International Journal of Future Generation Communication and Networking
Vol. 13, No. 3, (2020), pp. 2879–2893

Noise Prediction Model Comparison Study between Highways and Arterial City Roads, Bangalore

Kanimozhee S
Assistant Professor, School of Civil Engineering
REVA University,
Bangalore, Karnataka, India
kanimozhee.s@reva.edu.in

Siddharth Chougule
M Tech student, School of Civil Engineering,
REVA University,
Bangalore, Karnataka, India

Harish Parshram Chougule
M Tech student, School of Civil Engineering,
REVA University,
Bangalore, Karnataka, India

Anusha G S
M Tech student, School of Civil Engineering,
REVA University,
Bangalore, Karnataka, India

Abstract

The traffic noise models are important in designing roads and highways. In addition they are also used in assessment of existing noise conditions. In this paper a statistical and mathematical modeling approach has been used for predicting noise levels in Indian road conditions. The project was carried out in Bangalore city, in the south of India. The data was collected by traffic studies and measurement of noise levels at national highway NH-48 i.e., Bangalore-Mumbai highway and an arterial road at brigade road Bangalore, Karanataka. The noise levels were recorded using a noise/decibel meter. Based on the assessment with reference to "the Burgess Model", "FHWA MODEL", "FHWA TNM MODEL" and "ASJ RTN MODEL 2018" etc., fully compliant to ISO 9613, where, equivalent continuous weighted sound pressure level (LAeq) this entire data set was utilized to develop a new model for Indian road conditions. The traffic noise is known to be one of the major sources of environmental pollution nowadays; hence it has paved the way for development of models that enables to predict noise level from fundamental variables.

Keywords: *NH-48, the Burgess Model, FHWA Model, ASJ Model, noise meter, Laeq.*

Introduction

The traffic noise on the roads is known to-be among the most annoying source of noise as it is most wide spread. And because of the increasing number of vehicles and its widespread use, stringent measures are to be taken to control it. As per the reports of the recent study by the World Health Organization (2011) *"more than one million people are losing their lives due to noise pollution every year in western Europe alone".* The studies have shown that some of the most pervasive source of noise in our environment these days are those associated with transportation [1]. Traffic noise along highways tends to be dominant source of noise in urban as well as rural environment. The commitment of interstate clamor is 70%, aviation route makes 20% and railroad about 10% to generally speaking traffic

ISSN: 2233-7857 IJFGCN

commotion [4]. The greater part of the Indian roadways have blended traffic with a variety in rush hour gridlock volume, speed and other street and traffic parameters. Poor vehicle maintenance, poor riding surface, high speed and bad driving also add to noise levels. It is one of the major natural toxins that are experienced in day by day life. Traffic commotion keeps on expanding in size and reality considering people advancement urbanization and the related improvement in the usage of vehicles.

Growth of transportation-sector in India

The fantastic development in the Road Transportation Sector in India is a key component in the monetary turn of events. The Indian national expressways are the essential significant largest roadways [3]. They are looked after by the Central Government. India has a huge network of over 3.314 million kilometers of road system (2.1 million miles), which makes it a nation with the third biggest street organize on the planet. Indian highways comprise around 2% of the overall street system of India; however convey about 40% of the overall traffic. 65% of cargo and 80% traveler congestion is conveyed through streets. Number of vehicles is developing at a normal pace of 10.16% per year in the course of the most recent five years.

Traffic noise generation

At the point when a source of noise is fixed, it is known as a point source and it emanates sound similarly every which way like a beating circle. At the point when many sound sources are moving in a line, the sound transmits like a beating chamber from the sources[2]. It is critical to recognize point sources from line sources in light of the fact that these have various attributes.

Relation of noise with volume of traffic and speed

Diminishing rate confines in expressways and speeding up limits is regularly the best and cost efficient methods for lessening noise. For instance, lessening vehicle speeds from 40 to 30 Km/hr is as successful as expelling one a large portion of the vehicles from the roadway [5].

Indian noise standards

In India, encompassing quality of air and its guidelines in regard of commotion level has been endorsed under Environmental Protection Act, 1986 and are likewise provided in noise prevention and control rules 2000 and the principles of commotion in households, commercial, industrial and no noise areas in day and night time are given in **Table 1.**

Table 1: Ambient air quality standards with respect to noise

Area	Limits in dB (A) Leq	
	Day time	Night time
Industrial area	75	70
Commercial area	65	55
Residential area	55	45
Silent zone	50	40

Day – 006hrs to 0100hrs (16 hours)
Evening – 0100hrs to 006hrs (08 hours)
Areas of 100 meters around specific places like medical clinics, instructive foundations and courts might be proclaimed as quietness zone.

Burgess Model

The Burgess Noise model is used to compute the traffic noise equivalents (Leq) using the following formula by Burgess (1977),
Leq = 55.5 + 10.2log (Q) + 0.3P – 19.3log (d)

ISSN: 2233-7857 IJFGCN

Where, Q = is the vehicles flow
d = is the distance of source receiver.

Objectives

1. To monitor and assess ambient noise levels on major corridors of NH-48 of Bengaluru-Mumbai highway.
2. To measure the noise levels at interior roads/streets in the city of Bengaluru and compare them as per the standards of CPCB/WHO and other organizations.
3. To develop mathematical models relating to traffic parameters such as vehicular volume, vehicular speed and road geometrics w.r.t noise.
4. To study the variation of noise levels in city streets and on highways.
5. To specify the recommended noise levels in residential areas to ensure eco-friendly environment.

Methodology and Analysis

Selection of Site

The first main job for carrying out any project is site selection. Here to develop an arithmetical model for prediction of traffic noise, a six lane highway with free flow of traffic and without any obstructions like speed breakers, interchanges, traffic signals etc., was selected on Bangalore – Mumbai highway (NH- 48) via Nelamangala and an arterial road at brigade road Bangalore, in the south Indian state of Karnataka.

The overall length from Bangalore - Nelamangala toll booth to Nelamangala of NH- 48 is 12km. it is completely a six lane highway three lanes on each side. The stretch consists of shoulders on either direction of the road. The highway along this stretch is divided by raised kerb median of about 30-35cm and also has road arboriculture and housing electric poles for road illumination. The distance of the carriageway i.e., pavement width and shoulder distance, distance of property line from carriageway with respect to kerb were measured and was noted down to 10.5 meters for 3 lanes on each side. The distance was measured at possible available places along this stretch. The stretch is divided in three major mid blocks namely:

1. Makali
2. Dasanapura
3. Toll plaza

An arterial road at Brigade junction at the heart of Bangalore city in the southern region of the state of Karnataka is selected for the purpose of study. The total stretch of 2km was studied which is selected because that stretch has high traffic flow ie, huge number of vehicles pass through that junction. The investigation was carried out starting from junction signal up to the 2km length. It is a one-way road.

Traffic Volume Studies

The traffic volume count at highways was done by manual counting by employing two surveyors at each side of the road. The observers counted the number of vehicles passing the particular point at the survey location and recorded the same into the pre-generated tally sheets. The traffic volume is counted at junctions both on weekdays and on weekends. The traffic volume count was done three days a week for every junction with two days on a weekday and one day on weekends.

ISSN: 2233-7857 IJFGCN

Table 2: Volume at junction in PCU"s/hr along with V/C and the corresponding LOS

Sl No	Junction	Road Name	V (PCU/hr)	V/C	LOS
1	MAK ALI	NH-48(Bangalore toward Nelamangala)	1904	0.158	A
		NH-48(Nelamangala towards Bangalore)	1894	0.156	A
2	DASAN APURA	NH-48(Bangalore towards Nelamangala)	1756	0.145	A
		NH-48(Nelamangala towards Bangalore)	1778	0.149	A
3	TOLL PLAZA	NH-48(Bangalore towards Nelamangala)	1854	0.154	A
		NH-48(Nelamangala towards Bangalore)	1932	0.161	A

From the table 2 it is clear that the roads at the junctions are really good with V/C ratio ranging between 0.145 (Juntion-2, Bangalore towards Nelamangala) to 0.161 (Junction-3, Nelamangala towards Bangalore). The traffic volume observed at mid-blocks is given in table 3 below. From the table it is clear that the lowest V/C ratio obtained is 0.122 for the stretch between (Mid-block 4, Nelamangala towards Bangalore) and highest value is in between the stretch (Mid-block 1, Bangalore towards Nelamangala).

Table 3: Volume at mid-blocks in PCU/hr along with V/C

Midblock	Road Name	V (PCU/hr)	V/C
M-1	NH-48(Bangalore towards Nelamangala)	1890	0.155
	NH-48(Nelamangala towards Bangalore)	1854	0.154
M-2	NH-48(Bangalore towards Nelamangala)	1788	0.150
	NH-48(Nelamangala towards Bangalore)	1659	0.136

ISSN: 2233-7857 IJFGCN

	BANGALORE towards NELAMANGALA			NELAMANGALA towards BANGALORE		
	At property line	At shoulder	At kerb	At kerb	At shoulder	At property line
M-1	79.2	77.3	82.4	93.4	81.5	88.2
M-2	82.4	78.6	85.7	96.8	-	86.5
M-3	86.5	-	84.3	94.5	78.2	80.6
M-4	90.2	-	90.3	96.4	-	78.4

M-3	NH-48(Bangalore towards Nelamangala)	1621	0.134
	NH-48(Nelamangala towards Bangalore)	1652	0.136
M-4	NH-48(Bangalore towards Nelamangala)	1589	0.131
	NH-48(Nelamangala towards Bangalore)	1480	0.122

At arterial road

Table 4: Volume at arterial road in PCU"s/hr along with V/C and the corresponding LOS

Sl No	**Area**	**Road Name**	**V (PCU/hr)**	**V/C**	**LOS**

ISSN: 2233-7857 IJFGCN

1	AT SIGNAL	Entering the study stret	1658	0.136	**E**
2	AT END OF THE STRETCH	Exiting the study stretch	1620	0.134	**E**

Vehicular Speed Study

At highways

The vehicular spot speed study was carried at survey area. The spot speed study was done by marking two points A and B on the stretch 200m apart from each other. Two trained surveyors were placed at entry (A) and exit (B) points of the stretch. A stop was used to measure the time taken by the vehicles to travel from point A to B in seconds. A total of 50 vehicles were tabulated from each category (Trucks, buses, cars, bikes etc) and the average speed of vehicles is calculated from the observed data.

	BANGALORE towards NELAMANGALA			**NELAMANGALA towards BANGALORE**		
	At property line	At shoulder	At kerb	At kerb	At shoulder	At property line
J-1	78.6	86.7	92.4	91.4	89.3	77.4
J-2	75.4	90.2	90.8	98.6	91.2	79.3
J-3	87.3	87.4	102.5	103.5	99.2	74.8

ISSN: 2233-7857 IJFGCN

	BANGALORE towards NELAMANGALA			NELAMANGALA towards BANGALORE		
	At property line	At shoulder	At kerb	At kerb	At shoulder	At property line
J-1	78.6	86.7	92.4	91.4	89.3	77.4
J-2	75.4	90.2	90.8	98.6	91.2	79.3
J-3	87.3	87.4	102.5	103.5	99.2	74.8

Table 5: Various speed limits obtained from "S" curve (kmph)

JUNTION	LOCATION (TWO ENDS)	98% (DESIGN SPEED)	50% (MEDIAN SPEED)	85% (USL)	15% (LSL)
J-1 (MAKALI)	Bangalore towards Nelamangala	116	76	90	60
	Nelamangala towards Bangalore	113	74	86	56
J-2 (DASANAPURA)	Bangalore towards Nelamangala	107	72	82	52
	Nelamangala towards Bangalore	103	66	82	52
J-3 (TOLL PLAZA)	Bangalore towards Nelamangala	97	60	79	50
	Nelamangala towards Bangalore	101	62	80	51

At arterial road

Table 6: Various speed limits obtained from "S" curve

Noise Measurement (At highway)

For the estimation of noise, a handheld type noise meter is utilized which gives the immediate reading of the noise in terms of dB. The noise estimation was taken at the following areas at each midblock and at intersections around the same time and time of the traffic volume check and vehicular speed estimation. The noise values got in the field is at kerb, shoulder and at property line which are as appeared in the tables 7 and 8 respectively.

Table 7: Noise at mid-blocks in dB (A)

Table 8: Noise at Junctions in dB (A)

At arterial road

ISSN: 2233-7857 IJFGCN

Table 9: Noise at various junctions in dB (A)

	BRIGADE ROAD		
	At property line	At shoulder	At kerb
M-1	93.2	106.8	112.5
M-2	94.4	104.6	108.2
M-3	92.5	95.3	111.6

Data Collection and Analysis

Relationship of Noise with Volume

To build up the possible relationship of noise with the volume, different measurable parameters are utilized, for example, correlation and regression analysis. For a given traffic volumes streaming along the study stretch, three noise meters were utilized all the while to gauge the noise level, one at the kerb, one at the property line and one at the shoulders. The measured data of the noise are introduced in the table 7 along the V/C of the specific stretch. According to the investigations it is fitting to acquire the relationship of the noise regarding V/C as opposed to traffic volume alone. This will assist with acquiring the relationship of the noise concerning the road congestion rather than road traffic alone.

Table 10: Variation of noise with Volume (At highway)

Location	**98%(DESIGN SPEED)**	**50%(MEDIAN SPEED)**	**85% (USL)**	**15% (LSL)**
BRIGADE ROAD	42	30	38	8

Midblocks	**Location**	**Total VPCU/hr**	**V/C**	**Noise at kerb in**	**Noise at shoulder in**	**Noise at property**

ISSN: 2233-7857 IJFGCN

				dB(A)	dB(A)	line in dB(A)
M-1	BANG towards NELA	1890	0.155	82.4	77.3	82.4
	NELA towards BANG	1854	0.154	93.4	81.5	88.2
M-2	BANG towards NELA	1788	0.150	85.7	78.6	85.7
	NELA towards BANG	1659	0.136	96.8	-	86.5
M-3	BANG towards NELA	1621	0.134	84.3	-	84.3
	NELA towards BANG	1652	0.136	94.5	78.2	80.6
M-4	BANG towards NELA	1589	0.131	90.3	-	90.3
	NELA towards BANG	1480	0.122	96.4	-	78.4

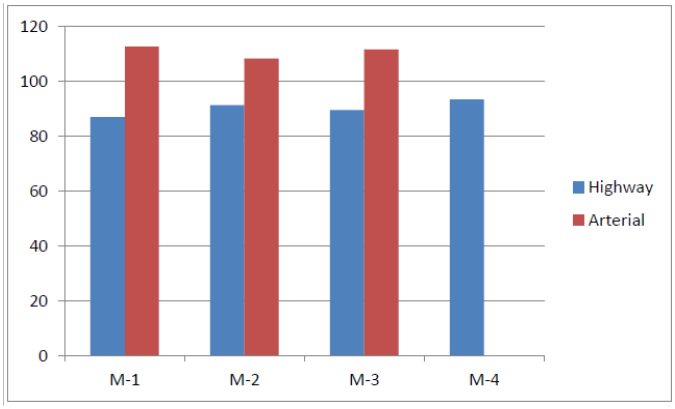
Table 11: Variation of noise with Volume (At arterial)

Location	Mid-blocks	Total VPCU/hr	V/C	Noise at kerb in dB(A)	Noise at shoulder in dB(A)	Noise at property line in dB(A)

ISSN: 2233-7857 IJFGCN

BRIGADE ROAD	M-1	1658	0.136	112.5	106.8	93.2
	M-2	1658	0.136	108.2	104.6	94.4
	M-3	1620	0.134	111.6	95.3	92.5

Comparison of noise levels at highway and arterial road



So as shown in the fig the noise at arterial roads is higher than that of highways due to various reasons like buildings, volume of vehicles, intensity of traffic, population etc which facilitates the reproduction or refraction of noise which increases the intensity of the noise.

BANGALORE towards NELAMANGALA	**Design speed**	**$y= 0.8656x^3 - 2.3x^2 - 9.922x + 128$**	**$R^2 = 1$**
	Median speed	**$y= -3.7x^3 + 27.3x^2 - 66.1x + 117$**	**$R^2 = 1$**

ISSN: 2233-7857 IJFGCN

	USL	y= $-1.1x^3 + 7.1x^2 - 17.6x + 98$	$R^2 = 1$
	LSL	y= $1x^3 - 8.2x^2 + 19.3x + 41$	$R^2 = 1$
NELAMANGALA towards BANGALORE	**Design speed**	y= $-0.865x^3 + 6.2x^2 - 15.64x + 118$	$R^2 = 1$
	Median speed	y= $-1.35x^3 + 12.3x^2 - 27.66x + 107$	$R^2 = 1$
	USL	y= $-2.4x^3 + 18.2x^2 - 46.5x + 102$	$R^2 = 1$

These charts are named as variations of congestion regarding the noise level. What's more, for all the investigation streets, the regression lines were created alongside r^2 value which was found very reassuring. To give expressly, since at all spots shoulder was not accessible, the relationships were acquired for the noise level at the kerb and at the property line. The acquired connections regarding a mathematical equation alongside r^2 values are introduced in the table 8, demonstrating that there will be solid relationship that exists between the congestion levels of the street with the noise.

Table 12: Variation of noise with the volume in the selected study area (At highway)

BANGALORE TOWARDS NELAMANGALA		
V/C vs noise at kerb	**y= $-0.62x^3 + 3.78x^2 - 8.21x + 94.3$**	**$R^2 = 1$**
V/C vs noise at property line	**y= $-1.4356x^3 + 10.52x^2 - 27.435x + 106$**	**$R^2 = 1$**
NELAMANGALA TOWARDS BANGALORE		
V/C vs noise at kerb	**y= $-0.27x^3 + 1.1x^2 - 1.62x + 96.8$**	**$R^2 = 1$**
V/C vs noise at property line	**y= $0.9963x^3 - 7.36x^2 + 13.862x + 78.5$**	**$R^2 = 1$**

Table 13: Variation of noise with the volume in the selected study area (At arterial)

BRIGADE ROAD		
V/C vs noise at kerb	**y= $-0.22x^3 + 0.98x^2 - 1.12x + 86.8$**	**$R^2 = 1$**
V/C vs noise at property line	**y= $0.8633^3 - 5.16x^2 + 11.612x + 86.3$**	**$R^2 = 1$**

ISSN: 2233-7857 IJFGCN

Relationship of Noise with Speed

Since the vehicular speed has a wide scope of variations because of mixed traffic stream condition, the combined speed of all the vehicles according to IRC proposals are considered for the current investigation. The values got are plotted on chart and analyzed as below for 98th percentile speed (design speed to see any deficiencies) 85th percentile value (upper speed limit which assists to install sign boards along the highways at the study areas which is impressively loaded up with pedestrians and vehicular activities together with road safety), 50th percentile (middle speed at which a large portion of the vehicle should move for safety condition) and 15th percentile speed (lower speed limit at which the vehicles moving will include danger to the safety like bullock carts, cycles, autos).
The corresponding variation of noise concerning the above speeds is figured along with their mathematical equation and R^2 value. Of all the different curves created, the more proper and the one which must be utilized for highways is Upper Speed Limit as any vehicle moves past this speed will be reserved for traffic violation.

Table 14: variation of noise with speed at the study location (At highway)

Table 15: variation of noise with speed at the study location (At arterial)

BRIGADE ROAD	**Design speed**	y= $\mathbf{0.28x^3 - 1.3x^2 - 6.712x + 52}$	$\mathbf{R^2 = 1}$
	Median speed	y= $\mathbf{-1.7x^3 + 19.3x^2 - 52.1x + 36}$	$\mathbf{R^2 = 1}$
	USL	y= $\mathbf{-0.81x^3 +5.2x^2 - 13.2x + 28}$	$\mathbf{R^2 = 1}$
	LSL	y= $\mathbf{0.88x^3 - 5.3x^2 + 16.13x + 16}$	$\mathbf{R^2 = 1}$

The variations of noise concerning the speed, when the noise meter was held at three distinct areas namely at the kerb (beginning of the kerb trail), toward the finish of the kerb/pathway and another situated at where the property line begins. This activity was done to comprehend the variation of the traffic noise with the horizontal distances. In a large portion of the areas, the noise level at the property line is past the permissible limits determined by the specialists. This causes safety dangers and furthermore demands the decrease in noise levels by different methods and measures.
The variations of the traffic noise regarding the fluctuating distances from the noise source demonstrate obviously the decrease in the noise level. The charts are produced for both the directions where noise observations were made at the kerb level, shoulder/footpath edge and the property line.
The read noise levels exceed 65 dB(A) at kerb level for all the areas M1-M4 and intersections J1-J3 which is alarming and required immediate attention of the authorities to reduce the noise levels which is indicated in the figure below.

Figure showing comparison of noise levels at mid-blocks and junctions on highways

ISSN: 2233-7857 IJFGCN

Comparison with Burgess Model

So as to approve the field values estimated for the noise and the standard model created by Burgess, considering pavement width, vehicular volume in PCU‟s/hr and % composition HTV‟s are compared for the validation. From the table 9, it is clear that there is a lot of variation and not noteworthy as per obtained square of the error and least square of the error. Consequently the measured values are not in the line with the burgess model which is created for the purpose.

Table 16: Comparison of measured values of noise with burgess model

Burgess	Field measured values	Variation (e)	e^2	Least square error
85.2	93.4	8.2	67.24	
76.27	82.4	6.13	37.58	
106.61	96.8	9.81	96.24	
87.59	85.7	-1.89	-3.57	
103.06	94.5	8.56	73.27	1.98
88.28	84.3	-3.98	-15.84	
97.40	96.4	0.93	0.86	
91.0	90.3	-0.70	-0.49	
			255.29	

Results and Discussion

The noise variation values to volume of traffic and vehicular speed (design speed, lower and upper speed limits and median speed), measured at kerb, shoulder and property line, are compared to the values with burgess model with reference particularly to traffic volume and road geometrics as said for highways. The level/ value of least square calculated is 1.98, it indicates that the measured values are in contrast and similar to Burgess Model especially for highways.
It is recommended for the people and to the authorities in Bangalore to provide clean and noise free environment for the people and overall society for say. The measured noise levels in the study stretch at highways or in the arterial roads are very high and at some points more than 100dB which poses a

ISSN: 2233-7857 IJFGCN

great danger to the health of people o f Bangalore and also to the animals present in the vicinity, hence it very necessary that immediate steps are taken for reducing or restricting the noise levels below the limits which are not harmful for human or animal health. The structures adjacent to the roads which are in immediate impact of noise must use certain materials which can curb the noise in the area for example double layered windows, and the rubber padding should be provided to the doors and windows to reduce the noise. The people should be made aware of the effects of noise pollution and awareness should be spread among people by employing sign boards, community programs with visual demonstration so that everyone can understand the ill effects of noise.

It is also strongly suggested to develop road arboriculture on the medians as well road sides in the view of arresting vehicular noise. Though it is already present at some parts of the study stretch it is not sufficient for the purpose. Wherever possible sound barriers or sound buffers should be provided to curb the noise, all these measures can reduce the sounds levels by 15dB or more. It is also recommended that stringent bylaws shall be laid for the building offsets as proven by the recent studies, reducing the sound levels by 6dB.

Conclusion

After the thorough study and analysis the following conclusions can be drawn

i. The comparison study between the noise levels and the arterial streets reveal that the noise levels at arterial are much higher than the highways for the various reasons mentioned.
ii. The arterial roads are small roads with high traffic volume of traffic which produce high intensity noise.
iii. At or along the study stretch both on highways and on arterial roads the road noise is at least 35-45% more than that of prescribed recommended values for betterment of human or animal health in residential areas and commercial spaces respectively.
iv. The noise levels will be high and increasing unless concerned authorities employ any kind measures as discussed in the results discussions to curb the same.
v. Even though the model is suitable for the highways, it is seen that the model can produce inaccurate results when employed for arterial roads at certain points, the reasons may be feasibility, space available and traffic volume etc.
vi. There is always scope for further studies and there is much need of educating the people regarding noise pollution and its harmful effects.

References

1. “Modelling of noise pollution due to heterogeneous highway traffic in India” (2019), Aditya Kamineni, Sunil Duda et al. Transport and Telecommunication, 2019, volume 20, no. 1, 22–39.

2. “Assessment, Prediction and Mapping of Noise Levels in Vellore City, India” (2019), N.Manojkumar, KhadarBasha and B.Srimuruganandam. Published by DeGruyter. Received Mar 06, 2019, accepted Jun 18, 2019.

3. “2-D noise maps for tier-2 city urban Indian roads” (2019), Dipeshkumar R, Sonaviya and Bhaven N. Tandel. Published by DeGruyter. Received Feb 04, 2019, accepted Mar 04, 2019.

4. “A Study of Noise Pollution Measurements and Possible Effects on Public Health in Ota Metropolis, Nigeria” (2019), Pelumi E. Oguntunde, Hilary I. Okagbue et al. Macedonian Journal of Medical Sciences. 2019 Apr 30; 7(8):1391-1395.

5. “Full-time exposure to occupational noise during pregnancy was associated with reduced birth weight in a nationwide cohort study of Swedish women” (2018), Jenny Selander, Lars Rylander et.al. Science of the Total Environment. Published by Elseveir Ltd.

ISSN: 2233-7857 IJFGCN

6. "Assessment of noise-levels of generator-sets in seven cities of South-Southern Nigeria" (2018), Osagie Ibhadode, I. T. Tenebe et.al. African Journal of Science, Technology, Innovation and Development. Published by Taylor & Francis, 17 Jan 2018.

7. "Assessment of uncertainty in urban traffic noise measurements" (2017), Andrzej Bąkowski, Leszek Radziszewski et.al. Published by Elseveir Ltd. Procedia Engineering 177 (2017) 281 – 288.

8. "Regression modelling of Traffic Noise Pollution at various crossings in Jammu City (J&K), India" (2017), Kaushal, Akanksha et.al. ESSENCE - International Journal for Environmental Rehabilitation and Conservation. Volume VIII: Special Edition: 2: 2017 [15 - 21].

9. "Assessment of Traffic Noise and Development of Noise Models for National Highway-06, Passing through Chhattisgarh, India" (2016), G. S. Vij, M. L. Agarawal and M. K.Gupta. Indian Journal of Science and Technology, Vol 9(47), DOI: 10.17485/ijst/2016/v9i47/103966, December 2016.

10. "Rapid Modeling Method for Road Traflc Noise Sources: A case study in Beijing" (2015), L.Zhu, X.Li et al. Published by DeGruyter. Received May 14, 2015; accepted Oct 08, 2015.
11. "Detection of Anomalous Noise Events for Real-Time Road-Traflc Noise Mapping: The DYNAMAP's project case study" (2018), Francesc Alías, Rosa Ma Alsina-Pagès, et al. Published by DeGruyter. Received Dec 28, 2017; accepted Jun 26, 2018.
12. "People exposed to traffic noise in European agglomerations from noise maps. A critical review" (2014), Miguel Arana et al. Published by DeGruyter. Received May 22, 2014; accepted September 8, 2014.
13. "Exposure to road traffic noise: Annoyance, perception and associated factors among Brazil's adult population" (2018), Karina Mary Paiva et al. Published by Elseveir Ltd, Science of the Total Environment. Received 27 June 2018; accepted 3 September 2018.
14. "Assessment of Noise Pollution in Selected Locations in Ota, Nigeria" (2018), Usikalu M.R and Kolawole O. RESEARCHGATE, International Journal of Civil Engineering and Technology September 2018.
15. "Dataset on Noise Level Measurement in Ota metropolis, Nigeria" (2018), Oyedepo, S.O et al. Published by Elseveir Ltd. Received 7 August 2018; accepted 13 December 2018.
16. "Traffic Noise prediction using FHWA model on NH - 28 in India" (2012), Pandey Govind et al. Journal of Environmental Research and Development, Received July 05, 2012, accepted September 15, 2012.

ISSN: 2233-7857 IJFGCN