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NOISE MODELING OF UAM AROUND VERTIPORTS BY SOUND BARRIER

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ABSTRACT

The present study aims to propose practical solutions to control the noise issue, which is a key challenge for the commercialization of Urban Air Mobility (UAM). Noise levels around vertiports during UAM urban operations were predicted using the SoundPLAN program, and the noise reduction effects were assessed through simulation modeling when various heights of noise barriers were applied at different distances and receiver heights. The comparison factors to confirm the noise reduction effect were set to L_{den}, L_{eq}, and L_{max}. The height of the sound barrier was investigated up to 27 m at 3 m intervals. In the present study, for noise prediction, two major vertiports on the K-UAM Grand Challenge phase 2-1 Ara Waterway demonstration route were targeted. As a result, it was found that significant noise reduction was observed at receiver points lower than the sound barrier. However, the noise reduction effect was minimal or absent at receiver points of similar or greater height than the sound barrier. This indicated that as the distance from the vertiport decreased, the noise reduction effect increased with the height of the sound barrier. Thus, it can be expected that the findings of this study could contribute to noise mitigation of UAM.

Keywords: *UAM(urban air mobility), sound barrier, vertiport, noise modeling, noise map*

1. INTRODUCTION

A significant challenge in the commercialization of Urban Air Mobility (UAM) is noise.[1] Aircraft like helicopters have caused disturbance to those living near airports due to elevated noise levels, frequently sparking community opposition. Because UAM utilizes electric vertical take-off and landing (eVTOL) technology, it is anticipated to produce less noise compared to traditional aircraft.[2] However, given that UAM operations primarily occur over urban centers, even with reduced noise compared to conventional aircraft, they will operate much closer to where people live and work. Consequently, UAM operation could introduce a new source of noise in existing urban areas, potentially increasing how intensely noise is perceived and raise concerns about sensitive reactions from city dwellers.[3] Therefore, to successfully commercialize UAM, the development and application of UAM-specific noise analysis and mitigation techniques are essential.

Sound barriers are recognized as important elements in decreasing environmental noise. In the transportation sector, they are installed alongside highways and railways to effectively lessen noise impacting nearby residential and commercial zones. [4] Sound barriers function by creating a physical obstruction that prevents sound from traveling directly to the listener. Beyond just traffic noise, these sound barriers are also employed to control noise from industrial activities, aiding in adherence to local noise ordinances and minimizing noise pollution in adjacent areas.

This study proposes a method for reducing noise generated by UAM operations through the use of an established technology: sound barriers. To achieve this, SounPLAN software is employed to predict and analyze noise levels by strategically placing sound barriers around vertiports, which are the take-off and landing locations for UAM within the city. The aim is to identify ways to lessen the noise impact of UAM operations on urban environments and to significantly contribute to the protection of the living environment for city residents

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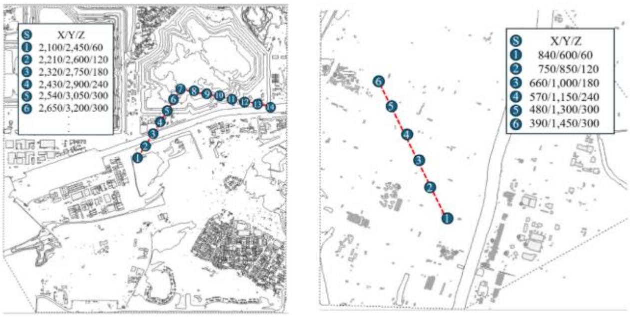
Table 1. UAM noise level by frequency

	63	125	250	500	1,000	2,000	4,000	8,000
Departure	83.7	69.5	64.7	62.9	62.7	62.2	63.3	32.6
Approach	77.1	74.8	78.1	75.5	84.8	79.9	72.3	38.5



(a) V1) (b) V2

Figure 1. Noise reduction rate according to the height of sound barrier.

2. RESEARCH METHOD

Noise maps were generated, and noise levels were predicted using the SoundPLAN program. Sound barriers were positioned along the road adjacent to the vertiport, and the material of the sound barriers was set to be reflective. The area simulated was the vertiport location of the K-UAM Grand Challenge. Table 1 shows the noise level of the UAM input into SoundPLAN. The height of the sound barriers was compared from 12 m to 27 m at 3 m intervals.

3. RESULTS

L_{eq} and L_{max} were predicted at two different points. L_{eq} prediction results showed that the noise level continuously decreased as the height of the sound barrier increased in 3 m increments. Furthermore, when the increase/decrease rate was compared, the noise level reduction was greater as the height of the sound barrier increased. This trend was consistent at both sound-receiving points. L_{max} did not show a decreasing trend up to 18 m. However, when the height of the sound barrier exceeded 20 m, the noise level was reduced by nearly 2% compared to the previous measurement. At R2, the noise level was nearly double that at R1.

4. CONCLUSION

In this study, the noise level according to the height of the sound barrier was predicted and analyzed using the SoundPLAN program. As a result of analyzing the noise reduction effect, there was a difference in the noise reduction rate depending on the height of the sound barrier and the distance from the sound source. Therefore, when determining the height of sound barriers to prevent noise impact on buildings around the vertiport, the appropriate height should be calculated considering the distance between the vertiport and the sound-receiving location. In addition, there was a difference in the noise reduction rate depending on the noise evaluation factors. In the case of UAM, L_{max} is a noise evaluation factor that requires more careful examination than L_{eq}. Therefore, selecting the height of the sound barrier that is most effective for L_{max} reduction will be effective in reducing overall noise.

5. REFERENCES

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