STUDY ON CHARACTERISTICS OF TRANSPORTATION NOISE SOURCES IN KLANG VALLEY, MALAYSIA

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Abstract: The main purpose of this study is to detect the level of noise pollution due to various modes of transportation, its effect towards the environment and to look at some of the control measures that can be adopted to minimise the impact of the noise emitted. Noise level measurements and recording were taken at a few selected sites in the Klang Valley. From the hourly continuous noise levels recorded for 24 hours by using the sound level meter and noise level analyser, it has been found that these areas are seriously polluted by these noise sources. Subsequently, the L_{eq}, L_{10}, L_{50} and L_{90} noise indices were identified and determined. Simultaneously, public survey has also been conducted to gauge the existing public attitude and degree of awareness towards contemporary transportation noise pollution problems.

1. INTRODUCTION

To quote a source from the national newspaper, NST, July 23, 1996 " Noise level in the country are, on an average, quite high. As the country becomes more affluent, noise levels becomes higher owing to construction projects, more vehicles and transportation and other factors." Another remark from a world renowned acoustic expert, Beranek (1971), "Modern technology has furnished its own fanfare an ever- increasing din that disturbs our sleep, interrupts our conversation, creates anxiety and annoyance, and sometimes damages hearing." These are just a few of the numerous comments and news on noise pollution which has been ignored and accepted as just another irritant in the past. However in recent years with the increase in environmental awareness noise, has been regarded as a serious form of pollution and is not to be underestimated. Noise is a complex pollutant and though many people are not aware of its significance, others are beginning to hear its call.

In the process of rapid development and industrialization towards the status of a developed nation, Malaysia has not been spared from the problem of noise pollution. This is clearly demonstrated by Figure 1.1 where highly developed states and cities such as Selangor and Federal Territory registered the highest and second highest number of pollution complaints in comparison to other states in Malaysia. In the recent years, rapid urbanisation experienced by major cities around Malaysia has led to dramatic increase in the need for more transportation facilities which will inevitably be accompanied by a proportionally high level of environmental noise. This is detrimental to both urban as well as residential

life styles as it has been noted that noise has a detrimental effect towards human health. According to the figures released by the Department of Environment (1988), a division of the Ministry of Science, Technology and Environment of Malaysia, the number of noise related complaints lodged have simultaneously registered a proportional increase as indicated by Figures 1.1, 1.2 and 1.3. To quote a source from the 1988 Environmental Quality Report, (DOE, 1988) "The increase in the number of noise-related complaints received by the Department of Environment from 74 cases in 1987 to 98 cases in 1988 clearly indicates the escalating public awareness and annoyance against noise pollution."

2. NOISE POLLUTION DUE TO TRANSPORTATION SYSTEMS

Other modes of transportation like aircraft, and trains can have both negative and positive impact on the environment. These mode of transportation themselves generate noise which could adversely affect the environment and should be minimized. However, on the positive side, if these modes are successful in reducing levels of road traffic, then there will be an overall reduction in noise levels on the roads.

Noise from transportation facilities regularly affects millions of people. In fact, transportation is the largest source of noise problems in the United States. Noise is the most serious environmental impact of rail transit lines and has often prompted objection to them. In New York City, sound levels exceeding 100 decibels have been measured in trains, in subway stations and on the street below elevated tracks (Huss and Mcshane, 1973). Levels of 93 to 98 decibels have been measured in Philadelphia. This compares with the standard acceptable noise levels at 55 decibels set by the World Health Organisation (WHO) and also noise levels of 70 decibels from freeway traffic at a distance of 50 feet (16 m.). The Light Rail Transit Association (Taplin, 1987) reported that noise measurement made on modern LRTs indicate interior noise levels in the range of 67 - 70 dB(A) and exterior levels (measured at 7.5 m and 50 kph) in the range of 76-80 dB(A). A comparable measurement of a metro train is 81 dB(A) and 89 dB(A) for a bus. With increasing environmental awareness, now noise abatement is a major consideration in designing new rail lines and vehicles.

Based on studies carried out in the United States, it has been found that where train-related noise levels within rooms exceed 40 dB(A), then people are likely to complain that the train noise annoys them and interferes with sleep (Hecki, 1987). In the U.S.A., criteria for groundborne train noise have been applied successfully on several mass transit systems and are included in the Guidelines of American Public Transit Association (APTA). The maximum groundborne noise level permitted vary from 30 dB(A) for low density residential to 40 dB(A) for high density residential areas. However, research is continuing to make LRTs quieter still.

Likewise aircraft noise has been another major source of noise pollution suffered by most of the developed countries as well as developing countries. Figure 2.1 shows the community noise levels recorded by the DOE at various airports in Malaysia are generally very high compared to the limit proposed by the World Health Organization (WHO). Community noise level around Subang International Airport, Malaysia is one of the

highest recorded. Records also show the total number of aircraft movements are increasing tremendously. This means there will be more noise due to landing or taking off of aircraft.

As in the case of the railway noise problem, so far not much attention has been paid to it as compared to other noise sources. This is probably due to the population exposed to it is not as great as those exposed to other types of noise sources. The community noise levels measured by DOE at various railway stations in Malaysia is shown in Figure 2.2 with the Kuala Lumpur Railway Station having the highest value.

Although both aircraft noise and railway noise problems are limited to the communities at the vicinity of the airport and railway track, the well being and the right to share a peaceful environment by these communities should not be neglected

3. THE EFFECTS OF NOISE POLLUTION

The possibility that noise has a detrimental effect on human health has been a strong impetus for research and a major argument for noise control. According to the WHO, health is regarded as more than the absence of disease; it encompass total physical and psychological well-being. In the world of noise literature, the term 'health effect' has been used to refer to any measurable effect of noise on a body system (eg. auditory, cardiovascular) whether or not the effect is known to be detrimental to well-being. Transportation noise is generally at a lower level and more intermittent than noise from other environmental sources. For this reason, the possible health effects of transportation noise have not been as extensively studied. Basically, the effects of noise on human health could be viewed from three different aspects:-

- the effects of noise on hearing
- the effects of noise on sleep
- other physiological and psychological effects of noise.

4. FIELD INVESTIGATIONS OF TRANSPORTATION NOISE

Generally the measurements of the transportation noise levels were made based on the instruction given by section 5.2.2 : Outdoor Measurements Near Buildings, of the B.S. 7445:1991 "Description and Measurement of Environmental Noise". To determine the degree of noise pollution transportation has on the existing environment, field noise level measurements are considered to be the most important and critical aspect of this study. This was to obtain the characteristics of the noise level distribution and noise level variation in the areas affected by these noise pollutants, and to make comparison of the noise levels among the study areas and with the international standard possible.

The 'A' weighted scale has been chosen for all noise level measurements in this study due to the fact it has been universally adopted for measurement of transport noise in many laws and ordinances to compensate for human hearing characteristics. The noise limit fixed by the U.S. Federal Aviation Administration (FAA) and the International Civil Aviation

Organisation (ICAO) used the Effective Perceived Noise Level (EPNL) and the Weighted Equivalent Continuous Perceived Noise Level (WECPNL), which take into account the frequency distribution of the noise, and the duration of the flyover of the aircraft noise. However due to the limitation where the filter set which is required to obtain the frequency distribution of the sound is not available in this study, the aircraft noise was also expressed using the A weighted noise level.

For the alphanumerical noise data, hourly sound pressure levels were measured in dB(A) and expressed as the L_{eq}, L_{max}, L_1, L_{10}, L_{50}, L_{90}, L_{99} where :-

L_{eq} = the equivalent sound level in dB(A)
L_1 = the sound pressure level exceeded 1% of time of the measurement
L_{10}= the noise level in dB(A) exceeded only 10% of the time or Peak Sound Level
L_{50} = the noise level in dB(A) exceeded only 50% of the time or Mean Sound Level
L_{90} = the noise level in dB(A) exceeded only 90% of the time or Residual Noise Level.
L_{99} = the sound pressure level exceeded 99% of time of the measurement
L_{max}= maximum sound level in dB(A)

L_{dn} = the modified version of L_{eq} for 24 hours which include a penalty of about 10 dB(A) taking into account greater annoyance produced by noise at night.

The sound pressure levels recorded in graphical form in variation of time were made for characterisation of the aircraft and railway noise, as well as for comparison of noise level variation for different locations of the study.

4.1 Sites Identified for Field Investigations

Since the areas most affected by the aircraft noise and railway noise problems are the residential areas at the vicinities of the airport and railway tracks, the locations chosen were those areas affected by these noise sources around the Klang Valley. In determining the suitability of the sites, various land uses for example residential, institutional, religious and recreational have been considered. The 24 hour continuous noise level was measured in this study.

Two sites were chosen for the detection of noise levels affected by the railway noise, namely at Kepong and Kajang while three sites were chosen for the measurement of the aircraft noise. They were at the Subang International Airport, Kampung Baru Subang and Subang Jaya in Selangor.

5.0 METHODOLOGY

Noise measurements for the aircraft and railway noise levels were made based on the instruction given by the section 5.2.2 : Outdoor Measurements Near Buildings, of the B.S. 7445:1991 " Description and Measurement of Environmental Noise".

The instruments used in this study are the CEL-493/3 Precision Integrating Impulse Sound Level Meter and the CEL-438 Noise level Analyser. The sound level meter provides a continuous indication of the instantaneous sound pressure level SPL in both analog and digital formats on a liquid crystal display, while at the same time calculating the equivalent continuous level L_{eq} and other parameters, with A-weighted and Linear frequency response. While the CEL-438 Noise level Analyser is an intelligent hard copy device designed for use with instruments equipped with the CEL low power digital interface.

Basically the procedures for the noise measurements are as follows:

a. The sound level meter is prepared for use. The 'med' range was selected for the medium range measuring the sound pressure level in between 40-141 dB and frequency range is set to 'A' for employing the A weighted network.
b. The microphone was inserted on to the preamplifier and mounted on a tripod and connected to the extension cable to the sound level meter. It is then set to the position 1 to 2 m from the facade, and 1.2 to 1.5 m above the floor of the premise, where the outdoor noise level will be taken.
c. The noise analyser was prepared for use. The program card is inserted in the analyser to down load the program and configuration of the analyser was done through the control panel and the menu to the required setting for the types, duration and interval time of measurement was carried out. Two reset periods of 1 hour and 5 seconds with consecutively alphanumeric and graphical print format was performed.
d. The sound level meter was connected to the noise level analyser via a cable. Two types of measuring setting were taken for 24 hours continuously at every location.
e. The acoustic calibration of the sound level meter was performed before and after measurements were made using the CEL-284 Acoustic Calibrator.

6. DISCUSSION OF RESULTS

The results of the noise level measurements have been graphically presented in Figures 5.1 to 5.5.

6.1 Railway Noise Study

From the analysis on the results of noise level measurements, the following conclusions have been derived:

- The newly constructed railway stations at Kepong and Kajang have increased railway noise pollution to the residents staying adjacent to the railway tracks and longer exposure to the locomotive noise when trains are stopped at the stations with engine running and have caused greater annoyance to the residents.

- Railway noise pollution was more serious in Kepong as compared to Kajang due to railway vehicles operations. The 24 hr. noise levels are summarized as below:

Noise Index	Noise Level dB(A) -Kepong	Noise Level dB(A) - Kajang
L_{dn}	66.59	64.34
L_{eq}	61.35	59.99
L_{10}	62.29	58.87
L_{50}	55.95	53.69
L_{90}	50.72	50.25

The higher noise pollution due to trains in Kepong was due to the higher number of daily trains passing and being a residential area, is not affected by other noise sources except for railway noise.

- Almost all the loud noise recorded in these two locations were generated by railway vehicles.
- Railway noise pollution has increased both in Kepong and Kajang over the past 5 years.

A public survey concluded noise pollution as the most concerning type of environmental pollution both in Kepong and Kajang.

Noise levels in both study locations were very high as compared to the recommended levels for residential purpose. Noise control countermeasures need to be taken immediately for the well being of the public. For the existing structures located adjacent to the railway tracks, the following suggestions can be employed :

a. Construct acoustical barriers beside the railway tracks at the portion where there are houses on the side of the tracks
b. Noise control at noise sources which include source control, path control, receiver control and land use control has to be implemented
c. Provide sound insulation system to the residents, at least at the side facing the railway tracks
d. Future development of housing projects adjacent to the railway tracks should be strictly prohibited. Proper land use management should be employed.

6.2 Aircraft noise study

Following are the conclusions derived from the study of aircraft noise pollution carried out at a few selected areas:

The 24 hour noise levels taken at the aircraft noise study area were as below:

Noise Index	Noise level dB(A) Subang Airport	Noise level dB(A) Subang Jaya	Noise level dB(A) Kg. Baru Subang
L_{dn}	80.38	64.44	64.73
L_{eq}	75.68	61.69	61.69
L_{10}	78.11	61.75	58.44
L_{50}	64.78	49.74	48.64
L_{90}	62.38	44.32	43.56

- Noise levels in Subang Airport were extremely high, earmuffs should be put on to avoid hearing damage.
- Kampung Baru Subang was less influence by traffic noise and has lower ambient noise level. Thus the effects of the aircraft noise were very significant and responsible for the high value of L_{dn} and L_{eq} in this area.
- Subang Jaya is one of the developed residential area in Klang Valley which is highly aircraft noise polluted. The high values of continuous sound pressure level L_{eq} and frequent aircraft noise occurrence have made this area unsuitable for its residential purpose.
- A public survey has reflected that noise pollution and air pollution were the most concerning types of environmental pollution in Subang Jaya. For Pekan Subang and Kampung Baru Subang, noise pollution had created greater annoyance to the public.
- The public has become very tolerant and used to the aircraft noise after long term of exposure to this noisy environment.
- The majority of the respondents in the survey do not intend to move from these areas, thus continuously being exposed to this noise pollution. Noise control countermeasures should be taken for the well being of this group of people, some of these are as follows:

1. Provide sound insulation system to the residents.

2. Relocate the residents most affected and prohibit noisy aircraft.

3. Noise control at source through engineering.

4. Employ airport operational noise reduction methods known.

In line with the government's vision to achieve developed nation status by the year 2020, aggressive national development which always accompany with increase of transportation services demand will certainly increase the railway and aircraft noise pollution level. The Light Rail Transit (LRT) System which just started its operation, has created an additional noise problem in the Klang Valley . The new Kuala Lumpur International Airport (KLIA) at Sepang which will be in operation soon , will also cause some changes to the aircraft noise problem.

Noise abatement and procedures for both the aircraft and railway noise pollution should be considered and carried out extensively in the future. Compatible land-use management is always the best and the cheapest method in noise control. Future population encroachment to the vicinity of new airport should be strictly prohibited, so that the present situation in Subang will not be repeated in the future.

7. PUBLIC SURVEY ON TRANSPORTATION NOISE POLLUTION

The importance of a social survey in acoustical studies has been pointed out by various experts in the past. Nevertheless, in general, it may be said that for the effects of noise on

social behaviour to be described in a reliable way leading to qualitative predictions, the levels need to be well in excess of those normally encountered. The most common way this may be observed and measured is by the method of questionnaire field studies .

7.1 Methodology

A standard questionnaire was randomly distributed and in some cases verbally directed to members of the public in order to correlate the public's degree of awareness and their inherent attitude towards noise pollution. A total of 110 people were questioned at the sites selected for the study. The form of questionnaire used consist of the method of rank order, method of successive categories and rating method. From the feedback obtained from the public survey, analysis of the results were carried out to categorically and systematically derive whatever conclusions or hypotheses possible.

7.2 Discussion On Results

Results from the investigation have been graphically presented in Figures 7.1 to 7.8. In general, as we observe more closely the results obtained from the public survey, there is unquestionably a growing sense of awareness among the majority of the public of the environmental quality of their surroundings, such as air, noise and water pollution. The majority of the respondents expressed noise pollution as their most concerned type of pollution.

Results demonstrated that there are strong indication of the extent to which the general public is affected by noise pollution while indulging in both indoor and outdoor activities. Not a single respondent refused to acknowledge the intrusion of noise in their everyday life, be it outdoors or indoors. It is also apparent that while the majority of the public is aware of the intrusion of noise in their life, they are still uncertain as to what extent noise affects their daily activities. This could be due to the simple reason that the majority of them have lived with the problem of noise pollution for far too long, they actually have become adapted to it. They are unable to actually evaluate its effects on them. The majority of the residents also indicated that that the noise pollution over the last 5 years have increased. However, most of the respondents do not possess any sound insulation system nor air-conditioning in their home or working place when they were interviewed, especially those from the lower income group.

The figures also showed that many of the public were uncertain about the current noise control legislation. Some respondents have the opinion that the noise control legislation must be inadequately effective hence causing the noise problems still going on after so many years.

8. CONCLUSION

From the analysis conducted on results obtained from the field investigation of the transportation noise in the Klang Valley, it was clear that most of the residents near the vicinity of the noise sources are constantly exposed to very high level of noise pollution. The selection of a few sites was to determine the intensity of the problems faced by the residents from the different locations.

Obviously some of the sound pressure level recorded i.e L_{max} was as high as 104.3 dB(A) was considered very high, and may cause hazardous health effects if prolonged exposure occured to the residents as discussed earlier. As a comparison, the L_{max} recorded from previous study by Lee & Sumiani (1994), was : for cars 84 dB(A), motorcycles 92 dB(A), minibuses 94 dB(A), long buses 90 dB(A) and 92 dB(A) for heavy lorries.

Some of the sites was less influenced by traffic noise, thus having lower ambient noise levels. Therefore the effects of the transportation noise toward these areas could be much higher . The values obtained from the studies shows the surrounding noise levels of the selected sites are mostly beyond the recommended level of 55 dB(A) for daytime and 45 dB (A) for nighttime as stipulated in the legislation for residential area.

The findings of this study also indicated the highly density residential area of Subang Jaya as the 'most aircraft noise polluted developed residential area' in Klang Valley and theoretically not suitable for residential purpose. Indeed some control measures and proper planning has to be implemented to overcome the adverse effects from noise pollution and for the well being of the residents.

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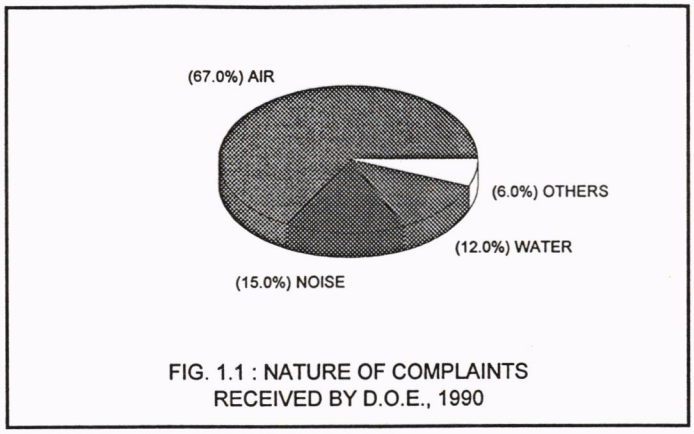


FIG. 1.1 : NATURE OF COMPLAINTS RECEIVED BY D.O.E., 1990

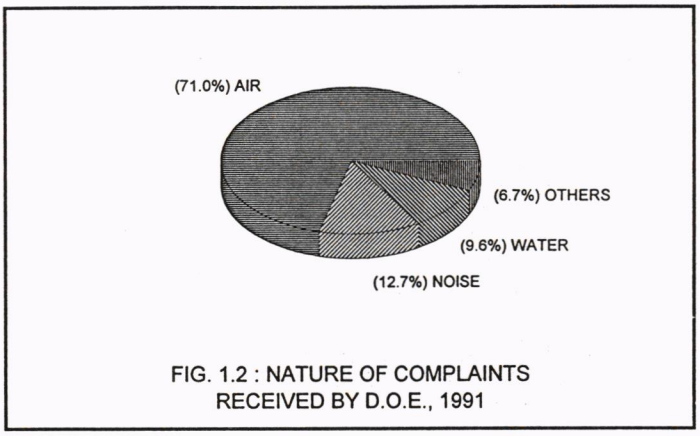
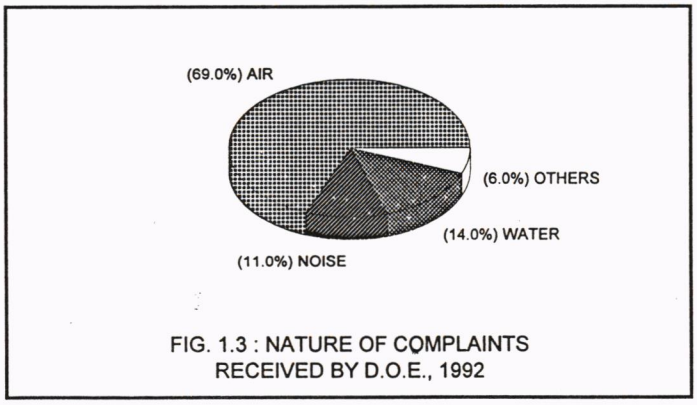


FIG. 1.2 : NATURE OF COMPLAINTS RECEIVED BY D.O.E., 1991



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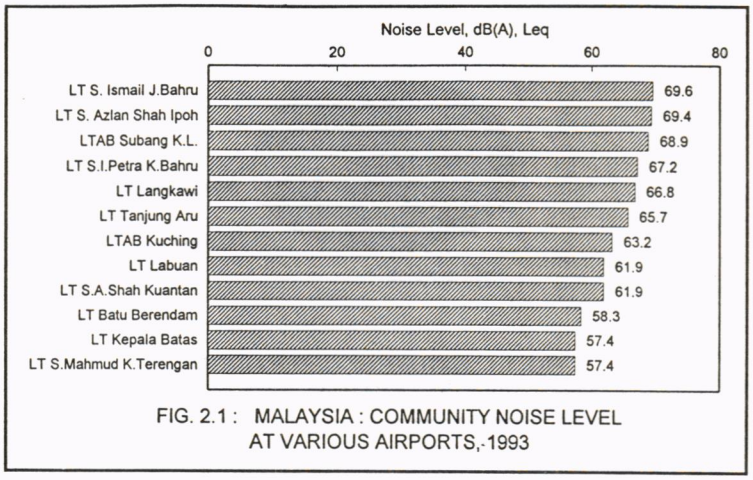

FIG. 2.1 : MALAYSIA : COMMUNITY NOISE LEVEL AT VARIOUS AIRPORTS,-1993

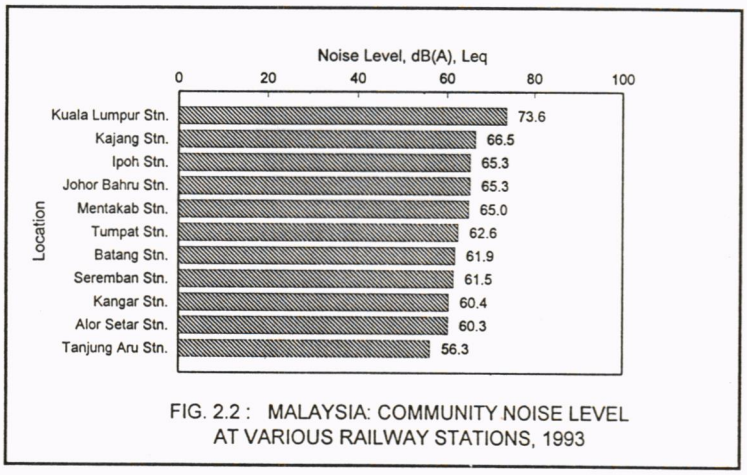

FIG. 2.2 : MALAYSIA: COMMUNITY NOISE LEVEL AT VARIOUS RAILWAY STATIONS, 1993

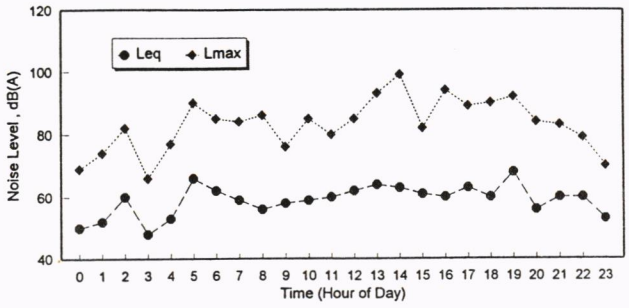

Fig. 5.1 : HOURLY Leq AND Lmax DISTRIBUTION FOR RAILWAY NOISE AT KEPONG

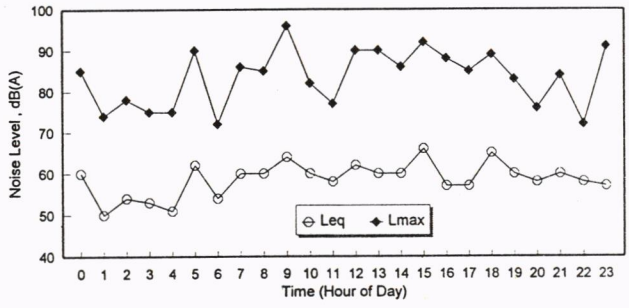

Fig. 5.2 : HOURLY Leq AND Lmax DISTRIBUTION FOR RAILWAY NOISE AT KAJANG

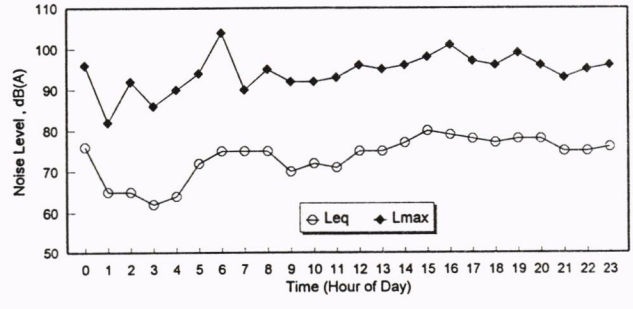

Fig. 5.3 : HOURLY Leq AND Lmax DISTRIBUTION FOR AIRCRAFT NOISE AT SUBANG AIRPORT

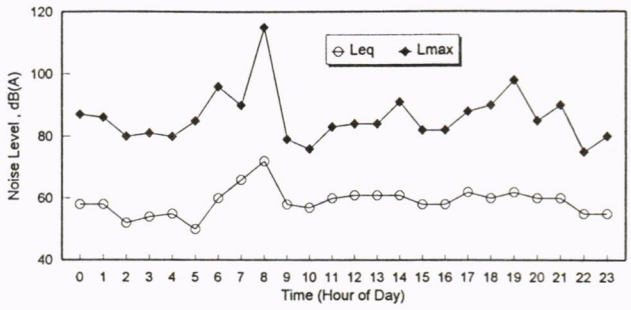

Fig. 5.4 : HOURLY Leq AND Lmax DISTRIBUTION FOR AIRCRAFT NOISE AT KG. BARU SUBANG

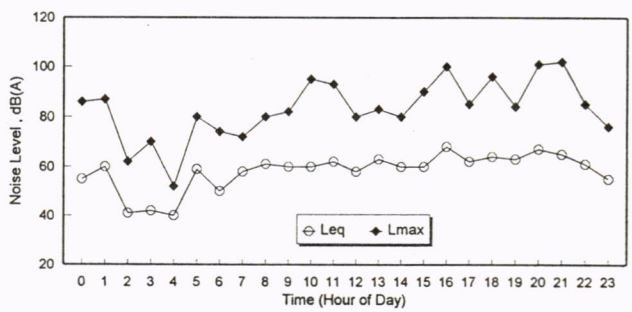

Fig. 5.5 : HOURLY Leq AND Lmax DISTRIBUTION FOR AIRCRAFT NOISE AT SUBANG JAYA

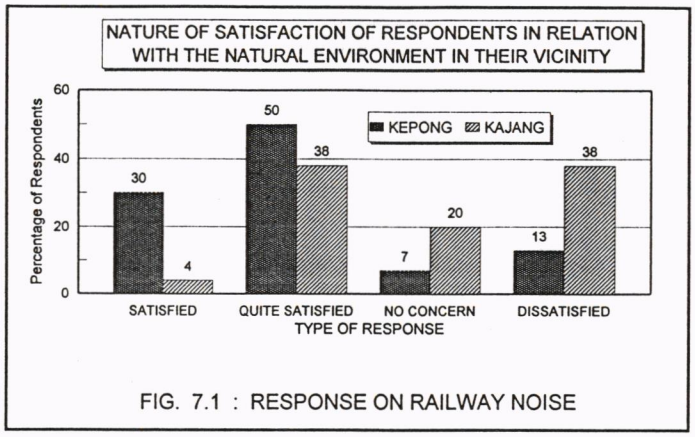

FIG. 7.1 : RESPONSE ON RAILWAY NOISE

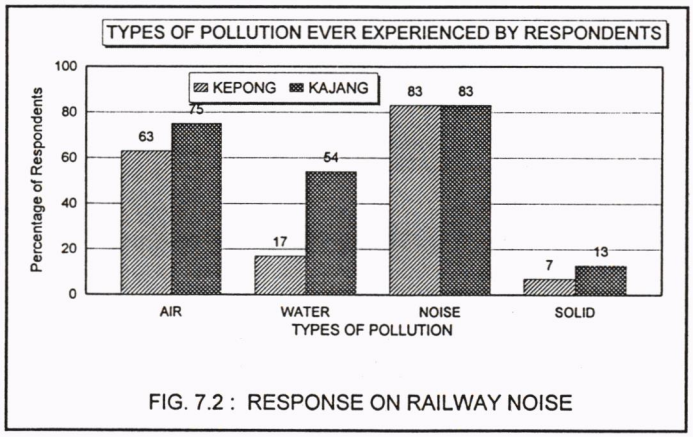

FIG. 7.2 : RESPONSE ON RAILWAY NOISE

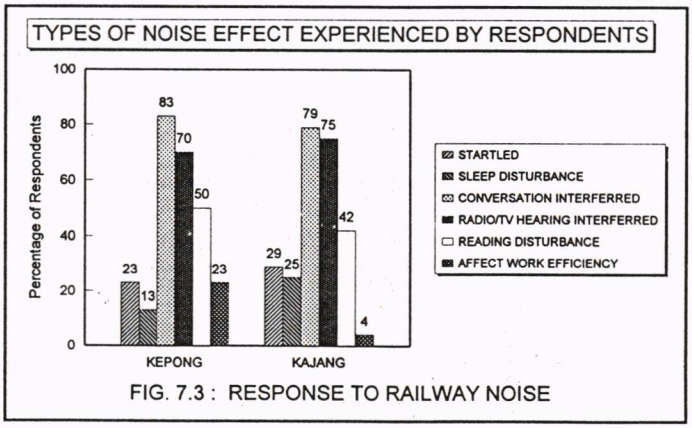

FIG. 7.3 : RESPONSE TO RAILWAY NOISE

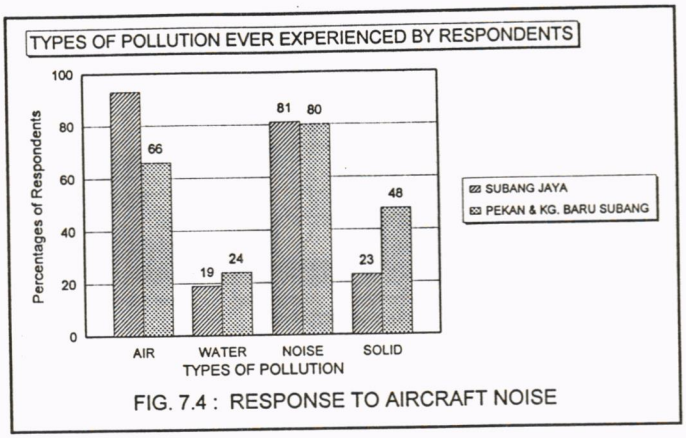

FIG. 7.4 : RESPONSE TO AIRCRAFT NOISE

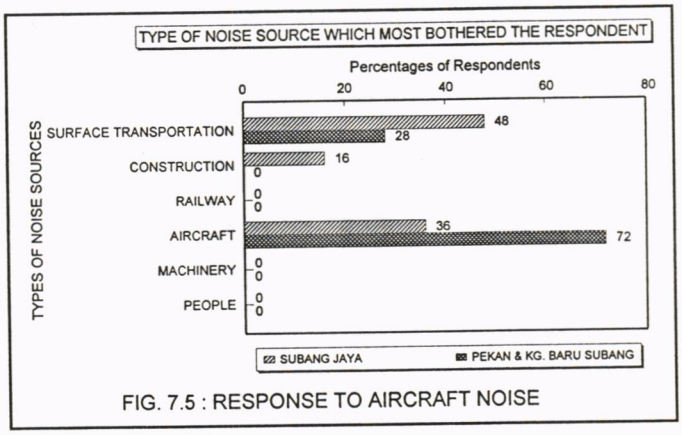

FIG. 7.5 : RESPONSE TO AIRCRAFT NOISE

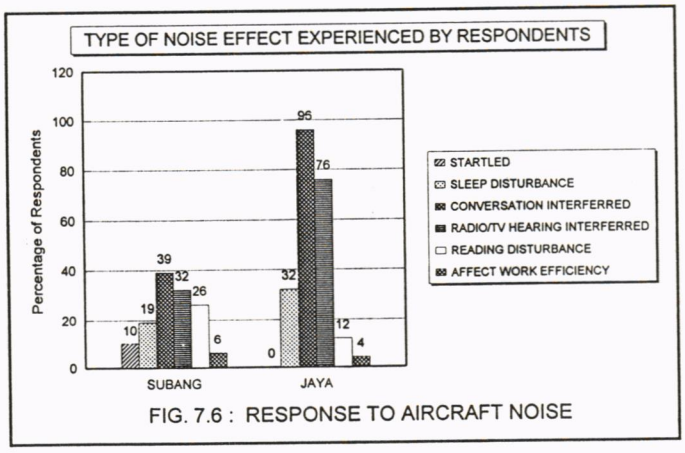

FIG. 7.6 : RESPONSE TO AIRCRAFT NOISE

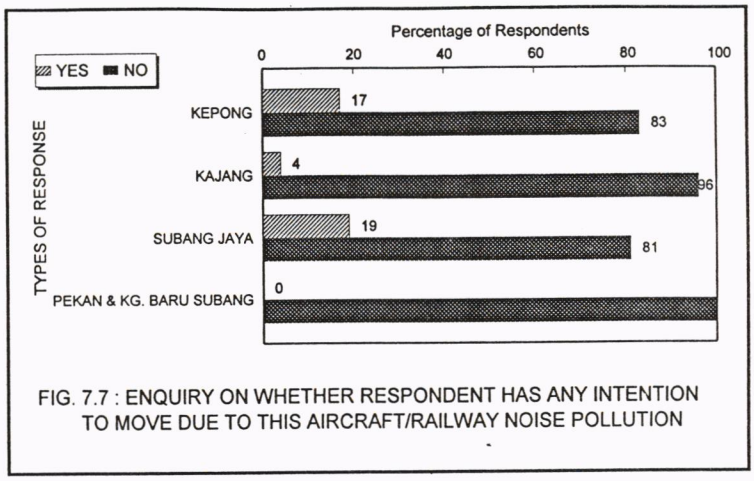

FIG. 7.7 : ENQUIRY ON WHETHER RESPONDENT HAS ANY INTENTION TO MOVE DUE TO THIS AIRCRAFT/RAILWAY NOISE POLLUTION

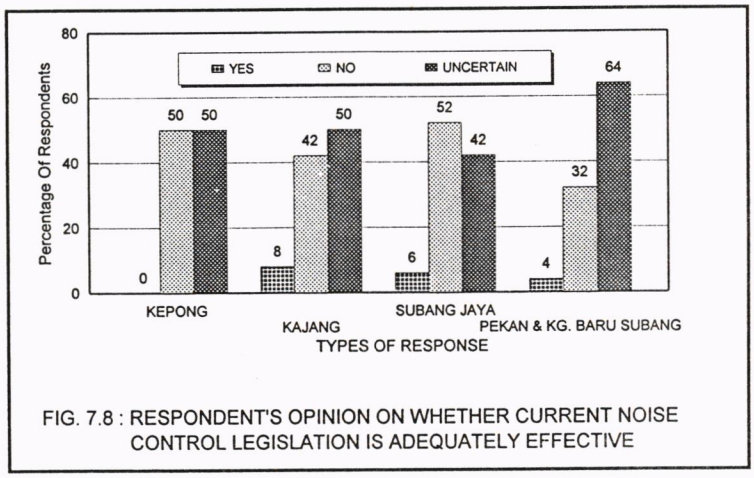

FIG. 7.8 : RESPONDENT'S OPINION ON WHETHER CURRENT NOISE CONTROL LEGISLATION IS ADEQUATELY EFFECTIVE