Research Article

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Use of mathematical models and computer software for analysis of traffic noise

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Abstract: Noise measurement and evaluation of the existing noise situation is carried out in the vicinity of selected roads to demonstrate the need for the design of anti-noise measures or to assess the effectiveness of the measures. The selection and number of measuring points, time and intervals, the road noise measurement procedure and the measuring instruments used shall be used in accordance with the provisions of the STN ISO 1996-1 and STN ISO 1996-2 standards. During the measurement, it is also necessary to determine the microclimatic conditions of measurement, such as temperature and relative humidity, wind direction and speed, barometric pressure, duration and intensity of precipitation at the measuring point. The determinant for the definition of road traffic noise is the equivalent sound level A or the equivalent sound level in the third octave bands over a given time interval. In specific cases, it is possible to determine the equivalent sound pressure level from individual vehicle transit.

Keywords: noise measurement, simulation, infrared technology

1 Introduction

The impact of noise on the population has increasing consequences related to the development of civilization. Almost every activity a person performs makes noise. In the past, very little attention has been paid to dealing with noise pollution in the vicinity of residential buildings. This was mainly due to the low degree of automobilization at the time of construction of large housing clusters. Since traffic noise is one of the biggest problems of big cities and agglomerations.

In view of the problems posed by transport, attention will be focused on road traffic noise and, in particular, its prevention in the construction process by designing effective anti-noise measures and the organization of transport using professional prediction software [1].

Road traffic is the most important source of noise in the city and is not only considered to be harmful to the environment, but also a threat to public health. This study therefore focused on the determination of road noise levels in the province of Phuket, including Muang Phuket District, Thalang and Kathu; and compares them to the predicted noise level using NMTHAI 1.2. [2]. Recognition of urban noise plays an important role in city governance and traffic safety.

The completion of urban noise recognition studies is mostly based on conventional acoustic properties such as Mel-Frequency Cepstral Coefficients (MFCC) and Cepstral Coefficients Linear Prediction (LPCC) and shallow structure classifiers such as the support vector machine (SVM) [3]. Vehicle vibration is a major problem in large cities and has a significant impact on human activities, comfort and health.

In addition to the known vibration mitigation strategies and their effects, innovative methods are developed using new physical concepts. These are already well developed in the case of acoustic barriers, for example from periodically arranged elements (known as 'sound' or 'phononic' crystals), but the shielding of structures from the effects of vibration is still at an earlier stage of development [4]. As urbanization is increasing in modern cities, major roads and motorways are being built closer to residential areas.

Due to some inattentive driving behaviours, such as acceleration and racing; illegal exhaust adjustment; and aging vehicles, traffic noise causes inconvenience to residents staying near the highway, especially during late night or early morning [5]. Road noise problems in Curitiba have resulted in significant distress. Noise levels are mea-

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sured and the effects that the community suffers are documented. Simultaneous measurements of noise levels, vehicle flow and traffic patterns were made around the main roads within Curitiba city district, and some mathematical models have been developed to estimate these sound pressure levels [6].

The main results obtained in a general study on noise pollution in Nablus, Palestine, represent equivalent noise level values (L-eq.), These were measured and recorded in tables for 50 cities spread throughout the area related to the city. The obtained noise level value of 50 L-eq. is an average of 68.0 dB (A). It has been detected that L-eq. for 58% of selected sites exceed 65.0 dB (A). This result is clearly higher than the international standards adopted [7].

To assess the environmental impact in Thailand, a road noise prediction model has been developed. The model was made under certain conditions; the vehicles were divided into two groups and the average noise level at standstill of each group was then determined from the measurement of many vehicles. The power level of each group was determined by measuring the noise level of the vehicles driven. The average power level of the vehicles that were driven was then described by the relation between the power level and the logarithm of the vehicle speed [8]. Traffic noise detection and analysis was conducted along three major roads in the Beijing urban area - the 2nd and 3rd circular routes passing around the city's central area and Chang-An Avenue, the main east-west corridor through the heart of the city.

The results indicate that these main roads are congested during the day and traffic noise levels along these roads are above 5 dB and above relevant environmental standards [9]. The urban sound environment of New York City (NYC) can, among others, be loud, disturbing, exciting and dynamic. As the vast majority of noise complaints registered on the NYC 311 information line suggest, the sound environment in cities has a significant impact on the quality of life of city residents. A long-term process of acoustic measurement and analysis is required to monitor and ultimately understand these particular sound environments.

The traditional environmental acoustic monitoring method relies on short-term measurement periods using expensive equipment, set-up and operation by experienced and costly personnel [10]. Noise level measurements associated with various forms of mass transit and comparison with exposure directives designed to protect against loss of hearing in New York City. Noise dosimetry was used to measure time-integrated noise levels in a representative sample of New York's mass transit systems (subway, bus, ferry, tram and commuter rail) on board of the transit vehicles and on boarding platforms or vehicle terminals [11].

Road traffic noise (RTN) is one of the largest pollutants in modern cities known to affect public health as a direct cause of many diseases for its people. Until recently, RTN maps were generated using representative static measurements collected by experts after manually removing all traffic-related or anomalous noise (ANE) events [12, 13].

2 The methodology for monitoring and prediction of road traffic noise

For a closer understanding of the research area it is appropriate to define the basic terms determined by the TP 15 / 2011 Methodical guideline: Design and assessment of noise protection measures for roads, SSC Bratislava, 2011:

a) a road is a land communication, respectively a route, intended for the traffic of road vehicles, the hallmark of which is a paved road with roadsides.
b) sound is the mechanical vibration of the environment which gives rise to sound perception in humans; The basic physical quantity describing sound is the sound pressure (sign p, ps, unit (Pa)) and rate, respectively frequency (designation f, unit (Hz)), according to standards: STN ISO 1996-1 and STN ISO 1996-2.
c) audible sound is any sound in the frequency range of the third-octave bands with a nominal center frequency of 20 Hz to 20 kHz (STN ISO 266).
d) noise is any disturbing, annoying, unpleasant, undesirable, inappropriate or harmful sound
e) noise load is a general denotation of the effect of sound (noise) in the environment, it can be expressed (quantified) by various quantities (e.g. the equivalent A sound level, maximum A sound level SLOW and others); sound pressure level (A) for a defined time interval is used to determine the noise load.
f) surface noise load is the effect of sound (noise) on the surface of the affected area of the monitored source of sound (noise) quantified by the values of the monitored quantity in the selected raster; imaging of the area noise load is performed using isophones (curves connecting points with the same values of the specified quantity) or in the form of colour-coded bands with a suitably selected range of values of the monitored quantity (usually the range of values is chosen as 1 dB or 5 dB); in the case of land transport, the quantity used to monitor the effect of

noise is the equivalent sound pressure level (A) over a defined period of time.

g) the sound pressure level is the continuous sound pressure value determined by the relation:

$$L = 10 * \log \left(\frac{p}{p_0}\right)^2 \qquad (1)$$

where:

- p is the sound pressure in (Pa)
- p_0 is the reference sound pressure, $p_0 = 2.10^{-5}$ Pa
- generally used is the sign: L, LS, unit (dB)

h) sound level A is the sound pressure level with frequency weighting A, it is the continuous sound pressure level according to point e, which is corrected by the frequency weighting function A according to the STN EN IEC 61672-1.
sign: LA, (at time weighing S will be LAS,), unit: (dB)

i) the equivalent acoustic (sound) pressure level (A) is a quantity defined by the relation:

$$L_{aeq} = 10 * \log \frac{1}{T}\int_{t_1}^{t_2} \left[\frac{pA(t)}{p_0}\right]^2 * dt \qquad (2)$$

where:

- pA (t) is the time function of the instantaneous sound pressure weighted by the frequency weighting function A,
- T is the integration interval, $T = t_2 - t_1$ in seconds,
- p_0 is the reference sound pressure, $p_0 = 2.10^{-5}$ Pa

j) determinant is a physical quantity that quantitatively and qualitatively characterizes noise and which is used to assess the adverse effects of noise in terms of public health protection. In the case of noise generated by road communications, road traffic, this is the equivalent level A of sound pressure (sound).

k) the value to be assessed is the value to be compared with the permissible value; it is the measured value or the value of the determinant, derived from the measured value, increased by the measurement uncertainty value, corrected and determined with respect to the reference time interval; in the case of noise prediction, this is the predicted value of the determinant including the relevant uncertainty with the indication: LR, Aeq, d, LR, Aeq, v, LRAeq, n, (for individual reference time intervals); in the STN ISO 1996-1 standard, the term assessment level is used for noise assessment.

l) the reference time interval is the time interval to which the sound data relates; in the case of objectification, this is the time interval to which the assessed or permissible value applies; the reference time interval for the day is from 06.00 to 18.00 (12 hours), for the evening from 18.00 to 22.00 (4 hours) and for the night from 22.00 to 06.00 (8 hours).

m) the permissible value of the determinant is an agreed limit the compliance with which is considered sufficient to ensure the protection of public health according to the current state of knowledge and economic level of society - designation: LAeq, d, p, Leq, v, p, LAeq, d, p.

n) the background noise is background whirr (residual sound in the STN ISO 1996-1 standard). It is sound or other influences registered by the measuring instrument (when measuring sound) even if the sound to be measured does not have an affect; in the case of prediction, it is the sound that is determined by calculation at a given location or territory, disregarding the monitored noise source.

o) the measurement time interval is the time interval in which the measurement value for the noise source to be monitored is measured.

p) the cumulative sound level is the level composed of the sound signal of the noise source (road) considered and the background noise (residual sound).

q) the protected space is the indoor or outdoor environment in which people are present permanently or repeatedly and for which permissible noise levels are set.

r) noise protection measure is a measure that, by implementing it, will reduce the noise load caused by the noise source under review (e.g. road traffic) at the site or territory being monitored.

s) the inserted noise reduction shield is the difference in sound pressure levels at the reception point before and after installation of the protective shield (see also ISO 10847).

t) calibration measurement is a measurement of the noise load caused by the noise source, in this case by road traffic, being monitored and intended primarily to verify the predicted values obtained by calculation using mathematical modelling; in these measurements, the measurement location is chosen so that the values of the determining quantities characterizing the sound source being monitored are not significantly affected by the background noise (residual noise) - the difference between the value determining the noise generated by the source and the magnitude of the quantity itself shall be greater than 10 dB.

If the difference is less than 10 dB but greater than 3 dB, the value of the determinant that will characterize the monitored source can be obtained by adding the background noise correction according to the STN ISO 1996-1,2 standard; the calibration measurements may also be performed at other time intervals than the reference time intervals; one-hour time intervals are suitable; during the measurements it is also necessary to monitor the intensity and composition of transport (minimum division into cars and trucks), average speed of individual types of vehicles moving along the monitored road section, and to describe the road surface. During the measurements it is necessary to monitor the meteorological parameters of the external environment - temperature, direction and speed of the wind, humidity, describe precipitation, it is also suitable to record the barometric pressure; measurements shall be made for the road surface condition and meteorological conditions for which the prediction will be performed.

2.1 Measuring devices

Noise measurement for the purpose of prediction is performed in the form of calibration measurements. It is basically a calibration of the mathematical model of the predicted area. However, they are essential to verify the functionality of the model. Calibration measurements are performed at systematically selected locations and their extent depends on the size of the calibrated model. With a well-prepared prediction, the deviation between the result of the calibration measurement and the result of the mathematical model is in the order of tenths of decibels.

In the case of neglecting certain aspects, such as traffic input data, model geometry or contour lines, the deviation may be up to decibels. The deviation in the order of decibel units can already be considered a considerable inaccuracy. In principle, however, with a serious approach and well-processed materials, the result of mathematical modelling is very accurate. The measurement is carried out by a set of measuring devices and accessories designed for this purpose. The principle of sound level measurement by a sound level meter is shown in the following diagram (Figure 1). Sound waves are captured by a measuring microphone and are transposed from a sound to an electrical signal using a preamplifier.

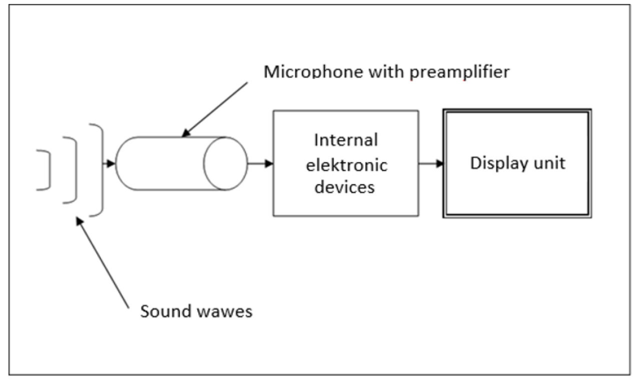

Figure 1: Sound measurement by sound level meter

For calibration measurements, sound analyzers in accuracy class 1 are used together with the so-called outdoor protector kit that protects the microphone and preamplifier from the weather impacts.

3 Modelling procedure

The mathematical model of road traffic noise prediction was processed by the Lima prediction software. The Lima prediction software is one of the most accurate software in its field. With its design, environment and partly also with its control, this software is similar to CAD software.

For the design and visualization of noise control measures a representative area has been modelled which by its appearance, function, as well as population size, recalls a real part of the village or town. The modelled area includes residential blocks of flats, apartment houses and family houses (hereinafter referred to as buildings). The heights of the buildings are derived from the number of above-ground floors of individual buildings determined by the survey of representative samples of residential buildings. Objects in the model are embedded in real terrain represented by contour lines of 1 m step. Absorption of terrain was taken into account in the model.

On roads and hard surfaces (compacted terrain, concrete, etc.), the surface coefficient was G = 0.1. On grass surfaces, the surface coefficient was G = 0.6. The ground absorption coefficients were determined in accordance with STN ISO 9613-2 Acoustics. Attenuation at sound propagation in outdoor areas. For better presentation of the development of noise situation of individual modeled variants - Figure 2, computational monitoring points (MPs) were implemented in the model for selected objects (2 m in front of the facade). These points are located at heights equal

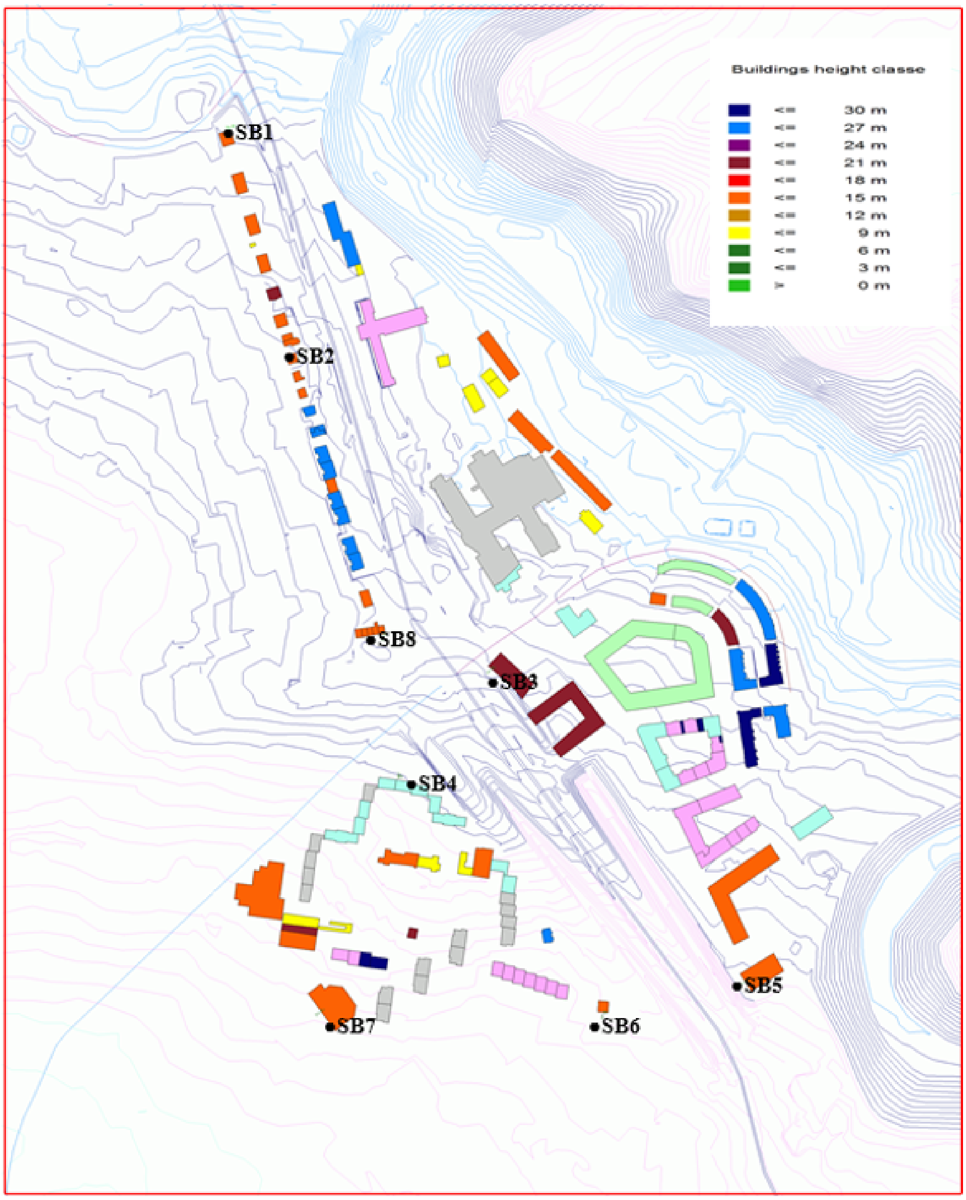

Figure 2: The modeled area showing the calculated monitored points (MP)

to the centre of the individual above-ground floors of the selected representative objects.

In terms of noise, the following measures were simulated on the main road routes of the model:

- change of road surface
- speed reduction from 50 km/h to 30 km/h
- standard intersections have been replaced by roundabouts
- noise barriers were built in exposed areas
- building a bypass along with the introduction of a residential zone

3.1 Construction of a by passs and establishment of the residential zone

Among the proposed measures, this is the most radical intervention in road infrastructure. The essence of the measure is:

- prohibition of truck entry into the residential zone, *i.e.*, the built-up area of the model
- installation of a commanding road sign showing the direction of travel with the additional sign 'For vehicles over 3.5 t'
- installation of the “No vehicle crossing” road sign

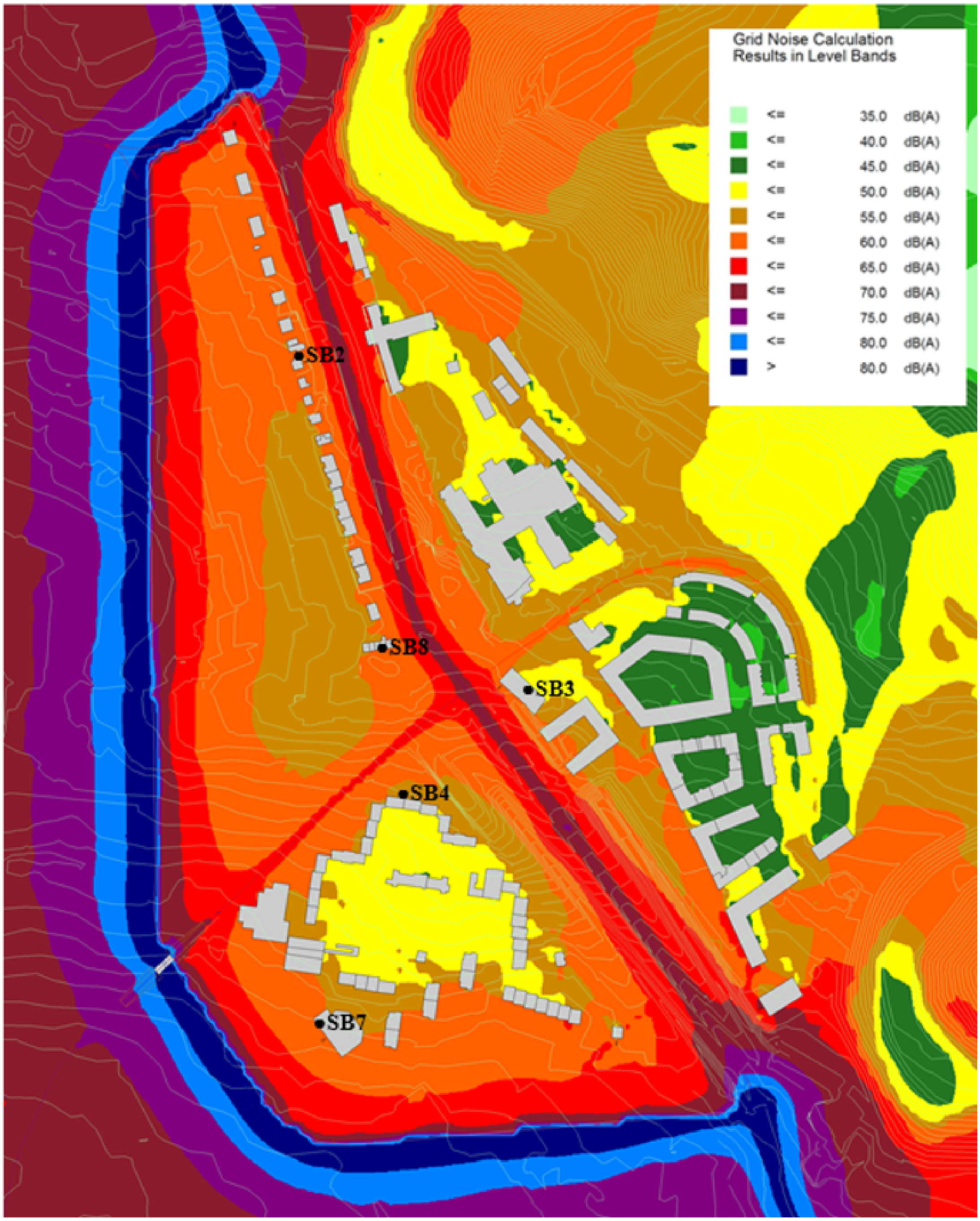

Figure 3: Calculated levels for variant with construction of a bypass - reference time interval – day

- installation of a road sign limiting the maximum speed
- construction of two roundabouts
- reduction of vehicle speed within the residential zone to 30 km / h
- maximum bypass speed of 70 km / h
- installation of a noise barrier at the bypass
- taking account of acceleration and deceleration

Under this measure, the entry of trucks over 3.5 tons into the built-up model area was prohibited. For the implementation of the measure, the road signs “Transit prohibited” and the road sign with commanded direction were used with the additional sign "For vehicles over 3.5 t" at both possible entrances to the built-up area of the model. The traffic signs were placed in front of the roundabouts at both entrances. When connecting to the bypass from the

Table 1: Funds for the bypass variant - road signs

Item name	**Unit price [€]**	**Number of necessary pieces**	**The total price of the item [€]**
Command road sign 30 km / h	33	6	198
Command road sign 50 km / h	33	2	198
Command road sign 70 km / h	33	2	66
Road sign "Commanded driving direction"	33	4	132
Road sign "Crossing prohibited"	33	2	66
Column	15	16	240
Al footer	15	16	240
Mounting on the post	2.1	32	67.2
Total price [€]			**403.2**

Table 2: The funds needed in the construction of circular intersections

Name	Intersection diameter [m]	Estimated price in € without VAT for 1 intersection	Price in € without VAT for 3 intersections
Circular intersection	30	663 878	**1 327 756**

Table 3: Funds for the bypass variant - noise barrier

Designation	Barrier length [m]	Barrier height [m]	Total surface area [m^2]	Price in € per a m^2	Price in € without VAT for the whole section
Noise barrier	1728	4	6912	71	**490 752**

Table 4: Funds for the bypass variant - asphalt bypass surface

Length of the communication [m]	Width of the communication [m]	Total surface area [m^2]	Price in € per a m^2	Price in € without VAT for the whole section
1691	11.5	19446.5	13.50	**262527.75**

roundabout, acceleration resp. vehicle deceleration was taken into accont in the following way:

- 20 m in front of the roundabout and during roundabout crossing - 20 km / h
- 30 m in front of the roundabout - 30 km / h
- 40 m in front of the roundabout - 40 km / h
- 50 - 100 m in front of a roundabout - 50 km / h - limited by a traffic sign
- > 100 m in front of the roundabout - 70 km / h.

The total length of the bypass is 1691 m. The bypass was designed as a two-lane road, *i.e.*, one lane in one direction. On the side facing the built-up area was built a noise barrier with a height of 4 m. Due to the fact that the local road was passing through the area of the planned bypass construction, it was necessary to build a bridge structure for the local road without the possibility of connecting to the bypass. The possibility of connection to the bypass was excluded on the local road because of the low traffic intensity of this road and the financial demands for building an interchange.

The traffic flow intensity for the main road in the built-up area, as well as all secondary roads, was chosen at the level of 5%. An intensity of 5% of the original traffic flow can be considered relevant relative to the number of model residential buildings. In determining the traffic flow, the prohibition of lorries entering the built-up area was taken into account, whilst supply vehicles were not considered in the calculation.

Funding is documented in the following tables:

The financial calculation related to the installation of traffic signs in the built-up area as well as at the bypass takes into account the price of the listed components necessary for the installation of traffic signs. However, the cost

Table 5: Calculated levels for a variant with the construction of a bypass - reference time interval – day

Monitored point	Floor	$L_{Aeq,\ 16h}$ [dB]	Permitted value [dB]	Deviation from NPH [dB]
MP 1	1.OGF	**58.6**	60	**−1.4**
	2.OGF	**62.1**	60	**2.1**
MP 2	1. OGF	**56.4**	60	**−3.7**
	2. OGF	**56.9**	60	**−3.1**
	3. OGF	**58.6**	60	**−1.4**
MP 3	1. OGF	**58.8**	60	**−1.2**
	2. OGF	**60.0**	60	**0.0**
	3. OGF	**59.7**	60	**−0.3**
	4. OGF	**59.3**	60	**−0.7**
MP 4	1. OGF	**53.6**	60	**−6.4**
	2. OGF	**54.3**	60	**−5.7**
	3. OGF	**54.6**	60	**−5.5**
	4. OGF	**54.7**	60	**−5.3**
	5. OGF	**54.9**	60	**−5.1**
	6.OGF	**54.9**	60	**−5.1**
	7. OGF	**55.0**	60	**−5.0**
	8. OGF	**55.2**	60	**−4.8**
MP 5	1. OGF	**57.8**	60	**−2.2**
	2. OGF	**66.6**	60	**6.6**
	3. OGF	**66.2**	60	**6.2**
MP 6	1. OGF	**57.9**	60	**−2.1**
	2. OGF	**60.9**	60	**0.9**
MP 7	1. OGF	**56.9**	60	**−3.1**
MP 8	1. OGF	**55.8**	60	**−4.3**
	2. OGF	**56.5**	60	**−3.5**

does not include labour costs and small earthworks related to the installation of these signs.

The calculation of the cost of the construction of roundabouts includes only the approximate cost of the material needed to carry out this project, and does not take into account the cost of labour and other works related to ground compaction.

For the sake of comparability, the price calculation for the installation of noise barriers is carried out without taking into account the cost of labour, fastening material and other metallurgical material. The calculation only takes into account the cost of opaque absorbent acoustic panels.

Only the price of asphalt 3 cm thick was used to calculate the financial costs associated with the application of the new asphalt surface to the bypass. Other costs such as the construction of the bridge structure, earthwork related to the treatment of the ground, the property settlement of the land under the road and others could not be accurately determined. These items may vary considerably depending on the region, current economic situation and the like. Therefore, the estimation of these items would not be objective.

The reference time interval - day

Based on the above mentioned input data, the mentioned parameters and the new road communication were defined into the modelled area.The following table shows the calculated values of equivalent sound pressure levels A at monitored calculation points for the variant with construction of a bypass:

The following visualization of the area documents the fundamental changes in the noise situation in the built-up area that occurred after the construction of the bypass:

After the implementation of the most extensive noise protection measure in the form of the construction of a bypass with the establishment of a residential zone, there was a significant change in noise conditions in the monitored modelled area. For the monitored calculated points MP 2, MP 3, MP 4, MP 7 and MP 8, there was a significant

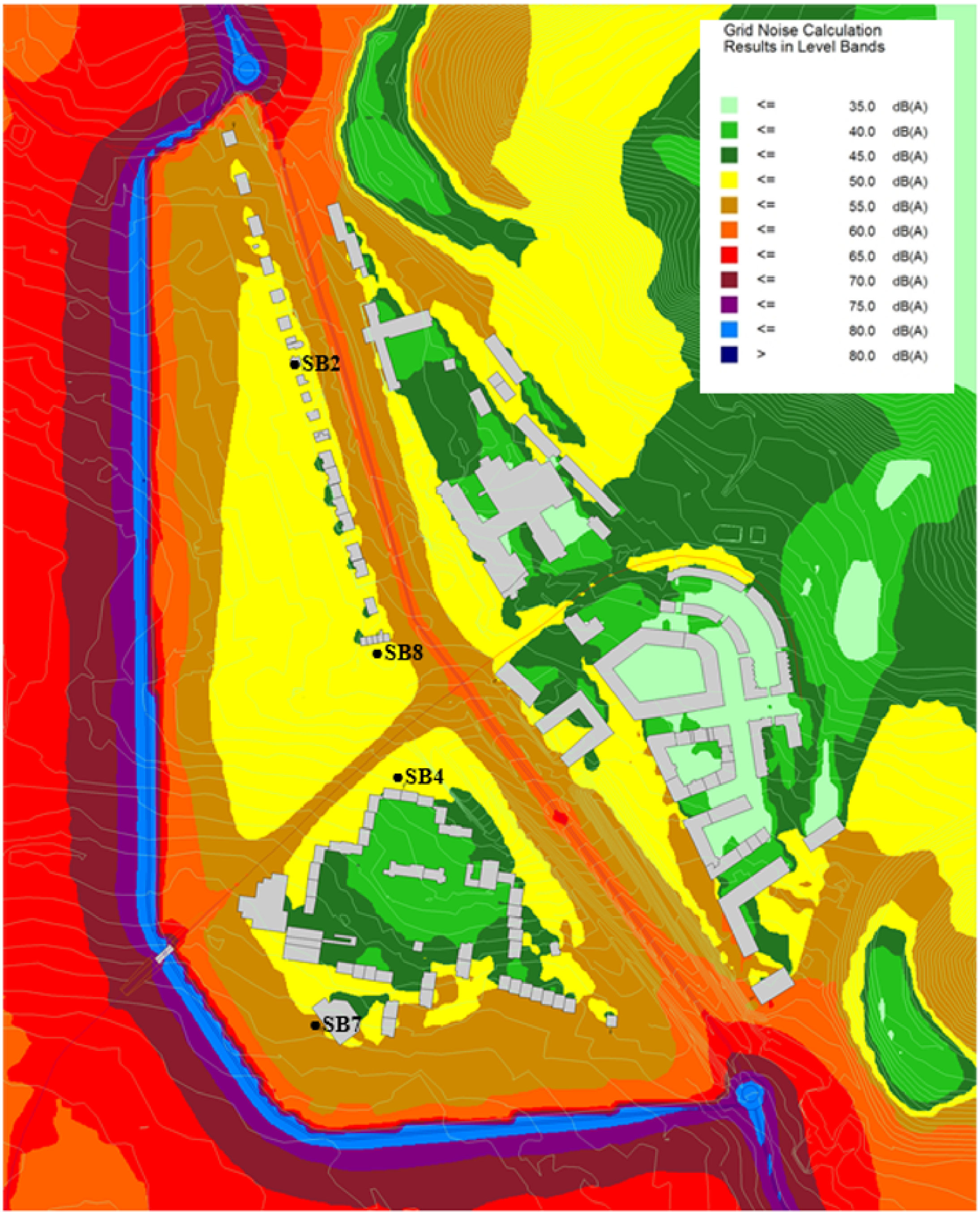

Figure 4: Calculated levels for a variant with the construction of a bypass - reference time interval – night

decrease in the equivalent sound pressure levels A relative to the zero variant and all previous modelled situations.

There was a significant increase in the noise load at the MP 5 monitored calculated point. In this case, the situation deteriorated by a significant 9.9 dB compared to the zero variant. The reason for this increase is obvious from the visualization. The same applies to the monitored calculated points MP 6 and MP 7, where the situation deteriorated as well. For the monitored calculated points MP 6 and MP 7, the increase ranged from 0.6 to 2.1 dB.

In general, however, an overall improvement of 10.7 to 15.4 dB can be noted. The reason for this decrease is clearly a shift of freight traffic to the bypass and a reduction in the speed of passing passenger cars in the residential zone. In this case, when freight traffic was excluded from the res-

Table 6: Calculated levels for a variant with the construction of a bypass - reference time interval - night

Monitored point	Floor	$L_{Aeq,\,8h}$ [dB]	Permitted value [dB]	Deviation from NPH [dB]
MP 1	1.OGF	**50.2**	50	**0.2**
	2.OGF	**54.5**	50	**4.5**
MP 2	1. OGF	**47.3**	50	**−2.7**
	2. OGF	**47.6**	50	**−2.4**
	3. OGF	**50.0**	50	**0.0**
MP 3	1. OGF	**50.7**	50	**0.6**
	2. OGF	**51.3**	50	**1.3**
	3. OGF	**51.5**	50	**1.5**
	4. OGF	**50.7**	50	**0.7**
MP 4	1. OGF	**45.6**	50	**−4.4**
	2. OGF	**46.0**	50	**−4.0**
	3. OGF	**46.2**	50	**−3.8**
	4. OGF	**46.3**	50	**−3.7**
	5. OGF	**46.4**	50	**−3.6**
	6.OGF	**46.4**	50	**−3.6**
	7. OGF	**46.5**	50	**−3.5**
	8. OGF	**46.8**	50	**−3.2**
MP 5	1. OGF	**51.3**	50	**1.3**
	2. OGF	**58.9**	50	**8,9**
	3. OGF	**58.8**	50	**8.8**
MP 6	1. OGF	**50.7**	50	**0.7**
	2. OGF	**54.3**	50	**4.3**
MP 7	1. OGF	**48.4**	50	**−1.6**
MP 8	1. OGF	**48.1**	50	**−1.9**
	2. OGF	**48.4**	50	**−1.6**

idential zone, the graph shown in the variation with the maximum speed limit applies.

The reference time interval - night

The following input data were used for the calculation in the reference time interval - night; in the variant with the construction of a bypass and the establishment of residential zone on the main road communication of the model:

- standard bituminous road surface with a correction of +1.1 dB for the deterioration of asphalt in the built-up area
- new asphalt surface without correction for bypass and roundabouts
- traffic intensity - passenger cars: 110 vehicles per hour , *i.e.*, 880 passenger cars over the entire reference time interval
- 5% of the original passenger traffic in the built-up area
- traffic intensity - trucks: 64 vehicles per hour, *i.e.*, 512 trucks over the entire reference time interval
- zohľadnenie rýchlosti vozidiel v závislosti na komunikácií
- the proportion of cars and trucks remained the same as in the zero variant calculation
- installation of noise barriers made of absorbent material 4 m high along the bypass on the side facing the residential area

Table 6 shows the equivalent sound pressure level A after the construction of a bypass within the reference time interval - night at individual monitored calculation points, which are located on the facades of selected objects:

The visualization of the area documents the fundamental changes in the noise situation in the built-up area that occurred after the construction of the bypass:

A radical improvement of the noise situation was also found within the reference time interval - night. There was a general improvement of 10.5 to 16.2 dB over the zero variant. This result can be considered as a successful solution to the noise situation in the area.

Nevertheless, at the calculated points monitored, the calculated equivalent sound pressure levels A have been reduced bellow the maximum permitted value only in MP 2, MP 4, MP 7 and MP 8. Other points, with the exception of the MP 5 calculated point under review, also recorded a decrease of noise, this, however, did not comply with the highest permissible value of noise. In case of the MP 5 monitored calculated point, the noise situation deteriorated by almost 9 dB due to the higher impact from vehicles crossing the roundabout.

4 Conclusion

The mathematical model of road traffic noise decrease belongs to the mathematical models and was processed using the Lima prediction software, which has effective means for analyzing traffic processes in the area of noise pollution. The model presented herein has a wide potential application and the document presented a simulation of one measure when used on the main road routes of the model, *i.e.* the construction of bypass and establishment of a residential zone in the monitored area.

However, the solution of each noise situation is always dependent on the specific situation in the given area and therefore this measure may or may not be suitable for other types of territory. This variant, with the construction of a bypass and the establishment of a residential zone, achieved a reduction in noise at the calculated points, but requires the most financial resources for its implementation.

The created simulation model has a certain importance in traffic management, elimination or mitigation of traffic noise and in creating noise maps of the territory. The model demonstrates the use of infrared technology applied in road traffic to eliminate noise pollution that needs to be monitored, reduced or eliminated.

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