

Assessment of Outdoor and Indoor Noise Pollution in Commercial Areas of Gorakhpur City

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Abstract— Acoustic noise beyond a level is harmful. Noise pollution in the recent times has been well recognized as one of the major trepidations that impact the quality of life in urban areas across the globe. The present work, shares the assessed data regarding indoor and outdoor noise levels in the commercial areas of Gorakhpur city. Selected points as per their purpose were sampled in commercial zone in order to cover the whole commercialized and populated area of the city. The observation sites were selected at eleven different locations in commercial areas of Gorakhpur city and Energy Equivalent noise (Leq) for hourly observations for indoor and outdoor noise were made at these sites. The relative standing of outdoor and indoor noise with respect to regulatory norms was looked into and the range of minimum and maximum values of Leq was also worked out. It is found that the outdoor noise levels are influenced by traffic volume and congestion, user's generators and crowd on roads. It is also seen that, on many sites, significant increase in indoor noise is observed only in the afternoon hours around 3:00 pm - 4:00 p.m. when large number of customers starts flowing into the shops after getting free from offices, schools and colleges and other establishments and commercial activity picks up. It is also observed that, even though there is a reduction in the noise level at indoor points as compared to outdoor points yet it is a point of concern that for most of the time during the day both the outdoor and indoor noise levels for beyond the maximum permissible limit of 65 dB, thus it is concluded that there is a need to adopt suitable control measures for the reduction of noise at outdoor and indoor points. It is suggested that implementation of speed limit to vehicles on road, provision of silencers and sound proof cage of generators, traffic decongestion and diversion, phasing out of old noisy vehicles, declaration of no horn zone and provision of noise barriers, wherever feasible, along with tree plantation may be considered for reduction of outdoor noise. The provision of sound absorptive surfaces and panels within the interior of the shops, regular servicing of fans, air coolers, air conditioners and other appliances and behavioral changes may be resorted for reducing indoor noise.

Keywords— *Noise pollution, Sound level, Equivalent continuous noise level (Leq), Noise assessment, Noise standards*

I INTRODUCTION

According to Robert Koch, a Nobel Prize winner German bacteriologist, "A day will come, man will have to fight merciless noise as the worst enemy of health"(Chauhan *et al*;2010). Noise is derived from Latin word, 'nausea'

implying "unwanted sound" or "sound that is loud, unpleasant or unexpected". Noise, a physical pollutant, is not easily recognized. This is because the sensitivity of human ear gets automatically adjusted to the ambient level of sound and so slow increases in the ambient level go unnoticed. Therefore, noise continues to do the damage silently. Noise pollution in the recent times has been well recognized as one of the major trepidations that impacts the quality of life in urban areas across the globe. Noise pollution is distinguished from other pollution categories due to its source and diffusion characteristics, which can adversely affect public health and environmental quality in urban environment. To know the level of pollution, the pollutant has to be measured. In case of the noise pollution, measurement is all the more essential because of the incapability of our auditory system to recognize slow changes. In developing countries like India, the expansions of urban commercial and industrial areas have caused great disparity in the progress of its regions, particularly, due to population growth. Noise is becoming an increasingly omnipresent, yet unnoticed form of pollution even in developed countries. The source of most outdoor noise worldwide is mainly caused by machines and transportation systems, motor vehicles, air craft and trains. Indoor noise can be caused by machines, building activities and music performances especially in some workplace. The effects of noise on human health and comfort are divided into four categories depending on its duration and volume. They are (i) physical effects such as hearing defects, (ii) physiological effects such as increased blood pressure, irregularity of heart rhythms (iii) psychological effects such as sleeplessness, going to sleep late, irritability, annoyance and stress (iv) effects on work performance such as reduction of productivity and misunderstanding what is heard(Evans & Hygee;2000). Therefore, assessing the problem and programming actions for controlling noise and its adverse effects have become an issue of immediate concern for community. In India, through the comprehensive Environment (Protection) Act, 1986 air act noise pollution has become an offence. In the recent past, the Government of India has introduced The Noise Pollution (Regulation and Control) Rules, 2000 for the noise producing and generating sources which clearly classifies our environment into four categories and specifies the allowable limits of noise

separately for day and night time for different urban environments. Although significant numbers of research papers have been published on various cities of India, S.Sampath et al (2004), Vidyasagar and Rao (2006), Ganwar et al (2006), Chauhan and Pande (2010), Alam Wazir (2011), Hunashal B. Rajiv et al (2012) carried out noise level assessment of Kerala, Vishakhapatnam, Bareilly, Guwahati, Dehradun and Kohlapur cities respectively and all of them found that the noise level of their respective cities was higher than the prescribed limit by Noise Pollution (Control and Regulation) Rules, 2000. With the rapid increase in commercial activities in the Gorakhpur city during past several years, it is proposed to carry out the assessment of outdoor and indoor noise levels in the commercial areas of the Gorakhpur city. The present paper highlights the same.

II METHODOLOGY

In the present study, the noise levels have been recorded with the help of *Precision Noise Level Meter of make 'Brue and Kjaer, Denmark (2232)'*. The data have been collected for overall 14 hours for outdoor noise measurement which includes both day and night time and 12 hours for indoor noise measurement on the respective days at the selected sites. The time interval of 5:00-6:00 a.m. was selected for night time whereas hourly samples were taken from 8:00 a.m. to 1:00 p.m. and 2:00 p.m. to 10:00 p.m. during day time. The time intervals are so selected as to cover most part of the day, from calm mornings, rush hours, pleasant evening, to silent nights, as they should be respectively. As far as possible, outdoor measurements have been taken from at least 1.5 m above the ground level and at least 3.5 m from reflecting surfaces, and indoor measurements were made at least 1.5 m above the floor, at least 1 m from walls and 1.5 m from the windows at the concerned hours for 10 minute duration at fixed intervals of 15 seconds. So about 40 readings are taken using the formula for each observation hour.

Relevant areas in different parts of commercial zones have been selected for the study. A total number of eleven

observation sites located in commercial zones have been selected in the city, where indoor and outdoor, day and night noise levels have been recorded. Utter care has been taken in noting down the observations at all the points. The sites have been selected so as to cover almost the whole city paying equal importance to different regions. Table 1 shows the list of sampling points.

Table 1 Sampling points

Area Category	Observation site
Commercial	i. Alinagar ii. Asuran iii. Bakshipur iv. BhalotiaMarket v. Dharmshala vi. Geeta Press vii. Golghar viii. Gorakhnath ix. Shahi Market x. Townhall xi. Urdu Bazaar

III ANALYSIS OF DATA, RESULT AND DISCUSSION

The calculated L_{eq} values of various sites with both outdoor and indoor noise levels have been plotted in the Figure 1 to Figure 11 for showing their relative standing with respect to one another.

The indoor and outdoor noise levels of the sampling points in the day time are generally varying from 51.52 to 89.39 dB. Though the recommended values for commercial zones should be less than 65dB but it was not found to be in the prescribed limit and the reasons were traffic jams, congested roads, and indiscipline among people. With these points in view, the outdoor and indoor noise levels at various observation sites are plotted with respect to regulatory norms as per Noise Pollution (Regulation and Control Rules, 2000) and their relative standing is shown for all the observation sites.

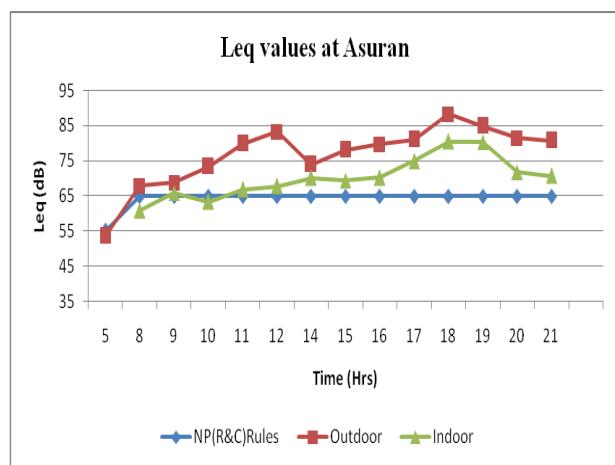


Fig 1 Outdoor and Indoor Noise Levels at Asuran Observation Site

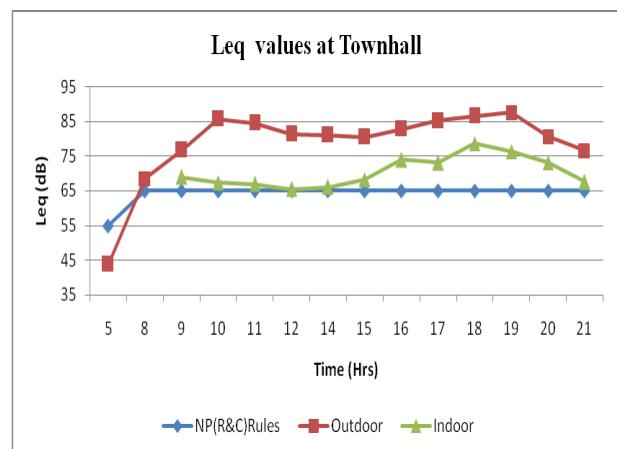


Fig 2 Outdoor and Indoor Noise Levels at Townhall Observation Site

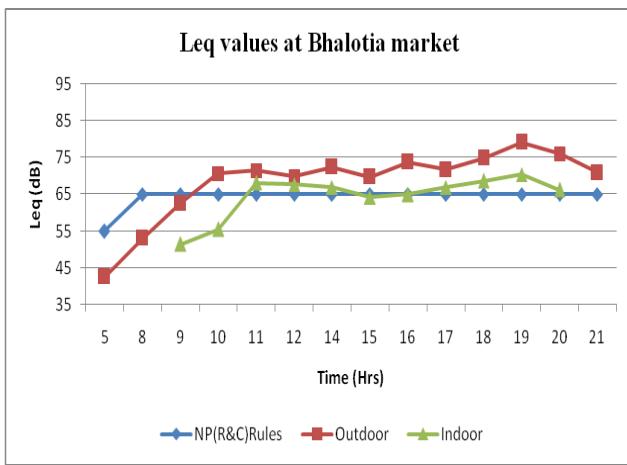


Fig 3 Outdoor and Indoor Noise Levels at Bhalotia Market Observation Site

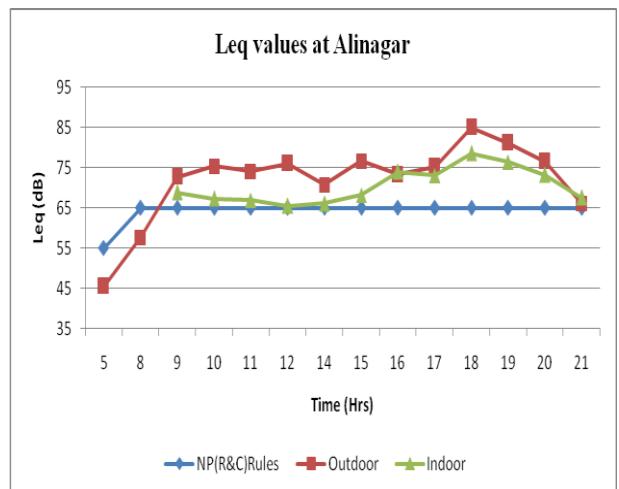


Fig 6 Outdoor and Indoor Noise Levels at Alinagar Observation Site

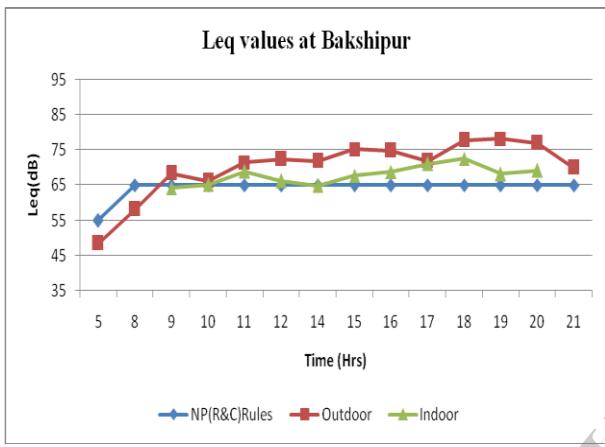


Fig 4 Outdoor and Indoor Noise Levels at Bakshipur Observation Site

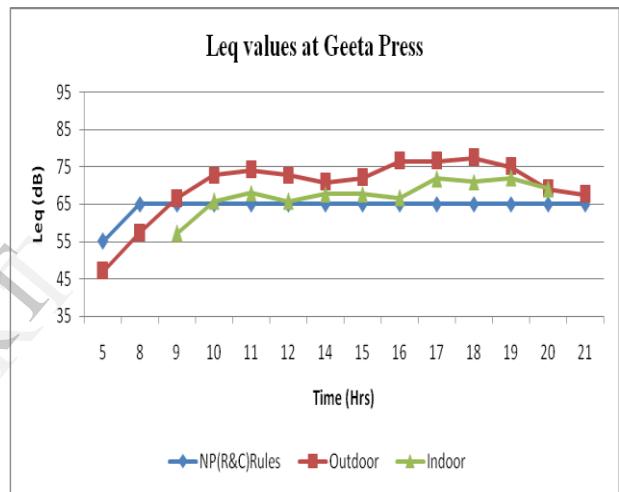


Fig 7 Outdoor and Indoor Noise Levels at Geeta Press Observation Site

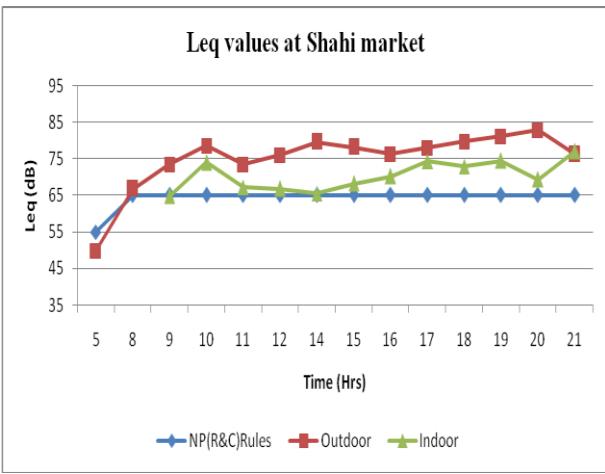


Fig 5 Outdoor and Indoor Noise Levels at Shahi Market Observation Site

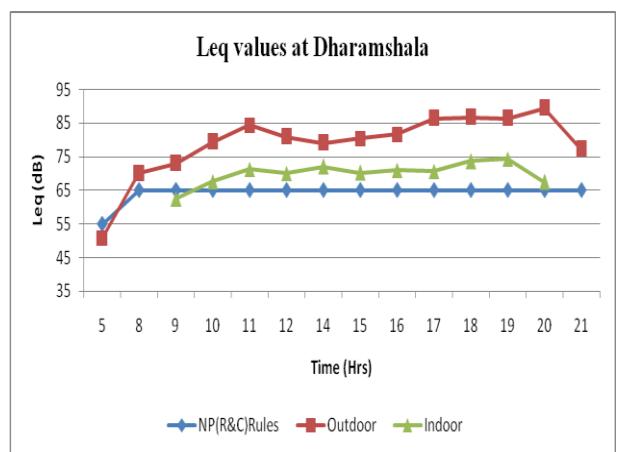


Fig 8 Outdoor and Indoor Noise Levels at Dharamshala Observation Site

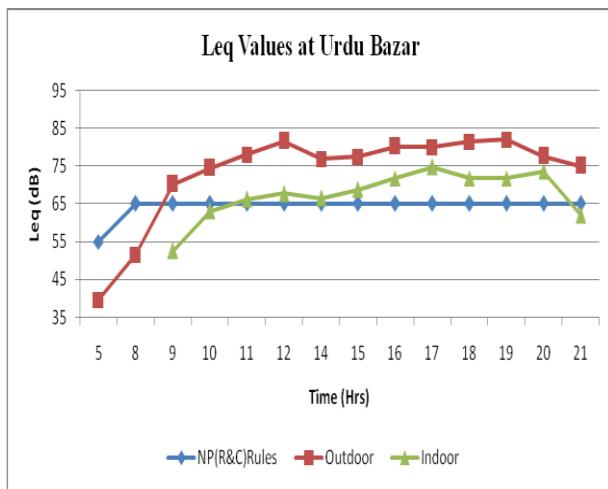


Fig 9 Outdoor and Indoor Noise Levels at Urdu Bazar Observation Site

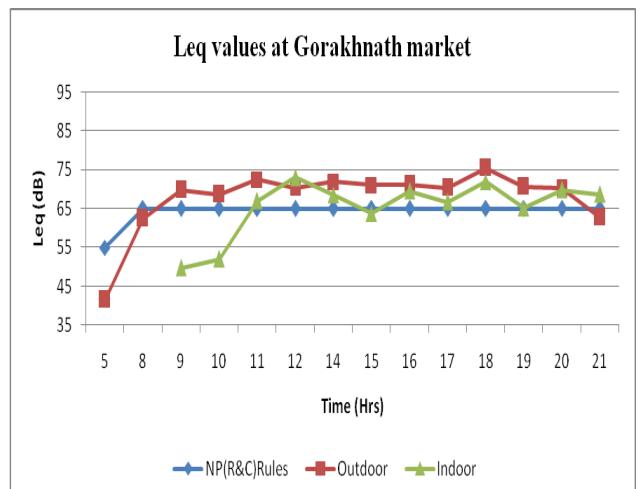


Fig 11 Outdoor and Indoor Noise Levels at Gorakhnath Market Observation Site

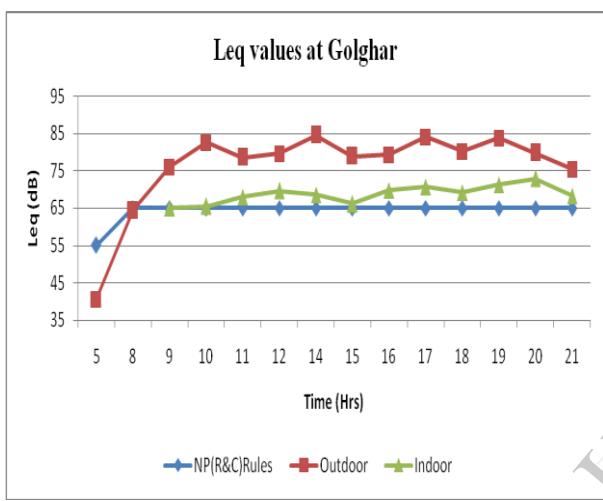


Fig 10 Outdoor and Indoor Noise Levels at Golghar Observation Site

It is seen from Fig.1 to 11 that, in general, the indoor noise levels remain, more or less in the lower range in forenoon when the business activity in the shops is low to moderate and start showing rising trend in the afternoon hours during 2:00 – 4:00 p.m. while reaching the peak in the evening hours after the customers in large numbers start flowing in after getting free from offices, schools, colleges and other establishments.

As summarized here, it is revealed that the range of noise levels in all the area is much higher than the permissible values per standards.

Table 2 Observed Outdoor maximum and minimum noise levels at various sampling stations

S.No .	Sampling Location	Day Time				Night time				
		Maximum Observed Leq dB(A)		Minimum Observed Leq dB(A)		Observed Leq dB(A)		Difference between max and minimum value dB(A)	Acceptable Noise Level dB(A)	Difference b/w Max. Observed Leq and Acceptable Value dB(A)
		Hour	Noise level	Hour	Noise level	Hour	Noise Level			
1	Asuran	18	88.32	8	67.84	5	53.49	20.48	65	23.32
2	Townhall	19	87.52	8	68.56	5	43.82	18.96	65	22.52
3	Bhalotia Market	19	79.12	8	52.98	5	42.59	26.14	65	14.12
4	Bakshipur	19	78.09	8	58.17	5	48.51	19.92	65	13.09
5	Shahi Market	20	82.88	8	66.82	5	49.89	16.06	65	17.88
6	Alinagar	18	84.97	8	57.64	5	45.53	27.33	65	19.97
7	Geeta Press	18	77.34	8	57.19	5	46.93	20.15	65	12.34
8	Dharamshala	20	89.39	8	70	5	50.93	19.39	65	24.39
9	Urdu Bazaar	19	82.02	8	51.52	5	39.61	30.5	65	17.02
10	Golghar	14	84.52	8	64.34	5	40.66	20.18	65	19.52
11	Gorakhnath Market	18	75.44	8	62.38	5	41.59	8.17	65	10.44

At a glance at Table 2 reveals that the difference between maximum observed outdoor noise (Leq) and acceptable noise level of 65 dB(A) at various observation sites lies in the range 10.44 -24.39 dB(A) which is greater than 10 dB

with respect to the maximum permissible values of 65 dB(A) and is, therefore, covered for suitable action by the prescribed authority on complain as per Noise Pollution (Regulation and Control) Rules, 2000.

Table 3 Observed Indoor maximum and minimum noise levels at various sampling stations

S.No.	Sampling Location	Day Time				Difference between max and minimum value dB(A)	Acceptable Noise Level dB(A) *	Difference b/w Max. Observed Leq and Acceptable Value dB(A)			
		Maximum Observed Leq dB(A)		Minimum Observed Leq dB(A)							
		Hour	Noise Level	Hour	Noise Level						
1	Asuran	18	80.47	8	60.79	19.68	50	30.47			
2	Townhall	18	78.6	12	65.46	13.14	50	28.6			
3	Bhalotia Market	19	70.4	9	51.4	19	50	20.4			
4	Bakshipur	18	72.53	9	64.23	8.3	50	22.53			
5	Shahi Market	21	77.05	9	64.8	12.25	50	27.05			
6	Alinagar	18	78.56	12	65.46	13.1	50	28.56			
7	Geeta Press	19	72.06	9	57.17	14.89	50	22.06			
8	Dharamshala	19	74.35	9	62.46	11.89	50	24.35			
9	Urdu Bazaar	17	74.71	9	52.55	22.16	50	24.71			
10	Golghar	20	72.93	9	65.06	7.87	50	22.93			
11	Gorakhnath Market	12	72.98	9	49.75	23.23	50	22.98			

*WHO guidelines (1996) defining maximum noise levels in Leq for specific environments

It is revealed from Table 3 that, at most of the observation sites, the minimum indoor noise levels are observed in early forenoon hours whereas the maximum indoor noise levels are observed in early forenoon hours whereas the maximum indoor noise levels are observed in the evening hours after 6:00 p.m. when the business activity in the shops is at the peak, except at Gorakhnath where the maximum indoor is observed at mid of the day which could be an outcome of increased traffic activity on adjoint roads.

It is also revealed from Table 3 that the indoor noise levels when compared to desirable value of 50 dB(A) as per WHO guidelines, are found to have exceeded the range 20.4 – 30.47 dB. This necessitates again the adoption of suitable remedial measures for control of outdoor noise and improvement of the interior surfaces in the shops to reduce the noise.

IV CONCLUSION AND RECOMMENDATIONS

- It have been found that the outdoor noise levels at all the observation sites in the commercial areas of the Gorakhpur city are exceeding permissible limit of 65 dB during day time as such suitable noise control measures are required.
- It has also been observed that the indoor noise levels is maximum after 6:00 p.m. till closing of shops which causes occupational noise exposure to workers.
- The indoor noise levels exceeds the desirable 50 dB WHO guidelines at all the observation sites.

The following several recommendations are made to reduce noise levels in the commercial area:

1. Recommendations to minimize the impacts of noise due to vehicular traffic, which is a major source of outdoor noise,

- Use of air horns, pressure horns and multi horns should be prohibited.
- Use of horns at traffic points, and on narrow ways and busy traffic should be prohibited.
- Adequate attention should be given on improvement and proper maintenance of road condition which will help in reduction of noise.
- Suitable measures should be adopted for decongestion of traffic on roads by adopting diversions and one way regulation.
- Movement of three wheelers and four wheelers on the congested roads like those in Urdu Bazar area should be prohibited.
- For traffic noise, wherever feasible, barriers, in the form of wall and vegetation may be provided.
- In noisy areas, limitations on speed of vehicles may also be implemented.

2. Recommendations in respect of architectural design for reducing indoor noise pollution

Architectural acoustics noise control practices include interior sound reverberation reduction, inter-room noise transfer mitigation.

- The majority of exterior noise enters through the windows. Dual pane windows with increased air space can improve isolations.

- To prevent the transfer of exterior noise into indoor, exterior building skin augmentation should be done in the case of new (or remoulded) apartments, hotels and shopping malls and complexes with stringent building codes with requirements of acoustical analysis, in order to protect building occupants.
- Vibration isolators should be provided like rubber mounts etc to avoid transmission of vibrating sounds.
- Sound absorption porous material which acts as a noise sponge by converting the sound energy into heat within the material may be provided on interiors. Common sound absorption materials include decoupled lead-based tiles, open cell foams and fibre glass.
- Due to reductions in cost, noise control technology can also be used in noise sensitive small business such as hotels and restaurants. Acoustically absorbent materials such as fibreglass duct liner, wood fibre panels and recycled denim jeans can serve as art work.
- Monitoring of loud speakers and sound system and regulating their use to the minimum.
- Generators sets should be monitored, maintained and tested for compliance with prescribed rules.

3. Other Measures :

- Government should consider the protection of population from community noise as an integral part of their policy for environmental protection.
- Government should consider implementing action plans with short term, medium term and long term objectives for reducing noise levels.
- Proper enforcement of already existing legislation to control noise pollution.
- Government should include noise as an important issue when assessing public health matter and support more research related to the occupational health effects of noise exposure.
- Periodic noise monitoring in various areas should be done and suitable control measures should be adopted.
- Noise impact assessment for any new or additional projects before granting the approval must be carried out.
- Traffic should be handled in a proper way by providing parking space and broadening the roads without affecting the ecosystem.

- A committee can be constituted to look into the noise related issues and to maintain the peaceful environment in the city.
- Apart from the official measures, proper awareness must be created among the people, about the negative impacts of noise pollution and the legislative rules, through NGO's, schools and other educational institutions. This can be further supported by other means of communication including print and electronic media.

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