Soundscape in Bus Station

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Abstract

Soundscape design is applied for the purpose of expressing the characteristics of places, by supplying suitable background sound for various places expressing their identity. Bus stations are a place for aggregating people using transportation. That is, people go into a station, buy a ticket, and wait for departure or for other passengers. Therefore, they need to create a more comfortable sound environment. This study aims to make bus stations a comfortable place acoustically for users. In this study, analysis on behavior at various locations in the space was performed. Measurements were taken on the approaching path, waiting place, departure and arrival platforms for sound levels and frequency characteristics. In addition, on acoustic specialists’ evaluation, using questionnaires, was also performed ambient noise, information broadcasting and users’ dialogue.

Introduction

While counteracting noise so far has relied on noise controls like reducing, or removing the noise, the new concept, ‘soundscape’, is to make a room more comfortable through the introduction of positive sounds. Examples include; BGM(background music) in public places, starting signals for electric trains, wall streams of subway platforms, environmental music systems for office buildings, sound installations in sports parks, similar to those of the botanical garden in Fukuoka, Japan or the soundscape plan in Vancouver City, Canada.

In Korea, keeping in step with this trend, research(1) on the classification of sounds into comfortable and uncomfortable sounds has been carried out based on human sensitivities. The Ministry of Environment has tried to create a database of beautiful sounds. This paper selected a bus station as the object of study and aims to improve the acoustic environment through the introduction of appealing sounds.

Survey and Measurement

2.1 Selection of object bus station

The bus station has comprised of an allocation, waiting and baggage room as well as other service facilities. In recent times, as a result of the development of highways, long distance touring coaches tend to be used as a substitute for trains. Therefore, bus stations have grown on a larger scale. Korea has bus stations in Seoul, and in each province or county. Urban stations are generally used for rapid transit railway, railway, subway, passenger ships and buses. Among them, there are about 240 bus stations in Korea for highway bus, suburban and urban buses etc.

In this study, CS and KC bus stations were chosen for research and were comprised of complex spaces like malls, boarding platforms, stores and connections to the airport and were on a large scale.

Fig. 1 and 2 are plans of the CS and KC bus stations locations where research was conducted. Measurement points for study were located at the waiting room for departure, ticket booths, pedestrian paths, arrival places and meeting rooms.

Similar places were chosen as measurement points in both cases. In case of pedestrian traffic although CS had no stores on either side and the only sound was that of pedestrians, KC had stores on both sides and the main sound sources were from music, pedestrians and general traffic noise.

The arrival place of CS is divided into a disembarkation and waiting place, therefore the difference in SPL (sound pressure level) between the inner and outer spaces was large. However, KC doesn’t divide the arrival points and the SPL was found to be large due to a mixing of sounds from traffic and the surrounding environment. As for the ticket booths, the CS ones make a deep hum because people are gathered for various functions such as ticketing, waiting and meeting. However, KC was relatively quiet as it only has noise from ticketing, resting and pedestrian traffic.
2.2 Measurement and results
Levels of sound according to time and frequency characteristics were measured for the purpose of comparing the difference between similar places. Figs. 3 and 4 show the time history, and spectrums for each measuring point. According to the time history, it was fluctuating in the range of 10 dB. The spectrum for the departures waiting room in both stations was shown to be similar at about 62dBA, and about 5dBA difference in the pedestrian walkways occurred with CS measured at 61.4dBA and KC at 66.4dBA. As for arrival places, CS showed levels of 58.8dBA, whilst KC showed 72.3dBA. The SPL for the space where inner and outer is not divided was shown to be high.

<table>
<thead>
<tr>
<th></th>
<th>KC</th>
<th>CS</th>
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<tbody>
<tr>
<td>Meeting place</td>
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<tr>
<td>Waiting room for departure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ticket place</td>
<td></td>
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<td>Moving path</td>
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<td>Arrival place</td>
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</table>

Fig. 3: Time history of SPL in each place

Subjective Evaluation
3.1 Subjective evaluation without sound supply
After performing measurements in selected locations, a subjective evaluation was carried out regarding the sound environment by ten acoustic specialists. Three-hundred and sixty-one adjectives were used in evaluation. Twenty-five adjectives were used to represent a good feeling toward the sound(2). For subjective evaluation, SD(semantic differential) methods were applied, therefore 25 pairs of adjectives with opposite meanings were also composed. A scale of 1-7 was used with 7 being positive and 1 a negative reaction to each sound.

Fig. 5 shows the results of the subjective evaluation for each place with ambient sound. The evaluation value on the image of place was higher than that of sound, the difference in the evaluation value by place was small ranging from 3 to 4. However, the values were different depending on the adjectives for each place having different characteristics.
3.2 Selection of sound sources for applying to each place

Sound sources for the bus stations were selected from a total of nine different styles and were applied to a soundscape design composed of natural sounds (wind, waves, running streams, rain and birds) and artificial sounds (classical music, news, Korean popular songs and English popular songs) including complex sounds.

Fig. 6 presents the characteristics over time for the supplied sounds using Cool Edit pro, software for editing sounds. Popular songs fluctuated greatly whilst the sound of running stream remained steady. Natural sounds fluctuated according to the sound of the wind, birds and waves. Fig. 7 shows an example of the frequency characteristics of hearing sounds in the object point measured with ambient sound.

3.3 Results of subjective evaluation

Using the 25 selected adjectives, the evaluation was carried out on the image of the acoustical environment at the studied locations when producing the nine sound sources. Table 1 shows the results of the subjective evaluation after hearing the sound from number 8. Number 8 is a complex sound, mixing natural (birds) and artificial (music). The mean value was generally greater than 5.

Fig. 8 plots the mean values when supplying and not supplying sound. Fig. 9 plots the differences so as to analyze the effects of the sounds by subtracting the value without sound from the value with sound. As shown from the figure the effects of sound source 8 were highest of all the sounds. Negative(-) values were also shown according to the sound, indicating that the sounds supplied may cause negative reactions.

Table 1: Results of subjective evaluations in each place when no. 8 sound source was supplied

<table>
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<tr>
<th>adjective</th>
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<th>4</th>
<th>5</th>
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</table>

Fig. 5: Results of subjective evaluation without sound supply

Fig. 6: Characteristics of supplying sound by time

Fig. 7: Frequency characteristics of hearing sound when supplying sounds in each place (CS, arrival place)
Fig. 8: Mean value of subjective evaluation with and without sound

Fig. 9: Effect of sounds supplied (difference of mean value with and without sound)

As a result, the effects shown were different depending on the location due to differing acoustic environments and types of sounds supplied. The most effective sound among the nine sound sources was a complex sound that mixed classical music and bird sounds.

Acknowledgements

This paper has been made possible by a project carried out by Eco-technopia21, supported by the Ministry of Environment.

References
