

## EVALUATION AND CONTROL OF CONSTRUCTION NOISE : THE STATE-OF-ART

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### INTRODUCTION

Construction noise is one of the important sources of environmental noise, as well as the industrial and varioud traffic noises. In Japan, the limit of A-weighted sound pressure level for constructions works, the allowable time period of construction works in a day and the allowable continuous workd at the same construction site have been specified in the Noise Regulation Act-1968. In this Act, the regulation of construction noise is aimed at the individual construction work which uses a specified construction machinery.

Owing to the special features of construction works, there still remain several problems concerning the evaluation and control of construction noise.

### SPECIAL FEATURES OF CONSTRUCTION WORKS

Special features of construction works from the viewpoint of noise are summarized as follows :

- (1) Construction works continue for a finite time period. Even in the case of a large-scaled construction work, it would finish after one to several years term.
- (2) With the advance of construction works, types of construction machines and the related noise characteristics change widely.
- (3) In many cases, noise sources, such as the earth-moving machinery, move randomly in the construction site. Also, heavy vehicles which carry the materials to and from the construction site might often become important noise sources.
- (4) There are various kinds of construction works which radiate single or repeated impulsive noises. Also, the noise radiated from the construction

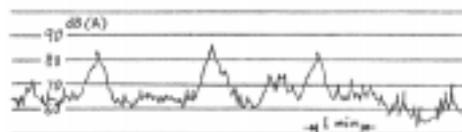


Fig. 1 Example of time history A - weighted sound pressure level at the construction site.

machines varies with the load condition.

EVALUATION OF CONSTRUCTION NOISE

Adove-mentioned features of construction works would result in the difficulties for the evaluation of noise. In general, it is necessary to deal with the construciton noise from two different viewpoints, i.e. the hearing protection of construction workers and the protection of living environment, neighbouring the construction site. In this paper, the noise problems affecting the community environment are described.

(1) Envaluation of construction noise radiated from the individual machinery or work.

Construction noises radiated from the individual machinery or work are important as the basis for the evaluation of the overall construction noise. These data are also necessary for the rating or labelling of machines.

In the Noise Regulation Act (Japan), the limit of A-weighted sound pressure level is specified at the position of 30m apart from the boundary of construction site. Here, A-weighted sound specified in the standard on sound level meters. Also, evaluation of sound pressure level is carried out by considering the time varying characteristics of noise.

For the direct measurement and evaluation of construction noise, ISO Standard 4872 would become the general fuidelines. Also, in the case of earm-moving machinery, it is necessary to consider the variatin of the position and load condition of machinery. For this purpose, ISO 6395 is now under preparation. In order to check the validity of this draft proposal, the experimental investigations were carried out at the Japan Construction Method and Machinery Research Institute [1]. Here, following two

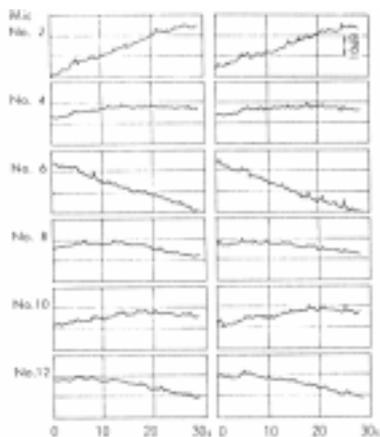


Fig. 2 Time history of A - weighted sound pressure level for the actual and simulated work cycles  
(1) Crawler tractor with dozer (forward)

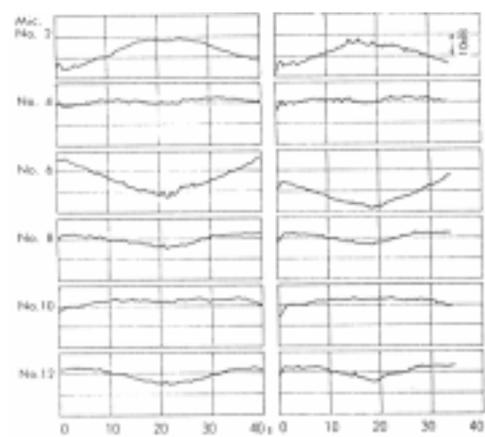


Fig. 3 Time history of A - weighted sound pressure level for the actual and simulated work cycles  
(2) Crawler loader

investigations were carried out by using four types of earth-moving machinery (Excavator, Wheel loader, Crawler loader and Tractor with dozer).

a) Comparison between actual and simulated work cycles. Examples of time history of A-weighted sound pressure level at several microphone positions are shown in Figs.2 and 3. From these results, the equivalent continuous A-weighted sound pressure levels averaged over the measuring hemi-sphere are shown in Table 1.

It is concluded that the simulated work cycles specified in the draft proposal would conform to the actual work cycles.

b) Number of microphone positions. Figure 4 shows the microphone arrangements for the investigation of checking the minimum number of microphone positions required to obtain the necessary accuracy of measurement. It is concluded that the six microphone positions would be sufficient for the measurement.

Table 1 Comparison of the actual and simulated work cycles

Types of machines	Work cycle	$L_{Aeq}$ [dB]	Measuring time period [ s ]	Running speed [Km / s]
Excavator	simulated	77.0	15.9	
	actual	76.0	18.4	
Wheel loader	simulated	80.6	14.0	8.7
	actual	80.1	13.2	9.3
Crawler loader	simulated	80.9	41.4	3.0
	actual	81.1	33.9	3.6
Tractor with dozer (forward)	simulated	76.4	26.0	2.4
	actual	75.6	28.8	2.1
Tractor with dozer (backward)	simulated	86.9	8.3	7.4
	actual	85.8	8.3	7.4

## (2) Evaluation of noise from overall construction works.

For the evaluation of the environmental impact of noise from overall construction works, it would be necessary to consider the long-term construction works, types of construction machines used in successive construction works, etc. This is closely connected with the problem of the prediction of construction noise.

From 1979 to 1980, the special committee (Chairman, Prof. S. Kuga), established in the Acoustical Society of Japan, has conducted the studies on the method of evaluation and prediction of noise caused by the construction work, by the contract with the Public Works Research Institute, Ministry of Construction [2].

Through the general survey on the various measures for the evaluation of noise, the equivalent continuous A-weighted sound pressure level seemed to be the appropriate measures as the basic quantity for the evaluation of construction noise. However, there remain some problems to be solved.

As already mentioned, there are a large number of construction

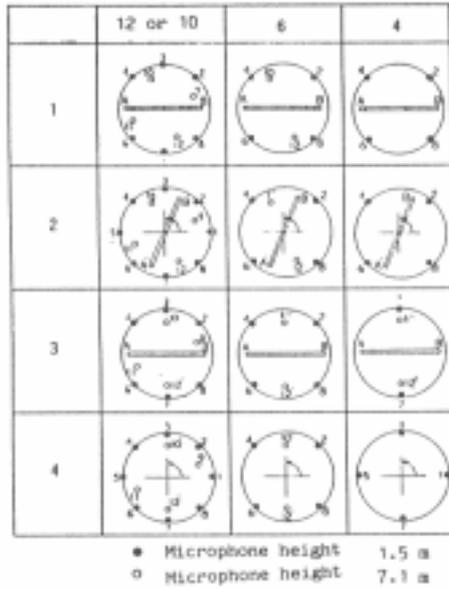


Fig. 4 Arrangements of microphone.

works which radiate impulsive noises. There are many investigations on the psychological effects of impulsive noise, by using the artificial signals or the actual noises. For the establishment of reasonable measures for the evaluation of these impulsive noises, it is necessary to expect the future development of these investigations.

Also, the evaluation of overall construction works should be based upon the social surveys, in parallel with the detailed psychological studies at the laboratory.

#### CONTROL OF CONSTRUCTION NOISE

For the control of construction noise, there are many three important technical directions.

The first and most important method is the noise reduction at the source, i.e. the development of the low noise machinery. This has been carried out mainly by the application of enclosures and silencers. Effective noise reduction has been obtained for excavators, tractors with dozer, portable compressors, diesel generators, drop hammers and so on. In these machines, several to 15 decibel reduction were obtained.

Next step of noise reduction is the substitution of the method of construction. For example, instead of the drop hammering, the earth-drilling or other methods are used in Japan.

The present subjects for the above two approaches are the application of the protection sheets or the sound barriers at the boundary of the construction site.

#### REFERENCES

- [1] Studies on the method of measurement of sound power level for earth-moving machinery -- work cycle test, Report of the Japan Construction Method and Machinery Research Institute (June, 1981) (in Japanese)
- [2] S.Kuba, Jour.Acoust.Soc.Jpn., 38, 301 (1982) (in Japanese)