E3S Web of Conferences **683**, 01001 (2026) https://doi.org/10.1051/e3sconf/202668301001
EEUPD 2025

Environment Assessment of Low-Altitude Port Selection Based on Urban Scene Characteristics

Jia Liu[1], Jiannan Huang[2], Hao Yang[1], Shengfei Guan[3], Rui Yang[4], Dan Chang[5*]

[1] China Academy of Civil Aviation Science and Technology, Beijing. 100028, China
[2] Beijing Smartchip Microelectronics Technology Company Limited, Beijing. 100192, China
[3] Shanghai International Airport CO., LTD, Shanghai. 200335, China
[4] Hong Kong-Zhuhai Airport Management Company Limited, Zhuhai. 519040, China
[5] Haikou Meilan International Airport, Haikou. 570000, China

Abstract. With the development of low-altitude economy in China, this article analyzed the importance of environment assessment. Then, the process and main contents were summarized to detail the assessment work. The three aspects were the bird risk assessment, wind field assessment and the noise assessment. Through both qualitative and quantitative analysis, the port selection environment assessment was proposed. Finally, used this theory, the Shaoxing project showed the practicality to improve the reliability development of low-altitude port selection.

1 Introduction

In recent years, the low altitude economy industry has flourished [1], Low altitude ports are the physical foundation for low altitude economic operations, providing support for aircraft takeoff and landing, energy supply and maintenance. Meanwhile, they sustained the efficient operation of low altitude aircraft in urban logistics, transportation, emergency rescue, and other scenarios. The National Comprehensive Transportation Network Planning clearly requires the construction of a network of general airports and low altitude ports to cover the urban and rural areas. It is planned to build 2500 general airports and various ports by 2035, with a total investment scale of 1.8 trillion yuan [2].

At present, people are more concerned about the performance of the aircraft itself and few studied takeoff/ landing facilities [3]-[5]. Low-altitude port is the foundation for flight safety and efficiency and their performance directly affects aircraft operations [6]. Then, the environment assessment is the core work in the decision-making process of port selection. The assessment should cover the entire process of "planning-port selection-design".

It is not only to meet the rigidity requirements of regulations, but also to achieve a balance among economic benefits, ecological security, and social benefits through comprehensive measures such as scientific port selection, quantification of ecological impact, and optimization of noise prevention and control.

This paper will explain the environment assessment from three aspects, including the methods, processes and analysis. A detailed account of practical application will be illustrated using the Shaoxing project as a case study.

2 Definition and Analysis of Environment Assessment

Because of the complexity of urban scene, there are many uncertainties in the environmental factors of low altitude clearance, which will affect the safety of aircraft flying at low altitudes. Therefore, environment assessment is necessary during port selection.

Through survey and analysis, the main risks to low altitude flight safety include bird strike risk and wind environmental conditions, while the serious risk to green environmental protection is noise interference. Therefore, the low altitude environment assessment proposed in this article also focuses on these three points.

2.1 Bird Risk Assessment

2.1.1 Definition

The "Construction Code of General Airports" specifies that the determination of general airport should take into account bird habitats and migration routes to reduce the risk of bird strikes. Meanwhile, the impact of flight activities on the living environment of birds should also been considered. Within the urban area, by conducting local bird surveys, the comprehensive information about the species, quantity, distribution range, activity altitude and patterns, and seasonal migration patterns of birds, can be obtained.

*Corresponding Author: liujia_zhdz@126.com

Analysis. Before the bird risk assessment, through the classification of on-site survey data, the bird database can be established for subsequent analysis.

Species Analysis. First, list the common bird species around the port. Then, analyze the body size, habits, and other characteristics of different bird species.

Niche Analysis. It consists of the food acquisition, habitat utilization and activity time.

Spatial and Temporal Analysis. There are three parts, including the seasonal migration, daily activity pattern and spatial distribution.

2.1.2 Bird Strike Risk Matrix

Based on the analysis of bird species and the operation of the port, the risk matrix method is used to evaluate the risk of bird strikes [7], as shown in Table 1. From the probability and severity aspects, the risk level of different regions can be obtained, as shown in Table 2.

Table 1. Risk Items

Risk Level	Clusters Number/ Score	Weight (g)/ Score	Flight Altitude (m)/ Score	Flight Speed (km/h)/ Score
Serious	(>122)/5	(>1000)/5	(32-62)/5	(>50)/5
High	(25-122)/4	(700-1000)/4	(24-32,62-84)/4	(30-50)/4
Middle	(10-25)/3	(400-700)/3	(16-24,84-106)/3	(25-30)/3
low	(5-10)/2	(100-400)/2	(8-16,106-128)/2	(15-25)/2
Very Low	(0-5)/1	(0-100)/1	(0-8,>128)/1	(0-15)/1

Table 2. Risk Matrix

•	**Bird Risk Level**	•	**High**	•	**Middle**	•	**Low**
1.	Risk Score	2.	12-20	3.	6-11	4.	0-5

2.1.3 Prevention and Governance Suggestion

Port Selection Optimization. By combining the bird survey with the low altitude ports plan, the high-risk areas can be predicted in advance. The areas with frequent bird activity should be avoided when selection and the locations with fewer bird habitats are better choices.

Environmental Modification. The appropriate modifications surrounding the ports should be taken to reduce bird habitats and food sources. Meanwhile, by vegetation control and water management, the frequency of bird activities can be reduced.

Combining these data with the planning and design of low altitude ports, it is possible to predict high-risk areas of bird strike. The bird and wildlife risk assessment can provide scientific basis for ports selection and is also the key to achieve harmonious coexistence between low altitude economy and ecological environment.

2.2 Wind Filed Assessment

2.2.1 Definition

For the construction of low-altitude ports in urban scene, the wind environment can directly affect the flight safety of aircraft. In the "Technical guidance for site selection of general aviation aerodrome" [8] published by the Civil Aviation Administration of China, it is recommended to set at least two approach and climb surfaces in the Final Approach and Takeoff Area (FATO). The main takeoff and landing direction should be consistent with the dominant wind direction. The downwind operation should be avoided as well as minimizing crosswind operation. Since there are a large number of high-rise buildings in urban areas with dense distribution, the ports selected are often located inside the buildings envelope surfaces. Therefore, when selecting a port, it is necessary to conduct detailed wind field computation to analyze the spatial flow field distribution qualitatively and quantitatively. Finally, an assessment is provided of the wind field influence on aircraft takeoff and landing lines.

Analysis.

Port area modeling. Using the professional software, the 3D model of the port is generated.

CFD numerical simulation. The Fluent software is used to simulate the wind field. The simulation results contain velocity and pressure distribution of any height.

2.3 Noise Assessment

2.3.1 Definition

For the construction of low-altitude port in urban scene, the environmental influence is the main evaluation index for city green development. Since the aircraft operation at low altitude is belonged to low-frequency noise source, their transfer range is mainly related to the distribution of surrounding buildings and facilities. In the city, there are many schools, residential districts, hospitals, and office areas allocated in the urban area, which are often near to the noise source due to the dense distribution. Therefore, when selecting a port, it is necessary to conduct detailed computation of aircraft noise distribution [9,10]. The results will show the noise distribution, noise duration, and related optimization plans qualitatively and quantitatively. Finally, the assessment results can provide the noise influence on different noise sensitive points.

Analysis.

Aircraft Model Aerodynamic Configuration. **Establish the proper aerodynamic noise model based on the parameters of the proposed aircraft model.**

Prediction of Aerodynamic Noise. **Adopt the professional equation to solve the noise prediction. Then, the aircraft noise distribution can be obtained.**

3 Environment Assessment Process

The complete environment assessment process is divided into multiple steps, from text data to on-site survey and finally to simulation. The conclusion of multiple assessment methods should be integrated to complete the whole assessment work, the assessment process diagram shown as Fig.1.

3.1 Information Collection

3.1.1 Project Analysis

Port selection should follow the government planning content, including the Low-altitude construction scale, location layout and construction timing.

3.1.2 Bird Information

Summarize the habitat environment of local birds, seasonal changes of bird spices, migrating types and flight altitude of birds.

3.1.3 Distribution of Surrounding Buildings

Identify the distribution of buildings within the evaluation area, including buildings, bridges and etc.

3.1.4 Meteorological Information

Obtain statistical data from meteorological observation station, including temperature, humidity, wind speed and wind direction

3.1.5 Local Industrial Form Analysis

Identify noise sensitive points, including residential areas, hospitals, schools, and other places. Subsequently, the noise assessment criteria can be established.

3.1.6 Proposed Aircraft Type

Prepare the design parameters of the aircraft model to be used, including aspect ratio, weight, rotation rate, maximum wind resistance velocity, and etc.

3.1.7 Flight Procedure

Design the reasonable flight route plan based on task requirements and actual conditions.

3.2 On-Site Survey

Investigators work on feet or driving. By using tools such as telescopes, cameras and GPS, the detailed investigations and record the bird, vegetation, and ecological environment can be conducted at the beginning of the port selection.

By conducting on-site survey, the actual situation can be compared and confirmed with text data. Further, determination of the evaluation level and scope can improve the effectiveness and efficiency of wind field and noise assessment work.

3.3 Simulation Calculation

3.1.1 Wind Filed Simulation

CFD numerical simulations of the target area were performed using professional commercial simulation software. Combining flight procedure design, the aerodynamic stability changes of aircraft on different flight lines can be obtained

3.1.2 Acoustical simulation

The target area acoustic simulation calculation is conducted through professional acoustic simulation software. Based on the the flight procedure design, the maximum noise level and duration of noise intensity in the area can be calculated.

3.4 Result Analysis

3.4.1 Bird Information Evaluation

Based on the survey information, the diverse habitat types can be listed. In terms of bird diversity observation, the survey can record multiple groups of birds. Combining flight procedures for bird activity analysis, the main bird activities, which may cause safety risks to aircraft flight, can be recognized in advance.

3.4.2 Wind Environmental Influence Evaluation

Analyze the aerodynamic characteristics of aircraft at different flight positions. According to wind field evaluation criteria and different aircraft positions, the wind field safety assessment can be conducted.

3.4.3 Noise Influence Evaluation

Predict and analyze the noise in sensitive areas based on the proposed aircraft type information. Following the noise evaluation standards, the corresponding noise evaluation is conducted against to different affected people.

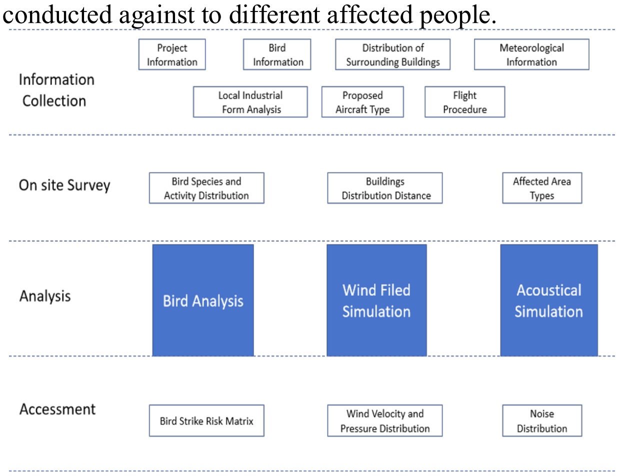


Fig. 1. Assessment Process Diagram.

4 Project Application

Our team is responsible for the low altitude ports selection work for the "Low altitude New Infrastructure in Yuecheng District" project of Shaoxing city. During the Shaoxing project, we allowed the rules mentioned before and provided the following detailed analysis.

4.1 Bird Risk Assessment

Based on statistics from bird survey data, a map of bird activity can be generated, as shown in Fig. 2. The bird risk matrix is shown in table 3, which can be seen that the Egret and Barn Swallow has the high risk level and Spotted Dove has the middle risk in Shaoxing City. During the construction and operation of the large-scale low altitude complex port, it must have a certain impact on the original natural landscape and ecological structure in the area. This change impacts on the habitats for birds, resulting in reducing the number of birds, potentially expanding their range of activity and increasing the bird strike risk.

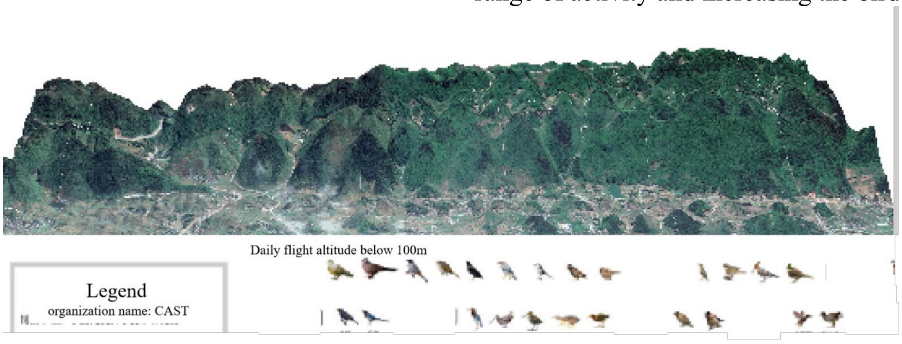


Fig. 2. Bird Activities Figure.

Table 3. Shaoxing Bird Risk Matrix

5. Bird Species	• Clusters Number	• Weight (g)	• Flight Altitude (m)	• Flight Speed (km/h)	6. Total Score
7. Egret	8. 50-80	9. 320-650	10. 20-30	11. 35-40	12. 15
13. Spotted Dove	14. 13-20	15. 120-205	16. 10-15	17. 8	18. 8
19. Barn Swallow	20. 80-150	21. 14-22	22. 10-50	23. 100-120	24. 15

4.2 Wind filed Assessment

The modeling and grid **is** shown in Fig.3. Selecting the dominant wind direction angle and wind speed, the numerical simulation was produced. The results contain several information, including the vertical velocity distribution and velocity distribution of different height, as shown in Fig.4 and Fig.5. The wind velocity decreased after the incoming northwest wind flowed through the elevated road and it continued to decrease in front of residential buildings. The wind velocity intensified above the roofs of residential buildings. And the flow structure in the leeward area of the building was complex with vortex shedding. From the velocity distribution of different heights, it could be seen that within the height range of 0.1m-50m, the aircraft was affected by the co-effect of northwest wind flow through bridges and residential buildings during the vertical flight path. However, within the height range of 50-100m, the wind velocity of the port area was less affected by the structure of the near ground wind field, as shown. But the wind velocity increment above the building roof and velocity deceleration zone generation towards the southeast, both would affect one of the departure routes.

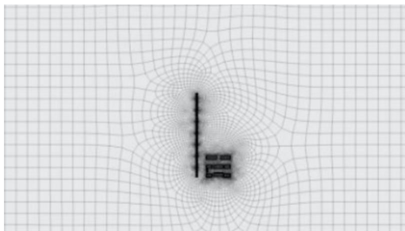
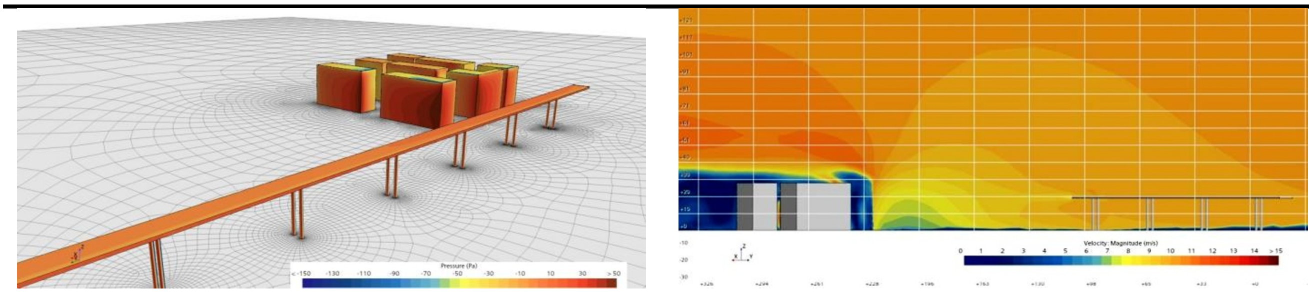


Fig. 3. Modeling and Grid of Port Area.



(1)Pressure Distribution Counter (2)Vertical Velocity Counter

Fig. 4. Counters with Northwest Incoming Flow.

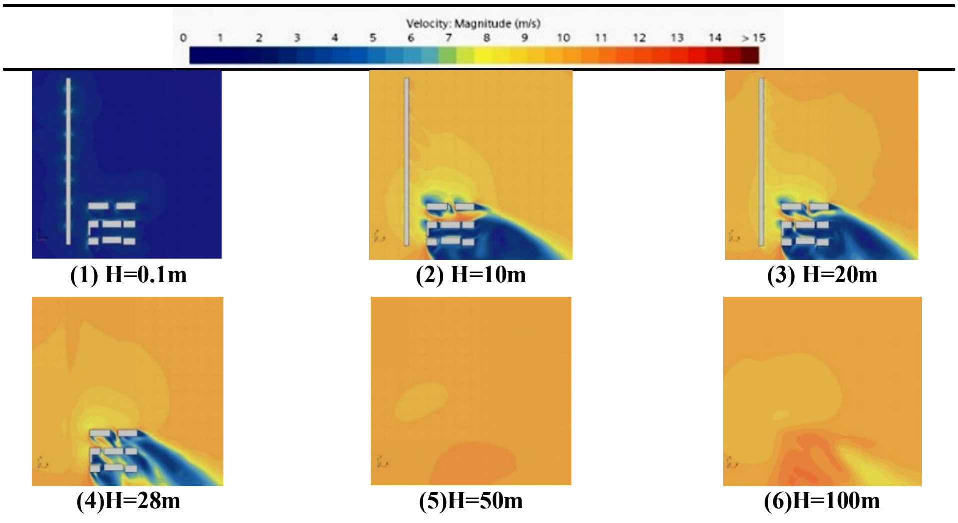


Fig. 5. Velocity Counter of Different Height with Northwest Incoming Flow.

4.3 Noise Assessment

By combining the bird survey with the low altitude ports plan, the high-risk areas can be predicted in advance. The areas with frequent bird activity should be avoided when selection and the locations with fewer bird habitats are better choices. The aircraft type adopted EC225. Combining the helicopter noise level and the flight procedure, Fig.6 showed the voice distribution levels under different flight situations. During takeoff, the helicopter raised about 50m and the amplitude of the sound pressure level directly below was 76dB. When flight route 1 was north, the helicopter operated at about 160m. The amplitude of the sound pressure level directly below was 66dB and it decreased to 54.71dB with 480m outward. When flight route 2 was south, the sound pressure influence area was different from that of the route 2. In conclusion, during the takeoff and landing phase, there existed the areas where the noise level exceeds 60dB, which may cause discomfort to the human body for a certain period of time, as the Table 4 shown. If departure direction is north, the noise level in residential areas will significantly decrease. If departure direction is south, the duration of high noise levels will be longer.

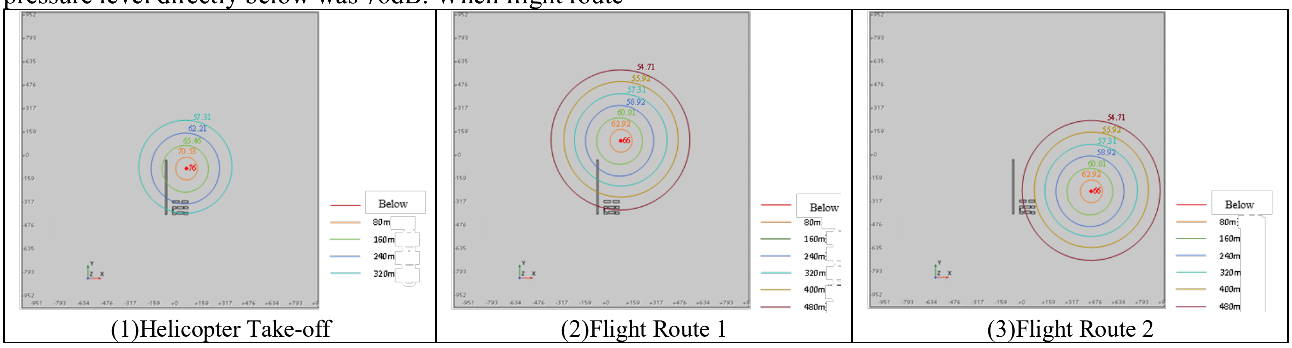


Fig. 6. Noise Range (unit: dB).

Table 4. Standard for the Environment Noise

25. I (30-59dB)	**26.** The noise within this range is tolerable for people. But begin to feel discomfort. When the noise reaches 40dB, it may start to disturb sleep.
27. II (60~89dB)	28. Within this range, the interference of noise on the autonomic nervous system will increase, so that people may listen difficultly. 85dB is generally considered a requirement for hearing protection. And long-term exposure to this noise level may cause damage to hearing.
29. III (90~120dB)	30. Noise within this range can significantly damage the nervous system and may cause irreversible damage to the auditory organs. Long time living in a noisy environment above 90dB can seriously affect hearing and cause other diseases, such as neurasthenia, headaches and high blood pressure.

5 Conclusion

After the research in this article, it can be concluded that conducting environment assessments during the port selection phase is a key tool for balancing project feasibility, safety and compliance. It not only reduces the full cycle cost through risk pre-management, but also ensures that the port selection plan complies with regional safety planning and sustainable development goals. Through scientific analysis, it can form the foundation for the success of the port selection project.

Acknowledgments

The research is supported by the Fundamental Research Funds of CASTC (x242060302235).

References

1. Gongyi Z., Xiaojing Y.: Digital Technology Driven Low-Altitude Economy from the Perspective of High-Quality Development: its Mechanism and Development Path. Journal of Yanbian University: Social Science Edition.2024(4).DOI:10.3969/j.issn.1009-3311.2024.04.009.
2. Xiaolan Z.: The main issues and policy suggestions for the development of China's low altitude economy. CHOGQINGJINGJI (5):32-37(2024).
3. Zhang G , Liu J , Zhao Y ,et al.:A reliable unmanned aerial vehicle multi-ship tracking method. PLOS ONE, 20(1) (2025)DOI:10.1371/journal.pone.0316933.
4. L. Lamia, J. Yuan , and F. Dioubi. STABILITY ANALYSIS OF A FRACTIONAL ORDERED QUADROTOR UNMANNED AERIAL VEHICLE CHAOTIC SYSTEM. Fractals 33.01(2025).
5. Lin J., Alkouz B., Bouguettaya A., et al.:Dynamic and Immersive Framework for Drone Delivery Services in Skyway Networks. ACM Transactions on Internet Technology, 25(1)(2025). DOI:10.1145/3708892.
6. Rui Q., Zhibo Y.: Research on the Location of Urban UAV Logistics Take-off and Landing Field. Scientific and Technological Innovation, (15):50-54(2024). DOI:10.3969/j.issn.1673-1328.2024.15.014.
7. LIU Z., WANG Z., CAO Y., CAI S., CHEN W., LU K.:Risk Assessment of Bird Strike at Airport Based on Improved CRITIC-cloud Model.ECOLOGY AND ENVIRONMENTAL SCIENCES, Vol. 34: 135-144 (2025) .
8. Civil Aviation Administration of China, Technical guidance for site selection of general aviation aerodrome, MH/T 5065.1-3-2023, Beijing, China, 2023.
9. Hanbo J., Han W., Wangqiao C., Peng Z., Siyang Z., Xin Z., Guocheng Z., Bao C.; Toward high-efficiency low-noise propellers: A numerical and experimental study. Physics of Fluids 1 July 2022; 34 (7): 076116. https://doi.org/10.1063/5.0098891.
10. YAN Q., WANG D., GAO P., WEI W.; Comparative Study on Aerodynamic Noise Characteristics of Unmanned Aerial Vehicle Series Rotors. Transactions of Beijing Institute of Technology.2024.Vol. 44 No. 5.