



Beijing New Airport Noise Environmental Impact Assessment and Influence Factors Analysis

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ABSTRACT

As the development of civil aviation, the aircraft noise pollution turned into a serious environmental problem in China. There are more than 100 airports at the end of 2015. In the Thirteen Five Plan of China, the government plans to build more than 500 general airports. Airport noise management and control will be a huge challenge. Environmental noise impact assessment for airport is key procedure of noise control. This paper used Beijing New Airport as an example, analyst various influence factors of airport noise.

Keywords: Airport noise; Airport Noise Environmental Impact Assessment; Beijing New Airport

1. INTRODUCTION

In the past five years, Chinese airport construction has been development rapidly. At the end of 2015, China already had 210 civil airports^[1]. In 2015, Chinese airport main production indicators maintained steady growth. Passenger throughput reached to 914.773 million passengers, an increase of 10.0% over the previous year; domestic routes completed 828.955 million passengers, an increase of 9.0% over the previous year; international routes completed 85.818 million passengers, an increase of 21.1% over the previous year. According the Civil Aviation Planning, China will have 244 airports at the end of 2020. It seems that Airport construction will continue to grow in a long period.

With the prosperity and development of the airport, noise pollution problem became increasingly severe. After the completion of the airport, airport noise control is difficult. Airport land planning is the most effective means of noise management. Therefore, at the phase of the environmental impact assessment of airport construction, the accuracy of airport noise prediction is particularly important. Beijing New Airport was used as an example to analyst airport noise prediction uncertainty at the environmental impact assessment stages.

2. BEIJING NEW AIRPORT ENVIRONMENT NOISE IMPACT ASSESSMENT

2.1 Beijing New Airport Project

Beijing Capital International Airport(BCIA) was built in 1954, and it was located in the northeast of Beijing city. It has three runways (East Runway, Middle Runway, east Runway) and the corresponding slide systems. East Runway is 3800 m × 60 m (F class), Middle Runway is 3800 m × 60 m (F class), West Runway is 3200 m × 50 m (E class)^[2]. It can meet all kinds of aircraft operational requirements. Passenger throughput of Beijing Capital International Airport has been ranked second in the world for the past five consecutive years. In 2015, passenger throughput was about 91.48 million, cargo throughput is about 1.4 million tons, aircraft movements are about 8.57 million vehicles. Airport passenger throughput currently had exceeded its design capacity and reached saturation, thus the increasing flight time was strictly controlled. Experts predicted that passenger throughput in Beijing would continue increasing. It is obvious that Beijing was lack of airport facilities support capacity and

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need to build a new airport urgently.

Beijing New Airport is one of the China national "Twelfth Five-Year Plan" key construction projects^[3]. In December 2012, China government approved the new airport project. The airport is positioned as a major international hub, the site is located in the north shore of the Yongding River, occupied the land of Beijing and Hebei Province. The annual passenger throughput is about 72 million passengers, cargo throughput is about 2.0 million tons, aircraft movements is about 630,000 vehicles. It covers an area of 30 square kilometers. The new airport project total investment is about 86 billion.

Beijing New Airport plans to build four runways in the first phase, and build 3 runways in the second phase. It will have seven runways and become one of the largest airports in the world. The scale of airport construction is huge, with a high density of aircraft taking off and landing, and it is very difficult to predict airport noise pollution.

2.2 Runway System

In the first stage, the airport will build four runways. According to distance from the terminal area, the runways were named as First East Runway, First West Runway, Second West Runway, and First North Runway, the information in seen Table 1 and the layout seen in Fig1^[2].

Table 1 – Runway Information

Runway Name	Runway Class	Length × Width m
West First Runway	F	3800×60
West Second Runway	F	3800×60
East First Runway	F	3800×60
North First Runway	F	3800×60

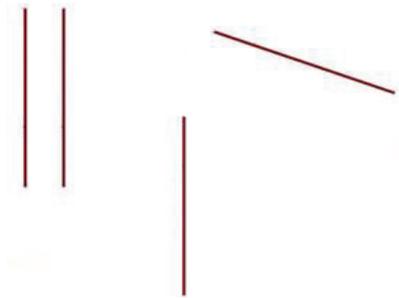


Figure 1 – Runway Layout

2.3 Airport Noise Evaluation Index

According to *aircraft noise around the airport environmental standards (GB9660-88)*, airport noise use WECPNL as evaluation index in China as follow^[4]:

$$L_{WECPN} = \bar{L}_{EPN} + 10 \log(N_1 + N_2 + 10N_3) - 39.4 \quad (dB) \quad (1)$$

where: N_1 is the day flights from 7 : 00 to 19 : 00; N_2 is the day flights from 19 : 00 to 22 : 00; N_3 is the day flights from 22 : 00 to 7 : 00; \bar{L}_{EPN} is the average effective perceived noise level of flight events.

$$\bar{L}_{EPN} = 10 \log \left[1 / (N_1 + N_2 + N_3) \sum_i \sum_j 10^{L_{EPN_{ij}}/10} \right] \quad (dB) \quad (2)$$

where: $L_{EPN_{ij}}$ is the i flight of j line cause a prediction point effective perceived noise level.

2.4 Airport Noise Impact Assessment Scope

According to the *Technical Guidelines for Noise Impact Assessment (HJ2.4-2009)* in China, Beijing New Airport make environment noise impact assessment as level one, which is the highest level in China. For Level one, assessment area should select like this: 6~12 km from end of each runway ends, 1~2 km from the side of each runway^[5], calculated noise value to the range of 70 dB. Considering multiplicity and complexity of this airport, the assessment area cope was expanded like this: 15 km from the end of each runway ends, 3 km from the side of each runway.

2.5 Environmental Noise Protection Objectives

Around the new airport, there is mainly rural environment with lower background noise. In the future when the airport operations, people lived around the airport would feel the significant changes of environmental noise. According to the airports map and site visiting, there are many objectives around the new airport site, that involves a total of airports environment noise assessment range, including 472 villages, 152 schools, 17 hospitals, 10 nursing homes and a zoo.

2.6 The Flight Data Prediction

Reference Beijing Capital International Airport flights, forecast the airport flight movements in 2025 are as follows:

Table 2 – List of aircraft movements forecast

Year	Category	Aircraft movements	Cargo movements	Other	Total
2025	Internal	467626	13200	30000	628211
	International	104385	13000		

Table 3– Aircraft type

Seat number	Aircraft type	Class code
50	EMB145、CRJ-200	B
90	ARJ21、EMB190	C
150	B737、A320、C919	C
210	B757、B767	D
260	B787、A350-800、A330-200、A340-300	E
310	A350-900、B777、A330-300、A340-600、B747-400	E
467	B747-8	F
550	A380	F

2.7 Noise Impact Area

The airport project use INM to predict the noise level in 2025. For the noise level and impact area, shown in Table 4. According noise prediction results, combined with the evaluation criteria of the local environmental protection department, the airport owners take different measures for noise control, example for sound insulation and relocation measures.

Table 4–Airport noise impact area in 2025

WECPNL(dB)	70~75	75~80	80~85	85~90	>90
Area (km ²)	86.83	37.435	15.527	6.917	4.577

3. AIRPORT NOISE PREDICT INFLUENCE FACTORS ANALYSIS

3.1 Airport Noise Model

INM was issued by the Federal Aviation Administration (FAA) and was widely used in the world. FAA issued the AEDT software instead of INM. In China most airport projects used INM to do noise calculation. The noise prediction method was based on simplifying the complex situation and making some assumptions. There is some difference between the calculated data and real noise data. INM software was designed to calculate the long-term average sound level. Due to weather conditions and other factors, there is some difference between the calculation result and the real noise data.

3.2 Aircraft Operation Procedure and Flight Movements

Aircraft operation procedure provides a certain order of a series of flight path, and it ensures that

the aircraft can be safe, smooth and economic at arrival or departure phase. Beijing new airport project plans to build 4 runways in the first phase, and 3 runways in the second phase. Currently, there is no mature multi-runway operations plan for reference. Noise prediction is closely related to Aircraft operation procedure. The flight procedures have uncertainty, so the noise prediction result has uncertainty too. The new airport flight movements were predicted based on Beijing Capital International Airport, it could have some changes in the future, so does the circadian proportion. If more flights departure or arrive at the night, it will increase the noise level.

3.3 Aircraft Types

Airport noise is mainly from aircraft noise. Aircraft noise performance (ANP) database data includes the noise characteristic data of approach and departure, and performance data of each model. Aircraft noise characteristics data and various performance data in accordance with the requirements are given in the reference conditions. But the database could not cover all the aircraft types, for example, aircraft made in China like C919.

3.4 Comparison of Calculated data and Monitoring data from BCIA

Beijing Capital Internal Airport measured data and calculated data seen in table 1. The measured data is from the noise monitoring system of the BCIA airport and the calculated data is from the INM software. Comparison of noise results February 1, 2010, INM used the actual flight data on the same day with the noise monitoring system. Comparison of results for the 2010 whole year, INM using the whole year flights number, noise monitoring system using the data of the 2010 monitoring results. The comparison is using INM calculated data minus the monitoring data.

Table 5–Comparison of calculated data and monitoring data

Monitoring site	February 1, 2010	2010 whole year	Monitoring site	February 1, 2010	2010 whole year
Site 1	-2.8	-0.1	Site 7	-1.5	-2.7
Site 2	-1.6	2.8	Site 8	-0.4	-0.8
Site 3	-2.5	2.0	Site 9	2.8	0.3
Site 4	0.7	-2.0	Site 10	-0.5	-2.8
Site 5	-0.2	3.0	Site 11	2.7	1.4
Site 6	-2.1	2.8	Site 12	1.2	2.3

4. CONCLUSIONS

Airport noise pollution was complained by people with high complaint rate. But once the airports open, it is very difficult to manage or control airport noise. Most experts believe that the environment noise impact assessment is a key stage for noise control. Using Beijing new airport as an example, there is some influential factors of airport noise and people should pay attention to this and try to improve the accuracy of noise environment impact assessment.

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