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OCCURRENCE AND EFFECTS OF LOW FREQUENCY NOISE

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INTRODUCTION

There are two sorts of low frequency noise problems in Japan. In the first sort, very low frequency noises cause windows or doors to vibrate and hence they emit rattling noises. The threshold level of rattling noise is 65∿70dB minimum but usually it is about 80dB. Sometimes low frequency noises cannot be directly heard, but they are found by the existence of rattling noises. In these cases the sound sources are diesel engines, compressors, furnaces in large factories, Shin-kansen (very rapid train) and highway bridges etc. In the second sort, the low frequency noise can be directly heard or felt. In many cases main frequencies are 20∿80Hz. The symptoms are insomnia, increase of heart beat and feeling of pressure on the head etc. In these cases the sound sources are boilers, compressors, freezers in supermarkets, and idling of automobiles etc. There were only 85 low frequency noise problems by the survey of Environment Agency of Japanese Government. But in the community noise problems, there are many low frequency noise problems. For examples, in the community noise problems, there are 25% idling noise problems of automobiles, 6.5% coolers noise problems and 3.4% air-conditioner noise problems, which contain many low frequency noise components.

LOW FREQUENCY NOISE EMITTED FROM HIGHWAY BRIDGES

An expansion joint of a highway bridge is impacted by a heavy truck and very low frequency noise is emitted from the highway. Low frequency noise is mainly radiated by vertical vibration of the spans of the bridge. The low frequency noise vibrates the windows or doors within 50m from the bridge and rattling noises are emitted from

them. The low frequency noise near "Nishi-Meihan Highway" bridge is shown in fig.1. Maximum of over all level is 95∿105dB just under the bridge. Many sufferers near this highway bridge brought a lawsuit to a district court. Inquiries of 22 persons near this bridge was done and high correlation coefficients are shown in Tab.1. The table shows the following.
(1) According to approaching to the bridge, rattling noises and the sound of "don" like a far cannon increase.
(2) Physical phenomena like "rattling noises" and the sounds of "don" have large correlation to psychological aspects like "fear, disturbance of thinking, request of removal". And these psychlogical aspect has large correlation to some symptoms of "insomnia, headache, symptoms like cold".

LOW FREQUENCY NOISE EMITTED FROM VERY RAPID TRAIN

It is said that many persons within 100m from Shin-kansen (very rapid train) are annoyed by vibrations and noises. Vibrations are not so large more than 100m apart from Shi-kansen, but low frequency noises are about 80∿90dB, which can vibrate windoors or doors. Main low frequency components are about 1∿63Hz as shown in fig.2. When the top of a train passes, sometimes very low frequency noise of 1Hz appears. SPL of LFN changes according to the velocity of Shin-kansen as shown in fig.3. Many persons more than 100m apart from Shin-kansen may be influenced by LFN.

LOW FREQUENCY NOISE EMITTED FROM INJECTION MOLDING MACHINE

There is an injection molding machine for synthetic resin, which has 1500 tons rated force. A man, who lives about 20m apart from the machines, complains vibration feeling of "Don Don" once or twice per a minute. But vibration is not so large as shown in fig.4 and LFN is a little large level than the threshold of hearing as shown in the same figure. This sufferer says that he can feel vibration by ears and not by feet. Aurthor cannot identify the vibration nor LFN. Origin is vibration of the machine but he feels LFN emitted by the vibration.

CRITERION TO AVOID PROBLEM

The nuisance occurred by LFN is owing to the rattling noise and the hearing of LFN itself. The minimum of thresholds of occurrence of rattling noise is 65∿70dB (line AB) and the minimum of thresholds of hearing is line BC as shown in fig.5. LFN below the line ABC occurrs no problem. But there are many LFN source in community of humankind, and this line is too difficult to clear. Line DEF by Dawson[1] or a little lower line is maybe appropriate. When LFN is between ABC and DEF and there is a complainant, it is necessary to

consult between a complainant, a man with LFN source and a specialist of a public institution.

REFERENCE

1) H.Dawson, Practical aspects of the low frequency noise problem, Journal of low frequency noise and vibration, vol.1, No.1, p28~44, 1982.

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item A	item B	Correlation Coefficient
distance from bridge	level of LFN	-0.81
	rattling noise	-0.75
	sound of "don"	-0.87
	pressure feeling on head	-0.70
	disturbance of thinking	-0.86
level of LFN	sound of "don"	0.86
	vibration of floor	0.75
	pressure feeling on head	0.81
	vibration feeling of body	0.81
	nausea	0.79
rattling of window	sound of "don"	0.84
	fear	0.70
	insomnia	0.75
	request of removal	0.81
	headache	0.80
	disturbance of thinking	0.84
	symptom like cold	0.74
sound of "don"	pressure feeling on head	0.86
	vibration feeling of body	0.72
	request of removal	0.72
	headache	0.71
	disturbance of thinking	0.82
	rat decrease	0.71
vibration of floor	nausea	0.82
noisy	insomnia	0.88
	headache	0.77
	disturbance of thinking	0.79
fear	insomnia	0.70
	feel languid	0.73
disturbance of thinking	headache	0.76
	symptom like cold	0.77
insomnia	feel languid	0.71
ringing in ear	symptom like cold	0.76

Tab.1 Correlation coefficients near Nishi-Meihan highway bridge

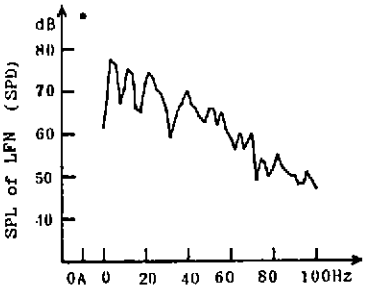

Fig.1 LFN (SPD) near a house (5m apart from a highway bridge)

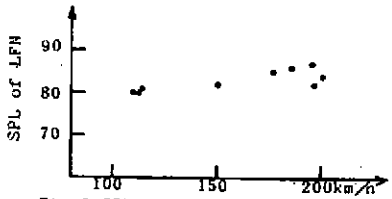

Fig.3 SPL of LFN and velocity of Shin-kansen (123m apart from Shin-kansen)

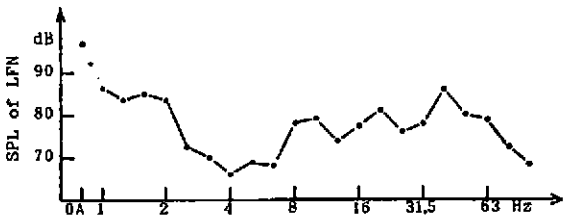

Fig.2 LFN of Shin-kansen (200km/h, 20m apart from Shin-kansen)

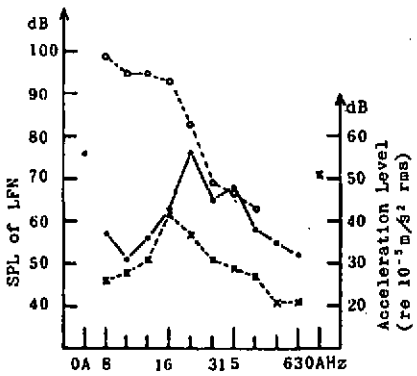

Fig.4 LFN (—·) and Acceleration (×---×) emitted by injection molding machine, and the sufferer's threshold of hearing (∘----∘)

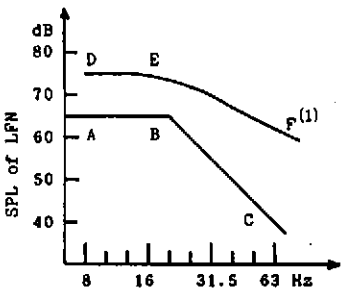

Fig.5 Empirical criterion to to avoid occurrence of LFN problem