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A Study on Noise Mapping & Modeling

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Abstract: **Noise pollution due to aviation is the one of the contentious environmental issues associated with airport and aircraft operators. Although, there are many other noise sources present at the airport, aircraft noise is readily identifiable and tends to stand as annoyance for many people. The study of Chhatrapati Shivaji International (CSI) Airport, Mumbai which is situated in the heart of the city, has been conducted to have an overview of the current noise situation at the airport, by identifying and monitoring the various noise sources including aircraft and background noise within and outside the airport boundary.**

Keywords: **Noise, Airport noise, aircraft, noise abatement, land use planning.**

1. INTRODUCTION

As noise pollution is emerging as an important environmental concern in India, Director General of Civil Aviation, India is working on stringent noise level standards for Indian Aviation sector. For the study purpose, Chhatrapati Shivaji International Airport has been selected to analyze the impact of the noise issue. The Airport is situated in the heart of the city, so it is very important to understand & analyse the noise generation sources which are from airport operation & also from surrounding activities by communities, vehicular traffic & other activities.

CSIA, formerly known as Sahar International Airport was started in the year 1942, consists of two crossed runways. Primary runway 09/27 is oriented towards East-West direction and the secondary runway 14/32 is oriented towards North-west and South-east direction. *(www.csia.in).*

The aim of this paper is to monitor, analyze & present the research results on the noise mapping & modeling for CSI Airport.

1.1 Objective of Study:

The objective of this paper is to map, study & analyze the aircraft noise events at CSI Airport which may help airport to take noise mitigation measures.

1.2 Land use Study:

Chhatrapati Shivaji International Airport is a brown field airport located in center of land- constrained city of Mumbai, the financial capital of India. CSIA is located at 19° 05' 27" North, 72° 52' 00" East, at an average field elevation of eight meters above sea level. Land use around Mumbai airport is a mixed type including industrial, commercial and traffic activities in Mumbai

The fig 1 shows the land use details of the surrounding area of 2 km radius from boundary of CSI Airport. As can be seen, the majority of the area (72%) is covered by the residential area including slums.

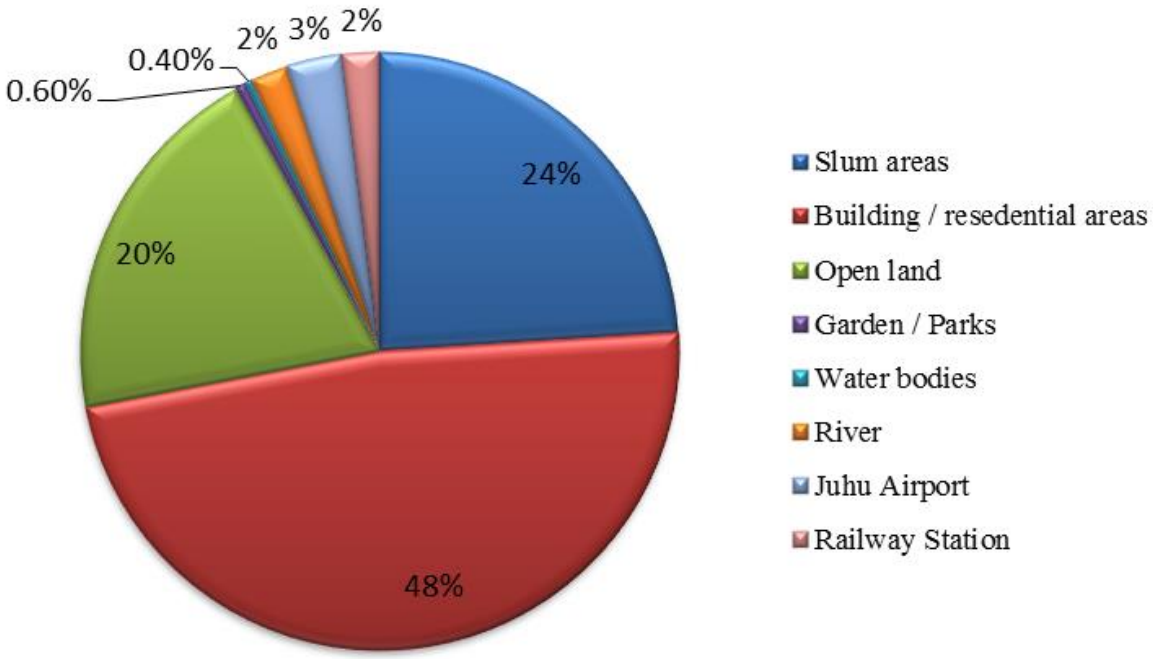

Fig. 1: Land use classification chart

1.3 Weather:

The climate in Mumbai throughout the year is hot and humid in summer & pleasant in winter. During summer the air becomes hotter around 35C (90% relative humidity) in the daytime and around 25C at night. The monsoon is intense with heavy rains during the months of June, July and August. The climate is cooler in around the airport because of large open space. The air temperatures in monsoon are around 30C (80% relative humidity) in the daytime and around 20C at night. During December and January, the climate in Mumbai is pleasant. The air temperatures are around 25C (75% relative humidity) in the daytime and around 15C at night. The average annual temperature is 27.0 ºC and the average annual precipitation is 216 cm

(Source: Indian Metrological dept. www.imdmumbai.gov.in)

2. RESEARCH METHODOLOGY

2.1 Measuring Equipment:

The noise monitoring terminal (NMT) type 3639 & 3655 are used for noise monitoring. All the NMTs equipped with communications equipment that makes the NMT accessible over the Internet.

2.2 NMT Specifications:

Manufacturer - Bruel & Kjaer Australia

Remote control capability

Includes Sound Analyzer Type 2250

Operation with microphone Type 4198, 4952 or 4184-A

Battery operated (90 hours)

Data retrieval via GPRS router, LAN& 3G

Measurement range <25 to >140 dB(A)

(Source: - Bruel & Kjaer; www.bksv.com/products)

2.3 Measurement Positions:

The noise levels are measured at seven different positions in and around the airport premises. The stationary & portable NMTs are used to record the noise events.

Fig 2: Noise Monitoring Locations

As shown in the fig 2, the noise monitoring locations are identified in the landing & takeoff funnel of the main runway and airside areas *(Aircraft Noise monitoring requirements by CPCB, 2008)*

2.4 Noise data & Indices:

The noise levels are captured for different noise index which are used further for noise modeling & mapping. For this project, study of the following metrics is done which is in compliance with the DGCA CAR *(CAR – Noise Management of Aircraft Operations, 2014)* for Aircraft Noise Management.

$L_{max\ day}$ $L_{max\ night}$

$L_{eq\ 24hr}$ L_{day}

L_{night}

2.5 Air Traffic data:

The flight plan data is collected from Airside Operations department of CSIA and also ADS-B receivers are installed to capture the aircraft details such as flight no, altitude, direction, origin & final destination etc. During the period of the measurement campaign (October 2015 to March 2016, 183 days) a total of 1,63,336 operations (landing & takeoff) were detected. *(http://www.apaoindia.com/)*

Of these, 81852 were arrivals, whilst the remaining 81484 operations were departures. The distribution of these operations among the runways has been as follows. The use of runway 14-32 is limited to those periods where the main runway (09-27) is under maintenance or when the use of 09-27 is not safe due to high crosswind.

2.6 Aircraft flight trajectories:

The flight trajectories are also being captured by ADS-B receiver and typical departure trajectory for runway 09-27 is shown below in fig.3. One of the important conclusion can be drawn from fig 3 below, is that all the departures are on the sea and there is very minimal disturbance to the community during departures.

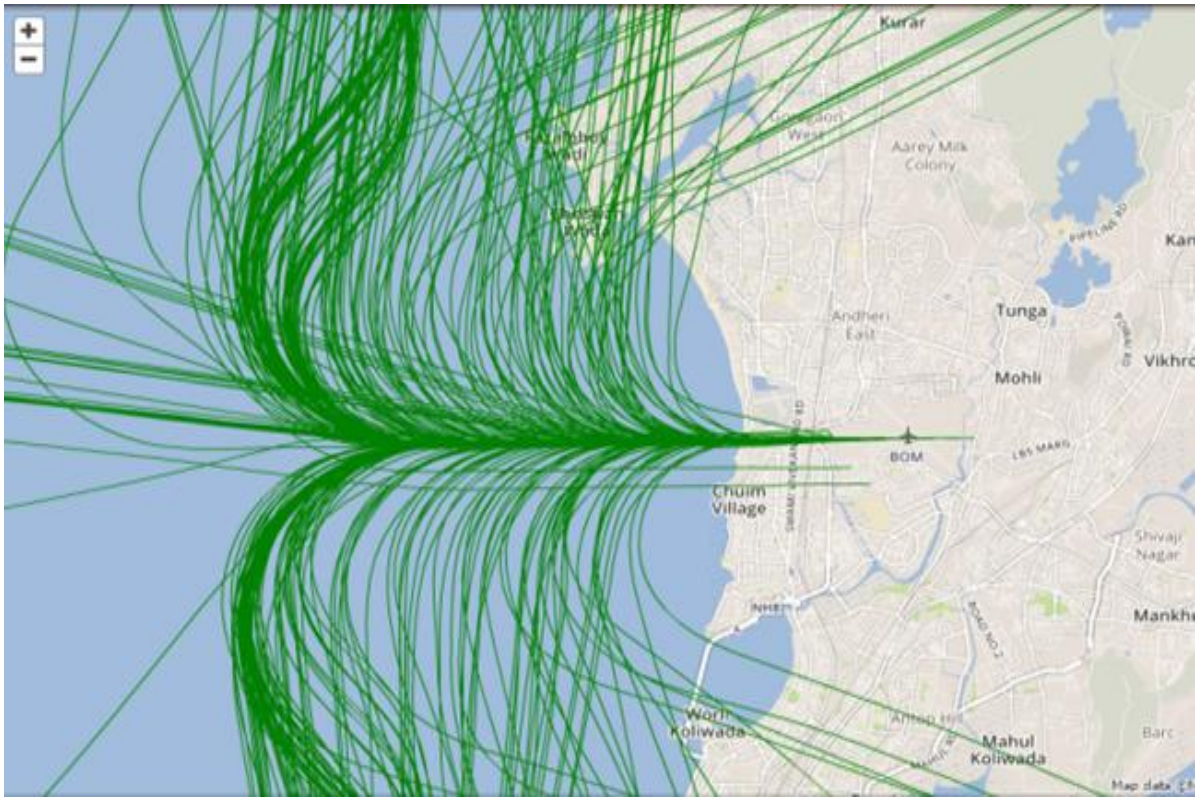

Fig 3: Typical Departure trajectory for a day

3. EVALUATION OF DATA & RESULTS

3.1 Noise Standards in India:

As the airport operation is being considered as an Industry, the noise standard as given in "The Noise Pollution (regulation & control) Rules, 2000" is being followed. The noise standards are defined for the different areas which are given as below:

Area Code	Category of Area /Zone	Limits in dB (A) Leq	
		Day Time	Night Time
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence Zone	50	40

-Day time shall mean from 6.00am to 10.00pm

-Night time shall mean from 10.00pm to 6.00am

*(Source: envfor.nic.in/legis/**noise**/**noise**.htm)*

3.2 Noise Contour (L_{day} 75 dB (A):

The noise contours for various indices have been prepared by using Integrated Noise Modeling methodology. *(Standard Method Noise Contour - EU Civil Aviation Conference 2005)* As can be seen in Fig 4, the day time noise contour (75 dBA) is crossing the airport boundary direction which affects the Jarimari area in Kurla having approx. 400 m spread from the airport boundary in SE direction. As the average day time background noise levels are in the range of 70 dBA, the day time noise level contour does not spread much out of the airport boundary.

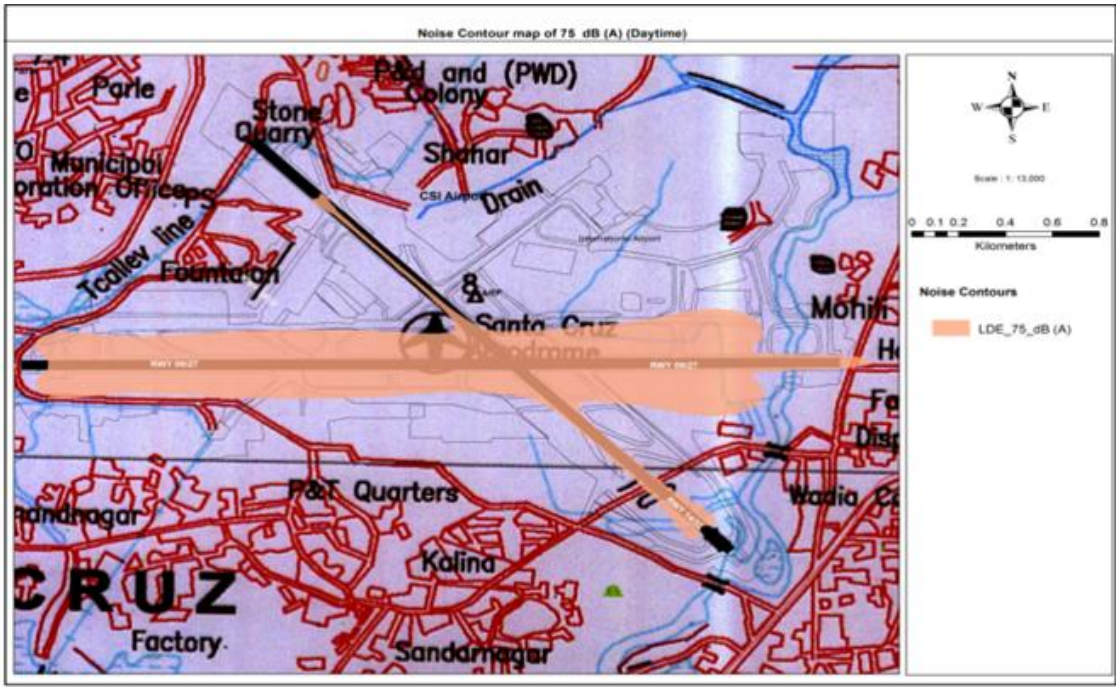

Fig 4: Noise contour L_{DE}75 dB(A)

3.3 Noise Contour (L_{night} 70 dB (A)):

As per the night noise contour of 70 dBA (fig 5), the tip of contour is spread about approx. 1 km from the airport boundary in SE direction. The background noise level in this area during night is approx. 60 dB (A). Through above analysis, it can be considerably summarized that spread of contour depends upon the prevailing wind directions at CSI Airport.

In order to determine the noise climate at CSIA, noise maps are determined by means of a modeling process. The model used for this purpose is Integrated Noise Model (INM), developed by the FAA, which is globally considered as a state-of-the-art model for airport noise mapping. Following internationally accepted conventions, noise maps are to be derived for a representative day of the year.

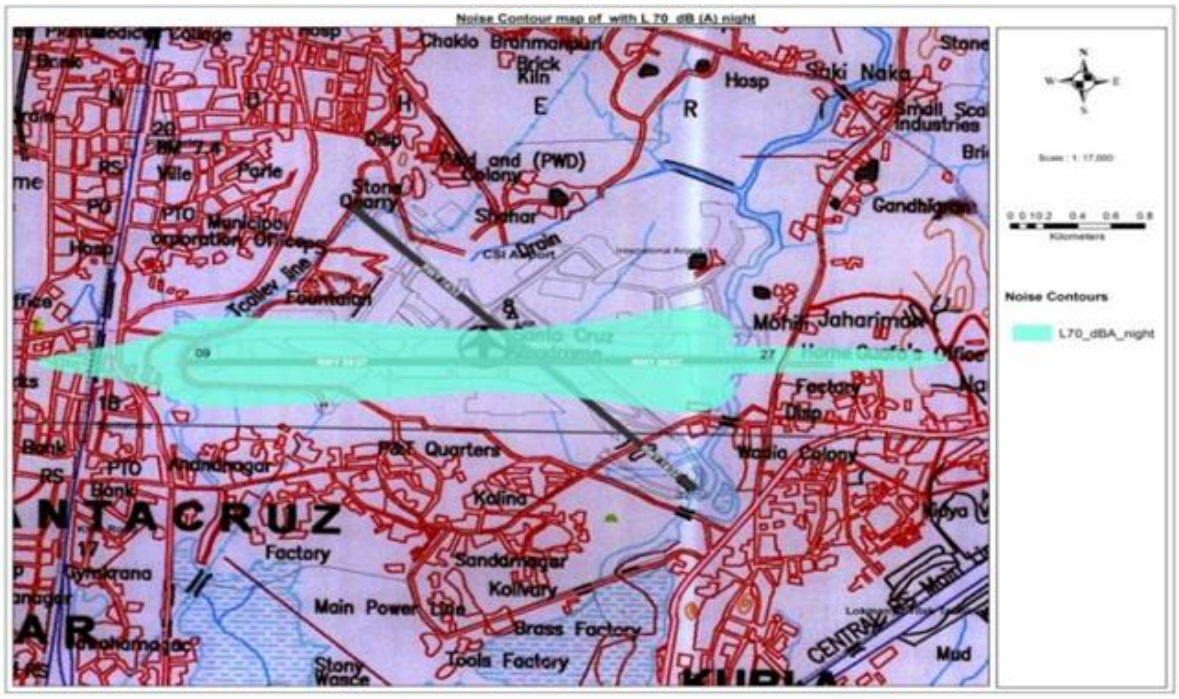

Fig5: Noise contour L_{night}70 dB(A)

3.4 Wind rose:

From the analysis it can be clearly observed that the wind direction prevailing during the study period is from NW & West direction. The effect of wind speed & direction on the noise generated from the aircraft operations is mentioned in section 3.3 above.

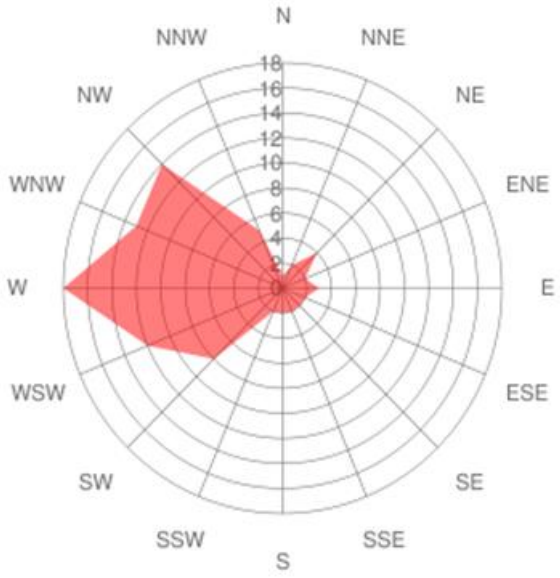

Fig 6: Wind rose diagram for CSIA

(Source: www.windfinder.com)

4. CONCLUSION & RECOMMENDATION

After studying the noise contours obtained through mapping & modelling process of noise data collected during the period, it is observed that the day time & night time noise levels around CSIA are within the limits as prescribed in The Noise Rules, 2000. In some areas during night, the noise contours overshadow the airport boundary, which can be due to the prevailing wind direction from the W & NW direction and vehicular traffic in the busy Western express highway passing right by the airport.. 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.

4.1 Proposed Mitigating Measures:

The mitigation measures to be sought within the framework of the ICAO "Balanced Approach". *(Doc 9829 AN/451, 2004, revision in 2007).*The Balanced Approach concept consists of identifying the noise problem and then analyzing & exploring the various measures available in the following four pillars:

- Noise reduction at source
- Land use planning and noise impact management
- Noise abatement operational procedures
- Operational restrictions

Over the last decade, aircraft noise has been reduced significantly due to noise reduction technologies implemented in the aircraft and engines. The fleets operating at CSIA are modern, and representative for the current aircraft fleet. In any case, any corrective actions in this field are responsibility of the aircraft/engine manufacturers and are therefore not further discussed here.

The main problem of the airport is the complete absence of land use planning around the airport, which has resulted due to encroachment, with the airport fully surrounded by residential and especially slum areas. Although actions in the area of land use planning would be the most effective in further improving the noise situation at CSIA, they are not within the

airport competence. The only viable action available to the airport is to demand proper land use planning from relevant government authorities.

Noise abatement operational procedures may be considered to reduce the noise around the airport. The procedure consists:

- Continuous descent approach (CDA)
- Continuous climb operations (CCO)
- Restriction on operation of reverse thrust at runway
- Single engine taxing procedure
- Engine run-up procedures

(DGCA CAR- Noise Management 2014)

Operational restriction to abate noise pollution in aviation sector is a last resort action and not a practical option even though such action is used in some European Countries, as such restrictions have long implications on global air traffic logistics & commerce.

ACKNOWLEDGEMENT

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REFERENCES

[1] Prof. S T Ingle, B.G.Pachpande, N.D.Wagh & S.B.Attarde, Jan. 2005. "Noise exposure and hearing loss among the traffic policemen working at busy streets of Jalgaon urban centre"

[2] Mr. Konstantinos Vogiatzis, March 2012. "Airport environmental noise mapping and land use management as an environmental protection action policy tool. The case of the Larnaka International Airport (Cyprus)"

[3] Bruel & Kjaer, May 2010. White paper on, "Legislation, Regulation and best practice in Airport Noise Management".

[4] Mr. NJS Burton, London South Bank University, 2004. "Method of Assessment of Aircraft Noise"

[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] Airport Council International Sept. 2015. "Managing Impact of Aviation Noise"

[8] UK Civil Aviation Authority, Feb 2004. "Noise Mapping – Aircraft Traffic Noise"

[9] Wyle Report, "Noise Basics and the Effect of Aviation Noise on the Environment".

[10] ICAO document 9829, 2004 & revision in 2007. "Guidance on the balanced approach to Aircraft Noise Management".