Case Studies of Field Measurements of Low Frequency Sound and Complaints by a Non Profit Organization for Supporting Noise, Vibration and Low Frequency Noise Complainants in Japan

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The number of noise complaints of Japan is around 15,000 a year and there are about 200 complaints of low frequency noise. In our NPO (Non Profit Organization), the specialists as volunteers on noise, vibration and low frequency noise take counsel with the complaints and measure the low frequency noise. It is difficult to measure the noise in the night by local government, and in such cases we measure the noise in the night for a long-time in complainant's house. However, sometimes we cannot find the appropriate level of low frequency noise, though the complainant appeals for the serious damage by low frequency noise. Therefore we measured the complaint's reaction at the same time with low frequency noise in the complainant's house. We analyzed the correlation between the complaint's reaction and measured low frequency noise. In many cases, we cannot find out the correlation between the measured low frequency noise and complainant's reaction.

1. INTRODUCTION

In our Non Profit Organization (NPO), the specialists as volunteers on noise, vibration, and low frequency noise (LFN) advise the complainants to solve the problems. If there is a demand from the complainant, we measure the noise and low frequency noise. The problems sometimes cannot be solved by local government and continue long time. These problems are on noise problems between neighborhoods and on low frequency noise. The consultations have much difficulty to solve these problems.

In addition, the staffs of local government have not sufficient measuring apparatus, and knowledge on low frequency noise. It is difficult to measure in the night and for long term. Many complainants continue to complain the noise or low frequency noise and they have some mental and physical disorders.

If it needs, we measure the noise and low frequency noise thorough one or two nights. In many cases the measured levels are lower than the low frequency reference value of Japan and hearing threshold level, though complainants complain very much. It is thought that one of the causes is ringing in the ears of the complainant [1, 2, 3].

The complainants do not accept the ringing ear. There is no otolaryngologist on ringing ear below 100 Hz.

It is demanded in the Japanese guide book on low frequency noise to confirm the correspondence between the sound source movement and the annoyance reaction. In the measurement if the time history of some frequency component and the annoying reaction is identified, we can find the causal frequency.

If any frequency does not correspond to the annoyance reaction, the low frequency noise is not the cause of complaint.

Therefore we asked the complainant to write the annoyance level. We

measured the noise and low frequency noise at the same time in complainant's house. Window(s) and door(s) were closed. We analyzed the correlation between the level of each frequency and the annoyance level, and we try to extract the causal frequency. In some cases the annoyance data are not continuous in certain time. In those cases we calculated the correlation coefficient only in the time of existence of annoyance data.

2. METHOD

2.1. SUBJECTS

We inspected six cases by the request of measurement of low frequency noise for two years (one man and five women). The ages are from thirties to nineties. According to the hearing of these people, they asserted that they were annoyed by serious low frequency noise by air conditioning outdoor units or unconfirmed sources.

2.2. Measuring equipment of low frequency noise

Using a low frequency sound level meter NA-18A(RION), we recorded equivalent sound pressure level ($L_{Geq,\ 10\ s}$, $L_{eq,\ 1/3oct,\ 10\ s}$), maximum (LGmax, Lmax, 1/3oct at each 10 s) up to 6,000 automatically about G weighted level and one-third octave band level from 1 Hz – 80 H at each 10 s. In addition, for reference, we recorded the sound pressure levels measured by sound level meter NA-20(RION) into a notebook computer.

2.3. Annoyance record of the complainant

Annoyance level was written on a paper or recorded by annoyance collecting apparatus (iPAQ) (see Photograph). The life actions such as going to bed or watching TV were memorized by the complainant, and that time was omitted from analysis. Annoyance was categorized into five levels.

A1: not at all,
A2: not so annoyed,
A3: a little annoyed,
A4: considerably annoyed,
A5: very much annoyed.
The decimal number also can be used.

3. RESULTS

We describe the measurement results and the main contents of the complaint in each case. Measurement results are shown in figures. (1) Time history of annoyance level, (2) Equivalent sound pressure level of low frequency sound in the time of low or high annoyance level ($L_{Geq,\ 10\ s}$, $L_{eq,\ 1/3oct,\ 10\ s}$). (3) The correlation coefficient between the

Photo: Annoyance collecting apparatus (iPAQ).

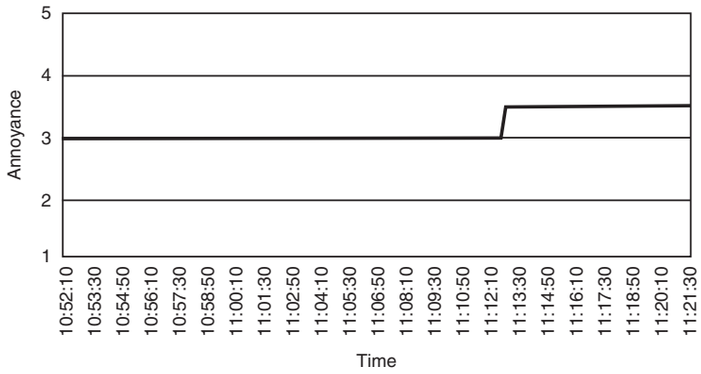

Figure 1.1. Time history of annoyance level.

equivalent sound pressure level at each frequency component and annoyance level at each 10 seconds.

3.1. Case 1 (female, 42 years)

Measurement time: from 10:52 to 11:21

Sound source: unknown or the outdoor unit of low-temperature storage in neighborhood. The running time is from 8:00 to 22:00.

Measurement place: 80 cm apart from the window faced to the sound source and 120 cm height in the ground floor.

Complaint: The outdoor unit was set half a year ago. After that time, she hears the sound of "woon or won-won". She has the feeling of vibration and feeling of pressure as if she is in an airplane or in a high speed train and she is irritated very much. She lives together with her parents and the parents hear the sound but have not special feeling on their heads or bodies.

Result: As shown in Figure 1.2, the level of low-frequency noise has reached to the threshold level at 50, 63 and 80 Hz. But the change of low frequency noise level does not correspond to the change of annoyance level (red and blue line). Figure 1.3 shows that the correlation coefficients are very small. There remains small possibility that the noise of over 100 Hz has the cause. But the outdoor unit may not be the cause.

3.2. CASE 2 (FEMALE, AGE 38)

Measurement time: from 21:45 to next day 7:01

Sound source: Unknown

Measurement place: 50 cm apart from the window glass of the bedroom, 120 cm height second floor of an apartment.

Complaint: from 3 months ago, she hears the sound of "kiin, wiin, boon, waan" in the night and she cannot sleep well. She lives with her parents but she only hears the sound.

Result: As shown in Figure 2.2, the level difference is very small between the time of low annoyance and high annoyance. All the frequency components are below the hearing threshold curve. All correlation coefficients are negative as shown in Figure 2.3. These negative correlation coefficients show that the annoyance increased when the level dropped. The cause of this case may be internal factors, such as tinnitus.

3.3. CASE 3 (MALE, AGE 93)

Measurement time: from 6:00 to next day 10:00 and from 10:50 to 13:00

Sound source: unknown (Complainant has unconfirmed suspicion, such as air conditioning outdoor unit on the roof of an apartment house).

Measurement place: Top floor of 9-storey apartment, center of a room, 120 cm height.

Complaint: He is aware of his tinnitus, but suspects the combined effects of low frequency noise. Formerly

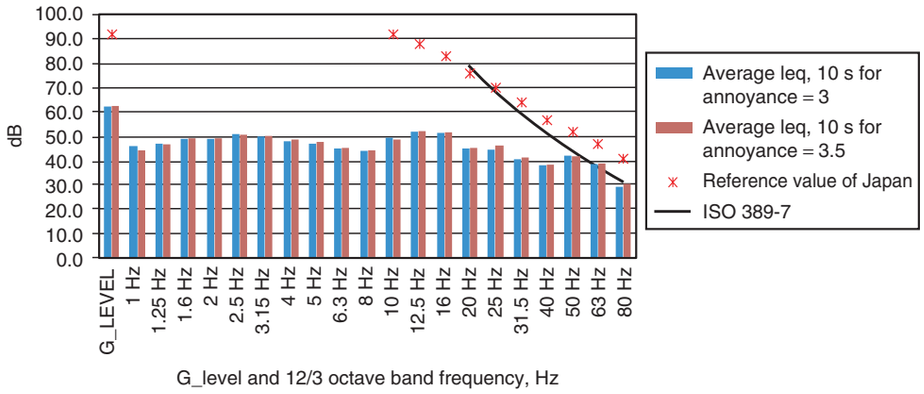

Figure 1.2. Average levels of low-frequency noise for different annoyance levels.

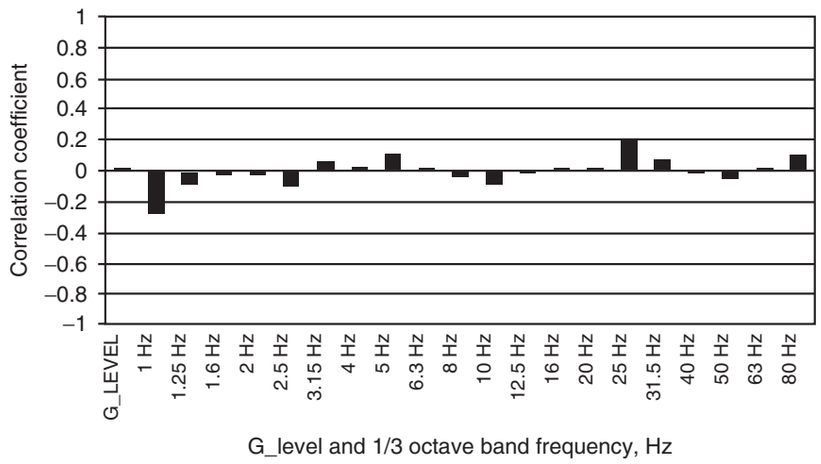

Figure 1.3. Correlation coefficients between annoyance levels and low frequency noise levels.

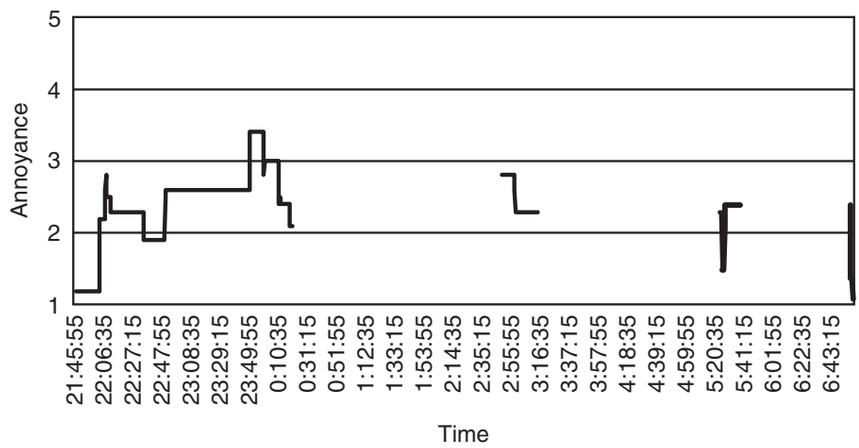

Figure 2.1. Time history of annoyance level (21:45:55-0:20:00, 2:50:05-3:15:05, 5:25:05-5:40:25, 6:59:05-7:01:25).

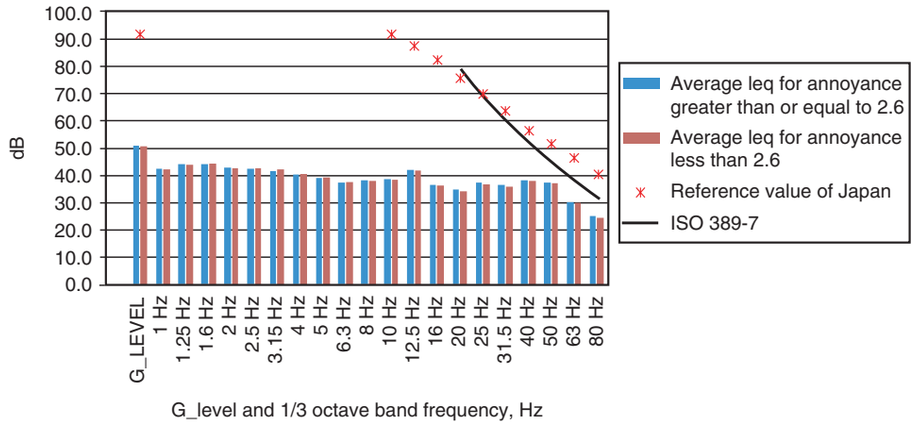

Figure 2.2. Average levels of low-frequency noise for different annoyance levels.

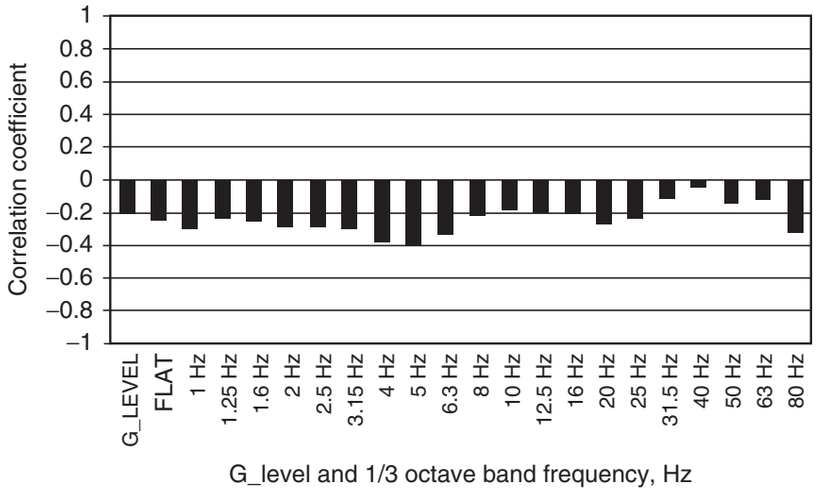

Figure 2.3. Correlation coefficients between annoyance levels and low frequency noise levels.

he has been suffered from insomnia, but now becomes better by using a medicament for introducing sleep.

Result: As shown in Figure 3.2, the level of the low-frequency noise is higher than the threshold curve at 50 Hz, 63 Hz, and 80 Hz. The consistent relationship between the low frequency noise level and the annoyance level has not been observed. In addition, as shown in Figure 3.3, the correlation coefficients are almost negative.

3.4. CASE 4 (FEMALE, AGE 73)

Measurement time: from 15:46 to next day 15:35

Sound source: unknown (She has some suspicion to air conditioning outdoor units, which are set on the top of a home for the aged people. This home is 110 m away from her house.

Measurement place: at the center of a room of the second floor, 120 cm apart from a window, 130 cm height.

Complaint: She hears the sound of "kiin, boon, woo, goo, don-don". She feels this sound in her head. Sometimes she feels body vibration and she is afraid that there occurs bad effect by low frequency noise.

Result: As shown in Figure 4.2, the level of low frequency noise is lower than the threshold curve at any frequency component. Figure 4.3 shows negative correlation coefficient at all frequency components except 50 Hz. 50

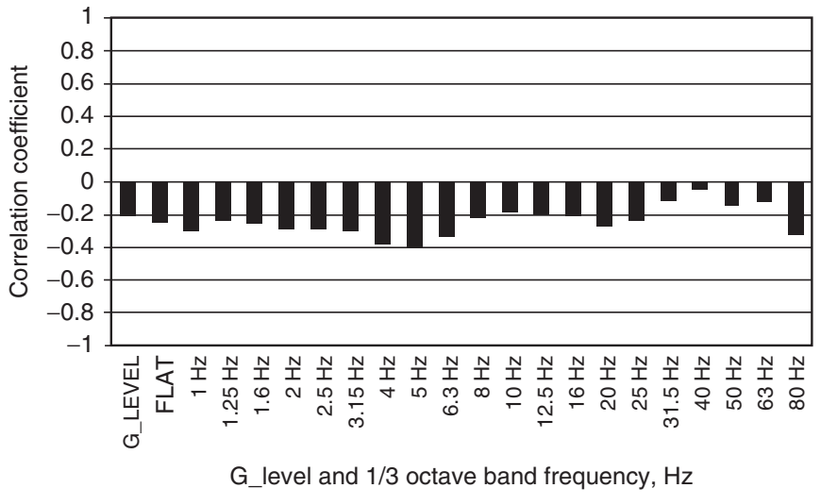

Figure 2.3. Correlation coefficients between annoyance levels and low frequency noise levels.

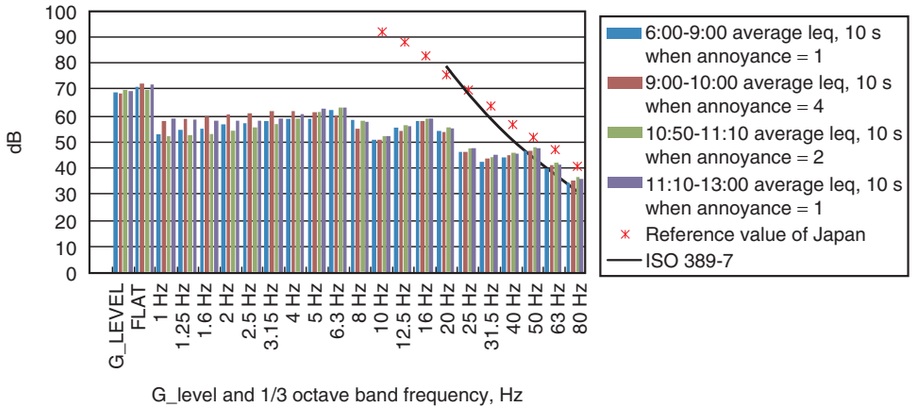

Figure 3.2. Average levels of low-frequency noise for different annoyance levels.

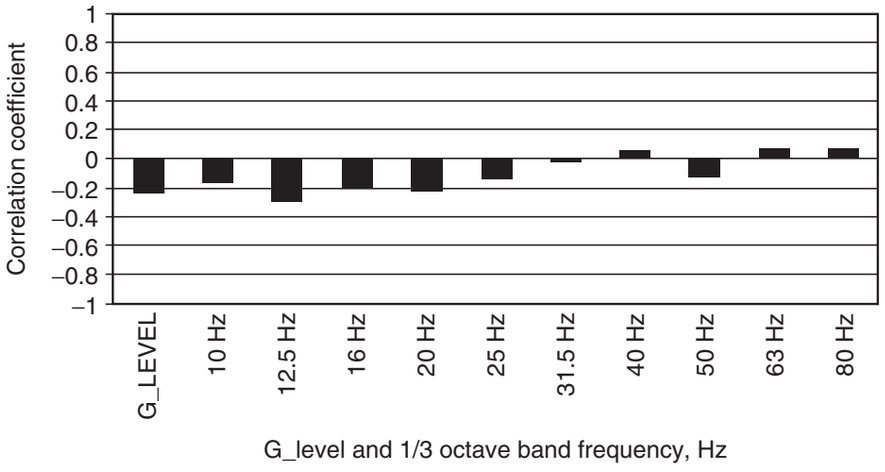

Figure 3.3. Correlation coefficients between annoyance levels and low frequency noise levels.

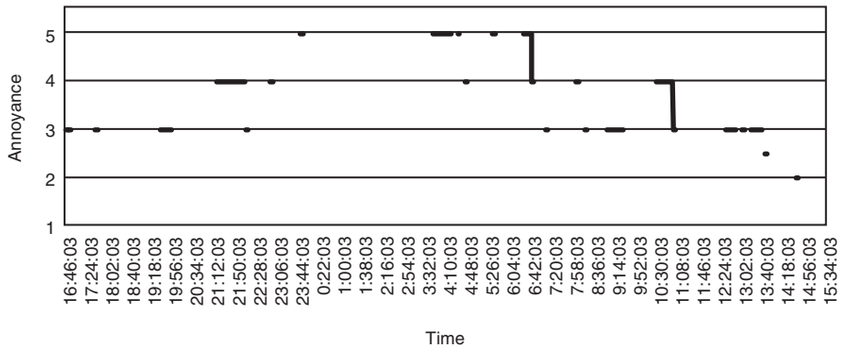

Figure 4.1. Time history of annoyance level.

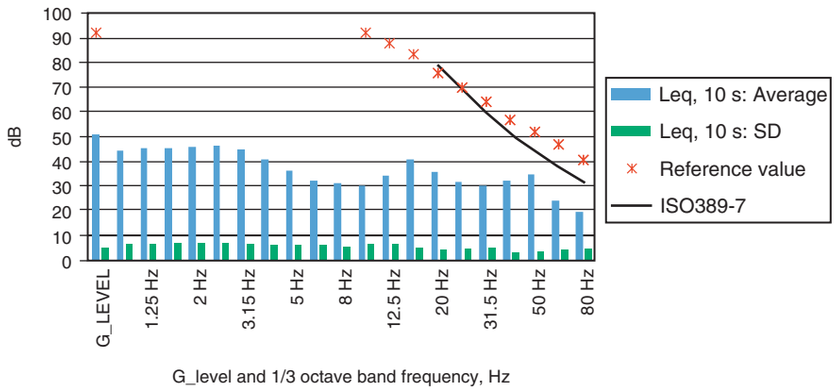

Figure 4.2. Average levels of low-frequency noise for all annoyance responses.

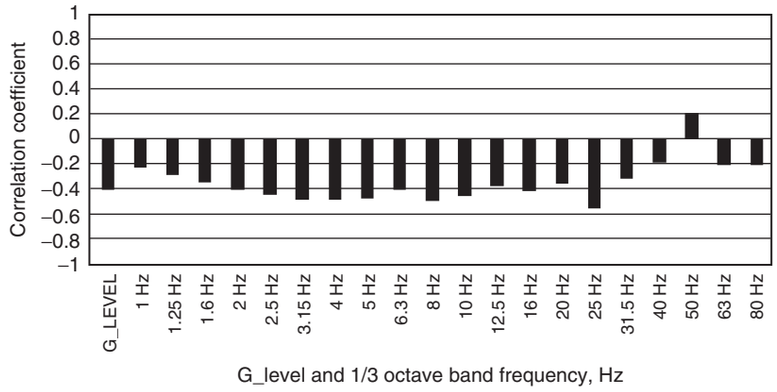

Figure 4.3. Correlation coefficients between annoyance levels and low frequency levels.

Hz rises to about 35 ~ 40 dB early in the morning from 0:06 to 7:56 at midnight by some sources. The level is lower than 44 dB (threshold of ISO). Considering her age, this 50 Hz component may not be the cause of the complaint.

3.5. CASE 5 (FEMALE, AGE 61)

Measurement time: from 16:56 to next day 15:32

Sound source: unknown, she has some suspicion to low-frequency noise from the exhaust vent in the hallway of

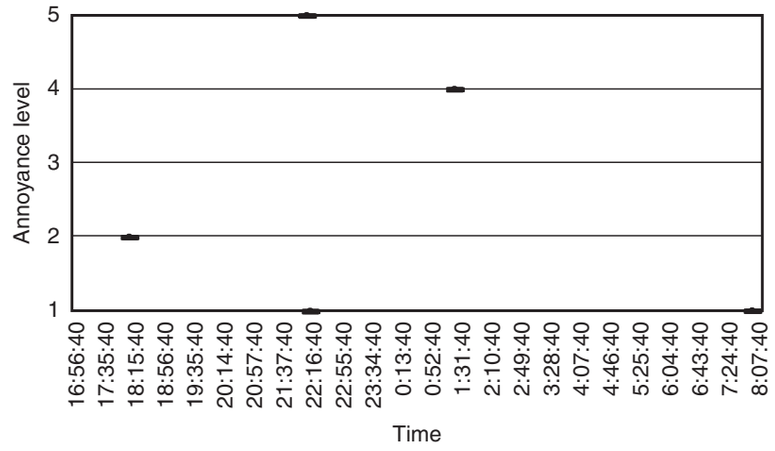

Figure 5.1. Time history of annoyance level (18:11:40-18:40:40, 22:14:40-22:15:40, 22:20:40-22:22:40, 1:31:40-1:33:40, 8:13:40-8:15:40).

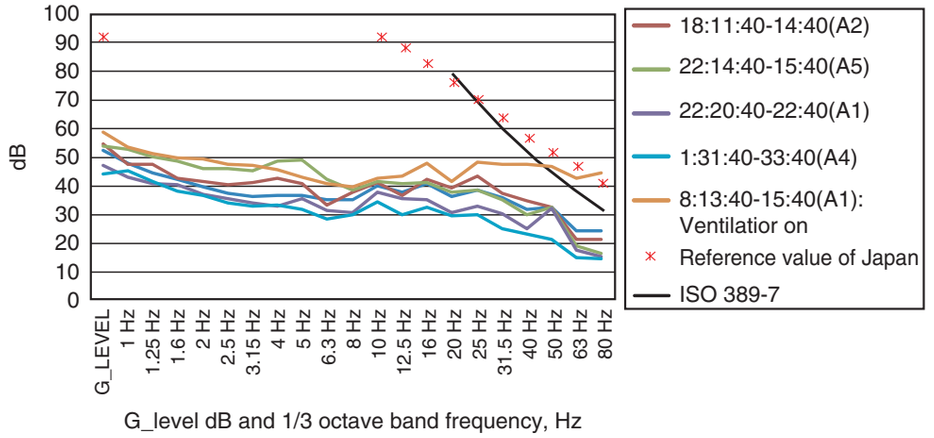

Figure 5.2. Average levels of low-frequency noise for different annoyance levels.

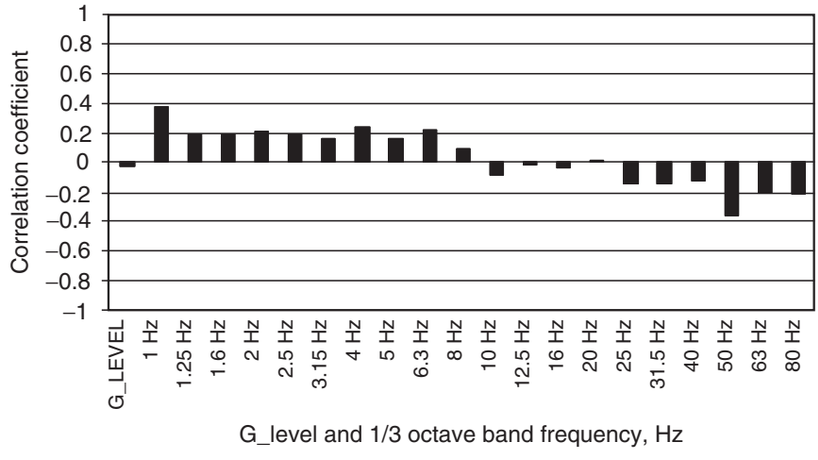

Figure 5.3. Correlation coefficients between annoyance levels and low frequency levels.

an apartment house. She took countermeasure to reduce the noise of the vent which belongs to her.

Measurement place: in a bath room located on the first floor of a four-story apartment, 130 cm height, the ventilator is shut down.

Complaint: She feels the sound of "Boon" at any room. She does not use an air conditioner and a television, and lives with windows closed always.

Result: Figure 5.2 shows that low-frequency noise is considerably lower than the threshold of ISO. When the ventilator in the measuring room moves, the level exceeds the threshold. But at that time the annoyance level is very small. Except this time the correlation coefficients are small.

To check the tinnitus she entered into an anechoic chamber of AIST (The National Institute of Advanced Industrial Science and Technology) and she said that she hears the same sound in her house. She convinced at that time that the noise in her house is tinnitus. However, when she returns to her house, she hears another low-frequency sound and the anxiety has not been resolved.

3.6. CASE 6 (FEMALE, AGE 36)

Measurement time: from 21:11 to 22:50
Sound source: unknown (She hears deep bass sound from the next neighbor).

Measurement place: Top floor of the three-story apartment, 13 cm from the wall, 13 cm height, 72 cm apart from the window. This position was decided by

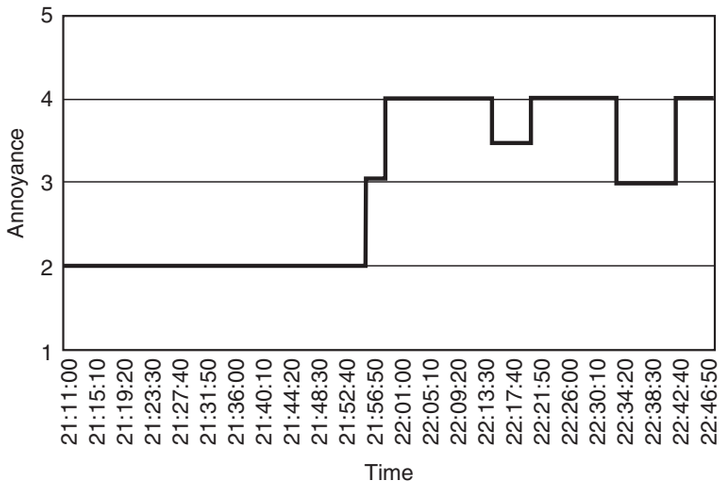

Figure 6.1. Time history of annoyance level.

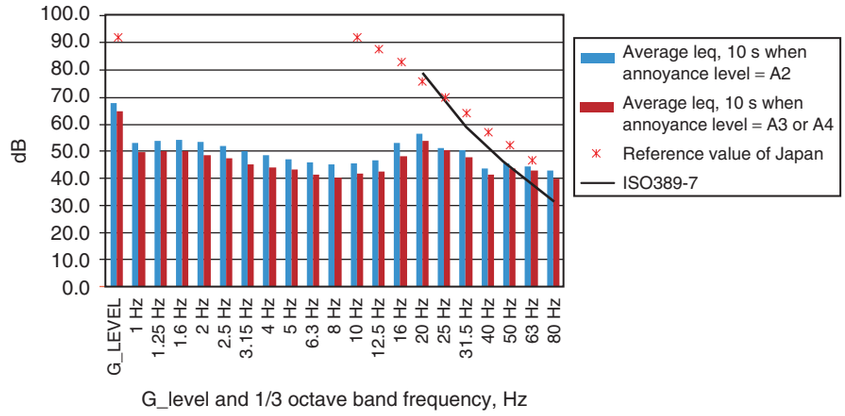

Figure 6.2. Average levels of low-frequency noise for different annoyance levels.

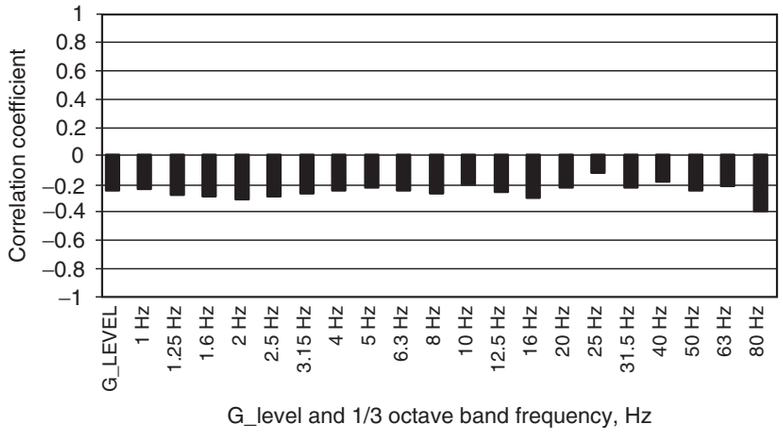

Figure 6.3. Correlation coefficients between annoyance levels and low frequency levels.

the complainant's designation. The house is about 100 m apart from heavy traffic national highway.

Complaint: the sound of video games comes in from the next door residents, from about half a year ago.

She hears the sound whole day and especially from midnight to early morning. She says that when the neighbor is absent, the noise does not come in.

Result: We measured the noise confirming that the neighbor is at home.

As shown in Figure 6.2, 63 and 80 Hz exceeds the threshold and at 80 Hz exceeds the reference value. But as shown in Fig. 6.2 highly annoyed level is not larger than the small annoyed level. A positive correlation coefficient cannot be found at any frequency.

In addition, there is a tendency that in the night annoyance increases, but the sound level is lower. Sound source, which complainant appeals, cannot be found.

4. DISCUSSION AND CONCLUSIONS

1. In many cases the time history of the annoyance level did not correspond to the time history of any frequency component. In these cases the causes were not low frequency noise. But these complainants did not accept the results.
2. In these cases, we cannot find the causal low frequency noise below 80 Hz. There rest the possibility of causal frequency over 100 Hz. But in our opinion, the possibility is very small.
3. If there is no causal noise, we have to find another cause and analyze the mechanism of the occurrence of complaint. Perhaps the ringing ear has some effect on complaint. In some cases they have some bad human relationships to neighbours.
4. Sometimes mass media of television, newspaper and articles in internet have effects on these phenomena. Almost every time, television insists that low frequency noise cannot be heard but very harmful.
5. Perhaps the effect of ringing ear and the erroneous knowledge of mass media may be mixed in the brain.
6. To solve these problems, it is necessary to make a comprehensive system with medical doctors, psychological counselors, local governmental staffs, engineers and specialists on noise and low frequency noise. [4].

ACKNOWLEDGEMENTS

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5 NOISE POLLUTION CHECKPOINTS IN PATNA SOON

Five automatic ambient noise pollution monitoring stations will soon be installed in Patna to help Bihar State Pollution Control Board (BSPCB) monitor the noise level in the state capital. A digital screen at these stations would automatically display the noise level for public information. The checkpoints will be set up at Gandhi Maidan bus stand, Patliputra Industrial area, Patna City chowk, Indira Gandhi planetarium and Beltron Bhawan (Shashtri Nagar). Patna is the eighth city in India and the first in the state where continuous noise monitoring stations are being installed. Currently, there are 35 such stations across seven cities, namely New Delhi, Mumbai, Lucknow, Kolkata, Bangalore, Hyderabad and Chennai. The results of permanent monitoring will be available on the BSPCB website as well as the Central Pollution Control Board (CPCB) website. "Earlier, noise pollution level was monitored randomly, mainly during festivals. But, with setting up of continuous automatic monitoring stations by April end, we would be able to know which places in the city exceeded the specified noise level," BSPCB chairman Subhash Chandra Singh. BSPCB scientist SN Jaiswal explained that these stations would monitor the intensity of noise and after collecting permanent data, the BSPCB would be able to formulate an action plan to control the noise pollution level in the city. According to the Noise Pollution (Regulation and Control) Rules, 2000, as amended in 2012, the noise level at market places between 6am to 10pm should be below 65 decibels (dB). During Dussehra, BSPCB had monitored noise pollution level at 65 different locations in Patna for three days and all exceeded the specified level.

HOSPITALITY BUSINESSES PROTEST NOISE RULES

Sunshine Coast businesses are rallying behind a proposal to eliminate strict noise level regulations, which they say are crippling the hospitality industry. Calls to remove the stringent decibel monitoring were just one of a dozen ideas being considered by the State Government as it reviews its liquor and gambling laws. Attorney-General Jarrod Bleijie said the primary focus of the discussion paper was to cut red tape for industry that was regulated by the laws. Caloundra businessman Bill Darby is part of the expert panel that will review the public feedback on the paper and present the information to the government. He will represent the Sunshine Coast Chambers of Commerce Alliance, which had a strong say in the discussion paper. He said the current strict "one-rule-for-all" regulations were hindering the vibrancy of the Coast's hospitality industry. "We are falling behind in the quality of hospitality music and entertainment offering for both people that live on the Coast and also tourists because of layers of legislation that have been added over the years," Mr Darby said. "It is making it very difficult to operate a good, diverse and vibrant range of restaurants, cafes and bars. The No.1 thing that the hospitality industry on the Sunshine Coast wants to see is the removal of decibel limits from the Act, so we can be more consistent with the other states where first occupancy rights are respected in the legislation."

COUNCIL FINED £25,000 FOR WORKERS HAVS

Wirral Borough council has been fined £25,000 after 29 employees were diagnosed with a debilitating condition that has left them with ongoing problems with their hands. The Health and Safety Executive (HSE) prosecuted Wirral Metropolitan Borough Council after workers in the Parks and Leisure Department were affected by Hand Arm Vibration syndrome. The council workers' duties included grass, hedge and tree cutting, primarily using vibrating equipment. A HSE investigation showed the council did not properly assess the risks they faced of using such equipment or implement suitable control measures, such as limiting exposure to the tools or providing alternatives.