Longitudinal study on community response to noise in Vietnam and Kumamoto

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Although a number of socio-acoustic surveys on community response to transportation noise have been conducted in developed countries thus far, only a few such surveys have been conducted in developing countries such as those in Southeast Asia. In order to remedy this situation and to contribute to Vietnamese and global noise policies, socio-acoustic surveys have been conducted in two cities of Vietnam since 2005. Since the first express railway line, Tokaido Shinkansen, was opened between Tokyo and Osaka in 1964, high-speed railway networks have been developed not only in Japan but also in Europe and some East Asian countries. The construction of the Kyushu Shinkansen Line began around the Kumamoto Station area in 2004. By the time the construction of the Shinkansen and the conventional railway lines is completed in 2016, the positions of the both lines will have changed, and the exposures of the houses to the noise from the railways will have altered accordingly. Therefore, in this paper, we present two ongoing longitudinal studies on community response to noise. The first study is a socio-acoustic survey on community response to aircraft, road traffic, and railway noises in four cities of Vietnam: Hanoi, Ho Chi Minh City, Hue, and Danang. The second study is on community response to the step changes in noise exposures in Kumamoto.

Key words: community response to noise, noise policy, Vietnam, Shinkansen, step change in noise exposure

1. INTRODUCTION

Although a number of socio-acoustic surveys on community response to transportation noise have been conducted in developed countries thus far, only a few such surveys have been conducted in developing countries such as those in Southeast Asia [1]. In order to remedy this situation and to contribute to Vietnamese and global noise policies, socio-acoustic surveys have been conducted in two cities of Vietnam since 2005 [2, 3].

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In this paper, we present two ongoing longitudinal studies on community response to noise. The first study is the socio-acoustic survey on community response to aircraft, road traffic, and railway noises in four cities of Vietnam: Hanoi, Ho Chi Minh City, Hue, and Danang. The second study is on community response to the step changes in exposure to the noise caused by the Shinkansen, the conventional railway, and the construction work going on in Kumamoto.

2. NOISE PROJECT IN VIETNAM

Vietnam is a developing country in Southeast Asia, and it is currently plagued with several environmental issues. Over the past decade, this country has experienced a period of market liberalization, and tremendous changes have occurred in its economy and industry—changes that have, on one hand, enhanced developmental opportunities, and on the other hand, have made the country more vulnerable to environmental deterioration. Among the pressing environmental concerns, the noise generated by transportation is an increasingly noticeable and serious problem in large cities such as Hanoi and Ho Chi Minh City. The execution of appropriate measures is therefore critical to coping with the current situation; however, no reliable data source of the community response to noise, which would help establish a practical noise policy, is yet available.

Table 1 Outline of noise project in Vietnam

	Hanoi	Hue	Da Nang	Ho Chi Minh City
2005	Road traffic	-	-	-
2006	Psycho-acoustic experiment	-	-	-
2007	-	-	-	Road traffic
2008	-	-	-	Aircraft + Road traffic
2009	Aircraft + Road traffic	-	-	-
2010	Railway			
2011	-	Railway, Road traffic	-	-
2012	-	-	Aircraft, Road traffic	-

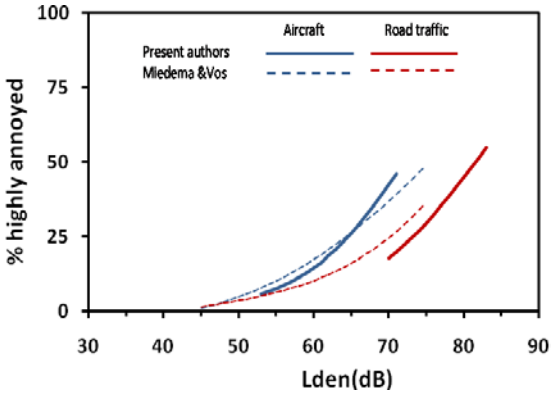

Fig. 2 Comparison between dose-response curves for aircraft and road traffic noises as determined by Miedema & Vos and present authors

The first socio-acoustic survey on community response to road traffic noise was conducted in Hanoi in 2005 and then in Ho Chi Minh City in 2007 [2]. In 2008, a combined aircraft and road traffic noise survey was conducted in Ho Chi Minh City [3], which was then followed by a similar combined survey in Hanoi in 2009. According to plans, a railway noise survey will be conducted in Hanoi in 2010, which will be followed by railway and road traffic noise surveys in Hue in 2011. Finally in 2012, aircraft and road traffic noise surveys will be conducted in Danang. Fig. 1 shows a map of Vietnam in which the names of the surveyed cities have been encircled. An outline of the noise project in Vietnam is summarized in Table 1.

Fig. 2 shows a comparison between the dose-response curves for road traffic and aircraft noises as obtained by Miedema and Vos (dotted lines) and those obtained by the present authors (solid lines). The dose-response curve for road traffic noise in Vietnam was drawn on the basis of the data obtained in Hanoi in 2005 and in Ho Chi Minh City in 2007. The dose-response curve for aircraft noise was drawn on the basis of the data obtained in Ho Chi Minh City in 2008. As shown in Fig. 2, the dose-response curve for the aircraft noise in Ho Chi Minh City was in good agreement with the curve obtained by Miedema and Vos. In contrast, the dose-response curve for road traffic noise obtained by the present authors is slightly lower than that obtained by Miedema and Vos. However, the dose-response curve for aircraft noise is drawn only on the basis of the data obtained in Ho Chi Minh City, and the exposure to road traffic noise in Hanoi and Ho Chi Minh City is limited to a higher noise exposure range. In order to draw the accurate dose-response curves for aircraft and road traffic noises in Vietnam, data from other, smaller cities such as Hue and Danang should be obtained.

Fig. 1 Map of Vietnam

3. STUDY OF STEP CHANGE IN SHINKANSEN NOISE EXPOSURE

3.1 Background and purpose

In 1964, the first super express train line in the world, the Tokaido Shinkansen Line, was opened between Tokyo and Osaka. In 1975, the Sanyo Shinkansen Line was opened between Osaka and Fukuoka, Kyushu Island. Shinkansen lines were later developed in Kyushu and the northern part of Honshu. These trains have safely transported a great number of people to and from the main cities of Japan and were a significant factor in the rapid economic growth in Japan from the 1960s to the 1980s. However, even though the economy and transportation were greatly enhanced since the introduction of the Shinkansen, serious noise and vibration pollution have also been observed in the areas along the Shinkansen lines.

In 2011, the Kyushu Shinkansen Line will be opened between Fukuoka and Kagoshima. In the area from Kami-Kumamoto Station to Kumamoto Station, where presently only a conventional railway is located, a Shinkansen line and a conventional railway line are currently under construction. Since the construction will occur in four phases (see Fig. 4), the people living along the railway line will be exposed to a step change in noise in every phase.

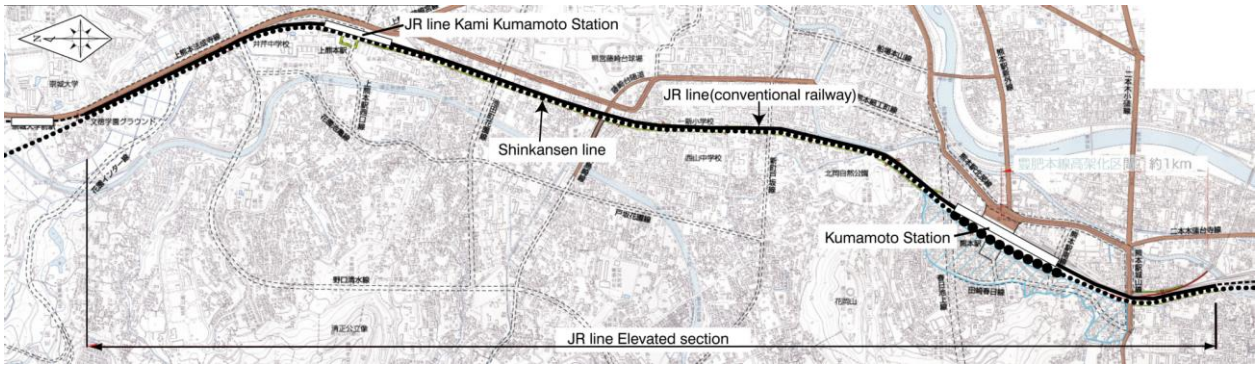

Fig. 3 Survey area for Shinkansen noise survey from 2009 to 2016

(a) Phase I from 2006 to 2011

(b) Phase II in 2011

(c) Phase III from 2011 to 2016

(d) Phase IV after 2016

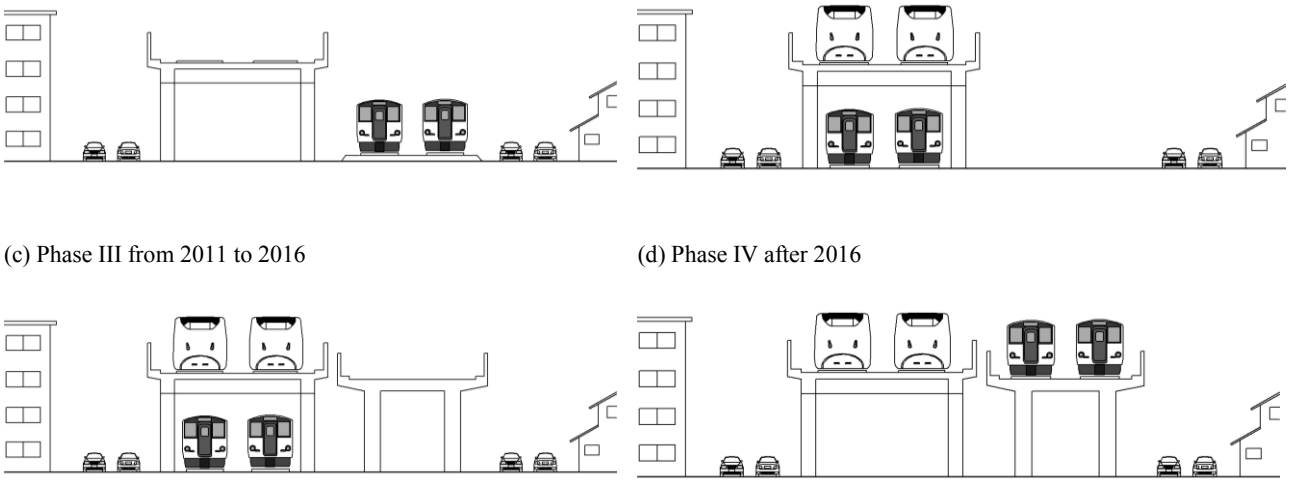

Fig. 4 Plan of socio-acoustic survey on step change in noise exposure from railways

Thus far, several social surveys on community response to the Shinkansen noise have been conducted in Japan. Sone *et al.* [4] conducted social surveys on the Shinkansen noise in areas along the New Tokaido and New Sanyo lines and compared the results with those obtained by the surveys on aircraft noise. Further, they discussed the application of several noise indices in evaluating the Shinkansen noise annoyance. Later on, Machida [5] showed the importance of the number of events, that is, the superiority of $L_{Aeq,24h}$ over L_{Amax} as the noise index, on the basis of several social surveys conducted in seven areas along the New Tokaido, Sanyo, Tohoku, and Joetsu lines. Both studies pointed out the effect of vibration on the noise annoyance on the basis of the respondents' subjective responses. Yano *et al.* [6] showed that the annoyance due to the Shinkansen noise was higher than that due to the conventional railway noise and suggested that this might be due to the stronger vibration caused by the Shinkansen than that caused by conventional railway.

Several studies from American and European countries have reported on the effects of step changes in noise exposures. For example, Fidell *et al.* [7] showed that there were no major differences in the sleep disturbance because of the changes in night-time aircraft noise exposure; however, in another study, *Fidell et al.* [8] discovered that the proportion of very or extremely annoyed respondents was remarkably greater than those predicted in the dose-response relationships determined by the social surveys before and after the introduction of a new runway. Ohrstrom [9] investigated the effects of a substantial road traffic noise reduction on annoyance, activity disturbances, and general well-being, and found significant improvements in

all these factors in the respondents' evaluations. Nilsson and Berglund [10] found that there was a slight but insignificant improvement in annoyance and activity disturbances after the erection of a noise barrier.

In this study, we attempt to investigate the effects of step change in the noise exposures on the community response to noise from Kami-Kumamoto Station to Kumamoto Station along the Kyushu Shinkansen Line. Further, we aim to contribute to the Japanese noise policies for Shinkansen noise, combined noise, and the step change in noise exposure.

3.2 Survey plan

(a) Survey area

The survey area is from Kami-Kumamoto Station to Kumamoto JR (Japan Railway) Station. Originally, only the JR line was in existence. The site to the east of the JR line was purchased for the construction of the temporary JR line. The Shinkansen line is being constructed at the site of the original JR line, as shown in Fig. 4(a). The survey site is set in an area 150 m on either side of the railway lines; approximately 4,000 houses exist in this area. The respondents are selected on a one-person-per-family basis and are divided into two groups, Groups A and B, each with a sample size of approximately 2,000.

(b) Survey phases

Phase I from 2006 to 2011

Currently, conventional trains run on railway tracks located on the east side of the Shinkansen line (see Fig. 4(a)). The major noise exposure in the areas along the lines is due to the conventional railway. A questionnaire survey will be administered to Group A in 2009 and 2010. Noise exposure will also be measured.

Phase II in 2011

The conventional railway line will be moved below the Shinkansen line, as shown in Fig. 4(b). The noise exposure will then be due to the conventional railway and the Shinkansen. A questionnaire survey will be administered to Group B in 2011.

Phase III from 2011 to 2016

The elevated conventional railway line will be constructed, as shown in Fig. 4(c). The major noise exposure will be due to the Shinkansen, the conventional railway lines, and the construction. Three kinds of noises will be combined. A questionnaire survey will be administered to Group A again in 2012.

Phase IV after 2016

This is the final stage of the railway line construction. The new elevated conventional railway line will be constructed on the eastern side of the Shinkansen line. The noise sources will be the same as those in Phase II, but the position of the conventional railway will be different (Fig. 4(d)). A questionnaire survey will be administered to Group B in 2016.

(c) Survey method

A distribute-collect method will be used. The key question, for example, in Phase III, is the annoyance due to the noise from the conventional railway, the Shinkansen, the ongoing construction, and due to a combination of these three noises. A standardized question to gauge the annoyance of the residents, as proposed by ICBEN (International Commission on Biological Effects of Noise) will be used during Phase III: "Thinking about the last 12 months or so, when you are here at home, how much does the following noise bother, disturb or annoy you: Extremely, very, moderately, slightly or not at all?"

(1) Conventional railway noise
(2) Shinkansen noise
(3) Construction noise
(4) Combined noise from the above three noise sources

4. SUMMARY

In this paper, we have provided an outline of the noise projects in Vietnam from 2005 to 2012. Further, we have discussed the study of the step change in Shinkansen noise exposure from 2009 to 2016.

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