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CORRELATING ROAD TRAFFIC EQUIVALENT NOISE LEVELS TO VARIOUS PHYSICAL AND ATMOSPHERIC PARAMETERS

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ABSTRACT

Modern rapidly expanding environment is facing various issues and one of such developing problems is that of noise. The impact of traffic noise is felt everywhere in urban (cities) as well as in rural areas (remote). Road traffic noise has been considered to be a major problem in most of the social surveys. The present paper aims at correlating various physical or atmospheric parameters with equivalent noise levels. It was found that there was negative correlation between L_{eq} and atmospheric temperature and L_{eq} and surface temperature while positive correlation was observed between L_{eq} and relative humidity, L_{eq} and vehicle count and L_{eq} and vehicle speed.

KEY WORDS : L_{eq}, Correlation, Equivalent noise levels.

INTRODUCTION

Sound is defined as airborne or atmospheric vibration perceptible to the ear. Noise is actually unwanted or undesirable sound. Noise pollution has been recognized as a major nuisance for the quality of living in developed areas all over the world. This is because of the increase in the number of vehicles and rapid industrialization. The noise level in urban areas especially along crossings has reached up alarming levels. Highway traffic noise has major contribution to road traffic noise. Noise levels are not constant and they vary with the type, number, speed of the vehicles, physical conditions of the road and other atmospheric parameters.

Various studies regarding the urban noise pollution and its impact on environment on the community have been made by various workers (Arana and Garcia, 1998; Suksaard *et al*., 1999; Abdel-Raziq and Zeid, 2000; Zannin *et al*., 2001; Zannin *et al*., 2003; Khilman, 2004; Piccolo *et al*., 2005).

Various factors have been found to influence the generation of road traffic noise are (a) Traffic speed (b) Traffic flow (c) Gradient of the road (d) Proportion of heavy vehicles (e) Type of the road surface (f) Obstruction caused by noise barriers (g) Attenuation of sound waves because of path length between the source and the receiver and also due to absorption by ground.

In the present study an attempt has been made to correlate the various physical and atmospheric parameters to equivalent noise levels. This correlation provides information for studying the variation of noise levels with changing environmental conditions. The future scope of this study lies in preparing a model for calculating noise levels in the study area.

Methodology

The present study was conducted on five main crossings lying on NH1A highway passing through the Jammu city. These crossings include:

Satwari crossing (Site I) - entry point of Jammu city

Vikram crossing (Site II) - one of the commercial areas of Jammu city

Jewel crossing (Site III) - Crossing at centre of Jammu city

Rehari crossing (Site IV) – Lies next to Jewel crossing

Amphalla crossing (Site V) – Exit point of Jammu city

Sound pressure levels were observed at the given sites with the help of calibrated Digital Sound Level Meter (Data Logger Model: 407764A). During observation, 20 readings of SPL (Sound Pressure Level) were recorded after an interval of 30 seconds each in a period of 10 minutes. From the data, equivalent noise level (L_{eq}) was calculated using formula:

$$L_{eq..}=10 \log\left(\sum_{i=1}^{n} fi\,10^{Li/10}\right)dB(A)$$

Where Li = sound intensity

fi = fraction of time for which sound pressure level persists

i = time interval

n = number of observations

At the same time atmospheric data like air temperature, surface temperature, and relative humidity were also determined at the respective sites using handheld Thermometer, Soil Thermometer and Psychrometer respectively. The numbers of vehicles (to and fro) per ten minute moving through the different crossings were manually counted at the selected sites. The speed of the vehicle (Km/hr) passing through the roads was measured using handheld speed radar gun (Model M10P) at the selected sites. The procedure was repeated during three seasons of the year Viz. Rainy, summer and winter season for the given sites. At the end Correlation was obtained between L_{eq} and other selected parameters to determine the variation involved.

OBSERVATION AND DISCUSSION

The analysis of correlation between L_{eq} and other parameters for the year was done. It was observed that there was negative significant correlation between L_{eq} and atmospheric temperature for all the five sites during all the three seasons (rainy, summer

Correlation between L_{eq} and other physical parameters at selected sites for the rainy, summer and summer season of Year I.

	Site	Leq (a)	A.T(b)	S.T (c)	R.H (d)	V.C (e)	Speed (f)	R1 (a vs b)	R2 (a vs c)	R3 (a vs d)	R4 (a vs e)	R5 (a vsf)
RAINY	I	90.93	32.43	29.83	77.67	517	28.67	-0.42	-0.63	0.99	0.98	0.26
	II	90.84	34.37	31.87	68.67	628.67	26.5	0.41	-0.20	0.99	0.82	0.86
	III	91.10	32.33	28.5	80.67	511.33	30.27	-0.26	-0.99	0.99	0.99	0.27
	IV	86.28	35.33	29	81	516.33	33.13	-0.75	-0.32	-0.38*	0.92	0.99
	V	84.12	33.2	30.33	73.33	533	33.83	-0.14	-0.28	0.97	0.23	0.82
SUMMER	I	81.96	36.65	30.33	53.33	507	28.87	-0.52	-0.31	0.89	0.81	0.89
	II	83.63	36.67	31.33	46.67	536	25.6	-0.45	-0.53	0.62	0.96	0.58
	III	86.98	38.33	30	52.67	545	22.83	-0.14	-0.26	0.44	0.98	0.54
	IV	81.09	34.33	29.17	50.67	427	27.13	-0.04	-0.18	0.08	0.99	0.26
	V	81.86	33.67	30	52	426.67	31.2	-0.23	-0.49	0.75	0.98	0.61
WINTER	I	77.28	11.34	13	70.67	560.67	33.53	-0.09	-0.27	0.08	0.97	0.30
	II	75.55	14.67	13.33	61.33	585.33	27.03	-0.80	-0.69	0.89	0.86	0.19
	III	82.29	15.33	13.67	63.33	579	25.67	-0.97	-0.81	0.99	0.99	0.57
	IV	75.243	13.67	12.33	64.67	520	24.43	-0.94	-0.69	0.99	0.89	0.99
	V	82.68	13.67	12	63.33	589	30	-0.22	-0.71	0.65	0.99	0.90

Correlation between L_{eq} and other physical parameters at selected sites for the rainy, summer and summer season of Year II.

	Site	Leq (a)	A.T(b)	S.T (c)	R.H (d)	V.C (e)	Speed (f)	R1 (a vs b)	R2 (a vs c)	R3 (a vs d)	R4 (a vs e)	R5 (a vs f)
RAINY	I	89.88	30.67	27	75.33	533.67	27	-0.68	-0.76	0.84	0.43	0.06
	II	90.66	32.33	30.03	77.33	570.67	27.567	-0.12	-0.28	0.62	0.96	0.14
	III	93.7	30.27	28.13	78.33	591	24.3	-0.06	-0.55	-0.99	0.85	0.41
	IV	85.49	31.2	28.5	80.33	514.33	24	-0.48	-0.30	0.76*	0.95	0.95
	V	87.5	30.47	27.27	83	557.67	29.67	-0.33	-0.36	0.99	0.99	0.89
SUMMER	I	82.07	37.17	30.17	45.67	514.33	25.97	-0.17	-0.12	0.12	0.94	0.75
	II	84.32	37.33	31.8	44	554	23.13	-0.67	-0.34	0.98	-0.13	0.83
	III	89.49	37.27	30.03	40	559.33	21.67	-0.13	-0.98	0.27	0.97	0.49
	IV	81.93	37.83	31.33	39.33	445	25.27	-0.24	-0.12	0.43	0.26	0.99
	V	82.83	37.17	31	41.67	453.33	24.97	-0.02	0.15	-0.59	0.96	0.53
WINTER	I	78.94	12.5	13.17	69	572	31.47	-0.63	-0.76	0.89	0.62	0.83
	II	79.67	14	12.43	69.67	583.67	26	-0.95	-0.88	0.68*	0.41	0.44
	III	87.35	14.17	13.17	70.33	605.33	23.67	-0.46	-0.39	0.44	0.99	0.92
	IV	80.00	14.17	12.33	66.33	533.67	25.07	-0.05	-0.11	0.63	0.71	0.82
	V	81.19	12.67	12.3	73.33	565	28.5	-0.09	-0.002	0.93	0.69	0.34

and winter) for the year I as well as year II. The correlation between L_{eq} and surface temperature was found to be significantly negative for both the year I and II during all the seasons of study period. The analysis of correlation Coefficients between L_{eq} and Relative Humidity revealed significant positive correlation for both the years except for Site IV of rainy season during Year I and Site III of Rainy season and Site V of Summer season during Year II. A significant positive correlation was observed between L_{eq} and vehicle count for both the Year I and II during all the seasons of study period. The correlation between L_{eq} and speed of vehicles in (Km/hr) was found to be significantly positive for both the year I and II during all the seasons of study period.

Pachiappan and Govindraj in (2013) observed positive correlation existing between L_{eq} and relative humidity, L_{eq} and traffic count and L_{eq} and vehicular speed and negative correlation was found between L_{eq} and atmospheric temperature and L_{eq} and surface temperature.

CONCLUSION

There was negative correlation between L_{eq} and atmospheric temperature and L_{eq} and surface temperature while positive correlation was observed between L_{eq} and relative humidity, L_{eq} and vehicle count and L_{eq} and vehicle speed.

Scope for Future Work

The future scope of this study lies in preparing a model for calculating noise levels in the study area. Different physical parameters can be used as independent variables and using Leq as dependent variable on these factors, regression modelling can be done to calculate noise levels.

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