МИНИСТЕРСТВО ОБРАЗОВАНИЯ РЕСПУБЛИКИ БЕЛАРУСЬ

ПОЛОЦКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ

БЕЛОРУССКИЙ НАЦИОНАЛЬНЫЙ ТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ

ИНСТИТУТ СТРОИТЕЛЬНЫХ МАТЕРИАЛОВ ВИЛЬНЮССКОГО ТЕХНИЧЕСКОГО УНИВЕРСИТЕТА им. ГЕДЕМИНАСА

БЕЛОЦЕРКОВСКИЙ НАЦИОНАЛЬНЫЙ АГРАРНЫЙ УНИВЕРСИТЕТ (УКРАИНА)

ПОЛИТЕХНИЧЕСКИЙ ИНСТИТУТ г. ЛЕЙРИИ (ПОРТУГАЛИЯ)

АРИЭЛЬСКИЙ УНИВЕРСИТЕТ (ИЗРАИЛЬ)

ПЕРМСКИЙ НАЦИОНАЛЬНЫЙ ИССЛЕДОВАТЕЛЬСКИЙ ПОЛИТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ (РОССИЯ)

ПЕТРОЗАВОДСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ (РОССИЯ)

# АРХИТЕКТУРНО-СТРОИТЕЛЬНЫЙ КОМПЛЕКС: ПРОБЛЕМЫ, ПЕРСПЕКТИВЫ, ИННОВАЦИИ

Электронный сборник статей
международной научной конференции,
посвященной 50-летию Полоцкого государственного университета

(Новополоцк, 5-6 апреля 2018 г.)

Под редакцией
канд. техн. наук, доцента А. А. Бакатовича;
канд. техн. наук, доцента Л. М. Парфеновой

Новополоцк
Полоцкий государственный университет
2018

УДК 72:624/628+69(082)



АРХИТЕКТУРНО-СТРОИТЕЛЬНЫЙ КОМПЛЕКС: ПРОБЛЕМЫ, ПЕРСПЕКТИВЫ, ИННОВАЦИИ [Электронный ресурс] : электронный сборник статей международной научной конференции, посвященной 50-летию Полоцкого государственного университета, Новополоцк, 5–6 апр. 2018 г. / Полоцкий государственный университет ; под ред. А. А. Бакатовича, Л. М. Парфеновой. – Новополоцк, 2018. – 1 электрон. опт. диск (CD-ROM).

Рассмотрены вопросы архитектуры и градостроительства в современных условиях, прогрессивные методы проведения инженерных изысканий и расчета строительных конструкций. Приведены результаты исследований ресурсо- и энергосберегающих строительных материалов и технологий, энергоресурсосберегающие и природоохранные инновационные решения в инженерных системах зданий и сооружений. Рассмотрены организационные аспекты строительства и управления недвижимостью, проблемы высшего архитектурного и строительного образования.

Для научных и инженерно-технических работников исследовательских, проектных и производственных организаций, а также преподавателей, аспирантов, магистрантов и студентов строительных специальностей учреждений образования.

*Сборник включен в Государственный регистр информационного ресурса. Регистрационное свидетельство № 3671815379 от 26.04.2018.*

Компьютерный дизайн К. В. Чулковой, В. А. Крупенина.

Технический редактор О. П. Михайлова.

Компьютерная верстка Т. А. Дарьяновой.

211440, ул. Блохина, 29, г. Новополоцк, Беларусь
тел. 8 (0214) 53 53 92, e-mail: a.bakatovich@psu.by; l.parfenova@psu.by

ISBN 978-985-531-608-5 

УДК 504.75

# ASSESSMENT OF ROAD TRAFFIC NOISE POLLUTION: A CASE STUDY

*Fareed M.A. Karim, Khaled Abdulhalim Rubassi*
Faculty of Engineering, University of Aden, Yemen
*Al Nahdi A.S*
Polotsk state University, Belarus
email: far_krm@yahoo.com

*The present study provides an evaluation of road traffic noise pollution in the city of Taiz. Statistical noise index $L_{10}$ (18 hour) was calculated at 55 streets throughout the city of Taiz. The British Calculation of Road Traffic Noise (CRTN) method was used to calculate the noise level throughout the city for the year 2015. Corrections for mean traffic speed, gradients, percent of heavy vehicles, road surface types are determined using appropriate expressions. The results showed that Taiz is environmentally noise polluted at all the studied locations ,except at two locations, with noise levels ranging between 60.1 and 73.7 dB(A); thereby exceeding the maximum allowable limit of 60 dB(A).Actual noise measurement carried out using sound level meter at 10 locations and it has been found that the difference between measured and calculated noise using CRTN method was within the limit ± 3.0 dB(A).*

*The CRTN method was also employed to predict future noise levels throughout the city for the year 2025which were found to be higher than the current predicted noise levels.*

*Keywords: Traffic Noise Pollution, Noise Assessment, CTRN, Taiz city.*

Noise in unwanted sound.The increasing urbanization in cities and the growth of activities therein have contributed to the mounting volume of noise, intruding upon the quiet life and privacy of the urban dwellers. The annoyance and discomfort caused by noise can at times assume serious proportions meriting urgent attention. Noise in cities is the result of a number of activities such as road traffic, aircraft, railways and industrial and constructional works. The traffic engineer is concerned with the abatement source of annoyance [1].

Generation of noise by road traffic

The generation of noise caused by road traffic can be considered under the following categories[2].

1- Noise generated by various parts of the vehicle;
   - Engine (Power Unit), especially during acceleration;
   - Aerodynamic friction;
   - Exhaust system;
   - Sounds of cooling fans, gearboxes and brakes;
   - Horns;
2- Noise contributed by the interaction between the vehicle and the road surface.
3- Noise dependent on the speed, flow and density of traffic.

Noise sources associated with transportation include passenger vehicles, medium trucks, heavy trucks and buses. Each of these vehicles produces noise, however, the source and the magnitude of the noise can vary greatly depending on the vehicle type, while the noise from passenger vehicles occurs mainly from the tire-roadway interface and is therefore located at ground level, it was found that noise from heavy trucks is produced by a combination of noise from the tires, the engine, and the exhaust, resulting in a noise source that is approximately 2 m, above the ground [3]. Table (1) shows the maximum limit or the acceptable limits allowed according to the Yemeni legislation noise control regulation for environment protection [4].

Table 1. – Yemeni Ambient Noise Standards

| LAND USE | Limits – Leq Decibel (A) | | |
|---|---|---|---|
| | Day 7:00-18:00 | Evening 18:00-23:00 | Night 23:00-07:00 |
| Rural Residences and Picnic Places | 45 | 40 | 35 |
| Residential Areas in sub-urbs | 50 | 45 | 40 |
| Urban Residential Areas | 55 | 50 | 45 |
| Urban Residential Areas with Workshops and City Centers | 60 | 55 | 50 |
| Industrial and Commercial Areas | 70 | 70 | 60 |

Developed countries in the world have put some norms on the noise levels. For example in Sweden, the guidelines forindoor noise levels are 45 dB and for outdoor are 65 dB [5]. If these limit values is exceeded, thenoise can be deemed to be a potential sanitary nuisance.

Study Area Profile. Large cities like Taiz face growing problems with noise pollution, which is a significant environmental problem in many developing areas. Fig. (1) shows the number of vehicles registered in Taiz city during 1996- 2008, from this figure, it can be seen that the high percentage of vehicles, the continuously increasing rate of growth in vehicle ownership due to fast development, the expansion of the economy and fast growth of the industrial and commercial sectors all contribute to noise pollution. In addition to the relatively large population growth of approximately 2.65 million in year 2008, the city has been expanding continuously in all directions during the past two decades. This high percentage of vehicles, along with the continuously increasing rate of growth in vehicle ownership, contributed to the high noise level recorded in this city. Predictions and measurements of road traffic noise levels are essential for roadway planning and noise control [6].

The number ofregistered vehicles in the city has increased from 9508 in 1996 to 67989 in 2008 recordingan average annual growth rate of 16.3% during 1996-2008[7].

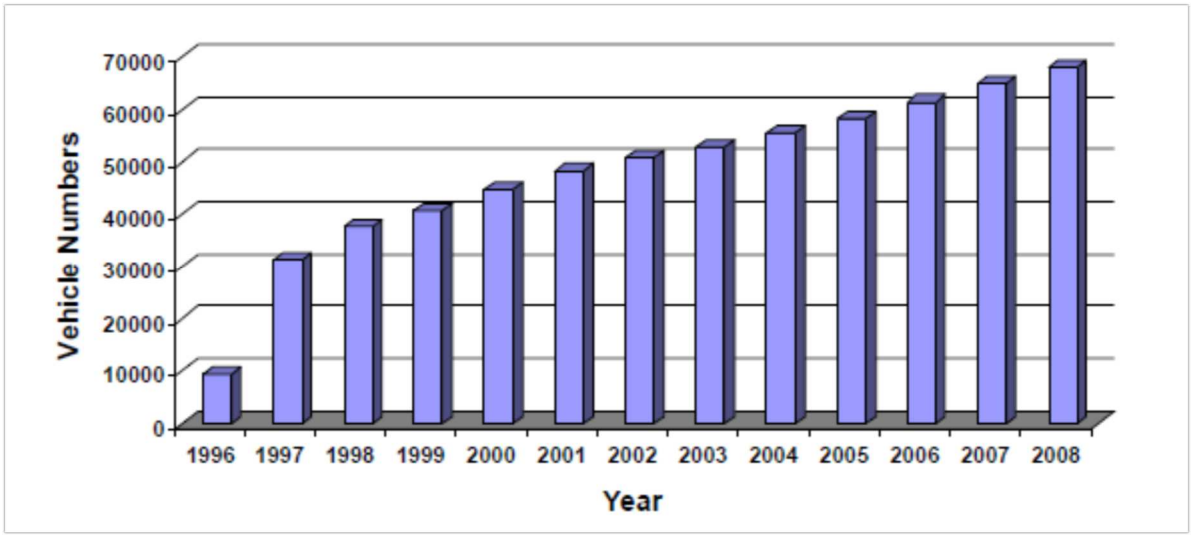


Figure 1. – Growth of Vehicles in Taiz

Earlier studies. Data on noise pollution in Yemen is scarce and not enough studies are available to present the effects of traffic noise pollution. However, noise measurement carried

out in year 2006 in the capital city of Sana'a as a part of Comprehensive Traffic Management study for Sana'a (Environment and Social Assessment)[8]. In this study 16 major intersection in the city were selected for the noise pollution study. The study showed that the equivalent noise level dB (A) at these sites varies from 72 to 77 dB(A) there by exceeding the permissible values given by the Yemeni Environmental Protection Agency, as shown in figure (2) below.

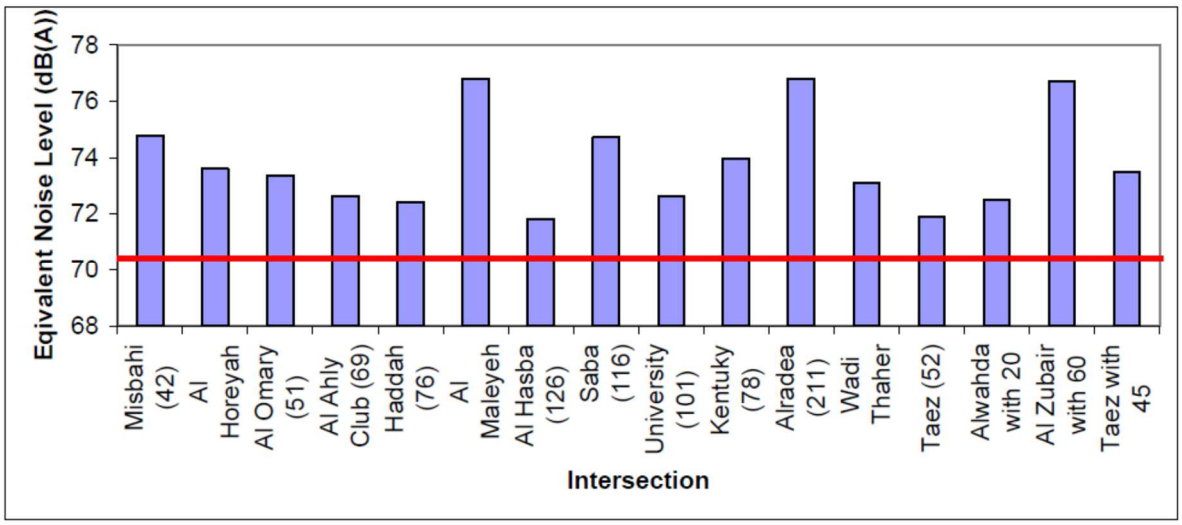


Figure 2. – Noise measurements at sixteen different crossings in Sana'a city

## 2. Materials and Methods

The adopted data collection procedure is designed in such a way to collect as much data in an accurate and practical manner. The noise measurement are taking place simultaneously along with the traffic count. The criteria for selection the measurement location is:

1. Class of the road (i.e. arterial, collector, or local);
2. Traffic volume and composition;
3. Land use within the road vicinity.

Specially designed forms were prepared to record and document all the collected data. The temperature and wind speed were recorded during the measurements, while the humidity data obtained from the Civil Aviation and Metrology Authority.

The noise is measured using a sound level meter. During the measurement, the sound level meter is located at a distance of about 10.0 m from the existing road level about 1.5 m above the road surface. For each measurement, two replicates were taken.

Traffic volumes and composition is counted and recorded manually by a team of surveyors during the measurement of noiseemissions. Each individual is assigned forcounting specific vehicle category. The traffic fleet was divided into light traffic and heavy traffic.

The data collection process took place in January 2010 in Taiz city at 55 streets throughout the city (figure 3). Classified traffic count carried out for the 18 hours between 06:00 to 24:00, as well as traffic speed, gradients, percent of heavy vehicles and road surface types are recorded. The data was forecasted for the years 2015 and 2025 using average annual growth rate mentioned above.

In this study, the levels of noise emitted by traffic are measured or predicted using the standard UK method for the Calculation of Road Traffic Noise (CRTN)[9]. All predicted or measured noise levels are expressed in terms of the index $L_{10}$ hourly or $L_{10}$ (18-hour) dB (A). The value of $L_{10}$ hourly dB(A) is the noise level exceeded for just 10% of the time over a period of one hour.

The $L_{10}$ (18-hour) dB(A) is the arithmetic average of the values of $L_{10}$ hourly dB(A) for each of the eighteen one-hour periods between 06:00 to 24:00 hours.

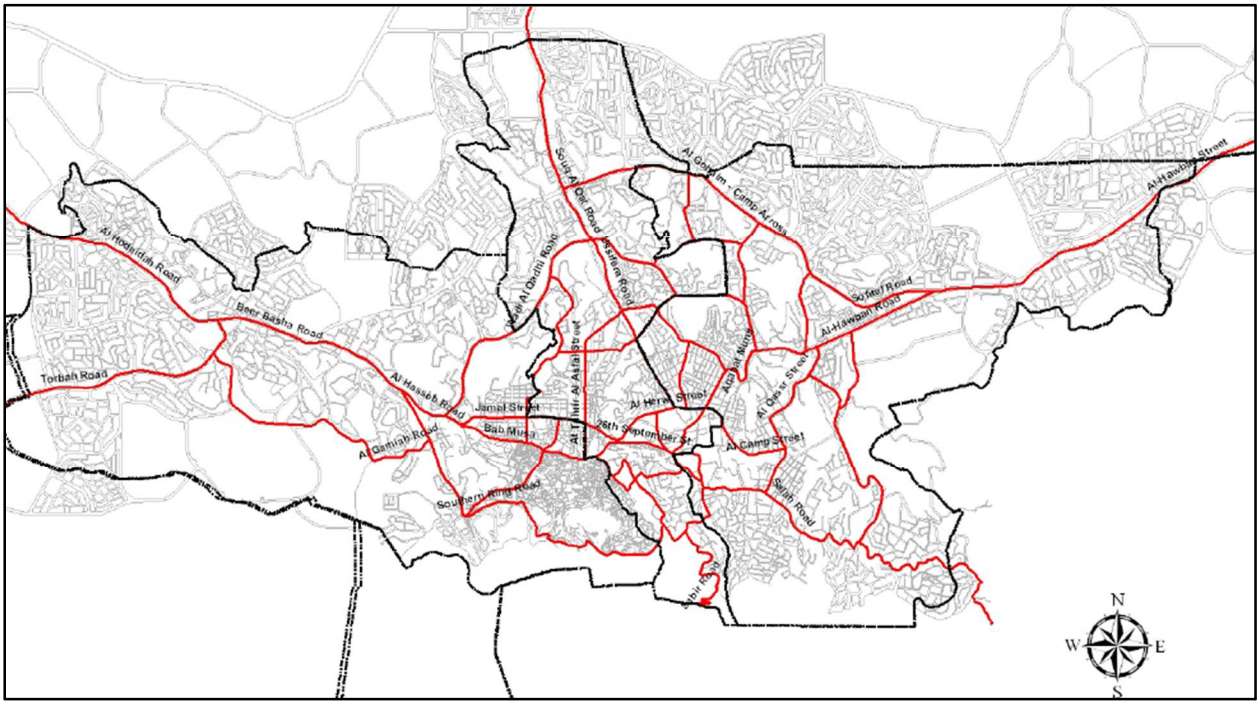


Figure 3. – Taiz City Road Network

The basic noise level hourly is predicted at 10 meters away from the nearside carriage-way according to the following equation:

$$L_{10}\text{ (hourly)} = 42.2 + 10\log_{10} q, \text{ dBA.} \longrightarrow \quad (1)$$

And the basic noise level in terms of total 18-hour flow is

$$L_{10}\text{ (18-hour)} = 29.1 + 10\log_{10} Q, \text{ dBA.} \longrightarrow \quad (2)$$

Where q and Q are the hourly traffic flow (vehicles/hour) and 18-hour flow (vehicles/hour), respectively. Correction for mean traffic speed, percentage of heavy vehicles, gradient, road surface and distance were carried out as per standard UK method.

Correction for mean traffic speed, percentage of heavy vehicles, surface types and gradient are carried out as per CRTN manual [9].

The correction for percentage of heavy vehicles and traffic speed are determined using thefollowing expressions

$$\Delta_{pV} = 33\log_{10}\left(V + 40 + \frac{500}{V}\right) + 10\log_{10}\left(1 + \frac{5p}{V}\right) - 68.8\text{ , dB(A).} \quad (3)$$

In this expression the percentage of heavy vehicles is given by

$$p = \frac{100f}{q} = \frac{100F}{Q} \quad . \quad (4)$$

Where *f* and *F* are the hourly and 18-hour flows of heavy vehicles, respectively.

Equation (3) is applied to the basic hourly or 18-hour levels. The value of *V* to be used in-equation (3) depends upon whether the road is level or on a gradient.

Once the speed of traffic is known them the adjustment for the extra noise from traffic on agradient is calculated from

$$\Delta_G = 0.3G \text{, dBA} \longrightarrow \quad (5)$$

*4. Road surface*

The noise level depends upon the amount of texture on the road surface. For roads which areimpervious to surface water and where the traffic speed used in expression (3) is$V \geq 75$ km/h a correction to the basic noise level is applied. The correction for concretesurfaces is given by

$$\Delta_{TD} = 10\log_{10}(90TD + 30) - 20 \text{, dBA} \longrightarrow \quad (6)$$

for bituminous surfaces

$$\Delta_{TD} = 10\log_{10}(20TD + 60) - 20 \text{, dBA} \longrightarrow \quad (7)$$

*where TD is the texture depth measured by the sand-patch test.*

*If V < 75 km/h:*

– *for impervious bituminous* road surfaces $\Delta TD = -1$ dBA;

– for pervious road surfaces $\Delta TD = -3.5$ .

***Future Noise Levels.*** The future noise levels at all sites were predicted using the CRTN method. The year 2025 was selected for the future prediction (n=10 years). The input data needed for predicting future noise levels were assumed to be the same as for the current year 2015. The future traffic flow used in the CRTN method was obtained by applying the following relationship using an annual growth rate of r%. This rate is based on the average growth rate of vehicles in Taiz city.

$$F = P\,(1+i)^n, \longrightarrow \quad (8)$$

where

F = Future predicted traffic volume;

P = Present traffic volume;

I = Rate of growth of vehicles;

n = Number of years.

Table (2) Show the 18 hourly traffic volumes, percentage of heavy vehicles and the calculated link wise noise pollution for the years 2015 and 2025 respectively. It is clear from Table (2) that the noise level at almost all the links for base year as well as future year exceeded the Yemeni ambient noise level.

Figures (4) and (5) show the link wise noise pollution in dB (A) for the years 2015 and 2025. It is clear from figures that the actual noise level exceeded the Yemeni ambient noise standards.

Table 2. – Calculated Link wise noise pollution for the years 2015 and 2025 in Taiz City

| Sl.No | Road Name | Stretch Name | LINKWISE NOISE POLLUTION L10(18-hour) dB(A) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2015 | | | 2025 | | |
| | | | Traffic volume (18-hour) | % Heavy vehicles | Noise pollution | Traffic volume (18-hour) | % Heavy vehicles | Noise pollution |
| *1* | *2* | *3* | *4* | *5* | *6* | *7* | *8* | *9* |
| 1 | Jamal Street | Bab Mu-sa/Jamal Street to Mohammed Ali Othaman | 28055 | 0.61 | 68.6 | 46872 | 0.61 | 70.1 |
| 2 | | Mohammed Ali Othaman to Al Awedhi | 29184 | 0.36 | 70.5 | 48779 | 0.36 | 72.0 |
| 3 | | Al Awedhi to Al Tehrir | 25867 | 0.35 | 69.9 | 43197 | 0.35 | 71.4 |
| 4 | | Al Tehrir to Al Muwasalat | 32158 | 0.38 | 68.7 | 53732 | 0.38 | 70.2 |
| 5 | Al Herwi Street | Muwasalat to Al Howd | 42368 | 0.46 | 69.8 | 70808 | 0.46 | 71.3 |
| 6 | | Al Howd to Al Camp | 18474 | 1.04 | 68.1 | 30861 | 1.04 | 69.6 |
| 7 | A Qassar Street | Al Kindi Jn to Al Qassar Jn | 15401 | 3.25 | 68.6 | 25722 | 3.25 | 70.1 |
| 8 | AL Askari Street | AL Askari Street | 14123 | 0.86 | 65.5 | 23608 | 0.86 | 67.0 |
| 9 | Sala Road | Sala Road | 6629 | 0.58 | 61.7 | 11085 | 0.58 | 63.2 |
| 10 | New Ring Road | New Ring Road | 3501 | 2.34 | 61.4 | 5850 | 2.34 | 63.0 |
| 11 | Saber Road | Saber Road | 4727 | 0.22 | 60.9 | 7905 | 0.22 | 62.5 |
| 12 | Al Kahira Castle | Al Kahira Castle | 8142 | 0.18 | 63.1 | 13609 | 0.18 | 64.6 |
| 13 | Southern Ring Road | Southern Ring Road | 19758 | 0.52 | 66.4 | 33021 | 0.52 | 67.9 |
| 14 | Al Gamian Road | Al Gamian Road * | 12808 | 2.83 | 66.1 | 21391 | 2.83 | 67.6 |
| 15 | Bab Musa - Sina Road | Bab Musa - Sina Road | 9917 | 1.25 | 64.0 | 16574 | 1.25 | 65.5 |
| 16 | 26th September | Bab Al Kabeer Jn to 26th September | 12565 | 0.42 | 64.3 | 21016 | 0.42 | 65.8 |
| 17 | Bab Musa | Bab Musa | 12510 | 1.56 | 66.6 | 20901 | 1.56 | 68.1 |
| 18 | Aqabat Mufera | Aqabat Mufera * | 13396 | 1.14 | 66.4 | 22419 | 1.14 | 67.9 |
| 19 | Wadi Al Qadi | Wadi Al Qadi * | 11040 | 12.31 | 71.7 | 18391 | 12.31 | 73.2 |
| 20 | Third Ring Road | Third Ring Road * | 13590 | 9.40 | 70.0 | 22651 | 9.40 | 71.5 |

Продолжение таблицы 2

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| 21 | Al Qat Road | Al Qat Road * | 9689 | 6.56 | 66.7 | 16161 | 6.56 | 68.2 |
| 22 | To Sofitel | Al Rawdha Jn to Sofitel | 2899 | 4.02 | 60.1 | 4837 | 4.02 | 61.6 |
| 23 | | Al Rawdha Jn to Poweplant Jn | 6440 | 6.52 | 68.0 | 10748 | 6.52 | 69.5 |
| 24 | Ussefera | Sinan Jn to Safer Jn | 11182 | 1.31 | 65.2 | 18688 | 1.31 | 66.7 |
| 25 | | Powerplant Jn to Sinan Jn | 18878 | 2.18 | 67.3 | 31534 | 2.18 | 68.8 |
| 26 | Al Tehrir Al Asfal Street | Al Tehrir Al Asfal Street | 14466 | 1.04 | 65.5 | 24174 | 1.04 | 67.0 |
| 27 | | Al Markazi Jn to Al Asfal St | 6126 | 0.24 | 61.5 | 10230 | 0.24 | 63.0 |
| 28 | Mohammed Ali Ottoman | Mohammed Ali Ottoman | 10000 | 0.52 | 63.5 | 16716 | 0.52 | 65.0 |
| 29 | Al Awedhi Street | Al Awedhi to Jamal Street | 15299 | 1.21 | 67.2 | 25564 | 1.21 | 68.8 |
| 30 | Al Tehrir Up | Al Tehrir up to Jamal Street | 5618 | 1.41 | 62.8 | 9390 | 1.41 | 64.3 |
| 31 | | Al Nokta Al Raba Jn to Public Park | 18567 | 0.71 | 66.4 | 31049 | 0.71 | 67.9 |
| 32 | Soug Assimil | Soug Assimil to Al Howd Jn | 2951 | 0.85 | 58.4 | 4933 | 0.85 | 59.9 |
| 33 | | Soug Assimil to Al Nokta Al Raba Jn | 5001 | 0.08 | 60.1 | 8371 | 0.08 | 61.5 |
| 34 | Aqabat Munif | Aqabat Munif Jn to Al Howd Jn | 26851 | 1.17 | 71.3 | 44855 | 1.17 | 72.8 |
| 35 | Al Hawaban | Aqabat Munif Jn to Farzat Sana'a Jn | 24265 | 1.81 | 68.3 | 40522 | 1.81 | 69.9 |
| 36 | Al Shab Jn | Al Shab Jn to Al Nokta Al Raba Jn | 18206 | 0.45 | 70.8 | 30447 | 0.45 | 72.3 |
| 37 | Ath Thwarah street | Al Kharabah Jn to Aqabat Munif Jn | 17734 | 1.01 | 66.6 | 29642 | 1.01 | 68.1 |
| 38 | Ash Shamsi Street | Ath Thawrah Jn to Al Ash-bat Jn | 18210 | 0.98 | 66.4 | 30425 | 0.98 | 67.9 |
| 39 | Gawlat Senan Al Baath | Sinan Jn to Al Kharaba Jn | 9893 | 1.21 | 63.9 | 16521 | 1.21 | 65.4 |

Окончание таблицы 2

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| 40 | | Kharabah Jn to Safer Jn | 18003 | 2.11 | 67.1 | 30075 | 2.11 | 68.6 |
| 41 | Al Horaish Street | Safer Jn to Al Horaish Jn | 17384 | 0.88 | 66.8 | 29038 | 0.88 | 68.3 |
| 42 | Second Ring Road | Kalabah Jn to 2nd Ring Road | 14065 | 1.41 | 65.6 | 23497 | 1.41 | 67.1 |
| 43 | Kalabah Bridge Road | Kalabah Jn to Petrol Pump | 8435 | 6.15 | 67.0 | 14058 | 6.15 | 68.5 |
| 44 | Sofitel Road | Petrol Pump to Jumla Market Jn | 14397 | 10.02 | 73.7 | 23974 | 10.02 | 75.2 |
| 45 | Soug Al Gomlah Road | Jumla Market Jn to Al Gom-lah Jn | 14307 | 6.05 | 67.9 | 23880 | 6.05 | 69.4 |
| 46 | Farzat Sanaa Road | Al Qassar Jn to Farzat Sa-na Jn | 38124 | 3.62 | 71.1 | 63644 | 3.62 | 72.6 |
| 47 | | Farzat Sana Jn to Kalabah Jn | 17907 | 1.60 | 66.7 | 29908 | 1.60 | 68.3 |
| 48 | Al Hawaban Road | Sofitel Jn to Al Qassar Jn | 32396 | 3.85 | 71.7 | 54066 | 3.85 | 73.2 |
| 49 | Sofitel Road | Sofitel Jn to Jumla Market Jn | 10341 | 13.51 | 69.2 | 17205 | 13.51 | 70.8 |
| 50 | Al Goham Al Qamariyah Road | Al Rawdha Hospital Jn to Kalabah Road | 12245 | 1.52 | 66.2 | 20466 | 1.52 | 67.7 |
| 51 | Al Haseeb Road | Saba Phone office to Al Haseeb Road * | 38400 | 3.74 | 71.5 | 64091 | 3.74 | 73.1 |
| 52 | 26 th September | Al Nokta Al Raba Jn to Tehrir Up | 6628 | 0.90 | 61.9 | 11085 | 0.90 | 63.4 |
| 53 | Safer Al Tahrir Al Asfal | Safer Jn to Al Tahrir | 11794 | 0.49 | 64.3 | 19699 | 0.49 | 65.8 |
| 54 | Al Masbah Wadi Al Qadi | Wadi Al Qadi to Al Masbah | 3265 | 1.01 | 59.5 | 5465 | 1.01 | 61.1 |
| 55 | | Mohammed Ali Ottoman Down to Al Masbah | 14602 | 1.19 | 66.0 | 24453 | 1.19 | 67.6 |

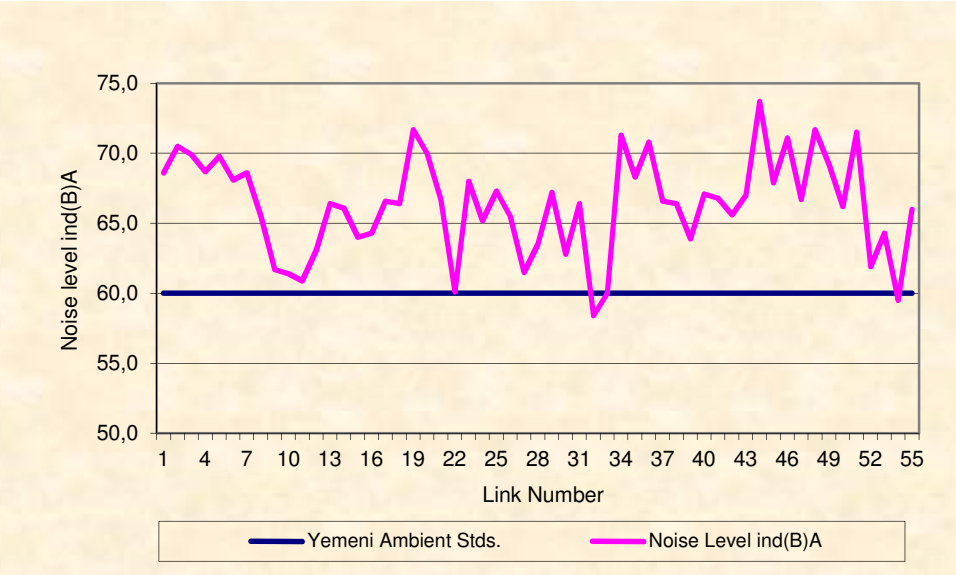


Figure 4. – Link wise Noise Pollution for the year 2015

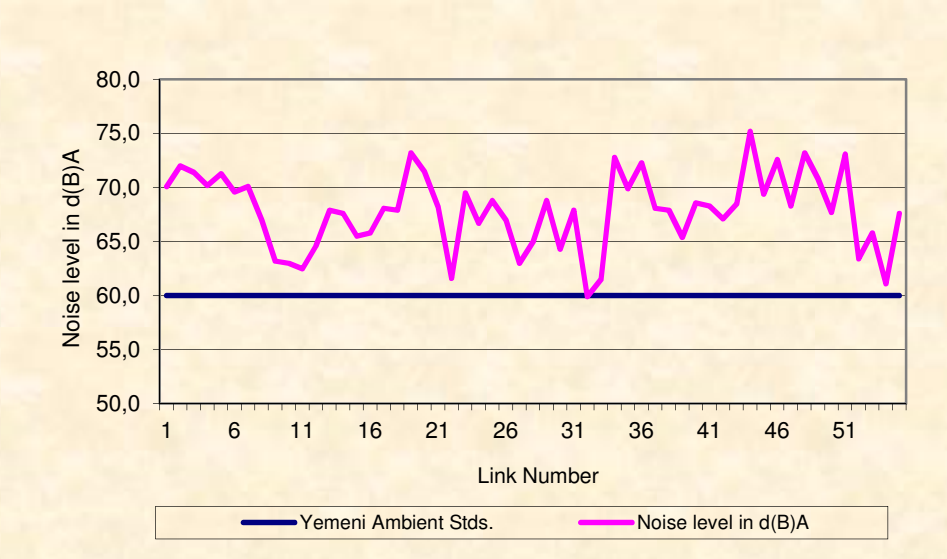


Figure 4. – Link wise Noise Level for the year 2015

**Results and Discussion.** Noise pollution is defined as the generation of unwelcome and displeasing sound in the environment. Among thevarious sources of noise pollution, automobiles and other transport systems contribute the maximum sound production.Because of the other important noise pollutants industrial production systems are negligible in the city, soit is possible to say that the root cause of noise pollution is transportation machines- traffic vehicles in Taiz city. The results showed that Taiz is environmentally noise polluted at all the studied locations, except at two locations, with noise levels ranging between 60.1 and 73.7 dB(A); thereby exceeding the maximum allowable limit of 60 dB(A).

To test the accuracy of CRTN method in Yemen environment, actual noise measurement carried out using sound level meter at 10 locations, the measurement procedure carried out as mentioned above, and it has been found that the difference between measured and calculated noise using CRTN method was within the limit ± 3.0 dB(A). Hence CRTN methodology can be used for predicting traffic noise level in Yemen.

The CRTN method was also employed to predict future noise levels throughout the city for the year 2025 which were found to be higher than the current predicted noise levels as shown in table (2) above. The results clearly show that the noise levels for the year 2025 found to be higher than the current predicted noise levels.

Adverse health effects of noise pollution. The World Health Organization (WHO) has documented seven categories of adverse health effects of noise pollution on humans [10]:

1- Hearing impairment.
2- Interference with spoken communication.
3- Sleep disturbances.
4- Cardiovascular disturbances.
5- Disturbances in mental health.
6- Impaired task performance.
7- Negative social behavior and annoyance reactions.

Control of Traffic Noise. Techniques available for control of traffic noise can be considered under the following headings[2]:

1- Changes in design of vehicles.
2- Changes in tyres and road surfaces.
3- Elimination of nosier vehicles.
4- Modifications in traffic operation.
5- Designing streets, buildings and areas for produces less noise.

Conclusion. Regarding the data achieved during noise measurement and the high equivalent noise level in all the streets in the city, implementing strategies to control the noise in Taiz city necessary. The results proved that noise pollution must be devoted more attention and reached serious levels and it has become one of the major environmental problems. Therefore, protections related to planning, technical, legislative and educational issues should be taken in order to avoid negative effects of noise pollution on the environment and human beings. In addition, the awareness of the population about the risk of noise pollution.

REFERENCES

1. London Noise Survey, H.M.S.O., London, U.K. 1968.
2. Kadiyali, L.R. Traffic Engineering and Transport Planning / L.R. Kadiyali/ – Khanna Publisher, 2000.
3. POWH (OHS) Unit: Noise Management Handbook, 2010.
4. Implementation List of the Environmental Protection Law, Yemen. 2005.
5. Pettersson, B. Indoor noise and high sound levels- a transcription of the Swedish national board of health and welfare's guidelines / B. Pettersson // J. of Sound and Vibration. – 1997. – 205 (4). – P. 475-480.
6. Khan, M.M. Traffic noise pollution in Karachi, Pakistan, / M.M. Khan, M.A. Memon, M.N. Khan // JLUMHS. – 2010. – Vol. 9. –P.114–120.
7. Central Statistical Organization. Statistical year book. Sana'a, Republic of Yemen: Ministry of Planning and International Cooperation (1996–2008).
8. Comprehensive Traffic Management study for Sana'a (Environment and Social Assessment). – 2007. – Vol. 2, Team International.
9. Department of Transport and Welsh Office. Calculation of Road Traffic Noise. HMSO, London, 1988.
10. Berglund B, Lindvall T. (Eds.) Community Noise. Archives of the Center for Sensory Research. 1995; 2: 1-195. This document is an updated version of the document published by the World Health Organization in 1995. Available at: http://www.who.int/docstore/peh/noise/guidelines2.html. Accessed January 6, 2007.