INDUSTRIAL NOISE ; A CASESTUDY IN DHAKA

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Introduction

Man is inescapably immersed in sound fields althrough his life. Some sounds are useful and desirable while others are disturbing and annoying and still others are harmful and damaging. Historically for a long time noise used to be viewed only as a disturbing or annoying element in the man-made environment and its quite extensive range of bodily harmful effects did not draw our serious attention. It has been discovered in recent years that in addition to causing annoyance and hearing loss noise can have other detrimental effects on human bodies and mind. Research has shown that when the noise level exceeds 70 dB which is about the level that prevails in a common city street, it begins to affect the human body adversely. Thus noise higher than 70 dB can cause an increased rate of heart beat, an increase in the body temperature, a slowing down of the digestive and the respiratory systems and so on. As a result the blood vessels of the body contracts, blood pressure increases and blood circulation in the heart decreases. If the noise level increases further, the resulting ill

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effects on a person become more pronounced and more diversified. All these happen automatically and one can not escape from such consequences under any circumstances because unlike most environmental elements, noise is independent of the process of 'acclimatization' in relation to its perception by a person. Even in sleep, a person can not escape the consequences of high noise levels. It has been experimentally observed that a relatively low level of 55 dB produces in a person the same effects when he is asleep as when he is awake. Although such a noise level may not interrupt his sleep decisively, it will none the less have the effects of a series of unsatisfactory 'cat naps' instead of a satisfying and refreshing sound sleep. If a person, particularly an aged or an ill one, suffers from such interruptions constantly for a long time then he may not only become .seriously unstable but also he may even develop schizophrenic, homicidal or suicidal tendencies.

Perhaps the largest single group in any country of the world exposed to the hazards of high levels of noise is formed by the industrial workers. The problem is of grave nature in the developed nations where life is greatly mechanised, industries are many in number, large in size and noisy in character. In a developing country like Bangladesh, the nature and extent of the problem may not be that serious but it is serious enough to merit attention from architects, engineers and others concerned. The situation here is potentially more alarming because of the fact that the industrial workers in Bangladesh as in most other developing countries are totally unaware, unlike their counterparts in the developed nations, of the dangers of working continuosly in a noisy environment. Bangladesh is not an industry based nation but the number of industries is increasing every year. There are several industrial townships in the country namely, Tongi, Khalishpur, Narayaganj and so on. Besides there are numerous small scale workshops in most of district towns and a sizable number of workers in this sector are often exposed to very high level of impact noise, if not steady level of harmful noise. There are no laws, regulations or codes of practice pertaining to the level of allowable noise in the industries. But then none is aware of the havoc that noise is actually playing. It is high time for us to take up the matter of noise in the industry seriously.

Objectives and Scopes of Investigation

The broad objective of the study and investigation was to collect information by noise measurements in a selected industry with a view to develop an understanding concerning the prevailing industrial noise scene. More specifically the objectives and scope of the study may be enumerated as follows :

1. Measurement of environmental noise level in dB(A) at work stations in the selected industry.
2. Measurement of environmental noise level in octave bands at work stations in the selected industry.

To make an assessment of whether noise problem exists in an industry or not one may take dB(A) measurements in the environment at different stations and compare the values with the following standards in different countries :

Table 1 : National Standards For Steady Noise Levels

Countries	dB(A)	Countries	dB(A)
Germany	90	Sweden	85
France	90	.USA	90
Belgium	90	Canada	90
UK	90	Australia	90

If the results of these simple measurements and comparisons indicate a noise climate beyond the level of acceptability then a further set of measurements should be made for octave band analysis because noise reduction measures are frequency dependent.

Measurement and Analysis Techniques

The most common noise measurement is expressed in dB(A) level. It is measured with a Sound Level Meter using the A-weighting filter to simulate the frequency response of the human ear. The sound signal is converted to an identical electrical signal by a high quality microphone. Since the signal is quite small it must be amplified before it can be read on a meter. After the first amplifier the signal may pass through a weighting network (A,B,C or D). An alternative to the network is an octave or third-octave filter which may be attached externally. After additional amplification the signal will now be of a high enough level to drive the meter — — after the audio-frequency voltages are fed to a rectifier giving a DC output proportional to the RMS or peak value of the signal at a defined time constant. The value read on the meter is the sound level in dB. The sound signal is also available at an output socket so that it may be fed to external instruments such as recorders or noise dose meters. The microphone choosen for a particular noise measurement will generally have to fulfil two rather different groups of conditions :

> Firstly, it must operate satisfactorily over a range of environmental conditions such as humidity, temperature, air pollution and wind.
>
> Secondly, it must also meet the technical constraints such as frequency response, sensitivity and directivity.

Generally speaking, the condenser type microphone is best able to meet these conditions and has therefore, become the most widely used type.

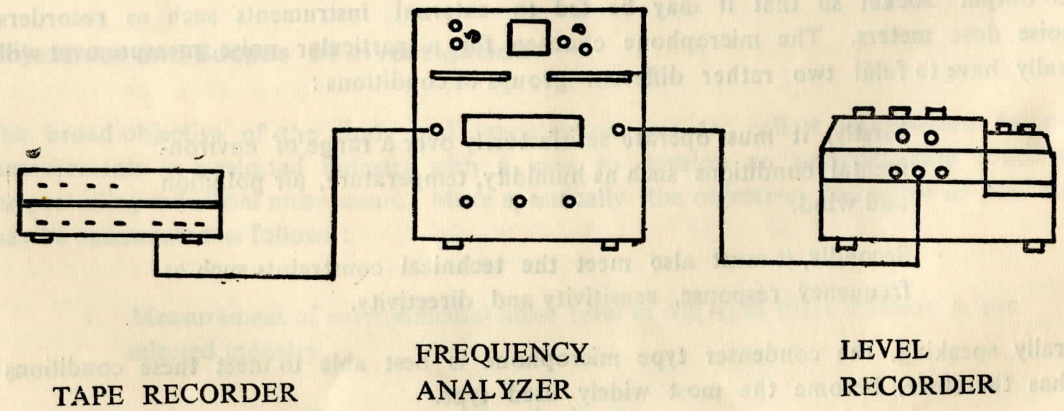
Before commencement of the experimental measurements, the SLM needs to be calibrated. This was done using a Pistophone which operated at 250 Hz and produced a sound level of 124 dB with an accuracy of ± 0.2 dB.

In the experimental measurements of sound levels a Precision Sound Level Meter with a high sensitivity 1/2" diameter free-field condenser microphone was used giving it a measuring range of 26 to 140 dB(A) and a wide frequency range, both in free and diffused sound fields due to its excellent omnidirectivity. Measurements were taken at the nodal points of a grid-iron plan superimposed on the space under investigation and the spot values of dB(A) were recorded.

Once the quick and simple dB(A) measurements were done, the next step in the experimental work was the frequency analysis of the measured noise in octave or third octave bands. Frequency analysis is required to predict the necessary insulation/absorption characteristics of noise barriers and space enclosures and to measure noise reduction between common walls of adjacent spaces. Frequency analysis is also invaluable when a noise control system must be reworked because it assists in defining the minimum modification that will enable the system to meet the desired specifications. Frequency analysis is performed with a combination of Precision Sound Level Meter and Frequency Analyzer which can be a battery operated, compact and portable device for direct measurements in the field.

In case of non-availability of such a compact and portable device a battery operated portable taperecorder may be used in conjunction with the SLM for recording and storage of field noise data for later processing in the laboratory and we had to adopt such a means in our case. The measurement setup was used as per the standard operating procedures and continuous reading for a period of approximately two minutes was recorded on the tape at the two selected stations in the factory which belonged to the noisiest sections of the industry.

Having done the field recording of the noise on the magnetic tape of the recorder, the equipments were brought back to the acoustic laboratory for processing of the noise through a Frequency Analyzer and recording the levels at various third-octave bands in a level recorder. The instrumentation for this phase of the investigation was as follows :



The Frequency Analyzer was a constant percentage bandwidth analyzer for use in the frequency range 2 Hz to 20 KHz in conjunction with the internal filters. The level recorder

was basically a recording voltmeter designed to accurately record the RMS, Average or Peak levels of an AC signal in the frequency range from 2Hz to 100 KHz. Recording as a function of time or frequency could be made on pre-printed, lined or frequency calibrated stripchart paper, 50 or 100 mm wide. In our case 100 mm wide recording paper was used and the experimental setup was operated as per the standard procedures.

Results

The results of the dB(A) spot values measured were as follows :

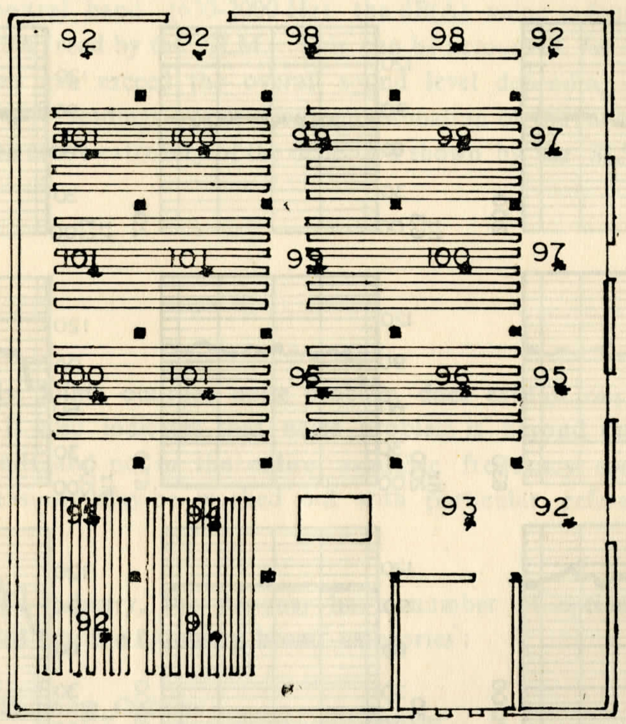
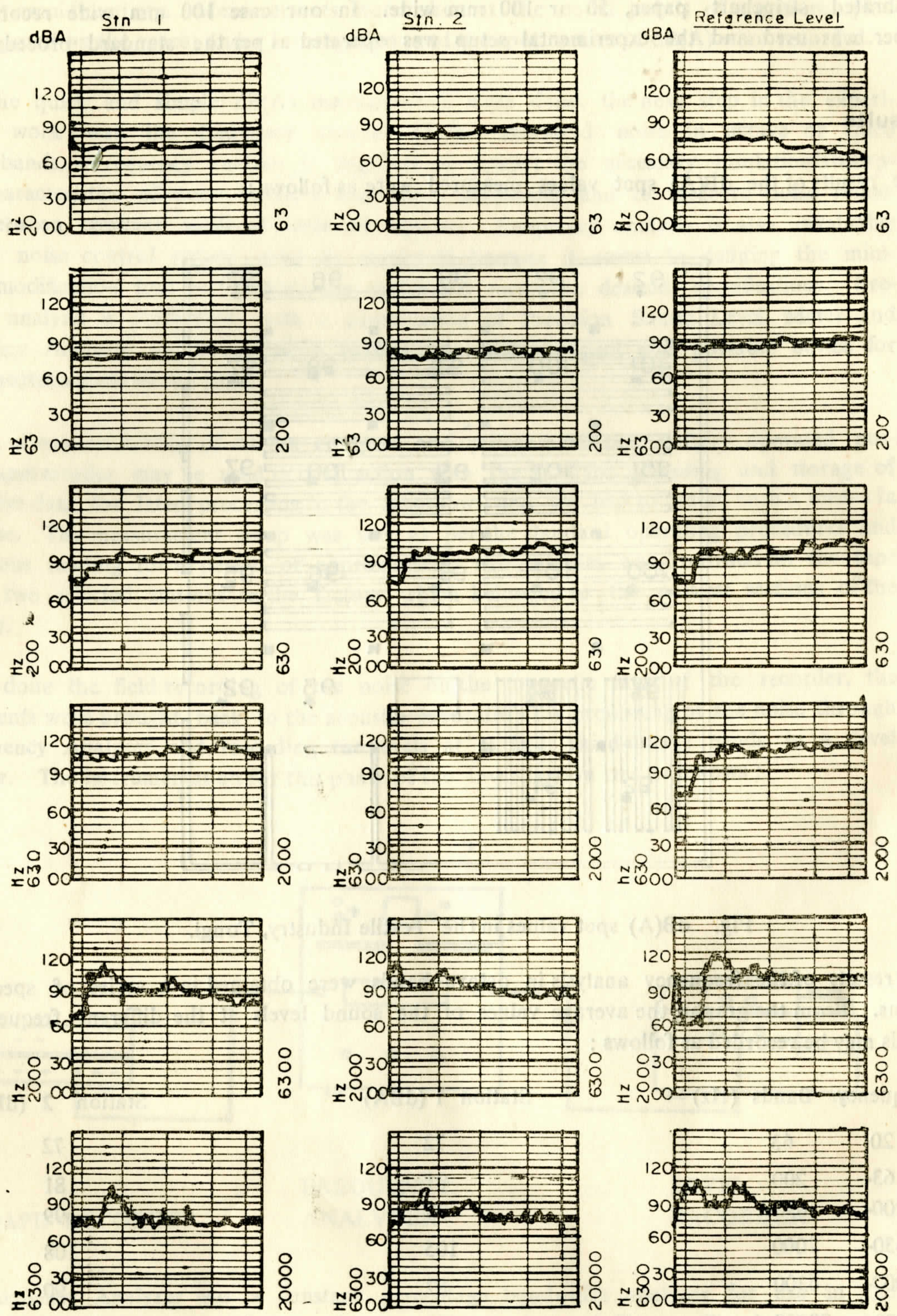


Fig. dB(A) spot values in the Textile Industry, Tongi.

The results of the frequency analysis in octave bands were obtained in a series of spectograms. From the graphs, the average values of the sound levels at the different frequency bands may be recorded as follows :

Frequency Bands (Hz)		Station 1 (dBA)	Station 2 (dBA)
20-	63	72	72
63-	200	81	81
200-	630	93	99
630-	2000	105	108
2000-	6300	87	90
6300-	20000	78	78

The spectograms representing variations of sound levels at the different frequency bands are reproduced as follows :



The third-octave analysis of the noise of the industry under study was carried out in order to identify the frequencies where the problem is most serious. It is known that sound absorption by a material is frequency dependent. The octave or third-octave analysis, thus, can guide the choice of absorptive materials for efficiency in the frequency bands where the noise occurs with greater severity.

The general character of the spectograms obtained from the two measuring stations is more or less identical. They show that the dB(A) levels in the case under study are above the allowable level of 90 dB(A) in the frequencies ranging from 200 to 6300 Hz. At other frequencies the values indicated are below the allowable level.

In one particular spectral band (630-2000 Hz), the dB(A) value is found to be higher than the spot value of dBA read by the SLM. This can be accounted for by the fact that intermittent or peak values can exceed the overall sound level depending on the type of noise source. Moreover, spot readings result from an estimation of the average sound pressure level rather than the entire extremity of the deflection shown by the SLM needle.

Conclusions

The case study clearly points out that noise problem does exist in our industries in rather severe magnitudes. It also indicates that noise problem is beyond the allowable limits in certain frequency bands and not in the entire available frequency spectrum. This means that noise control measures may be worked out with particular reference to the relevant frequencies.

For noise control in the industry, the designer has a number of options available to him. These may be classified into the following broad categories :

(i) Planning Options

(ii) Design Options

(iii) Construction Options

In each of these categories of options, the question of frequency component of the noise under consideration is of paramount interest because noise control measures and practices are frequency dependent. The study, apart from its technical contribution, will hopefully generate a degree of awareness in the related quarters concerning the issues pertaining to noise problem in the industry in Bangladesh.