Characteristics of vibration and noise in residential environment induced by road traffic and railway

by

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Presentation outline

- Research background
- Literature review
- Objectives of the study
- Methodology
- Results and discussion
- Conclusions
Environmental vibration and noise have been recognized as one of the major problems in residential environment.

(Source: Ministry of Environment, Japan)
Figure: Schematic diagram of current research
Literature Review

- Lee and Griffin (2012) investigated that total annoyance caused by combined noise and vibration was significantly greater than noise annoyance with both the window-open and window-closed condition.

- Morioka and Griffin (2010) reported that the frequency dependence of the equivalent comfort contours are highly dependent on vibration magnitude.

- Paulsen and Kastka (1995) reported that vibration influences the evaluation of noise annoyance and the assessment of the combined stimuli is dominated by noise.

- In a different study on combined effect of vibration and noise on annoyance, Howarth and Griffin (1991) found that the overall annoyance depends on the magnitudes of both stimuli and there might be interaction between effects of two stimuli.

- Howarth and Griffin (1990) showed that the vibration does not influence the judgment of the noise, but the noise could influence the judgment of the vibration.
Objective of the study

- The main objective of this study is to know the characteristics of vibration and noise in residential environments.

The main research objective is divided into following sub-objectives:

1. To explore the significant direction of vibration of buildings.
2. To find out dominant range of frequency for vibration and noise in buildings for substructure level and second floor.

![Three orthogonal directions related to structure](image)
**Methodology**

**Measurement**

- Railway-induced vibration and noise at 3 single-family Japanese houses.
- Road traffic-induced vibration and noise at 2 single-family Japanese houses.

**Figure:** Detail view of measurement

- Accelerometer
- Sound level meter

27 mtr. Saikyo line
Methodology (Contd)

Data Analysis

1. Fourier Transform and 1/3 Octave analysis was applied to know frequency contents of the vibration and noise from their spectra.

2. For the evaluation of vibration magnitude Vibration Level (VL), maximum transient vibration value (MTVV), and vibration dose value (VDV) were calculated.

3. Sound pressure level (SPL) was calculated for evaluation of noise.
Results and discussion

- **Vibration**
  - Vibration magnitude was evaluated in terms of maximum transient vibration value (MTVV), vibration dose value (VDV) and root mean square (Arms) of Vibration level (VL)

- **Vertical (z-axis) vibration was observed bigger in all three orthogonal directions in all houses.**
Results and discussion (Contd)

- **Vibration**

  - To summarize results of dominant frequencies, center frequencies in 1/3 octave center band was chosen as the reference values.

  - Frequencies of the 5 Hz and 6.3 Hz are observed as highly dominant in the substructure level and second floor for horizontal direction.

  - Frequencies of the 10 Hz and 12.5 Hz are observed dominant in the substructure level and second floor for vertical direction.
Results and discussion (Contd)

Noise

- Frequencies of 150 Hz and 350 Hz are observed dominant from their spectra.
- It can be seen from 1/3 octave spectrum that the value of SPL is 41.94 dB at 2 kHz.
Conclusions

- Waveform of vibration and noise record is found to be modulated amplitude, transient in nature with varying duration.
- Limited number of dominant frequencies are observed for all five houses.
- Dominant frequencies in both the vertical and horizontal directions are affected by several factors such as frequency content of excitation forces, dynamic characteristics of the ground, and dynamic characteristics of the house structure.
- Vertical (Z – axis) vibration is observed bigger in all three orthogonal directions in all five houses.
- Vibration induced by surface railway is seen highest in magnitude among all sources.
- The magnitude of sound pressure level is seen maximum at 2 kHz.
References


Thank you very much for kind attention !!!