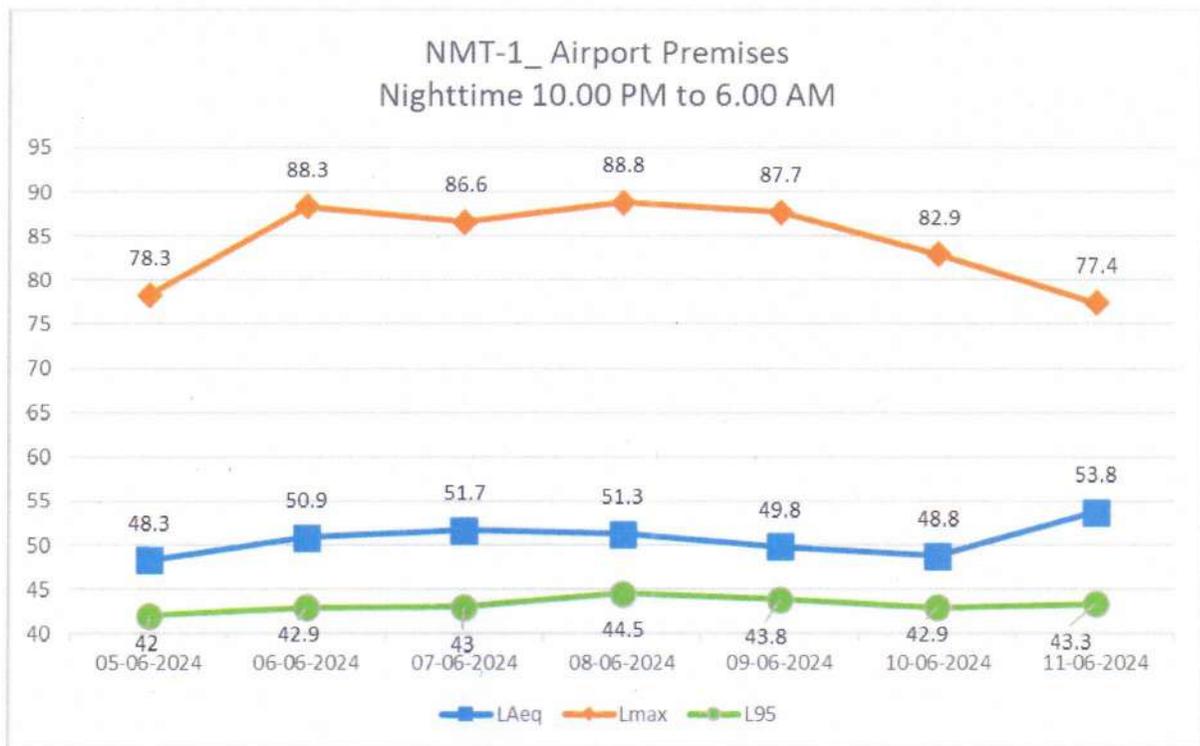


Figure 4.2: Nighttime NMT-1 Noise Indices

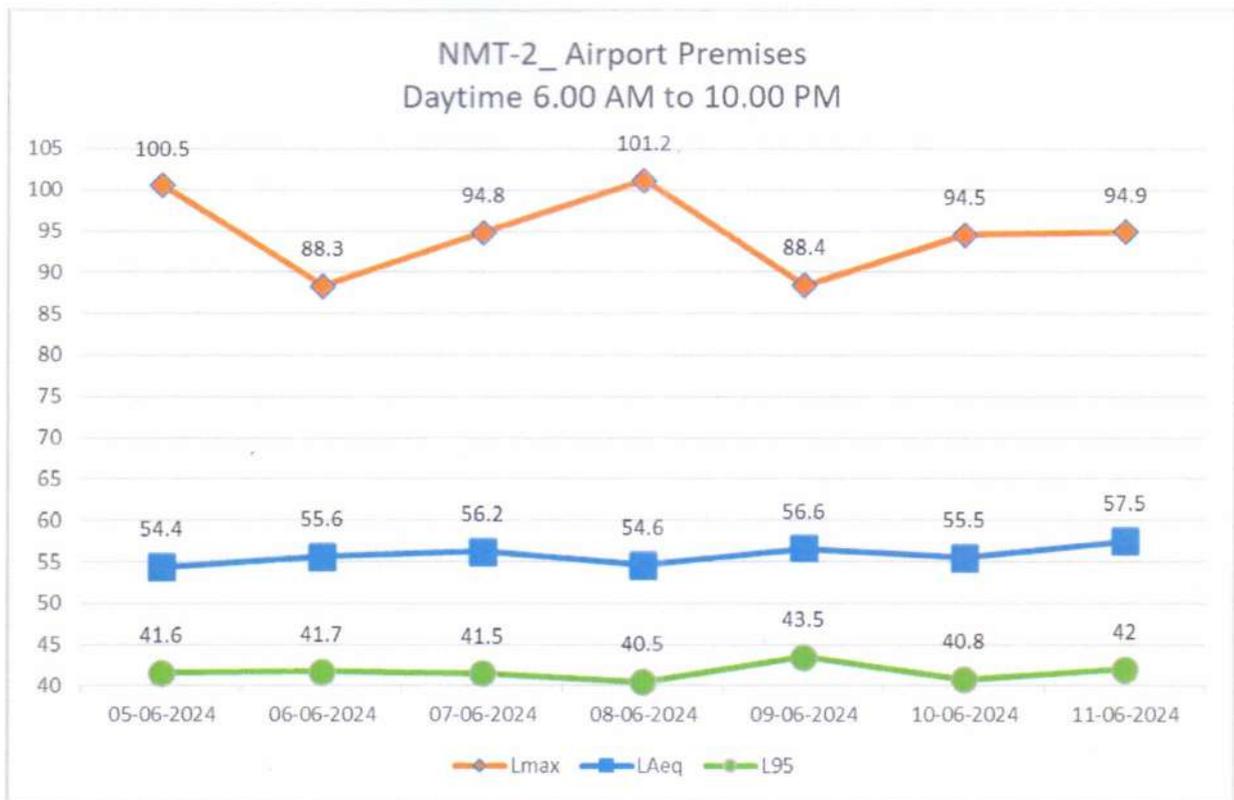


Figure 4.3: Daytime NMT-2 Noise Indices

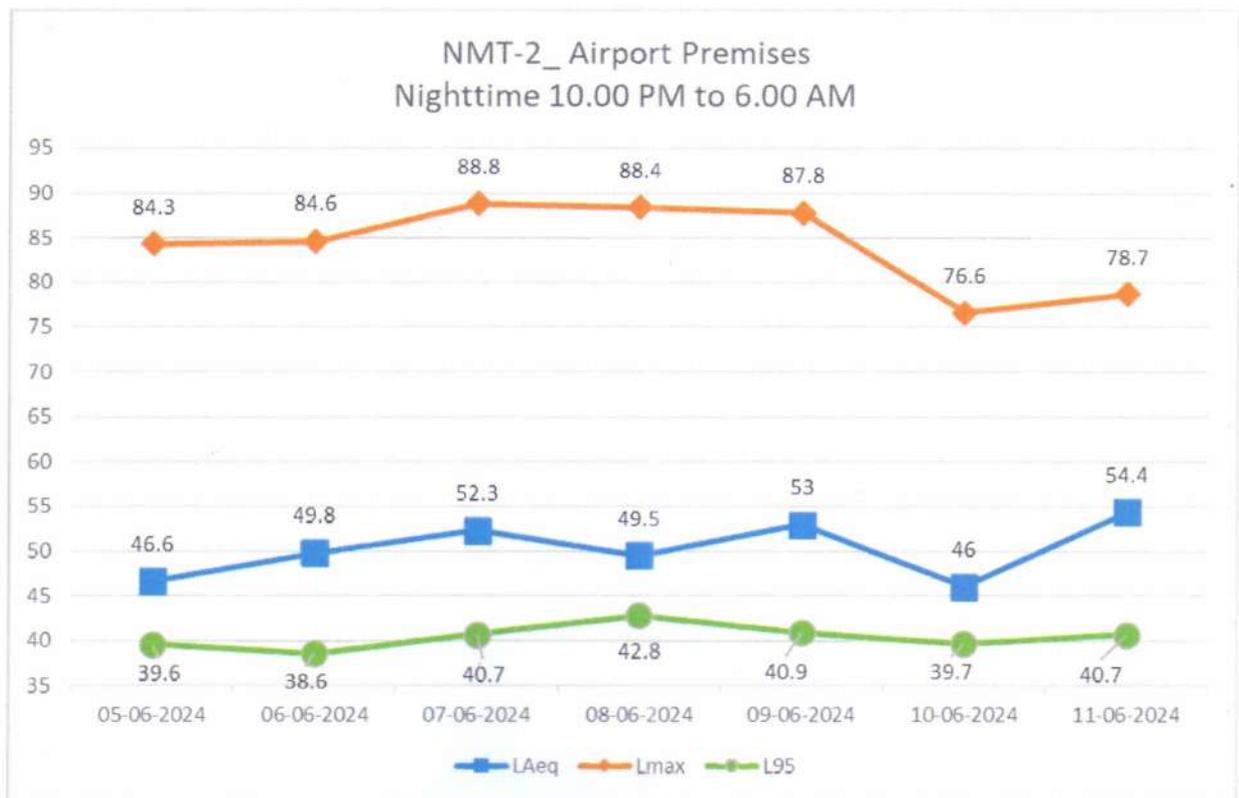


Figure 4.4: Nighttime NMT-2 Noise Indices

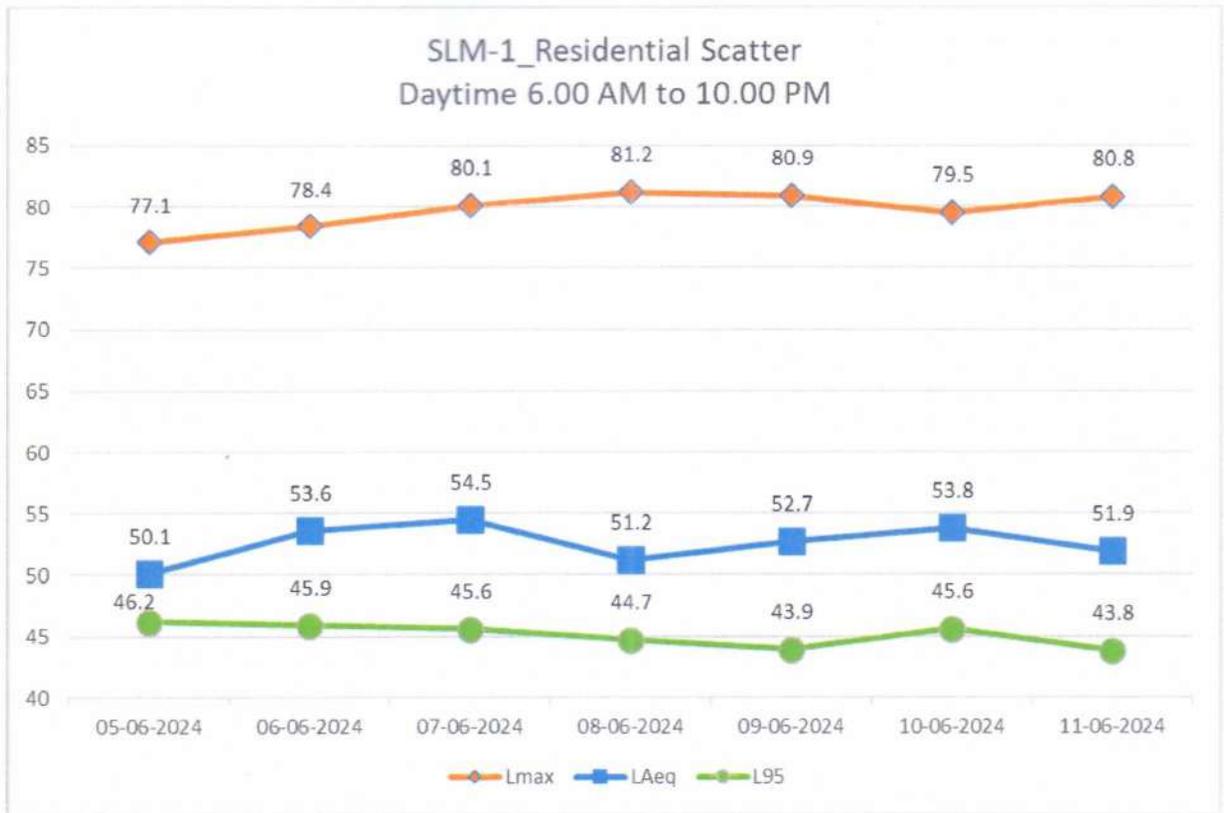


Figure 4.5: Daytime SLM-1 Noise Indices

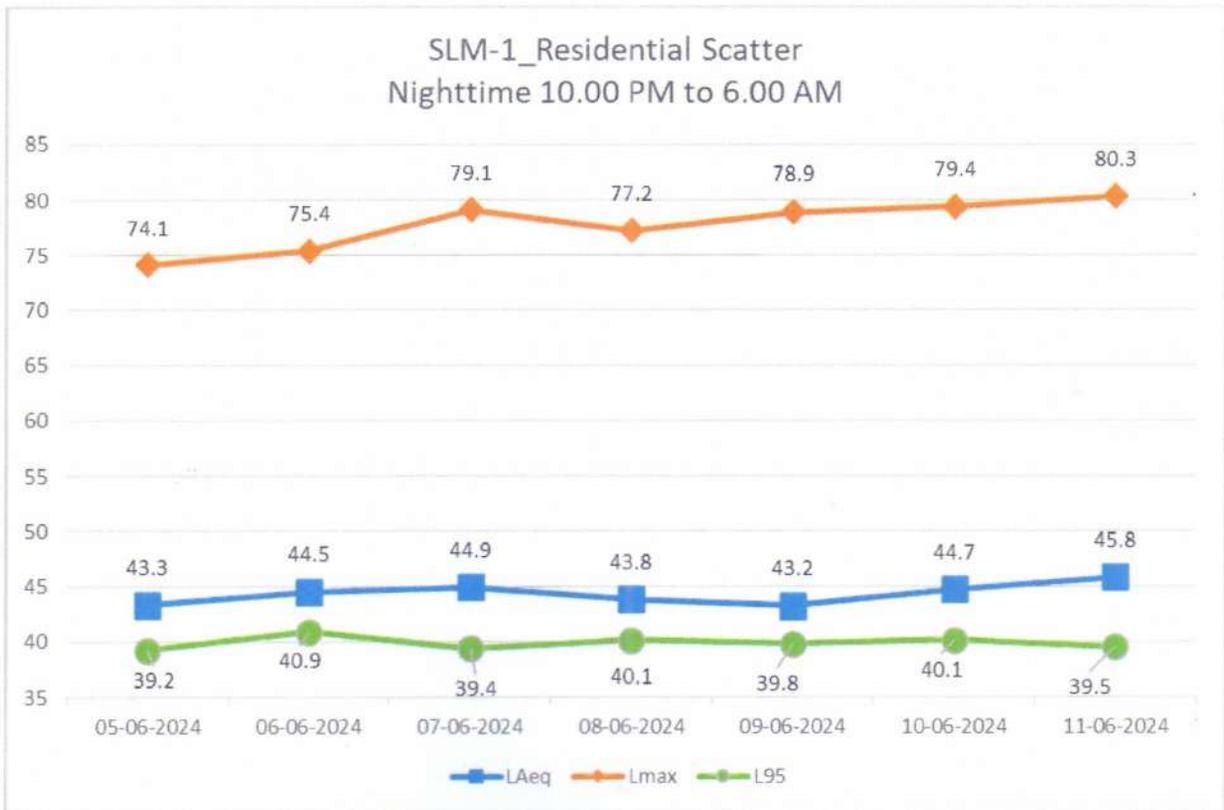


Figure 4.4: Nighttime NMT-2 Noise Indices

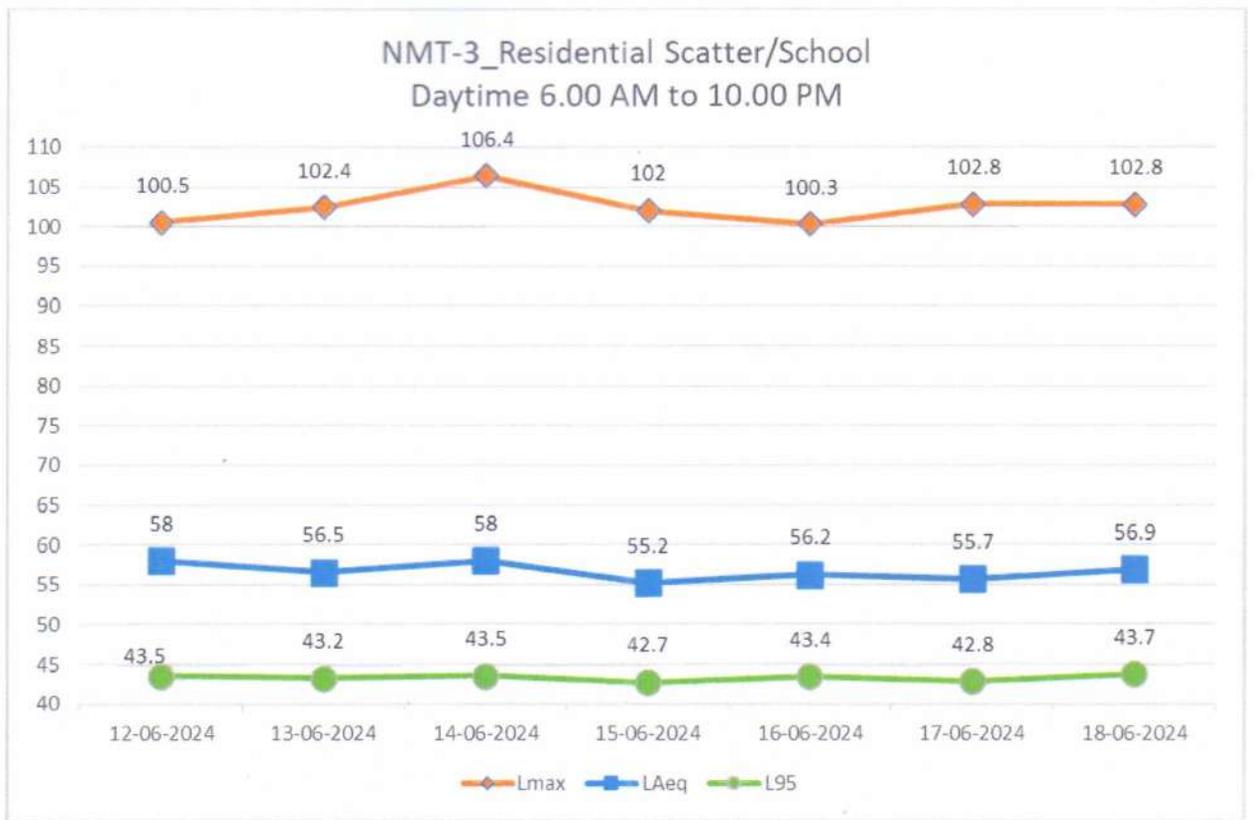


Figure 4.7: Daytime NMT-3 Noise Indices

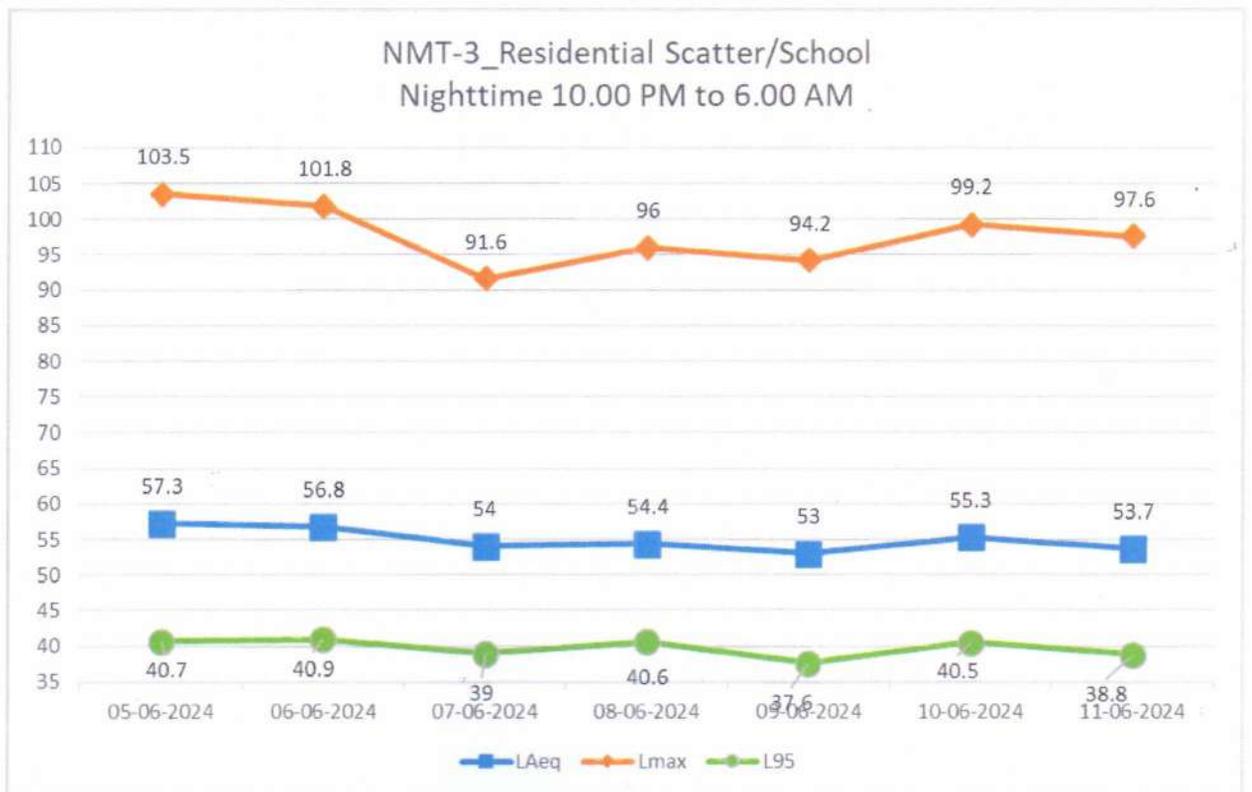


Figure 4.8: Nighttime NMT-3 Noise Indices

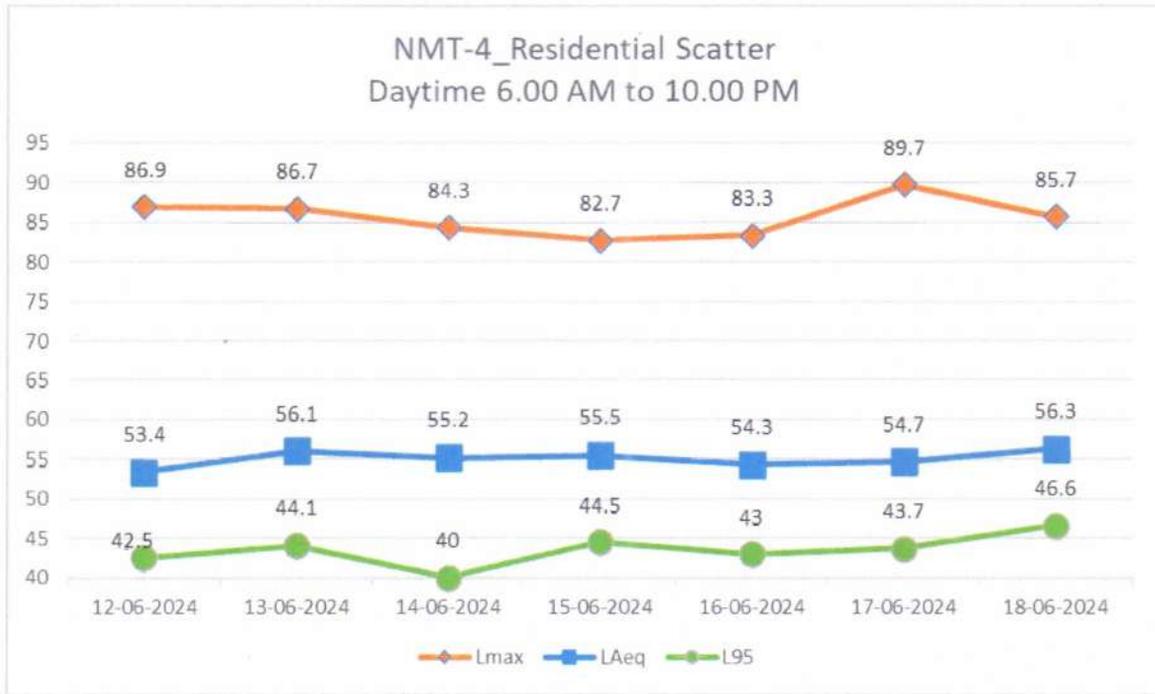


Figure 4.9: Daytime NMT-4 Noise Indices

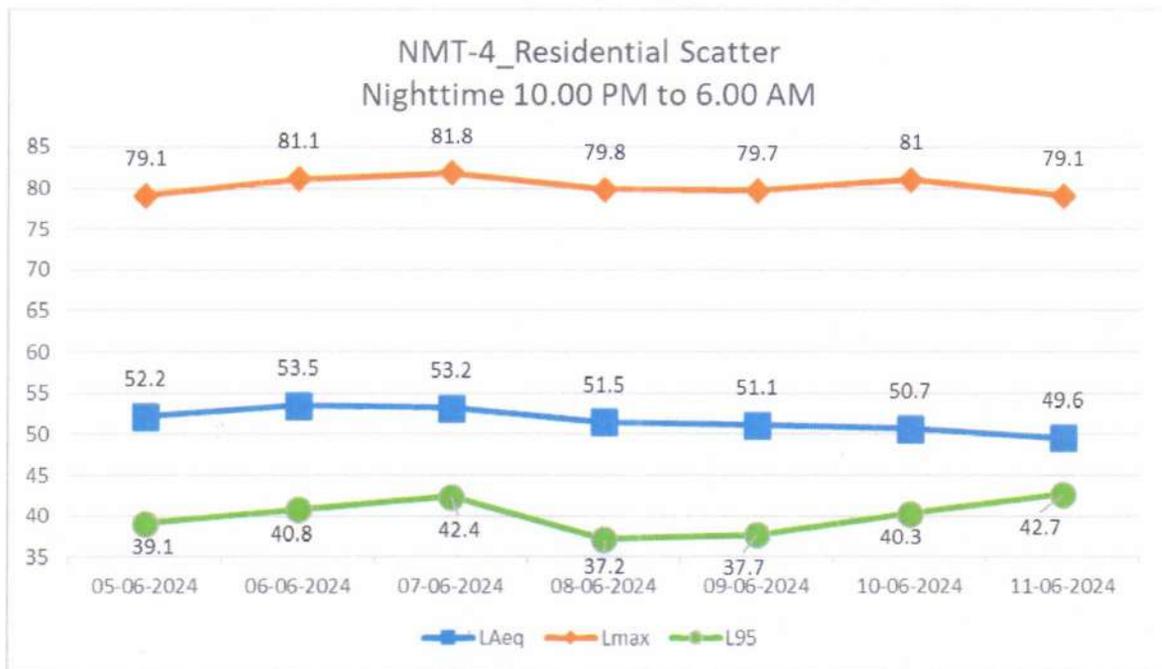


Figure 4.10: Nighttime NMT-4 Noise Indices

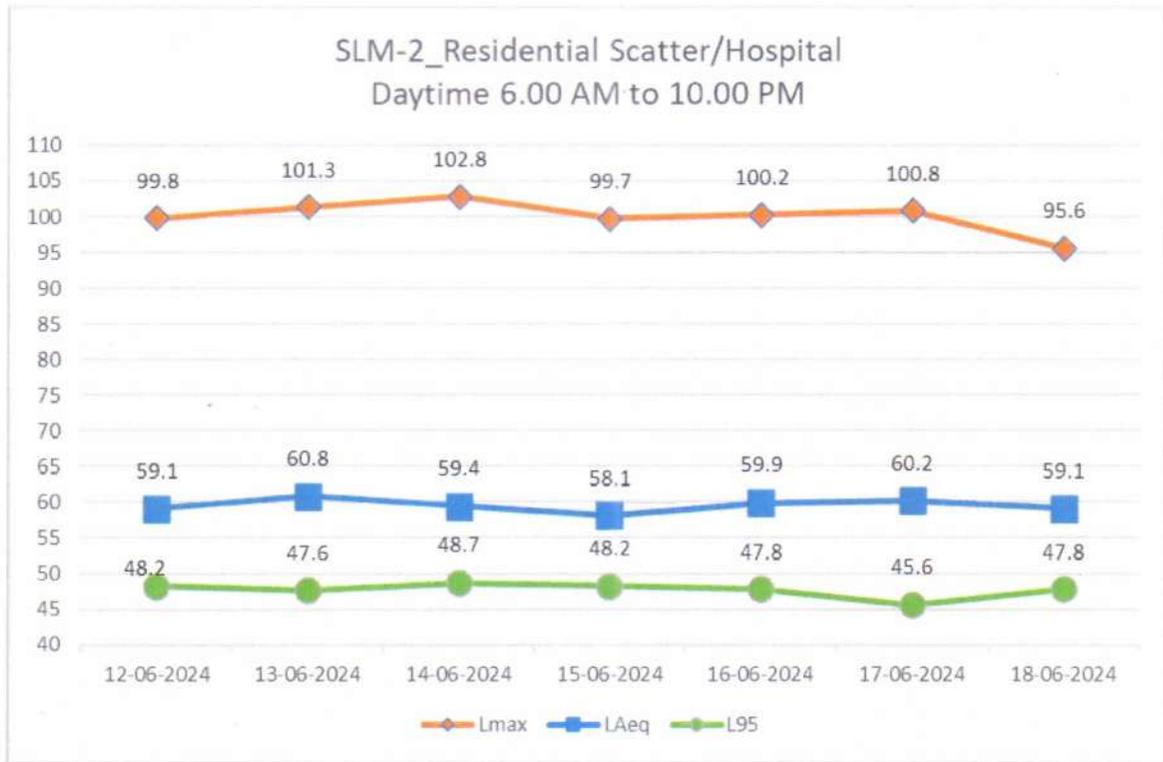


Figure 4.11: Daytime SLM-2 Noise Indices

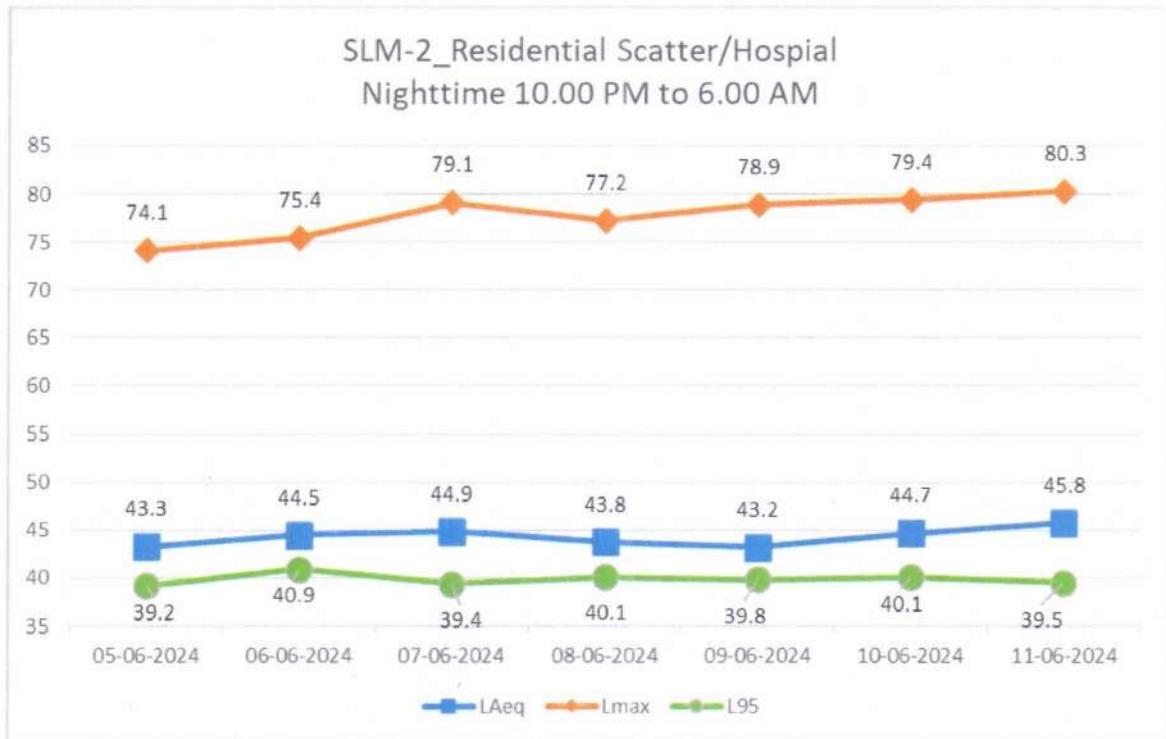


Figure 4.12: Nighttime SLM-2 Noise Indices

Fig. 4.1 to 4.12 depicts the day time and night time noise indices viz. L_{Aeq} , L_{max} , L_{95} of different locations. It shows that the highest L_{max} observed was 108.1 dB(A) at NMT-1 location. The day & night time L_{max} observed on all locations was very high. A-weighted sound levels vary with time. For example, as an aircraft approaches, the sound level increases, then falls and blends into the background as the aircraft recedes into the distance (though even the background varies as birds chirp or the wind blows or a vehicle passes by). This variation in sound level over time often makes it convenient to describe a particular noise "event" by its maximum sound level, abbreviated as L_{max} .

All recorded hourly L_{Aeq} values were near to the prescribed limits by MOEF&CC G.S.R. 568(E) during both day and night time. This indicates that the noise levels are significantly near to the prescribe limit even during night time, thereby causing annoyance and sleep disorder among the human habitation.

4.3 AIRPORT DETAILED SURVEY

The Surat international airport located in Gujarat, India, is second busiest airport in Gujarat, trailing only Ahmedabad in terms of aircraft movements and passenger traffic. The Surat airport was declared as an international airport in December 2023 and the expanded terminal building was inaugurated in the same month.

The expansion project aims to enhance the capacity and facilities of the Surat airport to cater to the growing demand in the region and provide an improved travel experience for international passengers. The Surat Airport has one terminal which handles domestic flights. The new terminal building at Surat Airport covers a total area of 8,500 square metres and has the capacity to handle up to 240 passengers an hour. AAI announced a significant development of the Surat airport in 2018, including the extension of the terminal building and apron, and the construction of a parallel taxi track. The existing two-level terminal building, designed to handle 250 passengers an hour, was expanded by 17,035m² to 25,520m². The terminal has the potential to increase capacity to 3,000 passengers per hour and an annual passenger handling capacity of 5.5 million.

The project also included the expansion of the apron by increasing the number of parking bays from 5 to 18. A new parallel taxi track, measuring 2,905m x 30m, was also added. The following are the details of the airport:

4.3.1 AIRPORT/RUNWAY DATA

1. IATA: STV
2. ICAO: VASU

3. Co-ordinates: 21°7'3.57"N 72°44'42.93"E

4. Elevation: 24 meters

5. Runway:

Direction	Length		Surface
	ft	m	
04/22	9,530	2,905	Asphalt

4.3.2 FLIGHT SCHEDULE

The Detailed flight schedule with aircraft type was collected from Airports Authority of India, Surat and verify with radar tracking data set. Popular flight routes from Surat Airport (STV) include Surat⇒New Delhi, Surat⇒Kolkata, Surat⇒Bengaluru, Surat⇒Goa, Surat⇒Jaipur, Surat⇒Hyderabad, Surat⇒Chennai, Surat⇒Sharjah, Surat⇒Dubai, are the most popular domestic and international flight routes. Surat airport also have non-scheduled flight connectivity with Rajkot, Bhavnagar, Ahmedabad and Vadodara.

Following are the tables of domestic departure, domestic arrival, international departure, international arrival, and non-scheduled flights.

Table 4.7 Schedule Domestic Arrival

AIRLINE	FLIGHT #	ORIGINATES	OPERATES	Aircraft Type
IndiGo	6E 2272	Delhi [DEL]	Daily	A320-251N
Air India Express	I5 588	Kolkata [CCU]	Daily	A320-214
IndiGo	BE 928	Hyderabad [HYD]	Daily	A320-251N
IndiGo	6E 6797	Chennai [MAA]	Tu/Th/Su	A320-251N
IndiGo	6E 184	Delhi (DEL)	Wednesday	A321-251NX
Air India Express	IX 1597	Delhi [DEL]	Daily	B737-8
Star Air	S5 144	Kishangarh (KQH)	Mo/Th/Fr/Sa	EMB145LR
Air India Express	IX 1173	Hyderabad [HYD]	Tu/Th/Sa/Su	B737-8
IndiGo	6E 6191	Pune [PNQ]	Tu/Th/Su	A320-251N
IndiGo	6E 7433	Indore [IDR]	Daily	ATR72-600
Star Air	S5 141	Belagavi [IXG]	Mo/Tu/Th/Su	EMB145LR
IndiGo	6E 465	Bengaluru [BLR]	Daily	A321-251NX
IndiGo	6E 715	Jaipur [JAI]	Daily	A320-251N
Air India Express	I5 613	Bengaluru [BLR]	Daily	A320-214
IndiGo	GE 7967	DIU [DIU]	Daily	ATR72-600
IndiGo	GE 2557	Delhi [DEL]	Daily	A321-251NX
IndiGo	6E 418	Goa [GOI]	Daily	A321-251NX
Star Air	S5 236	Hyderabad (HYD)	Tue/Fri/Sun	E175LR
IndiGo	6E 2383	Delhi [DEL]	Daily	A321-251NX
Air India Express	I5 1569	Delhi [DEL]	Daily	A320-214

Table 4.8 Schedule Domestic Departure

AIRLINE	FLIGHT #	DESTINATION	OPERATES	Aircraft Type
Air India Express	IX 1174	Hyderabad [HYD]	Mo/We/Fr/Su	B737-8
IndiGo	6E 2078	Delhi [DEL]	Daily	A320-251N
Air India Express	I5 592	Kolkata (CCU)	Daily	A320-214
IndiGo	6E 929	Hyderabad [HYD]	Mo/Tu/Fr/Su	A320-251N
IndiGo	6E 6192	Pune [PNQ]	Tu/Th/Su	A320-251N
IndiGo	6E 6042	Delhi [DEL]	Wednesday	A321-251NX
Air India Express	IX 1996	Delhi [DEL]	Daily	B737-8
Star Air	S5 142	Belagavi [IXG]	Mo/Th/Fr/Sa	EMB145LR
IndiGo	6E 7968	Diu (DIU)	Daily	ATR72-600
IndiGo	6E 2002	Chennai (MAA)	Tu/Th/Su	A320-251N
Star Air	S5 143	Kishangarh (KQH)	Mo/Tu/Th/Su	EMB145LR
IndiGo	6E 419	Goa [GOI]	Daily	A321-251NX
IndiGo	6E 784	Jaipur [JAI]	Daily	A320-251N
Air India Express	I5 613	Delhi [DEL]	Daily	A320-214
IndiGo	6E 2241	Delhi [DEL]	Daily	A321-251NX
IndiGo	6E 7432	Indore (IDR)	Daily	ATR72-600
Air India Express	IX 1178	Hyderabad [HYD]	Sunday	B737-8
IndiGo	6E 5034	Bengaluru [BLR]	Daily	A321-251NX
IndiGo	6E 929	Hyderabad [HYD]	We/Th/Sa	A320-251N
Star Air	S5 237	Hyderabad [HYD]	Tue/Fri/Sun	E175LR
IndiGo	6E 2384	Delhi [DEL]	Daily	A321-251NX
Air India Express	I5 1569	Bengaluru [BLR]	Daily	A320-214

Table 4.9 Schedule International Arrival

AIRLINE	FLIGHT #	ORIGINATES	OPERATES	Aircraft Type
Air India Express	IX 174	Dubai [DXB]	Thu/Sat	B737-8
IndiGo	6E 1508	Dubai [DXB]	We/Th/Sa	A320-251N
Air India Express	IX 172	Sharjah [SHJ]	Tu/We/Th/Fr/Su	B737-8
Air India Express	IX 174	Dubai [DXB]	Tue/Sun	B737-8

Table 4.10 Schedule International Departure

AIRLINE	FLIGHT #	DESTINATION	OPERATES	Aircraft Type
Air India Express	IX 171	Sharjah [SHJ]	Mo/We/Th/Fr/Sa	B737-8
IndiGo	GE 1507	Dubai [DXB]	We/Th/Sa	A320-251N
Air India Express	IX 173	Dubai [DXB]	Tue/Sun	B737-8
Air India Express	IX 173	Dubai [DXB]	Thu/Sat	B737-8

Table 4.11 Non-Schedule Arrival

AIRLINE	FLIGHT #	ORIGINATE	OPERATES	Aircraft Type
Ventura Airconnect	VTVAK	Ahmedabad	Daily	C208B
Ventura Airconnect	VTVAK	Rajkot	Daily	C208B
Ventura Airconnect	VTVAK	Bhavnagar	Daily	C208B
Ventura Airconnect	VTVAK	Ahmedabad	Daily	C208B
Ventura Airconnect	VTVAK	Vadodara	Sat	C208B

Table 4.12 Non-Schedule Departure

AIRLINE	FLIGHT #	DESTINATION	OPERATES	Aircraft Type
Ventura Airconnect	VTVAK	Ahmedabad	Daily	C208B
Ventura Airconnect	VTVAK	Rajkot	Daily	C208B
Ventura Airconnect	VTVAK	Bhavnagar	Daily	C208B
Ventura Airconnect	VTVAK	Ahmedabad	Daily	C208B
Ventura Airconnect	VTVAK	Vadodara	Sat	C208B

4.4 TRAFFIC, FLIGHT TRACKS AND CORRIDORS

Flightradar24 platform was used to collect the real time flight details. It shows real-time aircraft flight tracking information on a map. It is a global flight tracker that shows live air traffic from around the world. It combines data from several data sources including ADS-B, MLAT, satellite, and radar data. This positional data is aggregated with schedule and flight status data to create the flight tracking experience. The primary technology that Flightradar24 uses to receive flight information is called automatic dependent surveillance-broadcast (ADS-B). ADS-B technology is the long-term air traffic management replacement for radar technologies, especially in areas with limited radar coverage, such as remote areas and oceanic airspace. Aircraft broadcast a series of datapoints at regular intervals, including data on their position, altitude, speed, and much more. These signals are received by our network of ADS-B ground receivers, the largest such independent network in the world.

Flightradar24 also have facility to calculate positions of non-ADS-B equipped aircraft with the help of Multilateration (MLAT), by using a method known as Time Difference of Arrival (TDOA). By measuring the time, it takes to receive the signal from aircraft with an older Mode S transponder, it's possible to calculate the position of these aircraft. Representative data of flight (Radar tracking Data) reports are given in [Annexure-II](#).

Figure 4.13 & 4.14 depict the 2-D & 3-D view of flight tracks. Flight tracks are specific to a runway. The tracks consist of the track name, the landing / take off direction, a glide path and the detailed description of the flight path. The traffic data (how many planes for day/night) are also associated with the flight track. Flight tracks are usually followed up to a 10-kilometer influence radius. Aircraft do not follow a road or railway line; they are determined by air traffic control personnel who advise pilots to turn to a specific heading and fly in a certain direction for a specified time. Remaining input data were collected from Surat airport authority for current year.

The exact time and turn radius are the pilot's discretion and therefore the flight tracks can be described as corridors rather than lines. Flight operations and weather conditions also add to the variability. Around the airport there are mandatory reporting points, usually associated with a radio beacon that aircraft tend to fly over. For the calculation, the standards determine how the flight corridor is represented by individual line sources.

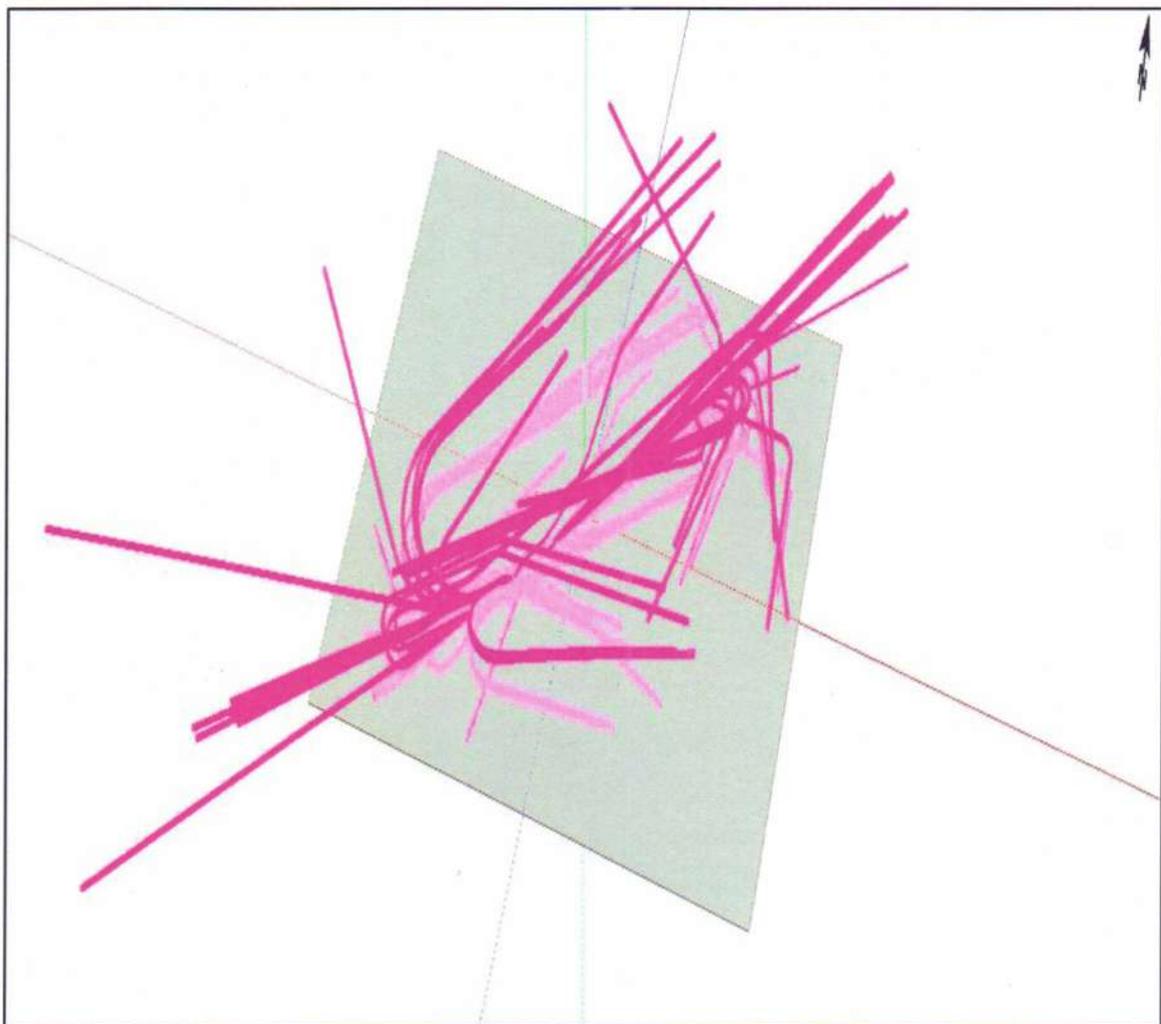
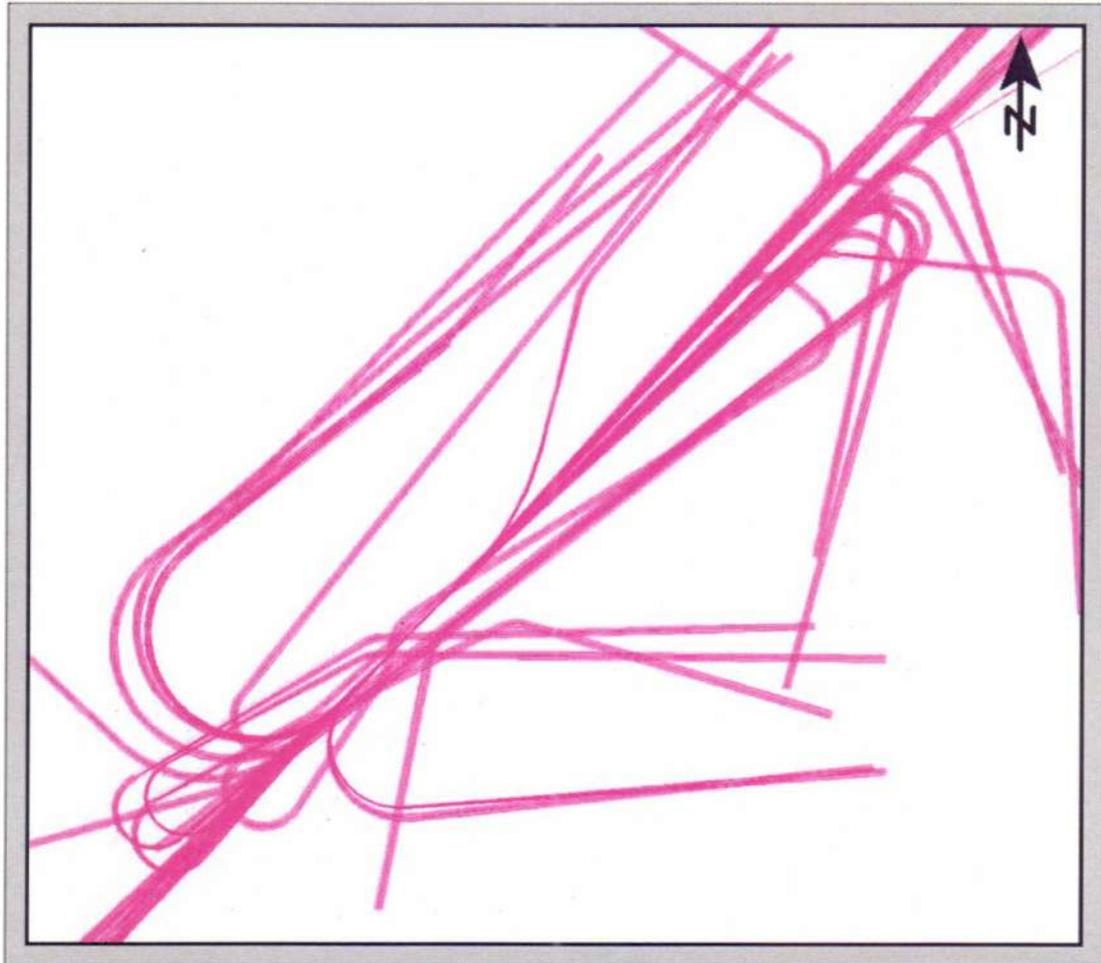


Figure 4.13: 3-D Model View Flight Tracks of Surat International Airport

Aircraft Noise Modelling

Project No. 1

Noise Mapping and Declaration of Airport Noise Zones at Surat International Airport



<p>Signs and symbols</p> <ul style="list-style-type: none"> — Road axis — Emission line ■ Surface ■ Central reservation — Wall --- inside tunnels ○ Signal — Railway axis — Emission line ■ Surface — Wall --- inside tunnels) Tunnel opening 	<p>Levels in dB(A)</p> <table style="width: 100%; border-collapse: collapse;"> <tr><td style="background-color: #008000; width: 20px;"></td><td>< 45</td></tr> <tr><td style="background-color: #90EE90; width: 20px;"></td><td>45 - 49</td></tr> <tr><td style="background-color: #FFFF00; width: 20px;"></td><td>49 - 53</td></tr> <tr><td style="background-color: #FFA500; width: 20px;"></td><td>53 - 57</td></tr> <tr><td style="background-color: #FF4500; width: 20px;"></td><td>57 - 61</td></tr> <tr><td style="background-color: #FF0000; width: 20px;"></td><td>61 - 65</td></tr> <tr><td style="background-color: #800000; width: 20px;"></td><td>65 - 69</td></tr> <tr><td style="background-color: #400080; width: 20px;"></td><td>69 - 73</td></tr> <tr><td style="background-color: #000080; width: 20px;"></td><td>73 - 77</td></tr> <tr><td style="background-color: #000000; width: 20px;"></td><td>>= 77</td></tr> </table>		< 45		45 - 49		49 - 53		53 - 57		57 - 61		61 - 65		65 - 69		69 - 73		73 - 77		>= 77	<div style="text-align: center;"> <p>Client: Airports Authority of India Surat International Airport, Surat</p> </div> <hr/> <p style="text-align: center;">UNISTAR ENVIRONMENT AND RESEARCH LABS PVT. LTD.</p> <div style="text-align: center;"> <p>Environment and Research Labs Pvt. Ltd.</p> </div> <hr/> <p>Length scale 1:182289</p> <div style="text-align: center;"> </div> <hr/> <p>Date: 28-06-2024 Project engineer: Dr. Dipeshkumar Sonaviya</p>
	< 45																					
	45 - 49																					
	49 - 53																					
	53 - 57																					
	57 - 61																					
	61 - 65																					
	65 - 69																					
	69 - 73																					
	73 - 77																					
	>= 77																					

Figure 4.14: 2-D View Flight Tracks of Surat International Airport

4.5 METEOROLOGICAL DATA

Noise propagation is affected by meteorological parameters like wind velocity & direction, temperature, air pressure, and humidity were collected from Indian Meteorological Department. This meteorological data also becomes one of the input parameters for SoundPLANnoise 9.0 software. Table 4.5 depicts data such as temperature, humidity, air pressure, and headwind of Surat International Airport (Surat City) of June 2024.

Table 4.13: Meteorological Data

Month	Humidity (%)	Air pressure (mb)	Headwind (kt)	Temperature (°C)
June-24	65.0	1002.0	13	35.8

5.1 GENERAL

This chapter highlights the noise mapping concept and noise mapping of study area. Noise maps were developed for Surat International Airport using computer simulation model (SoundPLANnoise 9.0 software).

5.2 CONCEPT OF NOISE MAPPING

Noise map is a map of an area, which is coloured according to the noise levels in the area (Sonaviya and Tandel, 2019b). Sometimes, the noise levels may be shown by contour lines, which show the boundaries between different noise levels in that area. The noise levels over an area will be varying all the time. For example, noise levels may rise as the aircraft approaches, and reduce again after it has passed. This would cause a short-term variation in noise level. In the longer term, wind, weather and season all affect noise levels.

This means that it is not possible to say with confidence what the noise level will be at any particular point at any instant in time, but where the noise sources are well-defined, such as road or rail traffic, or aircraft, then it is possible to say with some confidence what the long-term average noise level will be.

It may be thought that the best way of doing this is by measurement. A long-term average must be measured over a long period of time (24-hours) (Sonaviya and Tandel, 2020b). Secondly, to obtain complete coverage of an area, measurements would have to be made on private property, where access might be difficult, and thirdly, measurements cannot distinguish the different sources of noise, so they would not be able to give information on how much noise was being made by each of the sources in an area. For these and other reasons, noise mapping is usually done by calculation based on a computerized noise model of an area, although measurements may be appropriate in some cases.

A further benefit of having a noise map is that it can be used to assess the effects of transportation and other plans. Thus, the effect of a proposed new airport/existing airport can be assessed and suitable noise mitigation can be designed to minimize its impact. This is particularly important in

noise action planning, where a cost-benefit analysis of various options can be tested before a decision is made.

5.3 NOISE MAPS AND PREDICTION MODEL

The airport selected for noise mapping is Surat International Airport. The Surat city covers an area of about 326.515 sq.km and having population about 6.4 million as per 2016 estimation. There are seven zones in Surat city. These seven zones include diversified activities of business, residence, commerce, silent, and industry. A majorly flights has been observed on South-west zone of Surat city.

For developing aircraft noise model, it is essential to associate noise levels with generation, propagation and reception of aircraft noise. Every model needs three significant features such as the noise source, the path of propagation and the receiver. The noise source data consist of the aircraft type, aircraft engine type, flight path. The propagation path includes the perpendicular distance of receiver from source, average height of propagation above ground surface, the ground surface characteristics, angle of view of source from receptor and reflecting surface near to the source.

The data considered for receptor are the location, height and angle of view of the receptor and the reflecting surfaces near to receptor. The geometrical features of road and buildings were measured manually.

Buildings were made into the ground model. The heights of building were taken as 2.8 meter per floor. Residential as well as commercial buildings are located just on the road side and these buildings were minimum of 3 storeys and maximum of 13 storeys.

To develop noise map, country wise calculation models such as AzB 2008, AzB 1975, AzB 1975 DIN 45643, AzB 1975 Hungary, AzB 1975 ÖAL 24, BUF:2021 / 2018, CNOSSOS-EU AirNoise:2021/2015, CNOSSOS-AT: 2021/2019, DIN 45684-1: 2013-07, DIN 45689:2020, ECAC 2nd, 3rd and 4th Edition, ÖAL 24:2004, SANC VBUF. are available in SoundPLAN 9.0 software.

ECAC 4th edition model was used to develop the noise maps for the Surat International Airport. The predicted noise maps were developed for the year 2024. The time required to generate a single aircraft noise map depends upon the data inventory, however for this study, it ranged from 8 to 14 hours. Results of noise mapping shall be validated using actual measurements of aircraft noise around the airport, preferably at the points as chosen during the modeling.

Table 5.1: Day Time Measured and Predicted Values

Locations	Measured L_{Aeq}	Predicted L_{Aeq}
NMT-1_Airport Premises	57.3	57.9
NMT-2_Airport Premises	55.9	55.2
NMT-3_Residential Scatter/ School	56.8	53.9
NMT-4_Residential Scatter/Village	55.2	35.5
SLM-1_Residential Scatter	52.8	52.5
SLM-2_Residential Scatter/Hospital	59.6	59.0

Table 5.2: Night Time Measured and Predicted Values

Locations	Measured L_{Aeq}	Predicted L_{Aeq}
NMT-1_Airport Premises	51.0	45.8
NMT-2_Airport Premises	51.2	42.1
NMT-3_Residential Scatter/ School	55.2	40.0
NMT-4_Residential Scatter/Village	51.9	23.5
SLM-1_Residential Scatter	44.4	42.2
SLM-2_Residential Scatter/Hospital	49.3	46.8

Table 5.1 & 5.2 depict the noise values of prediction and measured. The maps of the model (e.g. Figure 5.1 & 5.2) describe the noise levels in form of contours. Noise contours highlight existing or potential areas of significant aircraft noise exposure (as prescribed by MOEF & CC notification, G.S.R. 568 (E)) and are a series of lines superimposed on a map of the airport's environs. These lines represent various levels of average exposure. Noise contours are used to assess the relative aircraft noise exposure levels of different runway and or flight corridor alternatives.

Aircraft Noise Modelling

Noise Mapping and Declaration of Airport Noise Zones at Surat International Airport

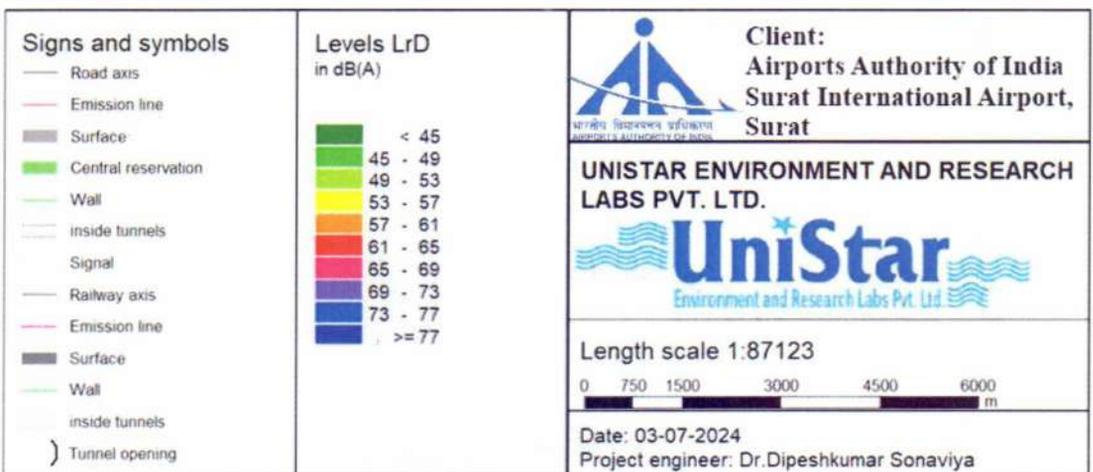
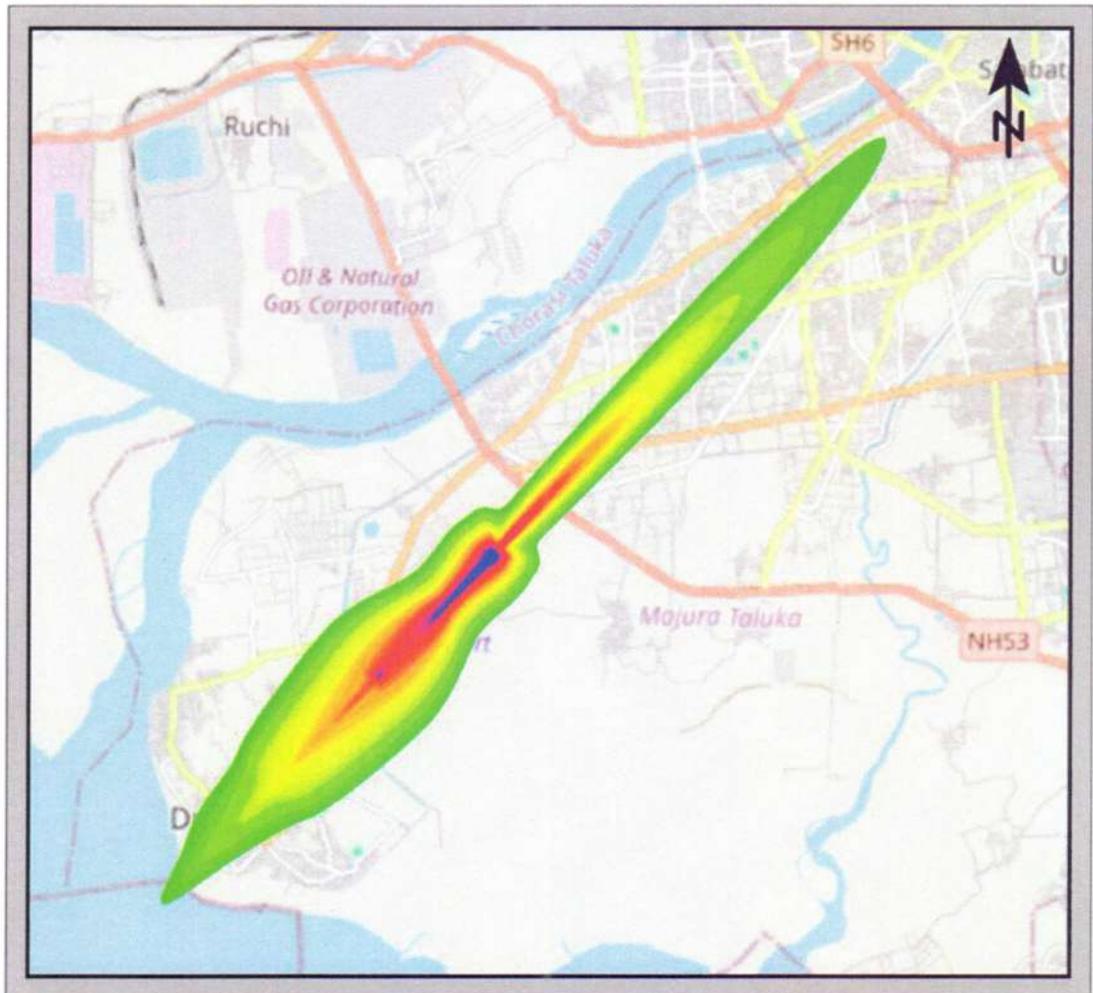
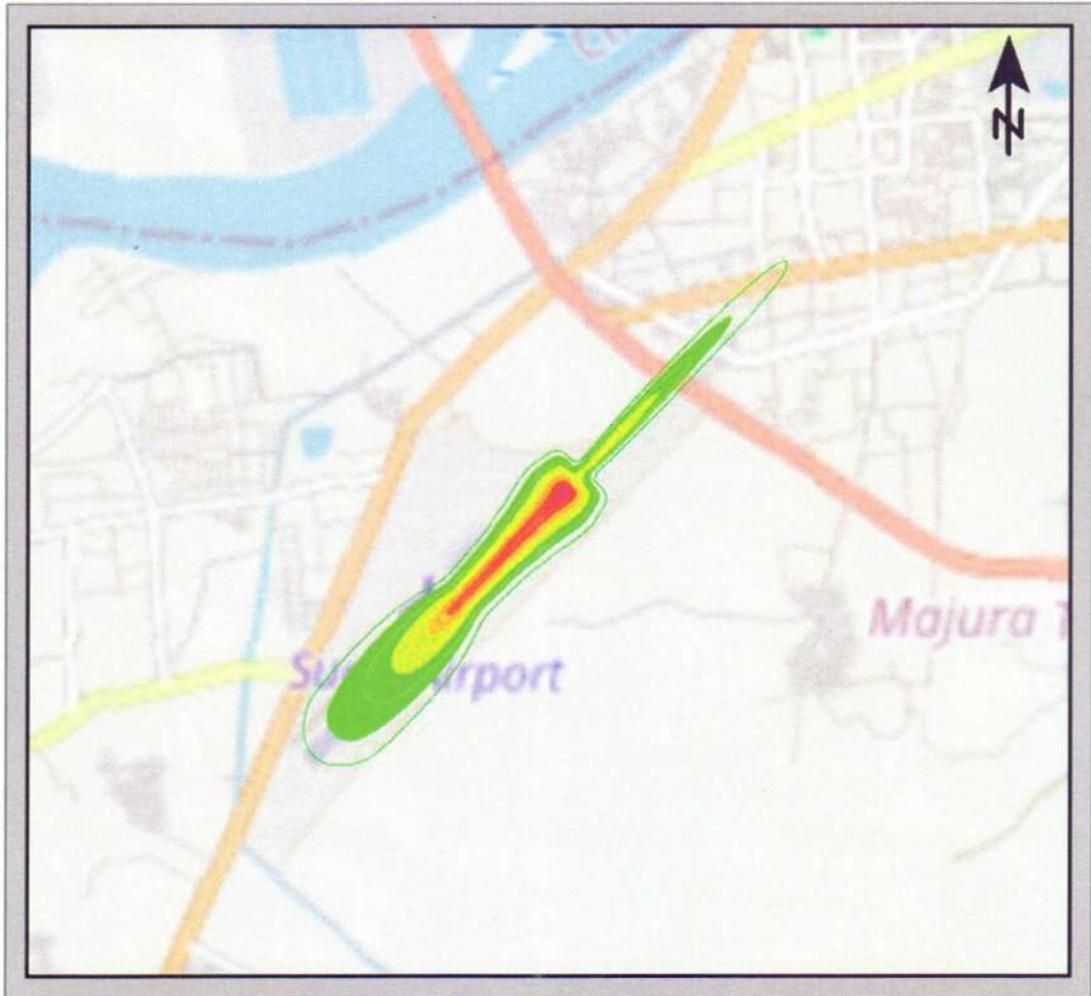


Figure 5.1 Day Time Noise Prediction Map

Aircraft Noise Modelling

Noise Mapping and Declaration of Airport Noise Zones at Surat International Airport



<p>Signs and symbols</p> <ul style="list-style-type: none"> — Road axis — Emission line ■ Surface ■ Central reservation — Wall — inside tunnels ○ Signal — Railway axis — Emission line ■ Surface — Wall — inside tunnels) Tunnel opening 	<p>Levels LrN in dB(A)</p> <ul style="list-style-type: none"> ■ < 45 ■ 45 - 49 ■ 49 - 53 ■ 53 - 57 ■ 57 - 61 ■ 61 - 65 ■ 65 - 69 ■ 69 - 73 ■ 73 - 77 ■ >= 77 	<div style="text-align: center;">  <p>Client: Airports Authority of India Surat International Airport, Surat</p> </div> <div style="text-align: center;"> <p>UNISTAR ENVIRONMENT AND RESEARCH LABS PVT. LTD.</p>  <p>Environment and Research Labs Pvt. Ltd.</p> </div> <div style="text-align: center;"> <p>Length scale 1:42428</p>  </div> <div style="text-align: center;"> <p>Date: 29-06-2024 Project engineer: Dr.Dipeshkumar Sonaviya</p> </div>
--	---	--

Figure 5.2: Night Time Noise Prediction Map

Aircraft Noise Mapping

Noise Mapping and Declaration of Airport Noise Zones at Surat International Airport

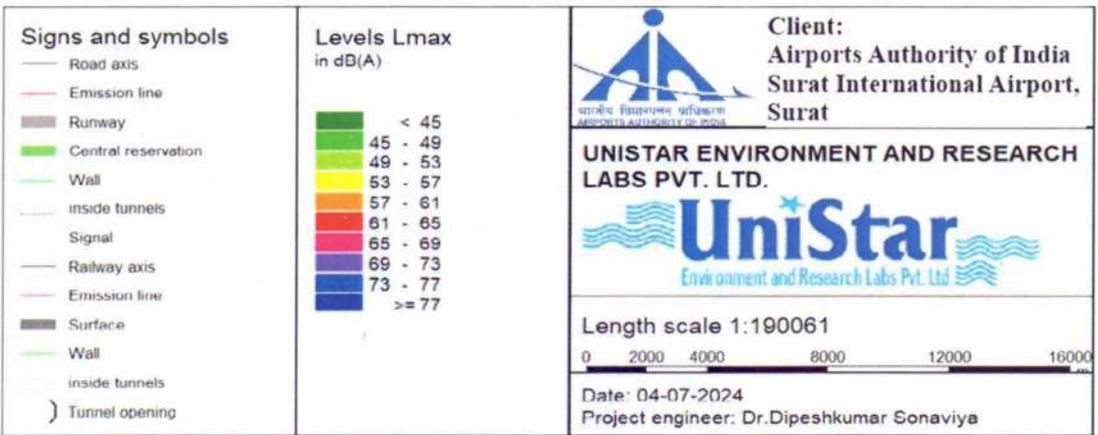
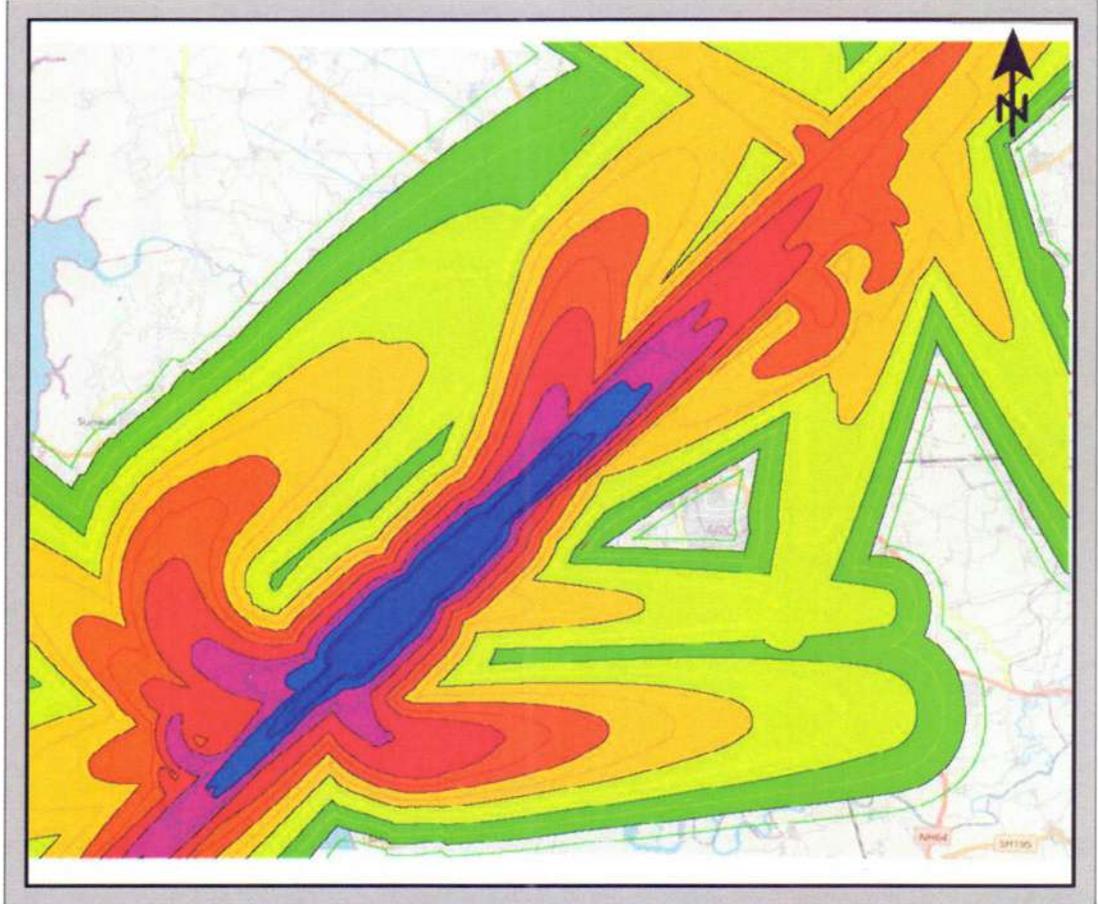


Figure 5.3: L_{max} Noise Prediction Map

Figure 5.1 & 5.2 shows an example set of contour maps. The colors indicate low (green), moderate (yellow) and high (red/blue) levels of noise impact. The transition from one colour to another reflects the obvious reality that there are really no clear dividing lines between shades of impact. For practical (e.g. 'head counting') purposes it is necessary to draw precise boundaries but the two diagrams are reminders that they are not definitive.

The Maximum A-Weighted Sound Level L_{max} , can measure the highest root mean square sound level that occurs during a single event in which sound level varies with time. The L_{max} metric can be used to describe a single aircraft noise event and is measured in decibels (dB). The L_{max} metric measures the maximum level of noise during a single event. It provides some measure of how intrusive the noise event is. It is also one of the few metrics that people can actually experience and measure. Figure 5.3 depicts the L_{max} noise contour map.

Different countries use different noise metrics and indices, different interpretations and different contour conventions. Although noise contouring is a well-established practice for depicting the extent and severity of aircraft noise impact around airports, contours are often criticized by those impacted for being too coarse and for not revealing important features of the noise such as the balance between the levels and numbers of individual events and their distribution across the hours of the day and night.

It is of course true that they do not; it has been explained that noise exposures are commonly defined only as long-term averages because effects on the community too can only be described in broad statistical terms. More information can be made available but that might be impossible to interpret in terms of community impact. Nevertheless, despite that obstacle, many authorities have found that providing additional information helps to inform the public discussions and consultations that are such an important part of effective noise mitigation programmes.

Table 5.1 & 5.2 depicts the difference of up to 10 dB (A) at some locations at night time in above model when compared to measured data. Fig. 5.1 & 5.2 depict road emission line where noise was generated by vehicles means main source of noise are vehicles at that location at night time.

The location NMT-3 is near by the Dumas beach, which is one of the most popular beaches among the local people of Surat. It is located 21 km southwest of Surat city. The beach is one of the picnic spots and managed by the Surat Municipal Corporation. People are enjoying at dumas beach for late night. Residential as well as commercial buildings are located just on the roadside and less parking space are available. Therefore, people park vehicles on main road. Due to varied vehicular dimension and composition, accelerating-decelerating speed, lack of lane discipline and un-

authorized parking on roads, horn honking becomes imperative. These two significant parameters viz. number of horn counts and un-authorized parking may be the leading cause of higher error percentage between observed and predicted noise values at location NMT-3.

The location NMT-4 is under abhwa village area and near by the state highway. This location was selected because this village is under few flights path of aircraft. Highway traffic noise is caused by tire-pavement interaction, aerodynamic sources (turbulent airflow around and partly through the vehicle), and the vehicle itself (the power-unit noise created by the engine, exhaust, or transmission). At highway speeds, tire-pavement interaction generally is the most dominant source (Sandberg and Ejsmont, 2002).

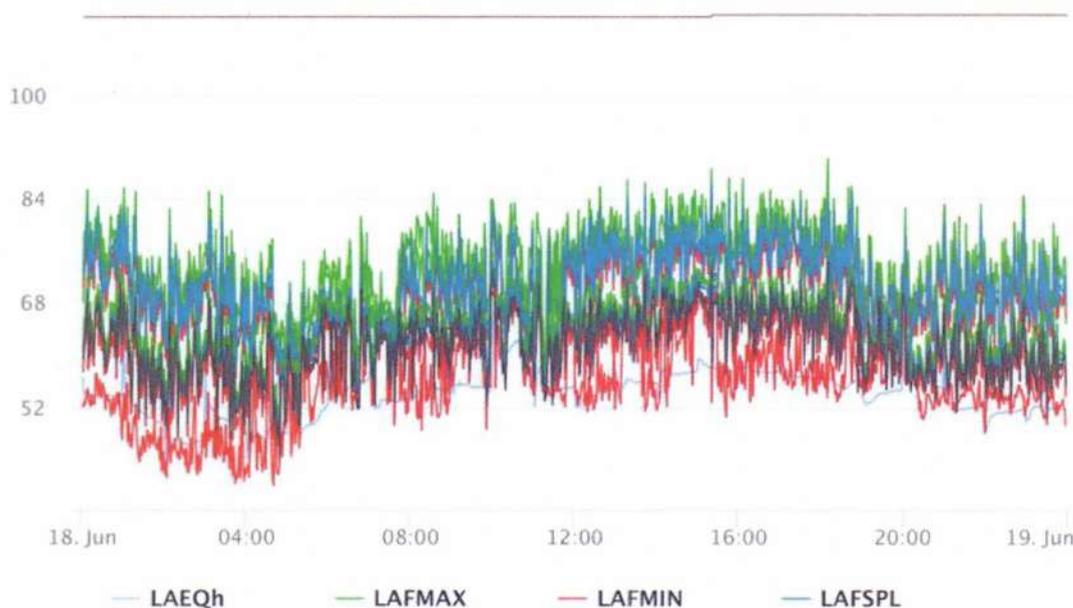


Figure 5.4: Level-Time Course of Sound Pressure Level Produced by Road Traffic on Highway at Location NMT-4

Figure 5.4 depicts a Level-time course of the sound pressure level situation with road traffic. Here, the levels are rather constant over time and consequently with low Intermittency ratio (IR). Air and railway traffic generally exhibit a high IR, with the exception of situations with such a high background noise (e.g., noise from other sources) that the events are partially or fully masked. Therefore, measured L_{Aeq} reading is differ compare to predicted level on location NMT-4.

The location NMT-1, NMT-2, and SLM-2 are entry points of the city. The movement of trucks is limited to non-peak traffic hours. Trucks are not allowed to enter the city between 6 am to 10 pm therefore the variation in results were observed during only the night time at these locations. The predicted L_{Aeq} values were based on only aircraft noise, while measured L_{Aeq} values were based on aircraft as well as other sources.

DECLARATION OF NOISE ZONE

6.1 GENERAL

The purpose of the aircraft noise modelling is to generate the noise contour maps for an existing or planned airport or to show the variations in contours for different operations / plans / future aircraft /noise abatement restrictions and so on. Parallel to the graphical representation of the noise contours, it is possible to get details of noise zone in form of noise maps. Aircraft noise contour maps can be used to calculate the total areas, residential populations affected, numbers of schools and hospitals, or other potentially noise sensitive locations, geographically located within defined aircraft noise contour bands.

6.2 DECLARATION OF NOISE ZONE

The Airport Noise Zone Area for Airport is defined as noise contour for day and night period 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 as amended from time to time on Height Restriction for Safeguarding of Aircraft Operation considering all approach and departure funnels and Instrument Flight Procedures (i.e. Instrument Approach Procedures, Standard Instrument Departure & Standard Terminal Arrival Route).

International Civil Aviation Organization (ICAO) and DGCA have defined Obstacle Limitation Surfaces (OLS) in and around the airports for safe and efficient operations of the flights. Accordingly, Ministry of Civil Aviation has issued Statutory Order (S.O. 84 E) dated 14th January, 2010 to protect these surfaces.

In line of the world best practices and based on the Committee recommendations, set up by MoCA for regulating the building construction around airports, MoCA (vide its letter dated 15th October 2012) has directed AAI to prepare the Colour Coded Zoning Map (CCZM) in grid form of all the civil airports, certify them and give copy of such maps to Local/Municipal Bodies.

CCZM of all the airports has been prepared and issued to the Local Bodies. Whole of the area around the airport has been divided in geo referenced grids of 1 minute by 1 minute (approximately 3 Square km) for the easy readability and implementation. The Local, Municipal or Town Planning and Development authorities can plan their development as per the CCZM.

Aircraft Noise Mapping

Noise Mapping and Declaration of Airport Noise Zones at Surat International Airport

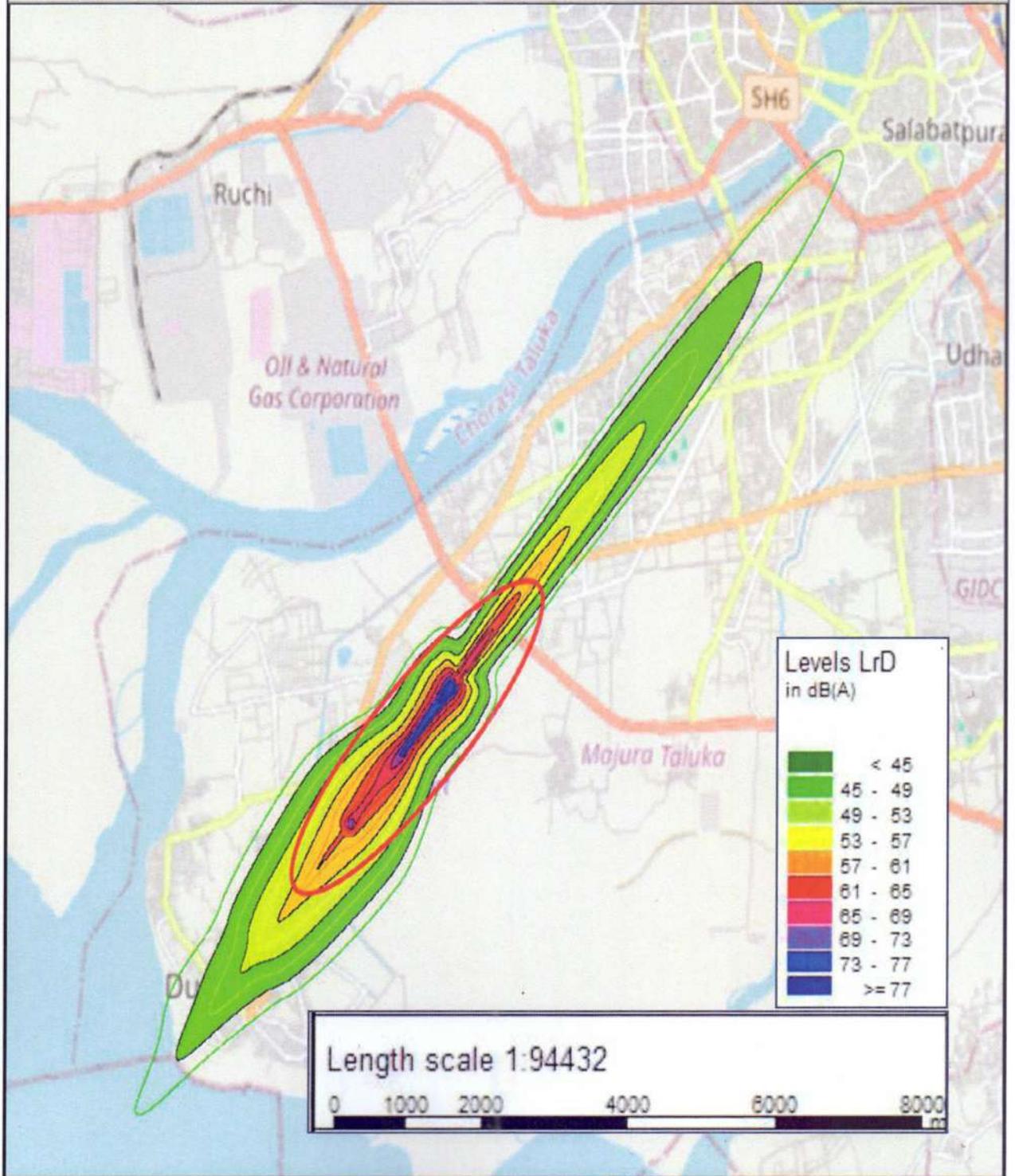


Figure 6.1: Day Time Noise Contour Map

Aircraft Noise Mapping

Noise Mapping and Declaration of Airport Noise Zones at Surat International Airport

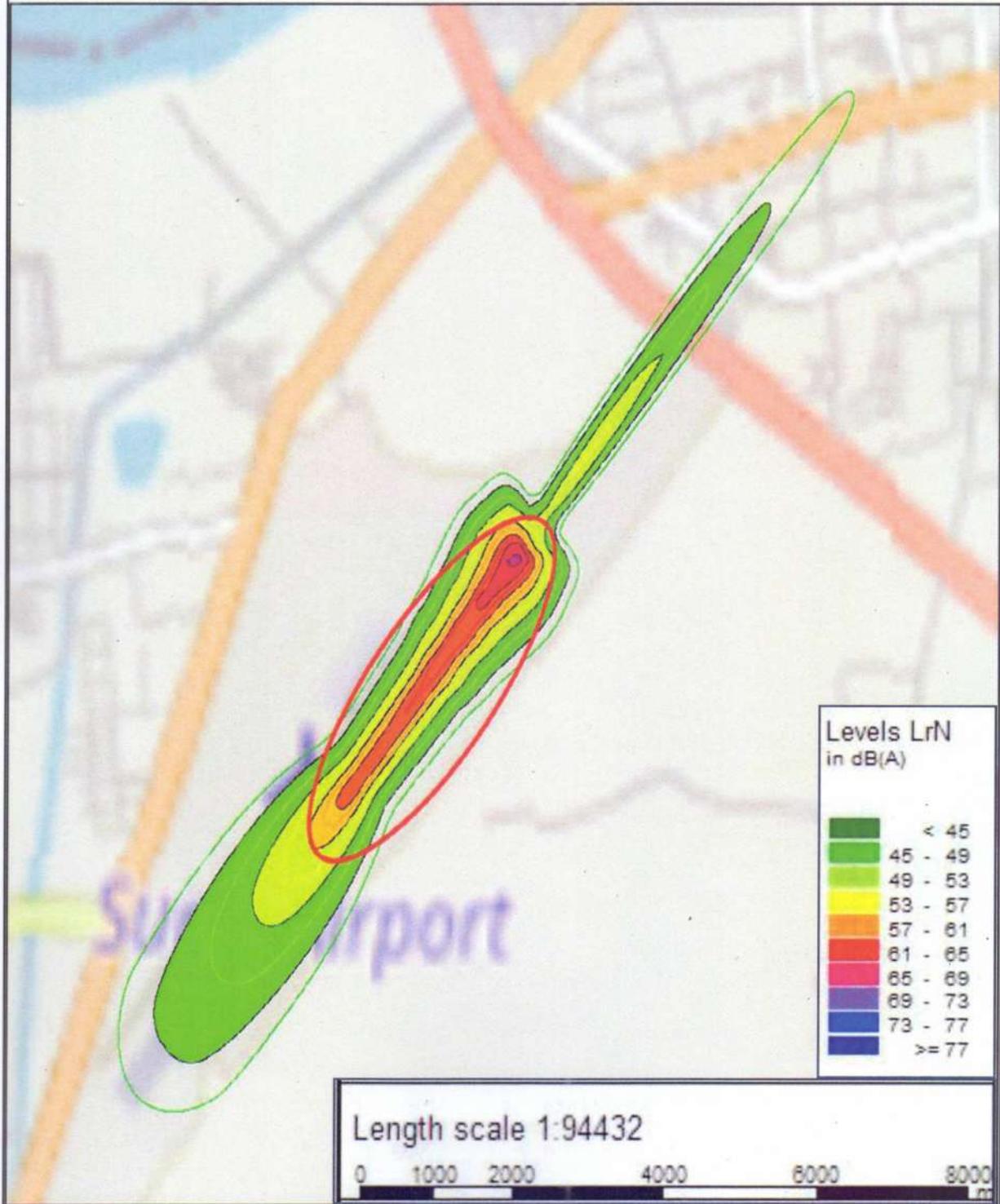


Figure 6.2: Night Time Noise Contour Map

Noise Mapping and Declaration of Airport Noise Zones at Surat International Airport

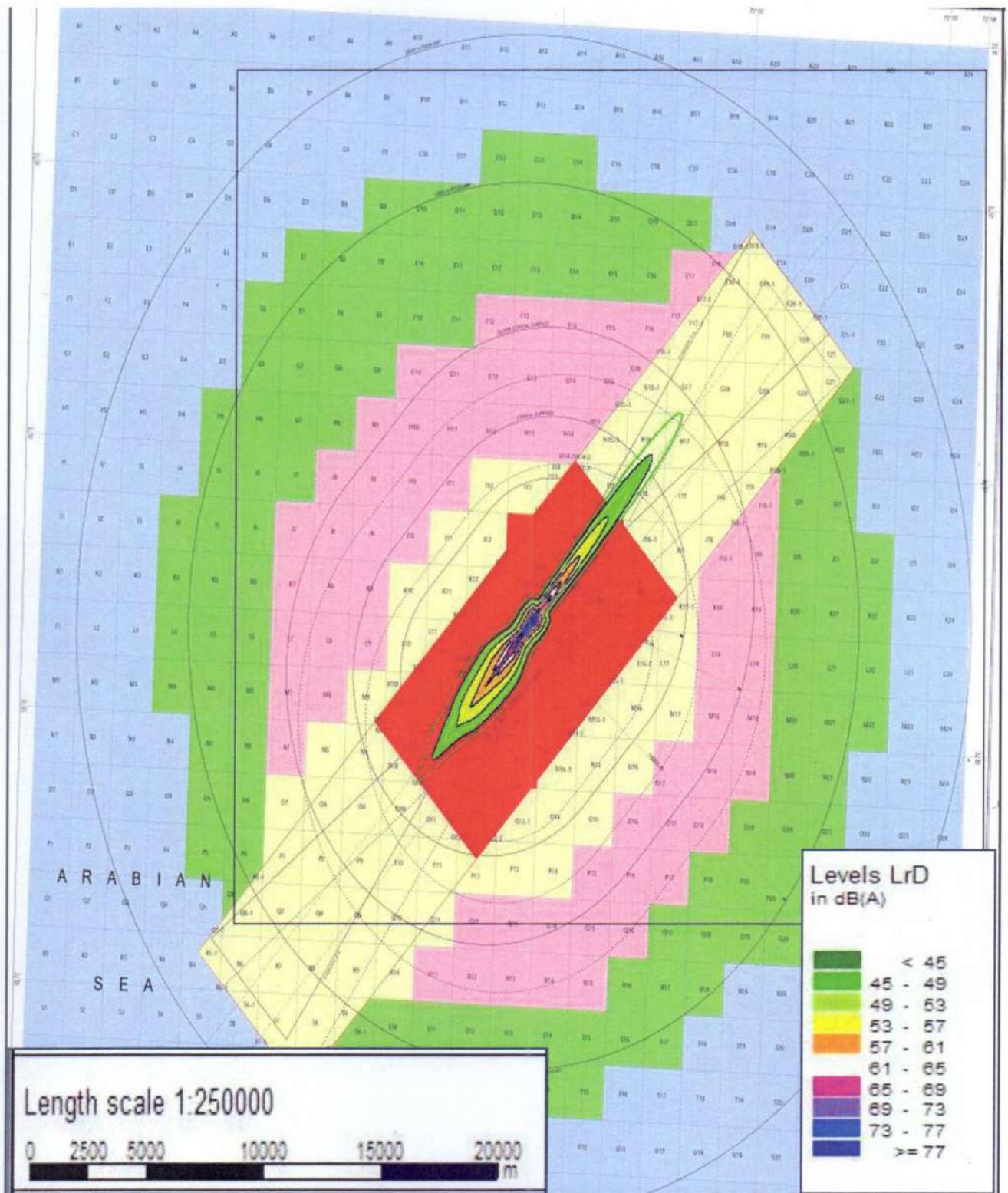


Figure 6.4: Daytime Colour Coded Zoning Map (CCZM) with Noise Contours of Surat International Airport

Noise Mapping and Declaration of Airport Noise Zones at Surat International Airport

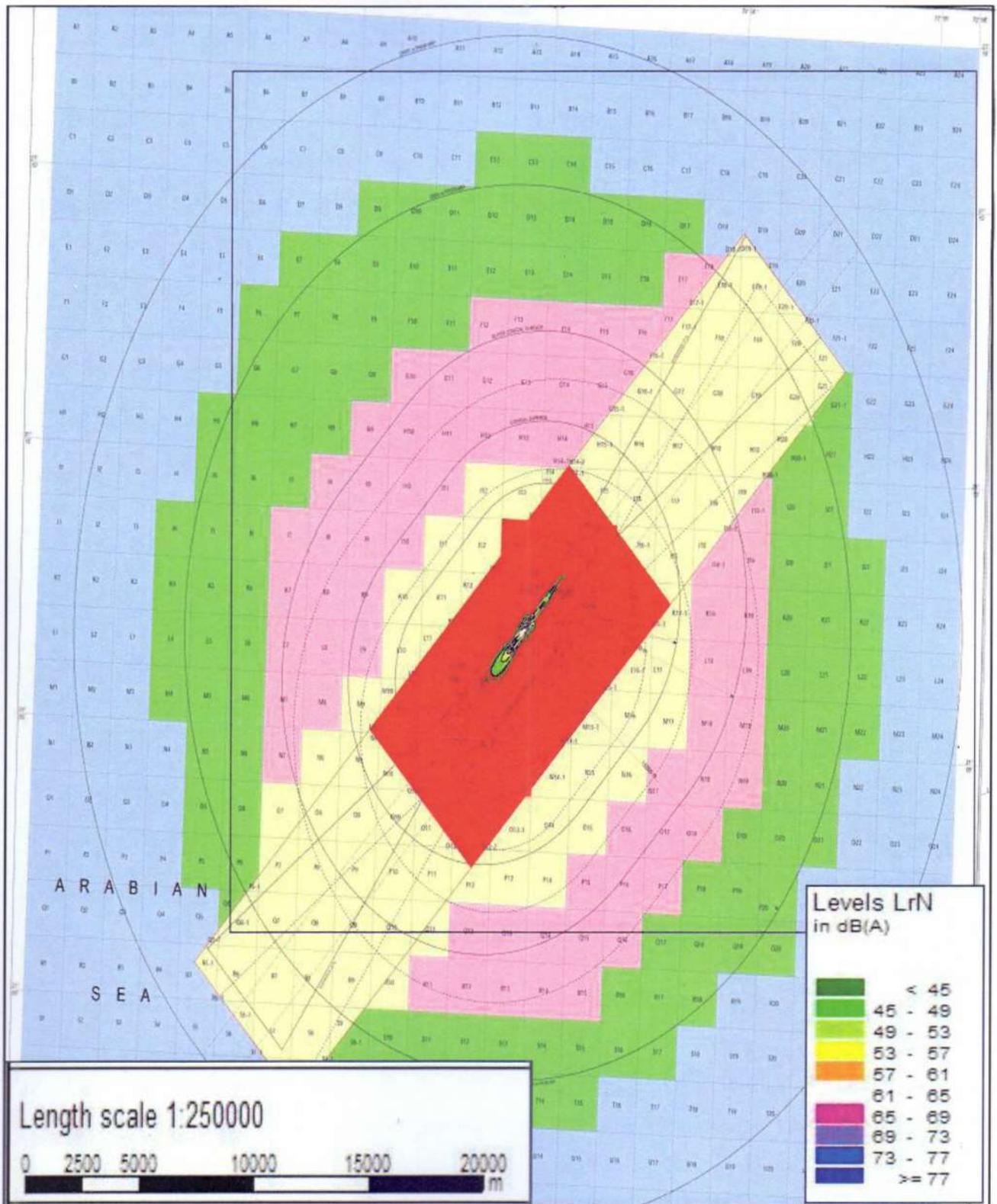


Figure 6.5: Nighttime Colour Coded Zoning Map (CCZM) with Noise Contours of Surat International Airport

CCZM can use to locate and identify the home grid, where the plot/site lies. The local authorities co-relate the colour of the home grid with the colour legend, available in CCZM and check the permitted top elevation in Above Mean Sea Level (AMSL). If the color of the home grid is red then the applicant shall file application to AAI through NOCAS at AAI website for issuance of NOC. The maximum elevation that can be approved through CCZM is up to 150 m, and where the requested top elevation is above 150 m, an applicant must apply online on NOCAS. The effective utilization of an airport is considerably influenced by natural features and man-made constructions inside and outside its boundary. These may result in limitations on the distances available for take-off and landing of aircraft. For these reasons certain areas of the local airspace must be regarded as integral parts of the aerodrome environment. Also, there is a need to protect the airport environment so that future airport expansion plans are smoothly implemented.

AAI, Surat has developed the Colour Coded Zoning Maps (CCZM) as shown in fig. 6.3. The CCZM depicts the Permissible Top Elevation (PTE) for a grid in a particular-coloured zone. The purpose of CCZM is to empower local bodies to clear the building proposals requesting top elevation below CCZM elevation, without referring to AAI. The Airport Noise Zone is identified from L_{day} and L_{night} noise contour maps which were generated by SoundPLANnoise 9.0. The fig. 6.1 depict the L_{Aeq} during daytime was observed above 65 dBA parallel to flight path within 4000 meters from Surat International airports towards north and south, which is higher than prescribe limit and marked by red oval circle. Similarly, fig. 6.2 depict that within 1500 meters from Surat International airports towards north and south, the L_{eq} during nighttime was observed above 60 dBA parallel to flight path which is higher than prescribe limit and also marked by red oval circle.

Surat is the hub of diamond & textile industries and based on the passenger statistics of last three years, the flight/aircraft and passenger's frequency will increase in future on Surat International Airport. Therefore, the current noise scenario will change and increase if the frequency of flight will increase. Here, Surat Airport Noise Zone map has been developed for LDN on the basis of existing G.S.R 751 (E), issued by the Ministry of Civil Aviation (Height Restrictions for Safeguarding of Aircraft Operations) Rules, 2015 published on 30th September, 2015 and given in *Annexure-V*. Fig. 6.4& 6.5 depict the daytime and nighttime Noise Colour Coded Zoning Maps. Development Authorities / Regional Planning Department can specify provisions for inclusion of sound resistance in new buildings, facilities and projects of residential, institutional, hospital and commercial facilities in the design, construction and materials selections for improving indoor environment under existing building codes and bye laws for any building constructions coming under airport noise zones.

CONCLUSION & NOISE MANAGEMENT ACTION PLAN

7.1 CONCLUSION

Acoustic model and appropriate methods for aircraft noise predictions around airports have been completed as per DGCA guidelines. Results of noise mapping were validate using actual measurements of aircraft noise around the airport. Noise contour maps has been developed using ECAC 4th edition model available in SoundPLANnoise 9.0. Present noise monitoring study concluded that the day time & night time noise levels within the prescribe limit of CPCB. The predicted L_{Aeq} by model near by the flight path during daytime & nighttime were found above the prescribe limit of CPCB within 4000 meters form the airport towards north and south. Surat city is now the commercial and economic center of South Gujarat. Therefore, it is concluded that base on the last three-year passenger statistics, aircraft movements will definitely increase.

Airport Noise Zone has been declared within 4 kms radius of airport 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. Airport Noise Zone Map is available in Annexure-III. However, airport can also focus on the noise abatement techniques & mitigation measures to control the noise levels while maintaining the passenger growth for the airport. The results of the noise modeling indicate people living around Surat International airport is affected by aircraft noise.

7.2 NOISE MANAGEMENT ACTION PLAN

Airport operator can develop following noise abatement procedures specific to their airport, jointly with AAI/ATC in order to reduce/minimize the noise generated through aircraft operations at their airports, when the noise limits exceed:

- i) Continuous Descent Approach (CDA) at all airports in place of step-down approaches and Continuous Climb Operations (CCO).
- ii) Optimum and efficient utilization of all the operational runways on a fixed hourly basis in order to evenly distribute the noise generated during take-offs and landings. It should be the sole responsibility of the airport operator to identify the sensitive runways and the flight paths from community annoyance point of view.

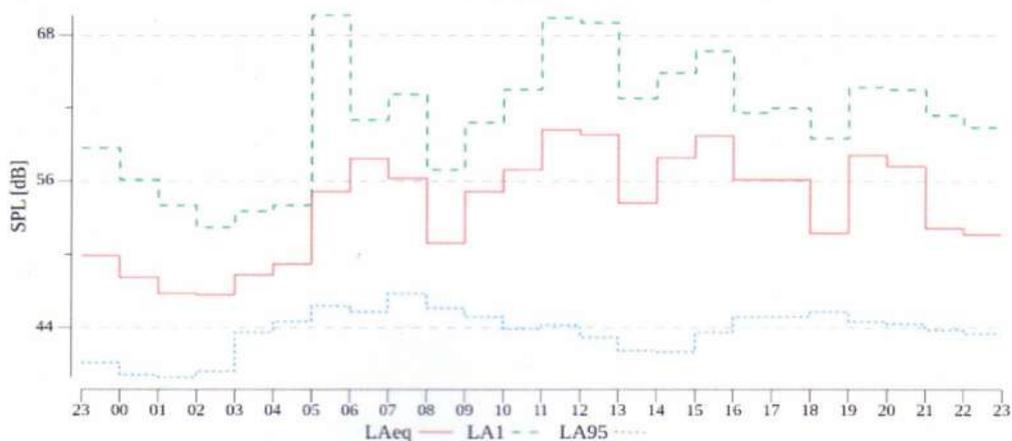
- iii) Engine run up management procedure by identifying such locations where engine run-ups can be performed along with information about aircraft orientation, permissible time of day, maximum permissible thrust level and duration, etc.
- iv) GPU/APU Management procedure and provision of Fixed Electrical Ground Power (wherever applicable) in order to minimize the use of Ground Power Unit (GPU) and Auxiliary Power Unit (APU) during aircraft parking at bay.

ANNEXURE-1- REPRESENTATIVE NOISE ANALYSIS REPORT & SITE PHOTOGRAPHS

Thursday, 06.06.2024

Time	LAeq [dB]	L1 [dB]	L95 [dB]
00	49.9	58.7	41.1
01	48.1	56.1	40.1
02	46.8	54.0	39.9
03	46.7	52.2	40.4
04	48.3	53.5	43.6
05	49.2	54.0	44.5
06	55.1	69.6	45.8
07	57.8	61.0	45.3
08	56.2	63.1	46.8
09	50.9	56.9	45.6
10	55.1	60.8	44.9
11	56.9	63.5	43.9
12	60.2	69.4	44.2
13	59.8	69.0	43.2
14	54.2	62.8	42.1
15	57.9	64.9	42.0
16	59.7	66.7	43.6
17	56.1	61.6	44.9
18	56.1	62.0	44.9
19	51.7	59.5	45.3
20	58.1	63.7	44.5
21	57.2	63.5	44.3
22	52.1	61.4	43.8
23	51.6	60.4	43.5

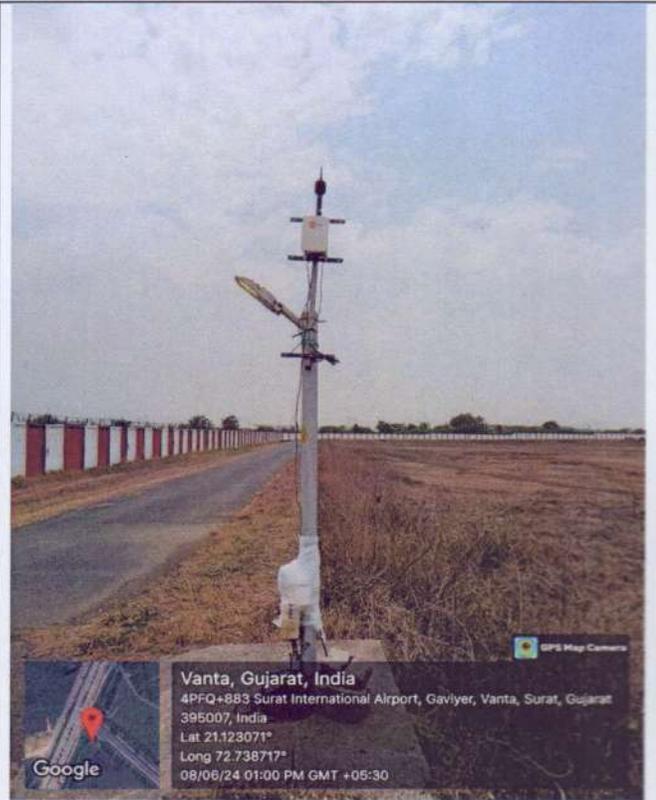
2024-06-06



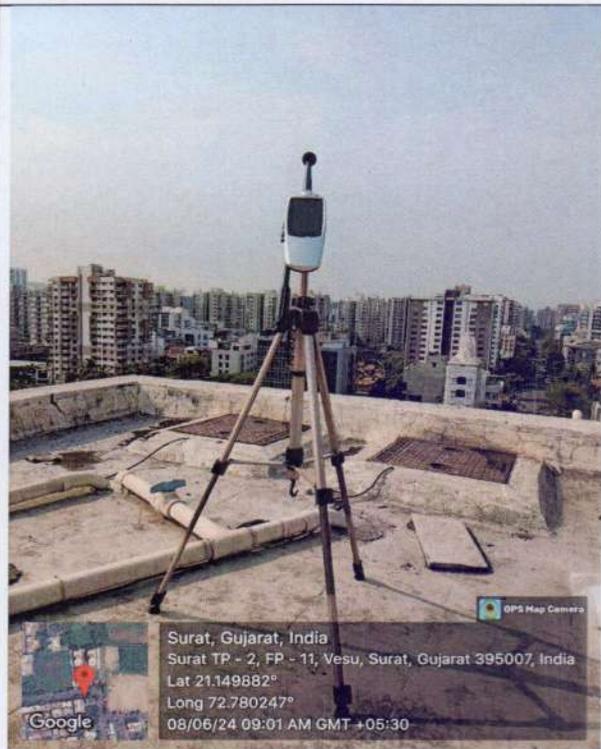
Noise Monitoring Pictures



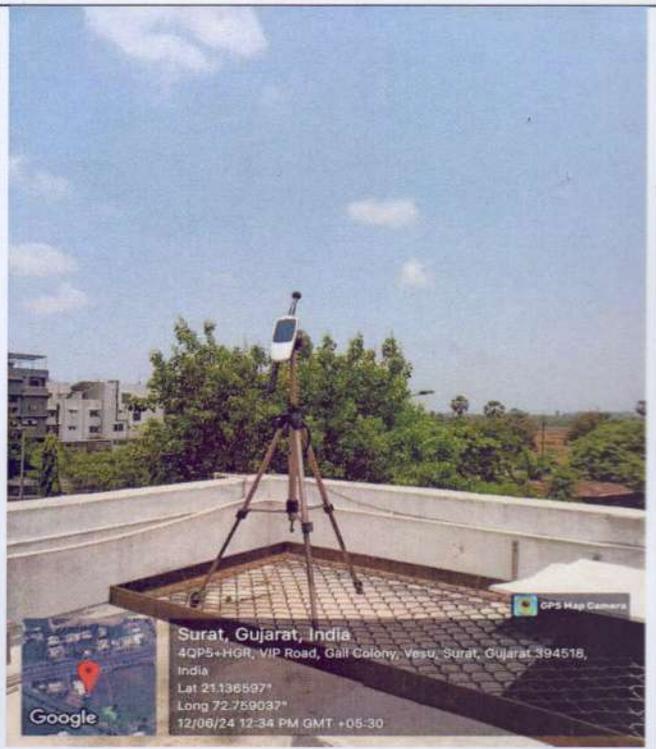
Noise Monitoring-1-NMT-1_S08 at 22 end



Noise Monitoring-2-NMT-2_S07 at 04 end



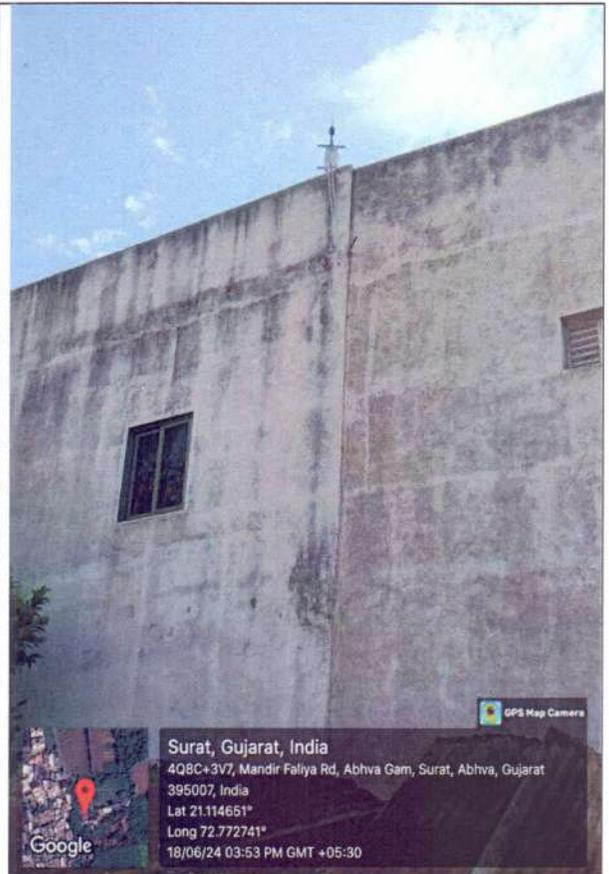
Noise Monitoring-3-SLM-1



Noise Monitoring-4-SLM-2



Noise Monitoring-5-NMT-3_S07



Noise Monitoring-6-NMT-4_S08

ANNEXURE-II- EXAMPLE FILE FOR AIRCRAFT A320-214

Flight Operation: Approach/Arrival

Profile:

Decelerate: S=-3035.1; Vcas=30.0; Vtas=22.0; A=0 ft (0 m); F_delta=2500; Theta=1.000; Delta=1.000; epsilon=0.00; optype=A; segtype=stLandingGroundRoll

Decelerate: S=-303.5; Vcas=129.6; Vtas=121.6; A=0 ft (0 m); F_delta=10000; Theta=1.000; Delta=1.000; epsilon=0.00; optype=A; segtype=stLandingGroundRoll

Descend Landing Approach: S=0.0; Vcas=135.3; Vtas=127.3; A=0 ft (0 m); F_delta=4328; Theta=1.000; Delta=1.000; epsilon=0.00; optype=A; segtype=stLandingGroundRoll

Descend: S=954.1; Vcas=132.6; Vtas=124.7; A=50 ft (15 m); F_delta=4336; Theta=1.000; Delta=0.998; epsilon=0.00; optype=A; segtype=48tair

Descend: S=33784.9; Vcas=132.6; Vtas=127.9; A=1771 ft (540 m); F_delta=4616; Theta=0.988; Delta=0.938; epsilon=0.00; optype=A; segtype=48tair

Descend Transition: S=34784.9; Vcas=132.6; Vtas=128.0; A=1823 ft (556 m); F_delta=0; Theta=0.987; Delta=0.936; epsilon=0.00; optype=A; segtype=48tair

DescendDecel/DescendIdle Transition: S=37055.6; Vcas=141.0; Vtas=136.9; A=1942 ft (592 m); F_delta=0; Theta=0.987; Delta=0.932; epsilon=0.00; optype=A; segtype=48tair

DescendDecel/DescendIdle Transition: S=49878.1; Vcas=173.7; Vtas=172.2; A=2614 ft (797 m); F_delta=0; Theta=0.982; Delta=0.909; epsilon=0.00; optype=A; segtype=48tair

DescendDecel/DescendIdle Transition: S=57243.4; Vcas=182.2; Vtas=182.1; A=3000 ft (914 m); F_delta=0; Theta=0.979; Delta=0.896; epsilon=0.00; optype=A; segtype=48tair

S=-3035.1; Vcas=30.0; Vtas=22.0; A=0 ft (0 m); F_delta=2500; Theta=1.000; Delta=1.000; epsilon=0.00; optype=A; segtype=stLandingGroundRoll

S=-303.5; Vcas=129.6; Vtas=121.6; A=0 ft (0 m); F_delta=10000; Theta=1.000; Delta=1.000; epsilon=0.00; optype=A; segtype=stLandingGroundRoll

S=0.0; Vcas=135.3; Vtas=127.3; A=0 ft (0 m); F_delta=4328; Theta=1.000; Delta=1.000; epsilon=0.00; optype=A; segtype=stLandingGroundRoll

S=954.1; Vcas=132.6; Vtas=124.7; A=50 ft (15 m); F_delta=4336; Theta=1.000; Delta=0.998; epsilon=0.00; optype=A; segtype=48tair

S=33784.9; Vcas=132.6; Vtas=127.9; A=1771 ft (540 m); F_delta=4616; Theta=0.988; Delta=0.938; epsilon=0.00; optype=A; segtype=48tair

S=34784.9; Vcas=132.6; Vtas=128.0; A=1823 ft (556 m); F_delta=1059; Theta=0.987; Delta=0.936; epsilon=0.00; optype=A; segtype=49tair

S=36055.6; Vcas=137.3; Vtas=132.9; A=1890 ft (576 m); F_delta=994; Theta=0.987; Delta=0.934; epsilon=0.00; optype=A; segtype=49tair

S=37055.6; Vcas=141.0; Vtas=136.9; A=1942 ft (592 m); F_delta=943; Theta=0.987; Delta=0.932; epsilon=0.00; optype=A; segtype=49tair

S=48878.1; Vcas=171.1; Vtas=169.4; A=2562 ft (781 m); F_delta=540; Theta=0.982; Delta=0.911; epsilon=0.00; optype=A; segtype=49tair

S=49878.1; Vcas=173.7; Vtas=172.2; A=2614 ft (797 m); F_delta=506; Theta=0.982; Delta=0.909; epsilon=0.00; optype=A; segtype=49tair

S=56243.4; Vcas=181.0; Vtas=180.8; A=2948 ft (898 m); F_delta=417; Theta=0.980; Delta=0.898; epsilon=0.00; optype=A; segtype=49tair

S=57243.4; Vcas=182.2; Vtas=182.1; A=3000 ft (914 m); F_delta=403; Theta=0.979; Delta=0.896; epsilon=0.00; optype=A; segtype=49tair

S=106293.0; Vcas=250.0; Vtas=264.7; A=6000 ft (1829 m); F_delta=1; Theta=0.959; Delta=0.801; epsilon=0.00; optype=A; segtype=49tair

S=3035.1; Vcas=30.0; Vtas=22.0; A=0 ft (0 m); F_delta=2500; Theta=1.000; Delta=1.000; epsilon=0.00; optype=A; segtype=stLandingGroundRoll

S=303.5; Vcas=129.6; Vtas=121.6; A=0 ft (0 m); F_delta=10000; Theta=1.000; Delta=1.000; epsilon=0.00; optype=A; segtype=stLandingGroundRoll

S=0.0; Vcas=135.3; Vtas=127.3; A=0 ft (0 m); F_delta=4328; Theta=1.000; Delta=1.000; epsilon=0.00; optype=A; segtype=stLandingGroundRoll

S=-954.1; Vcas=132.6; Vtas=124.7; A=50 ft (15 m); F_delta=4336; Theta=1.000; Delta=0.998; epsilon=0.00; optype=A; segtype=49tair

S=-33784.9; Vcas=132.6; Vtas=127.9; A=1771 ft (540 m); F_delta=4616; Theta=0.988; Delta=0.938; epsilon=0.00; optype=A; segtype=49tair

S=-34784.9; Vcas=132.6; Vtas=128.0; A=1823 ft (556 m); F_delta=1059; Theta=0.987; Delta=0.936; epsilon=0.00; optype=A; segtype=49tair

S=-36055.6; Vcas=137.3; Vtas=132.9; A=1890 ft (576 m); F_delta=994; Theta=0.987; Delta=0.934; epsilon=0.00; optype=A; segtype=49tair

S=-37055.6; Vcas=141.0; Vtas=136.9; A=1942 ft (592 m); F_delta=943; Theta=0.987; Delta=0.932; epsilon=0.00; optype=A; segtype=stair

S=-48878.1; Vcas=171.1; Vtas=169.4; A=2562 ft (781 m); F_delta=540; Theta=0.982; Delta=0.911; epsilon=0.00; optype=A; segtype=49tair



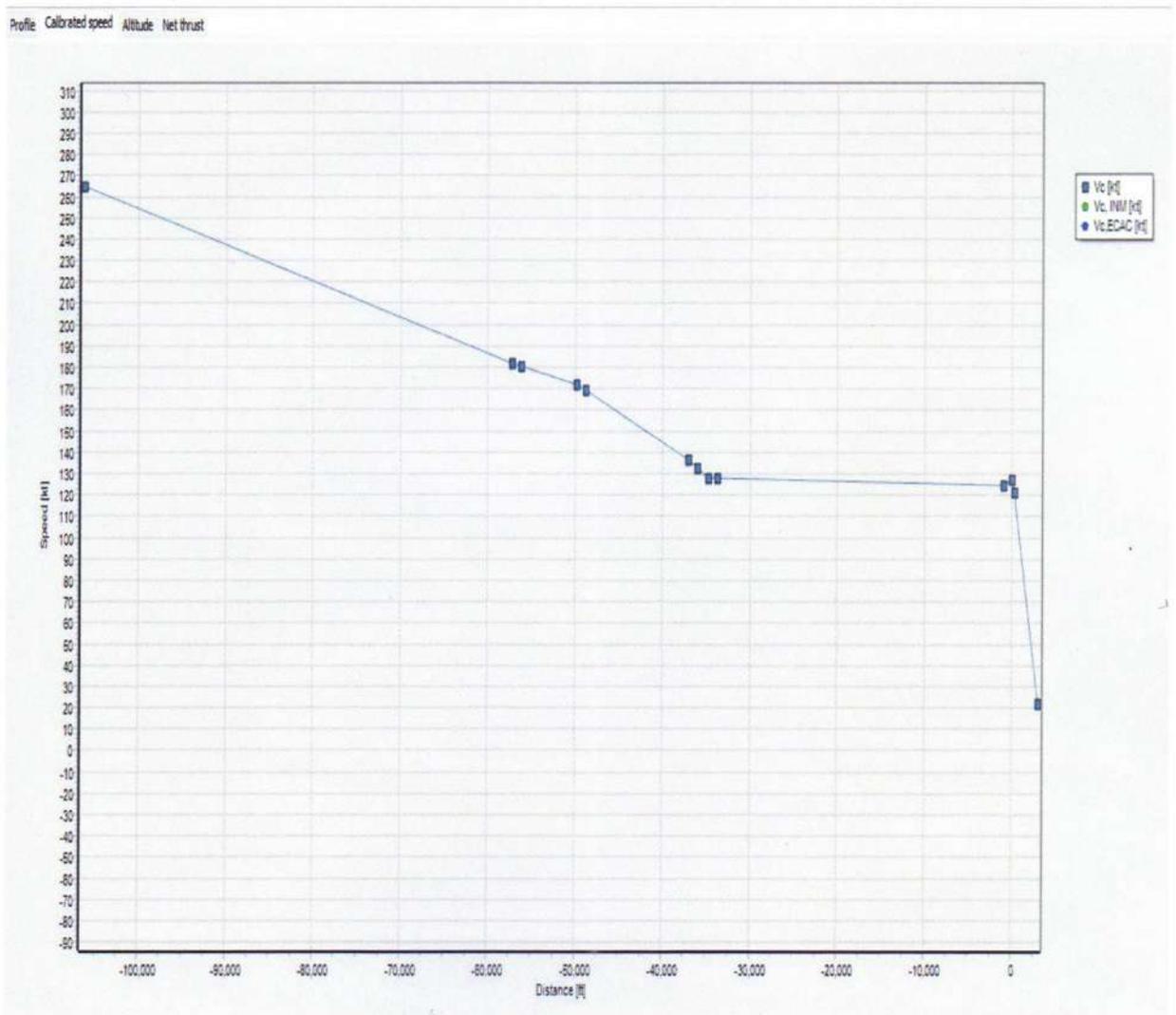
S=-49878.1; Vcas=173.7; Vtas=172.2; A=2614 ft (797 m); F_delta=506; Theta=0.982; Delta=0.909; epsilon=0.00; optype=A; segtype=50tair

S=-56243.4; Vcas=181.0; Vtas=180.8; A=2948 ft (898 m); F_delta=417; Theta=0.980; Delta=0.898; epsilon=0.00; optype=A; segtype=50tair

S=-57243.4; Vcas=182.2; Vtas=182.1; A=3000 ft (914 m); F_delta=403; Theta=0.979; Delta=0.896; epsilon=0.00; optype=A; segtype=50tair

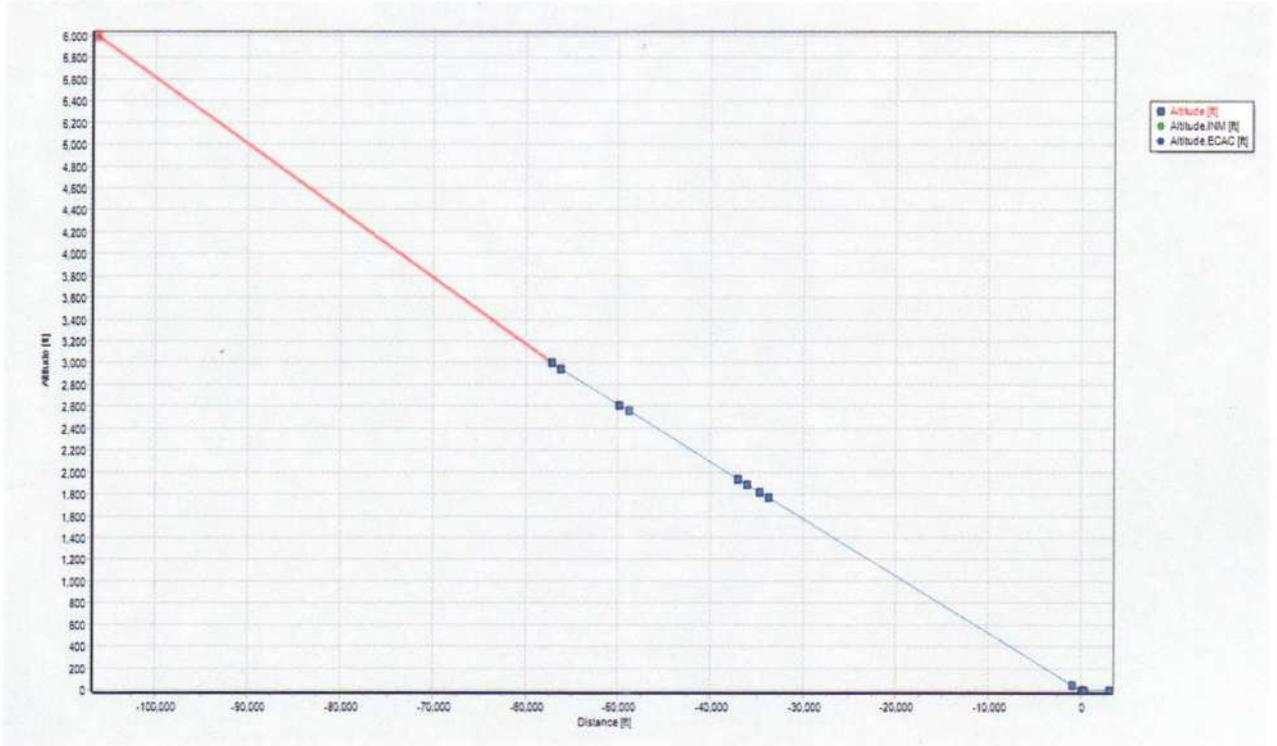
S=-106293.0; Vcas=250.0; Vtas=264.7; A=6000 ft (1829 m); F_delta=1; Theta=0.959; Delta=0.801; epsilon=0.00; optype=A; segtype=stair

Calibrated Speed:



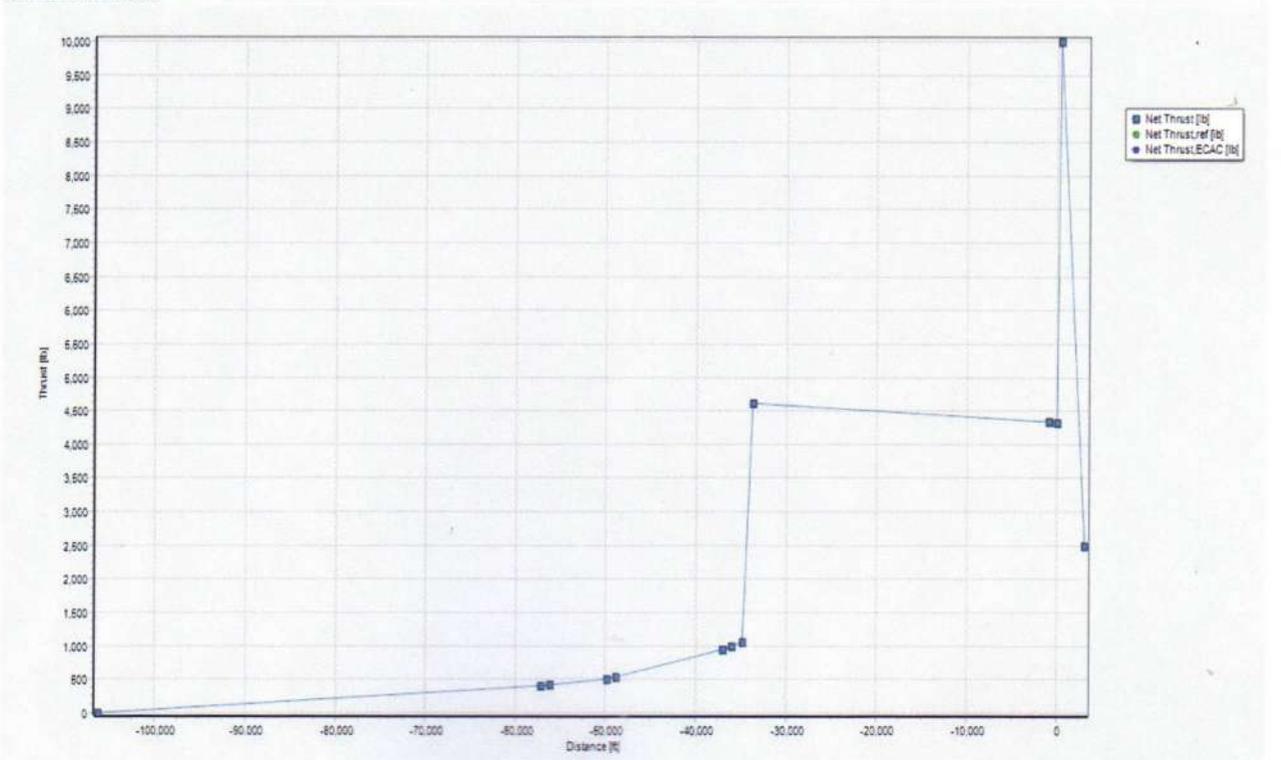
Altitude:

Profile Calibrated speed Altitude Net thrust



Net Thrust:

Profile Calibrated speed Altitude Net thrust



ANNEXURE-III- THE GAZETTE OF INDIA, MOEF&CC NOTIFICATION,
G.S.R. 568(E)

रजिस्ट्री सं० डी० एल०-33004/99

REGD. NO. D. L.-33004/99


भारत का राजपत्र
The Gazette of India

असाधारण
EXTRAORDINARY
भाग II—खण्ड 3—उप-खण्ड (i)
PART II—Section 3—Sub-section (i)
प्राधिकार से प्रकाशित
PUBLISHED BY AUTHORITY

सं. 413] नई दिल्ली, सोमवार, जून 18, 2018/ज्येष्ठ 28, 1940
No. 413] NEW DELHI, MONDAY, JUNE 18, 2018/JYAISTHA 28, 1940

पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय
अधिसूचना
नई दिल्ली, 18 जून, 2018

सा.का.नि. 568(अ)—केन्द्रीय सरकार पर्यावरण (संरक्षण) अधिनियम, 1986 (1986 का 29) की धारा 6 और धारा 25 में प्रदत्त शक्तियों का उपयोग करते हुए पर्यावरण (संरक्षण) नियमावली, 1986 में और संशोधन करने के लिए एतद्वारा निम्नलिखित नियम बनाती है, अर्थात्:-

- (1) इन नियमों का संक्षिप्त नाम पर्यावरण (संरक्षण) संशोधन नियम, 2018 है।
(2) ये राजपत्र में प्रकाशन की तारीख को प्रवृत्त होंगे।
- पर्यावरण (संरक्षण) नियम, 1986 में, अनुसूची-1 में क्रम सं.111 और उससे संबंधित प्रविष्टियों के बाद निम्नलिखित क्रम संख्या और प्रविष्टियां अंतःस्थापित की जाएंगी, अर्थात् :-

क्रम सं.	उद्योग	प्राचल	मानदंड	
1	2	3	4	
		विमानपत्तन ध्वनि परििक्षेत्र में ध्वनि के संबंध में परिवेशी वायु गुणवत्ता मानक		
112	विमानपत्तन	विमानपत्तनों के प्रकार	db (A) Leq में सीमाएं	
			दिन का समय	रात्रि का समय
		व्यस्त विमानपत्तन	70	65
		प्रस्तावित विमानपत्तनों से इतर सभी अन्य विमानपत्तन	65	60

3394 GI/2018

(1)

परिभाषाएं:

- (क) 'dB (A) Leq माप A पर डेसीबल में ध्वनि स्तर में भारित औसत में लगे समय को सूचित करता है, जो मानवीय श्रवण से संबंधित है। भारित औसत के लिए समय सीमा के लिए दिन में 6.00 प्रातः से 10.00 बजे रात्रि तक और रात्रि समय में 10.00 बजे रात्रि से 6.00 बजे प्रातः तक की समय सीमा पर विचार किया जाता है।
- (ख) db (A) Leq "A" से ध्वनि के मापन में भारिता वारम्बारता और मानव श्रवण की वारम्बारता प्रतिक्रिया विशेषताओं के प्रति समनुरूपता को सूचित करता है। (मानव श्रवण सीमा 20 Hz से 20 KHz तक है)
- (ग) "डेसीबल" बह इकाई है जिसमें ध्वनि मापित की जाती है।
- (घ) Leq : B यह एक विनिर्दिष्ट समय सीमा में ध्वनि स्तर का ऊर्जा औसत है।
- (ङ.) व्यस्त विमानपत्तन- विमानपत्तनों पर ध्वनि प्रबंधन के प्रयोजनार्थ एक व्यस्त विमान पत्तन को "उम नागर विमानपत्तन, जहां हल्के यानों के केवल प्रशिक्षण प्रयोजनार्थ संचालन को छोड़कर, 50,000 प्रति वर्ष यानीय संचालन (विमान के उड़ान भरने अथवा उसे उतारने की क्रिया) से अधिक हो, के रूप में परिभाषित किया जाएगा।
- (च) उड़ान भरना- उड़ान भरने की शक्ति के प्रयोग से उड़ान भरने की अंतिम उच्च सीमा तक की अवस्था
- (छ) जमीन पर उतरना -लैंडिंग फ्लेयर की शुरुआत से उड़ान का एक चरण, जब तक कि जमीन पर उतरने के लिए विमान, धावन पथ (रनवे) पर रुक नहीं जाता जब अथवा टच-एण्ड-गो लैंडिंग के मामले में उड़ान भरने के लिए शक्ति प्रयुक्त की जाती है।
- (ज) Lmax - यह db (A) में विमान की अधिकतम ध्वनि स्तर के लिए इकाई है, जो संबंधित विमानपत्तनों के लिए नागर विमानन महानिदेशालय द्वारा अधिसूचित ध्वनि मानकों के अनुसार अनुवीक्षण अवस्थान पर विमानों के लिए अधिकतम अथवा उच्चतम ध्वनि मान है।
- (झ) अन्य विमानपत्तन- ऐसा विमानपत्तन, जहां 15000 से अधिक किंतु 50000 से कम वार्षिक यानीय संचालन हो रहे हैं।
- (ञ) प्रस्तावित विमानपत्तन-ऐसा विमानपत्तन जो अभी प्रचालनात्मक नहीं है किंतु निर्माणाधीन है।

टिप्पणी :

- (i) दिन का समय 6.00 प्रातः से 10.00 बजे रात्रि तक और रात्रि समय 10.00 बजे रात्रि से 6.00 बजे प्रातः तक अभिप्रेत है।
- (ii) उपरोक्त विनिर्दिष्ट सीमाओं की 10 dB (A) Leq की सहनीय सीमा होगी।
- (iii) निर्धारित सीमा में सभी धावन पथों (रनवे) से रक्षा विमान और विमान के उतरने और उड़ान भरने के दौरान ध्वनि और विमान इंजन/ग्राउंड रनअप, इस प्रयोजनार्थ विमानपत्तन संचालक द्वारा अभिनिर्धारित की गई हेलीपैड अवस्थानों को शामिल नहीं किया गया है।
- (iv) तथापि, यानीय ध्वनि के लिए Lmax के रूप में सीमा, इस अधिसूचना के पैरा 1 में यथा उल्लिखित विमानपत्तनों द्वारा संस्थापित यानीय ध्वनि अनुवीक्षण अवस्थानों पर नागर विमानन महानिदेशालय के अनुमोदन से विमानपत्तन संचालकों द्वारा अधिसूचित की जाएगी।
- (v) उपरोक्त विनिर्दिष्ट ध्वनि सीमाएं, निम्नलिखित मौजूदा परिक्षेत्रों की ध्वनि सीमाओं के संबंध में परिवेशी वायु गुणवत्ता को प्रतिस्थापित और अधिकांत करेगी;
- (क) शांत;
- (ख) आवासीय; और
- (ग) वाणिज्यिक क्षेत्रों;

- (vi) जैसा कि विमानपत्तन ध्वनि परिक्षेत्रों के अंतर्गत सीधे तौर पर आ रहे क्षेत्रों में ध्वनि प्रदूषण (विनियमन और नियंत्रण) नियम, 2000 में विनिर्दिष्ट किया गया है।
- (vii) विमानपत्तनों की समूची चारदीवारी के भीतर ध्वनि मानक, औद्योगिक क्षेत्रों के लिए लागू किए गए अनुसार होंगे अर्थात् ध्वनि (विनियमन और नियंत्रण) नियम, 2000 के अनुसार दिन के समय 75 dB (A) Leq होंगे और रात्रि के समय 70 dB (A) Leq होंगे और विमानपत्तन की चारदीवारी पर भिन्न-भिन्न बिंदुओं पर मापित किया जाएगा और तब उमका औसत निकाला जाएगा।
- (viii) यह अधिसूचना उम नागर विमानपत्तन पर लागू नहीं होगी जहां वार्षिक यानीय संचालन 15,000 से कम है।
- 1 (1) नए प्रस्तावित विमानपत्तनों को छोड़कर, विमानपत्तनों के लिए:
- dB (A) Leq जैसा उल्लेख किया गया है, "विमानपत्तन ध्वनि परिक्षेत्र" में लागू के अतिरिक्त, dB (A) में Lmax मान को केवल 50,000 से अधिक वार्षिक यानीय संचालन कर रहे विमानपत्तनों के लिए नागर विमानन महानिदेशालय के अनुमोदन से विमानपत्तन संचालकों द्वारा प्रकाशित किया जाएगा। इन Lmax मानों का एयरलाइन्स द्वारा अनुपालन किया जाएगा और इन विमानपत्तन के संचालकों द्वारा अनुवीक्षण किया जाएगा। नागर विमानन महानिदेशालय के सूचित किया जाएगा है। भविष्य में जब भी आवश्यकता होगी, इन Lmax मान की समीक्षा की जाएगी।
- (2) प्रस्तावित विमानपत्तनों के लिए (अभी संचालन किया जाना है):
- (i) किसी भी नए/नवनिर्मित विमानपत्तनों के लिए ध्वनि मोडलिंग, विमानपत्तन संचालकों द्वारा की जाएगी और पर्यावरण प्रभाव मूल्यांकन अधिसूचना, 2006 के तहत पर्यावरणीय स्वीकृति प्राप्त करते समय पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय को परिणाम प्रस्तुत किए जाएंगे।
- (ii) विमानपत्तन संचालक पैरा 4 में विनिर्दिष्ट किए अनुसार विमानपत्तन ध्वनि परिक्षेत्र भी विकसित करेंगे और विमानपत्तन के आस-पास आवश्यक भूमि उपयोग आयोजना के लिए उसे आवास और शहरी कार्य मंत्रालय और संबंधित राज्य विकास प्राधिकरण के साथ साझा करेंगे।
- (iii) संबंधित राज्य/संघ शासित प्रदेश विकास प्राधिकरण किसी ध्वनि न्यूनीकरण उपाय के बिना विमानपत्तन ध्वनि परिक्षेत्र में आ रहे नए आवासीय, संस्थागत और वाणिज्यिक सुविधाओं और अन्य ध्वनि संवेदनशील क्षेत्र को अनुमति नहीं देंगे।
2. जैसा कि ऊपर विनिर्दिष्ट किया गया है विमानपत्तन ध्वनि परिक्षेत्र में लागू ध्वनि स्तरों का अनुपालन विमानपत्तन संचालकों द्वारा किया जाएगा और नागर विमानन महानिदेशालय द्वारा उसका पर्यवेक्षण किया जाना है।
3. विमानपत्तन प्रचालक, विमानपत्तन-ध्वनि मानकों के अनुपालन हेतु ध्वनि प्रबंधन योजना तैयार करेंगे।
4. **विमानपत्तन ध्वनि परिक्षेत्र:**
- (1) प्रत्येक विमानपत्तन के लिए, विमानपत्तन ध्वनि परिक्षेत्र को विमानपत्तन के मास्टर प्लान के अनुसार विमानपत्तनों के एयर नेविगेशन सेवा प्रदाता के साथ परामर्श करके सभी प्रवेश और प्रस्थान फनलों और उपकरण उड़ान प्रक्रियाओं (अर्थात् उपकरण प्रवेश प्रक्रिया, मानक उपकरण प्रस्थान एवं मानक टर्मिनल आगमन मार्ग) पर विचार करते हुए विमान संचालन की सुरक्षा के लिए ऊंचाई प्रतिबंध पर समय-समय पर यथा-संशोधित, 30 सितम्बर, 2015 को प्रकाशित नागर विमानन मंत्रालय (विमान प्रचालनों की सुरक्षा के लिए ऊंचाई प्रतिबंध) नियम, 2015 द्वारा जारी मौजूदा मा.का.नि. 751 (अ) के आधार पर संबंधित विमानपत्तन प्रचालक द्वारा दिन और रात की अवधि के लिए ध्वनि रूप-रेखा के रूप में परिभाषित किया जाएगा। इसे नागर विमानन महानिदेशालय द्वारा अनुमोदित किया जाएगा और संबंधित विमानपत्तन प्रचालकों की वेबसाइट पर प्रदर्शित किया जाएगा। यह कार्य अंतिम अधिसूचना जारी करने की तारीख से दो साल के भीतर पूरा किया जाएगा।

(2) राज्य/संघ शासित प्रदेश विकास प्राधिकरणों को विमानपत्तन के आम-पाम भूमि उपयोग योजना के लिए विमानपत्तन ध्वनि परिक्षेत्र में विमानपत्तन प्रचालनअपेक्षाओं पर विचार करना चाहिए।

5. विमानपत्तन ध्वनि मैपिंग:

सभी विमानपत्तनों के लिए ध्वनि मैपिंग का कार्य विमानपत्तन के मास्टर प्लान के अनुसार, विमानपत्तन भावी विमान संचलन और यातायात अनुमानों पर विचार करते हुए विमानपत्तन के प्रचालकों द्वारा नागर विमानन महानिदेशक की अपेक्षाओं में निर्दिष्ट आवश्यकताओं के अनुसार किया जाना चाहिए। यह जानकारी विमानपत्तनों के प्रमुख स्थानों के साथ-साथ संबंधित विमानपत्तन प्रचालक और राज्य/संघ शासित प्रदेश विकास प्राधिकरण की वेबसाइट में प्रदर्शित की जाएगी।

6. प्रोटोकाल और मापन प्रक्रिया:

पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय और केंद्रीय प्रदूषण नियंत्रण बोर्ड की वेबसाइट पर प्रदर्शित विमानपत्तन ध्वनि परिक्षेत्र के लिए निगरानी प्रोटोकाल और मापन प्रक्रिया का अनुपालन किया जाएगा।

7. विकास प्राधिकरण/क्षेत्रीय आयोजना विभाग, विमानपत्तन ध्वनि परिक्षेत्रों के अंतर्गत आने वाले किसी भी भवन निर्माण के लिए मौजूदा भवन कोडों और उप-कानूनों के तहत भीतरी वातावरण में सुधार के लिए डिज़ाइन, निर्माण और सामग्रियों के चयन में नई इमारतों, सुविधाओं और आवासीय, संस्थागत, अस्पताल और वाणिज्यिक सुविधाओं की परियोजनाओं में ध्वनि प्रतिरोध को शामिल करने के लिए प्रावधान निर्दिष्ट करेंगे।

8. सभी विमानपत्तन, एयरलाइन और प्राधिकरण अधिसूचना की तारीख से दो साल के भीतर अधिसूचना में निर्दिष्ट अपेक्षाओं का पालन करेंगे।"

[फा. सं. क्यू-15017/31/2015-सीपीडब्ल्यू]

डॉ. ए. संधिल बेल, वैज्ञानिक 'जी'

टिप्पण: प्रमुख नियम, भारत के राजपत्र, असाधारण, भाग-II, खंड 3, उप-खंड (i) में दिनांक 19 नवम्बर, 1986 की संख्या - का.आ 844 (अ) के द्वारा प्रकाशित किए गए थे और अंतिम संशोधन दिनांक 22 मार्च, 2018 की अधिसूचना सा.का.नि. 263 (अ) द्वारा किया गया।

MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE

NOTIFICATION

New Delhi, the 18th June, 2018

G.S.R. 568(E).—In exercise of the powers conferred by sections 6 and 25 of the Environment (Protection) Act, 1986 (29 of 1986), the Central Government hereby makes the following rules further to amend the Environment (Protection) Rules, 1986, namely:

1. (1) These rules may be called the Environment (Protection) Amendment Rules, 2018.
- (2) They shall come into force on the date of their publication in the Official Gazette.

2. In the Environment (Protection) Rules, 1986, in Schedule-I, after serial number 111 and the entries relating thereto, the following serial number and the entries shall be inserted, namely:-

Sl. No.	Industry	Parameters	Standards	
1	2	3	4	
		Ambient Air Quality Standards with respect to Noise in Airport Noise Zone		
112	Airports	Type of Airports	Limits in dB (A) Leq*	
			Day Time	Night Time
		Busy Airports	70	65
		All other Airports excluding proposed airports	65	60

Definitions:

- *dB(A) Leq denotes the time weighted average of the level of sound in decibels on scale A which is relatable to human hearing. A day time from 6.00 a.m. to 10.00 p.m. and night time from 10.00 p.m. to 6.00 a.m. are considered for time weighted average.
- "A", in dB(A) Leq, denotes the frequency weighting in the measurement of noise and corresponds to frequency response characteristics of the human ear (The range of human hearing is 20 Hz to 20 kHz).
- A "decibel" is a unit in which noise is measured.
- Leq: It is energy mean of the noise level over a specified period.
- Busy Airport - For the purpose of noise management at airports, a busy airport shall be defined as "a civil airport which has more than 50,000 aircraft movements per year (a movement being a take-off or a landing)" excluding those purely for training purposes on light aircraft.
- Take-off - A phase of flight from the application of takeoff power to an altitude of final take-off segment.
- Landing - A phase of flight from the beginning of the landing flare until aircraft exits the landing runway comes to a stop on the runway, or when power is applied for takeoff in the case of a touch-and-go landing.
- Lmax is unit for aircraft maximum noise level in units dB(A) which is maximum or peak noise value for aircrafts at the monitoring location in accordance with the noise standards notified by the Directorate General of Civil Aviation for respective airports.
- Other Airports - an airport having more than 15000 but less than 50000 aircraft movement annually.
- Proposed Airports - airport that is not functional yet and is under development.

- Note :**
- Day time shall mean from 6.00 a.m. to 10.00 p.m and night time shall mean from 10.00 p.m. to 6.00 a.m.
 - The above specified limits shall have a tolerance limit of 10dB (A) Leq.
 - The specified limit excludes defense aircraft and aircraft landing and take-off noise from all runways and aircraft engine/ground run-ups, helipad locations earmarked by Airport Operator for this purpose.
 - However, the limit for aircraft noise as Lmax will be notified by the airport operator with approval of the Directorate General of Civil Aviation at the aircraft noise monitoring locations installed by the airports as mentioned in paragraph 1 of this notification.
 - The noise limits specified in above shall replace and supersede the ambient air quality in respect of noise limits of the following existing zones:
 - Silence;
 - Residential; and
 - Commercial areas;

- (vi) As specified in the Noise Pollution (Regulation and Control) Rules, 2000 in the areas falling directly under Airport Noise Zone.
 - (vii) The 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 as per the Noise (Regulation and Control) Rules 2000 and shall be measured at different points of airport boundary and then averaged.
 - (viii) These standards will not be applicable to a civil airport which has less than 15,000 aircraft movement annually.
- 1(1) For Airports excluding newly proposed airports:
In addition to dB(A) Leq applicable in the 'airport noise zones' specified above, Lmax value in dB(A) shall be published by the airport operator with approval of the Directorate General of Civil Aviation only for airports having more than 50,000 annual traffic movements. These Lmax values shall be complied by airlines and to be monitored and communicated by Airport Operator to the Directorate General of Civil Aviation. These Lmax value shall be reviewed as and when there is a requirement in future.
- (2) For Proposed Airports (yet to be operationalized):
- (i) For any upcoming/New Airports, noise modeling shall be conducted by the airport operators and results should be submitted to the Ministry of Environment, Forest and Climate Change while seeking Environment Clearance under the Environment Impact Assessment Notification, 2006.
 - (ii) The airport operators should also develop airport noise zone as specified in paragraph 4 and share the same with Ministry of Housing and Urban Affairs and concerned State Development Authority for necessary land use planning around airport.
 - (iii) The concerned State / Union Territory Development Authorities should not allow any new residential, institutions & commercial facilities and other noise sensitive area falling in the airport noise zone area without any noise reduction measure.
2. Compliance of noise levels applicable to Airport Noise Zone as specified above shall lie with the airport operator and overseen by the Directorate General of Civil Aviation.
3. Airport operators shall prepare Noise Management Plan for compliance of the Airport Noise Standards.
4. Airport Noise Zones:
- (1) The Airport Noise Zone area for each Airport shall be defined as Noise Contour for day and night period by the respective 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 as amended from time to time on Height Restriction for Safeguarding of Aircraft Operation considering all approach and departure funnels and Instrument Flight Procedures (i.e. Instrument Approach Procedures, Standard Instrument Departure & Standard Terminal Arrival Route) in consultation with airports Air Navigation Service Provider as per the Master Plan of the Airport. The same shall be approved by the Directorate General of Civil Aviation and displayed on the website of respective Airport Operators. This activity shall be completed within two years from the date of issuance of the final notification.
 - (2) State / Union Territory Development Authorities should take into consideration of Airport Operations requirements in the airport noise zone area for the land use planning around the airport.
5. Airport Noise Mapping:
Noise mapping in for all airports should be carried out as per the requirements specified in the Director General Civil Aviation's requirements by the airport operators considering future aircraft movement and traffic projections of the airport as per the Master Plan of the Airport. This information to be displayed at a prominent places at Airports as well as in the website of respective Airport Operator and State / Union Territory Development Authority.
6. Protocol and Measurements Procedure:
Monitoring protocol and measurements procedure for airport noise zone displayed on the website of the Ministry of Environment, Forest and the Climate Change and the Central Pollution Control Board shall be followed.
7. Development Authorities / Regional Planning Department shall specify provisions for inclusion of sound resistance in new buildings, facilities and projects of residential, institutional, hospital and commercial facilities in the design, construction and materials selections for improving indoor environment under existing building codes and bye laws for any building constructions coming under airport noise zones.

8. All the Airport, Airline and Authority shall comply with the requirements specified in the notification within two years from the date of notification. ”.

[F.No. Q-15017/31/2015-CPW]

Dr. A. SENTHIL VEL, Scientist 'G'

Note : The principal rules were published in the Gazette of India, Extraordinary, Part II, Section 3, Sub-section (i), *vide* number S.O. 844 (E), dated the 19th November, 1986 and last amended *vide* notification G.S.R. 263(E), dated the 22th March, 2018.

Minutes of Meeting

Subject: Minutes of meeting for Noise study Report for “Noise Mapping and declaration of airport Noise Zone at Surat International Airport.”

VENUE OF MEETING: Conference room.11.07.2024 at 11:30Hrs

MEMBERS / STAKE HOLDERS PRESENT: Following member were present in above meeting:-

SR NO.	NAME	POSITION	Organization	Remarks
1	Sh. S.C.Bhalse	Officiating APD Surat	AAI	
2	Sh. Krishna Datta Verma	DGM (E-C) In-charge Civil	AAI	
3	Sh.Akshay Raju Ghandat	MGR (ops)	AAI	
4	Deep Mehta	S.M	Air India Express	
5	M.M.Agrawal	AGM(E-E)	AAI	
6	Sunil Kumar	AM (E-C)	AAI	
7	Anand Bharani	AM (FS)	AAI	
8	Arvind Kumar	Insp/E	CISF	
9	Hitesh Maurya	SM (ATM)	AAI	

The Officiating Airport Director Sh. S.C. Bhalse welcomed all members/stake holders in the meeting. He directed Sh. Sunil Kumar AM (E-C) to explain about the noise mapping and declaration of Airport Noise Zone at Surat International Airport to all the Member present in meeting. Accordingly Sh. Sunil Kumar explained about the requirement of Noise mapping work, its scope.

To comply the mandatory requirement of Ministry of Forest and Environment and Climate Change (MOEF & CC) and DGCA, noise mapping is required at Surat International Airport and this work is being done by the agency M/S Unistar Environment and research labs Pvt. Ltd, Vapi.



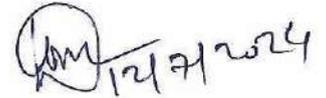
The Civil In-Charge explained to the stake holders about the requirement of conducting pre plan meeting to comply the mandatory requirement as per CAR F. No. 04-01/2010-AED (Vol. II) & that of DGCA.

Sh. Sunil Kumar AM (E-C) explained that Noise measurements were carried out during 05th June 2024 to 18th June 2024. Field measurements have been taken by using Spot Noise Monitoring Terminal and Bedrock Class-1 Sound Level Meter for 24-hour duration at both approaches of Runway i.e. 04 & 22 side. Monitoring was divided in two parts as per Central Pollution Control Board (CPCB) guidelines, day time 6.00 am to 10.00 pm and night time 10.00 pm to 6.00 am. The noise monitoring terminal & sound level meter is calibrated prior to each measurement using a calibrator. Sound level meter is mounted on height of 4 m above the floor level as per the CPCB guideline. After carrying out above study in details, a draft report has been submitted by the executing agency.

In-charge civil requested to all Members present in the meeting to give feedback, any suggestion for mitigation of Noise by Aircraft at Surat International Airport. Accordingly few member suggested that advance technology can be adopted by Aircraft manufacturing companies to reduce noise created by Aircraft.

In-charge Civil further replied to queries raised by stakeholders and informed that the Draft report will now be submitted to DGCA for clearance and approval.

The meeting ended with vote of thanks by Officiating Airport Director, Surat International Airport.



(Krishna Datta Verma)

Dy. G.M (E-C)

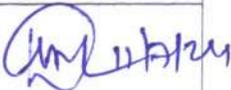
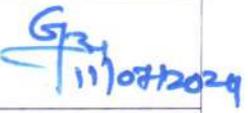
Airport Authority of India

Surat International Airport -394550

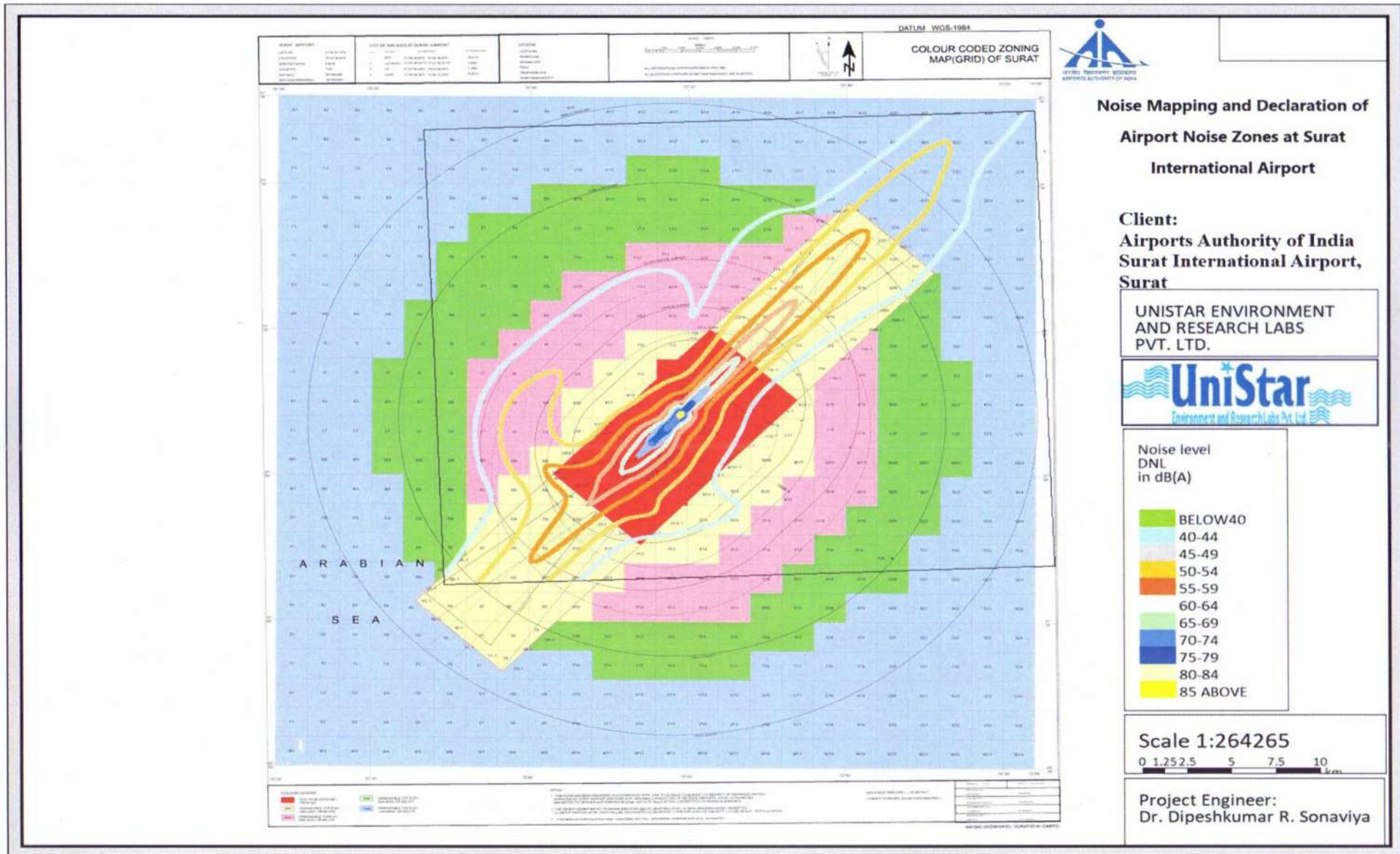
Attendance sheet for Noise study

Date- 11/07/2024

Name of Work: Noise mapping and declaration of airport noise zones at Surat International Airport

SR NO.	NAME	Designation	Organization	Signature
1	Sh. S. C Bhalse	officiating APD SURAT	AAI	
2	Sh. K. D. Verma	DGM (E-c)	AAI	
3	Sh. Akshay Raju Ghandet	MGR (OPS)	AAI	 11/07/2024
4	DEEP MEHTA	XXXXXXXXXX XXXXXXXXXX S. M	AIR INDIA EXPRESS	Deep A mehta
5	M. M. Agrawal	AGM (E-c)	AAI	
6	SUNIL KUMAR	AM (E-c)	AAI	
7	Arvind Bhatani	HM (FS)	AAI	
8	Arvind Kumar	Insp/E	CISF	
9	Hirsh Maloya	S.M (ATM)	AAI	
10				
11				
12				
13				

ANNEXURE-V SURAT AIRPORT NOISE ZONE MAP



REFERENCES

1. Agarwal, S., & Swami, B. L. (2011b). Comprehensive approach for the development of traffic noise prediction model for Jaipur city. *Environmental Monitoring and Assessment*, 172(1–4), 113–120. <https://doi.org/10.1007/s10661-010-1320-z>
2. Arana, Martin, R. S., Nagore, I., & Pérez, D. (2013). Main results of strategic noise maps and action plans in Navarre (Spain). *Environmental Monitoring and Assessment*, 185(6), 4951–4957. <https://doi.org/10.1007/s10661-012-2916-2>
3. Asensio, C., Recuero, M., & Ruiz, M. (2011). Noise mapping. *Applied Acoustics*, 72(8), 477–478. <https://doi.org/10.1016/j.apacoust.2011.01.013>
4. Bravo-Moncayo, L., Lucio-Naranjo, J., Chávez, M., Pavón-García, I., & Garzón, C. (2019).
5. Central Pollution Control Board (CPCB), June 2008. Guideline on “Requirement and Procedure for Monitoring Ambient Noise Level due to Aircrafts”
6. Director General of Civil Aviation, Dec 2014. Directive (CAR) of “Noise Management of Aircraft operation at Airports”
7. A machine learning approach for traffic-noise annoyance assessment. *Applied Acoustics*, 156, 262–270. <https://doi.org/10.1016/j.apacoust.2019.07.010>
8. Hadzi-Nikolova, M., Mirakovski, D., Ristova, E., & Ceravolo, S. (2012). Modelling and Mapping of Urban Noise Pollution with SoundPLAN Software. In *International Scientific Technical Conference on "trans & MOTAUTO '12"* (Vol. 185, pp. 182–185).
9. Halperin, D. (2014). Environmental noise and sleep disturbances: A threat to health? *Sleep Science*, 7(4), 209–212. <https://doi.org/10.1016/j.slsci.2014.11.003>
10. Istamto, T., Houthuijs, D., & Lebre, E. (2014). Willingness to pay to avoid health risks from road-traffic-related air pollution and noise across five countries. *Science of the Total Environment*, 497–498, 420–429. <https://doi.org/10.1016/j.scitotenv.2014.07.110>
11. Jhanwar, D. (2016). Noise Pollution: A Review. *Journal of Environment Pollution and Human Health*, 4(3), 72–77. <https://doi.org/10.12691/jephh-4-3-3>
12. Kalawapudi, K., Singh, T., Dey, J., Vijay, R., & Kumar, R. (2020). Noise pollution in Mumbai Metropolitan Region (MMR): An emerging environmental threat. *Environmental Monitoring and Assessment*, 192(2), 1–20. <https://doi.org/10.1007/s10661-020-8121-9>

13. Karantonis, P., Gowen, T., & Simon, M. (2010). Further comparison of traffic noise predictions using the CadnaA and SoundPLAN noise prediction models. In 20th International Congress on Acoustics 2010, ICA 2010 - (Vol. 3, pp. 1792–1797).
14. Ko, J. H., Chang, S. Il, & Lee, B. C. (2011). Noise impact assessment by utilizing noise map and GIS: A case study in the city of Chungju, Republic of Korea. *Applied Acoustics*, 72(8), 544–550. <https://doi.org/10.1016/j.apacoust.2010.09.002>
15. Lavanya, C., Dhankar, R., & Chhikara, S. (2014). Review Article “Noise Pollution”: an Overview. *International Journal of Current Research*, 6(5), 6536–6543.
16. Leng Ang, L., Cui, F., Poh, H., (2024). Benchmarking the aircraft noise mapping package developed for a unified urban environmental modelling tool. *Noise Mapping*, 11(1), 1-24. <https://doi.org/10.1515/noise-2024-0001>
17. Manojkumar, N., Basha, K., & Srimuruganandam, B. (2019). Assessment, Prediction and Mapping of Noise Levels in Vellore City, India. *Noise Mapping*, 6(1), 38–51. <https://doi.org/10.1515/noise-2019-0004>
18. Manvell, D., & Hartog Van Banda, E. (2011). Good practice in the use of noise mapping software. *Applied Acoustics*, 72(8), 527–533. <https://doi.org/10.1016/j.apacoust.2010.10.002>
19. Mioduszewski, P., Ejsmont, J. A., Grabowski, J., & Karpiński, D. (2011). Noise map validation by continuous noise monitoring. *Applied Acoustics*, 72(8), 582–589. <https://doi.org/10.1016/j.apacoust.2011.01.012>
20. Mishra, R. K., Rangnekar, S., & Parida, M. (2008). Survey on Noise Pollution and Its Management. *Journal of the IPHE, India*, 2008–09(4), 30–34.
21. MoEF &CC gazette notification G.S.R. 568 (E) dated 18.06.2018.
22. Ministry Of Civil Aviation Notification, New Delhi G.S.R. 751 (E), dated 30th September, 2015
23. Oguntunde, P. E., Okagbue, H. I., Oguntunde, O. A., & Odetunmibi, O. O. (2019). Public Health in Ota Metropolis. *Access Macedonian Journal of Medical Sciences*, 7(8), 1391. <https://doi.org/10.3889/oamjms.2019.234>
24. Pal, D., & Bhattacharya, D. (2012). Effect of road traffic noise pollution on human work efficiency in government offices, private organizations, and commercial business centres in

Agartala City using fuzzy expert system: A case study. *Advances in Fuzzy Systems*, 1– 9. <https://doi.org/10.1155/2012/828593>

25. Paszkowski, W., & Sobiech, M. (2019). The Modeling of the Acoustic Condition of Urban Environment Using Noise Annoyance Assessment. *Environmental Modeling and Assessment*, 24(3), 319–330. <https://doi.org/10.1007/s10666-018-9643-1>

26. Parking Policy for Surat city. (2018). Surat Municipal Corporation, 1–107.

27. Petrovici, A., Claudia, T., Gey, F., Nedeff, F., & Oana, I. (2015). Noise Prediction, Calculation and Mapping Using Specialized Software. *Journal of Engineering Studies and Research*, 21(3), 59–64. <https://doi.org/10.29081/jesr.v21i3.19>

28. Sandberg, U., and Ejsmont, J. A. (2002). Tyre/Road Noise Reference Book. INFORMEX, Kisa, Sweden

29. Singh, N., & Davar, S. C. (2004). Noise Pollution-Sources, Effects and Control. *Journal of Human Ecology*, 16(3), 181–187. <https://doi.org/10.1080/09709274.2004.11905735>

30. Sonaviya, D., & Tandel, B. (2016). A quick review on noise propagation models and software. In *ICSBE-2016 – 7th International Conference on Sustainable Built Environment* (pp. 96–100). Kandy, Sri Lanka.

31. Sonaviya, D., Tandel, B., (2019a), “A Review on GIS Based approach for road traffic noise mapping”, *Indian Journal of Science and Technology*, Vol.12 (14), pg-1-6. DOI: 10.17485/ijst/2019/v12i14/132481

32. Sonaviya, D. R., & Tandel, B. N. (2019b). 2-D noise maps for tier-2 city urban Indian roads. *Noise Mapping*, 6(1), 1–7. <https://doi.org/10.1515/noise-2019-0001>

33. Sonaviya, D., Tandel, B., (2020a), “Integrated Road traffic noise mapping in urban Indian context”, *Noise Mapping*, Vol.7, pg-99-113. DOI: 10.1515/noise- 2020- 0009

34. Sonaviya, D., Tandel, B., (2020b), “Prediction and limitations of noise maps developed for heterogeneous urban road traffic condition: A case study of Surat city, India”, *Sound & Vibration*, Vol.55(1), pg- 57-68. DOI:10.32604/sv.2021.010715

35. Sonaviya, D., Tandel, B., (2020c), “Appraisal of urban road traffic noise in tier- II city (Surat city), India”, *Sound & Vibration*, Vol. 56, No. 1, pg. 77–88. DOI: 10.32604/sv.2022.014334

36. Sonaviya, D., Tandel, B., (2021), "Noise abatement approach using computer simulation model for urban Indian road of tier-2 city", Archives of Acoustics, Vol. 46, No. 3, pg. 531–537. DOI: 10.24425/aoa.2021.138145

