EUROPEAN COMMISSION

PROVISION OF SERVICES IN THE SECTOR OF COOPERATION RELATED TO:

Lot 6: Environment

Framework Contract N°IB/AMS/451

Beneficiary Country: Slovak Republic

Request for Services N° Czuerozova31-Phare-SR-PAO/CFCU

Project "The assessment and management of environmental noise"

Interim Report

July 2004

Consortium

AGRIFOR Consult

Avenue Einstein, 3 – 1300 Wavre – Belgium

Tél. + 32 – 10.24.50.35 – Fax + 32 – 10.24.50.38

Email : info@agrifor.be

ARCA CONSULTING (Italia) – CIRAD (France) – DARUDEC (Denmark)
DFS (Germany) - IAC (The Netherlands) – IFREMER (France) - JVL (Belgium)

ABBREVIATIONS

CFCU	Central Finance and Contracting Unit
EAS	Environmental Accession Strategy
EC	European Commission
ECD	Delegation of the European Commission
END	EU- Directive on environmental noise
EU	European Union
IA	Implementing Agency
ISPA	Instrument for Structural Polices for Pre-accession
MAs	Management Authorities
MCRD	Ministry of Construction & Regional Development of the Slovak Republic
MTPT	Ministry of Transport, Posts and Telecommunications
MEuro	Millions of Euro
MoE SR	Ministry of Environment of the Slovak Republic
MoH	Ministry of Health of the Slovak Republic
NPAA	National Programme for the Adoption of the Acquis Communitaire
PAO	Programme Authorising Officer
NPHA	National Public Health Authority of Slovak Republic
SR	Slovak Republic
TA	Technical Assistance
ToR	Terms of Reference
WHO	World Health Organisation

Table of Contents

1. PROJECT INTRODUCTION

1.1. Project Background

The Slovak Republic carried out the National Programme for the Adoption of the *Acquis Communautaire* (NPAA) as one of the key documents in the process of approaching the acquisition of full membership in the European Union.

In the pre-accession process and the process of gradual harmonisation of Slovak legislation with European, the environmental directives take very important place.

A special and very significant theme of environmental area is the protection of environment and health against noise. Noise belongs to the one of the most important psychosocial factors of environment quality and quality of life in general. It may cause hearing loss that impairs life quality by causing sleep disturbance, high annoyance, and other negative health effects.

It is part of Community policy to achieve a high level of health and environmental protection and one of the objectives to be pursued is protection against noise. In the Green Paper on Future Noise Policy, the Commission addressed noise in the environment as one of the main environmental problems in Europe. Preventive measures in this field of public health will have to be taken according to EU requirements and WHO research reports in the nearly future.

Certain categories of noise emissions from products are already covered by Community legislation, such as Council Directive 70/157/EEC relating to the permissible sound level and the exhaust system of motor vehicles, Council Directive 77/311/ EEC of 29 March 1977 relating to the driver perceived noise level of wheeled agricultural or forestry tractors, Council Directive 80/51/EEC on the limitation of noise emissions from subsonic aircraft and its complementary directives, Council Directive 92/61/EEC relating to the type-approval of two or three-wheel motor vehicles and Directive 2000/14/EC of the European Parliament and of the Council relating to the noise emission in the environment by equipment for use outdoors

In the last year the Commission has adopted ***Directive 2002/49/EC of the European Parliament and the Council of 25 June 2002 relating to the assessment and management of environmental noise.***
The aim of this Directive is to define a common approach intended to avoid, prevent or reduce the harmful effects, including annoyance, caused by exposure of environmental noise. The following actions shall be implemented progressively:

(a) determination of exposure of environmental noise, through noise mapping, by methods of assessment common in the Member States,

(b) ensuring that information on environmental noise and its effects is made available to the public,

(c) adoption of action plans by the Member States, based upon noise-mapping results, with a view to prevent and reduce environmental noise where necessary and particularly where exposure levels can induce harmful effects on human health and to preserve environmental noise quality where it is good.

The noise theme is of a wide scope and there are many different institutions, central offices of state administration responsible for a noise control in the Slovak Republic, specially Ministry of Health, Ministry of Environment, Ministry of Transport, Post and Telecommunications, State Office for Standardization, Measurement and Testing and their subordinate organisations. The Ministry of Health of SR (MoH) was appointed during the pre-accession process by the SR Government Decision No.1232 from 13. November 2002 as a responsible institution for harmonisation of the Slovak law with the Directive 2002/49/EC. MoH provides this through its subordinate organisation National Public Health Authority – Department of National Reference Centre for Noise and Vibration (NRC for noise and vibration), as a top specialised centre in the area of environment and health noise protection.

NRC for noise and vibration is presently preparing the proposal of the Legal Act about assessment and management of environmental noise, harmonised with EU requirements, which should be submitted to the Slovak Parliament before June 2004. Successful implementation of entire Directive 2002/49/EC including its all amendments requires lot of high sophisticated work of a large scope. Considering that, there are not enough expert capacities available in responsible institutions in Slovak Republic and there is an inevitable need for foreign expert participation in order to make use of their capacity and experiences from the harmonisation process and praxis.

2. PROJECT DESCRIPTION

2.1. Overall objective

The harmonization and implementation of the Directive 2002/49/EC with the Slovak legislation in the area of Environment and Health Noise protection.

2.2. Specific objectives of the project

Preparedness of all necessary technical and human resources for direct implementation of all regulations related to the Directive 2002/49/EC in the Slovak Republic.

3. INCEPTION PHASE ACTIVITIES

3.1. Requested services

One framework arrangement is envisaged, which will cover following activities:

Activity 1
Technical and legislative support of the Directive 2002/49/EC implementation into Slovak legislation.

This activity includes, but is not limited by:
- (1) in close cooperation with Slovak experts (relevant employees of NPHA) preparation of proposal on appropriate institutional framework to ensure entire implementation of Directive 2002/49/EC (e.g. determination of relationships among all concerned institutions, duty to provide relevant information, duty to carry out necessary activities etc.)
- (2) in close cooperation with Slovak experts to propose the model of action plan (according to the conditions of the Directive 2002/49/EC) for application of noise control and noise assessment.
- (3) 4-days training of 10 responsible NPI employees. The training will contain detailed explanation of particular paragraphs and provisions of Directive 2002/49/EC and its Annexes, related documents and technical standards.
- (4) expert's opinion on current proposal of Act of the National Council of the SR on environmental noise and related legislation, which should be fully harmonized with the Directive 2002/49/EC

Activity 2
Development of detailed methodologies for measurement and calculation of environmental noise (emitted by the major sources, in particular road and rail vehicles and infrastructure, aircraft, outdoor and industrial equipment and mobile machinery) and methodology for development of noise mapping and action plans, especially:
- (5) re-definition of the noise indicators and theirs measurement and assessment methodology according to the EU requirements
- (6) state of the art analysis of calculation methodology and procedures, selection and modification of appropriate methodology for Slovak conditions
- (7) development of the methodology for noise mapping
- (8) realization of terrain environmental noise measurement to verify proposed methodology
- (9) Training of relevant NPI employees (ca 15 people) to work and use above- mentioned methodology.

Training duration - 2 days

These 9 partial activities have been detailed and modified (supplemented) in agreement with all parties included. The result was a work plan with the steps necessary to achieve the defined results.

4. PROJECT PROGRESS

This paragraph describes the project progress covering the period of the 13th of April 2004 to the end of June. During this period several missions of experts to Slovakia were carried out.

Progress relating to activity 1.1. and 1.4.
The project started effectively end of April. At that time a draft of the law about the implementation of the Directive 2002/49/EC was just in the procedure of approval. The detailed contents have been discussed with the beneficiary – on the basis of the beneficiary's report - and as it was a direct implementation of the Directive without special relation to national aspects there was no reason to criticize or modify anything of this draft.

The beneficiary explained the existing opinion about the concerned institutions, their duty to provide relevant information, duty to carry out necessary activities etc.
It is planned that the MoH through NPHA is central coordinator of the noise mapping activities. The duty of providing the necessary input data and calculation of noise maps remains at the organisations responsible for the area resp. the noise source. The magistrate of the cities Bratislava and Kosice will be responsible for the agglomeration area.

The MoH, supported by the NPHA planned to collect the strategic noise maps and the statistical data about distribution of noise levels versus inhabitants, do some spot checks on the quality of these results and send them to the Commission as required in Annex VI of the directive.

Benefits and drawbacks of this strategy and of alternatives have been and are still in discussion.

It is undoubtedly the best way to let the responsibility of data acquisition at the organizations that are responsible for the dominating noise source. Insofar it is recommended that it remain the duty of the above-mentioned organisations to provide all relevant information.

The noise mapping itself and all activities necessary (e.g. data for the terrain model, modelling of Bratislava and Kosice, calculating and deriving the information required about noise distribution and population) is a problem in areas, where the responsibilities of these organisations overlap, especially in the cities where railways, roads and even aircraft emissions determine the sound level.

In the relatively small country Slovakia it could be an alternative strategy to do the modelling, calculation and to derive the necessary noise information at one central position – e.g. at the NPHA. This would minimize the necessary work for interfacing and therefore eliminate a main source for high financial expenditure and even for uncertainties and errors. The drawback of this solution would be that there is no responsibility of those acquiring the data for their quality.

This discussion is still going on and a decision will be taken by the end of this project.

So it can be stated that the work on points 1.1. and 1.4. in the ToR began end of April and have been finished as far as the experts part is concerned. A decision about the final recommendation of the experts about the distribution of responsibilities will be taken next weeks.
The technical part of the institutional framework is described in Annex 1. (see A1-2., figure A1-1). These are mainly references to the calculation methods for different noise types,

modifications of these general methods to apply for slovakian conditions, specifications for verifying measurements and specifications for software and institutes to enshure the quality of noise maps and action plans.

The papers itself will be developed under activity 2 after the calculation methods have been decided.

Progress relating to activity 1.2.
The frame of action plans have been discussed. There is the possibility to fix certain noise type and domain related limiting values. Action plans have to be derived, if these limiting values are exceeded. The limiting values themselves can be oriented at the existing framework of noise limits.
The disadvantage of inventing special limiting values is that these are in a certain way competitive to existing noise limits and that they make actions compulsary – even in cases where real measures are not possible. An alternative is to invent not limiting, but "actuating" values where actions have to be taken into consideration. This system has been chosen in Germany.
When deciding about actuating values, the real situation and the existing distribution of noise levels shall be taken into account. With existing knowledge the noise levels
L_{den} = 65 dB(A)
and
L_n = 55 dB(A)
would be recommended. But this must further be discussed with slovakian experts.

Another point are actions to prevent quiet areas from being distroyed by more noise – the proposal that will be further discussed with slovakian experts is to restrict this prevention of quiet areas to agglomerations and to use actuating levels 20 dB lower than those mentioned above.

Progress relating to activity 1.3.
The 4 days training is planned to be provided in the end of September 2004.

In the first phase of the project the emphasis was laid on the activity 2 and the finalisation of the activity 1 was postponed to the September and October 2004.

Progress relating to activity 2

The points 2.5 to 2.8 are related to an invention of the technical methodology. So the overall work plan of the project described in ToR mostly covering sub-activities of activity 2, but including all activities to be done to finalise activity 1 is following:

Table 1: Detailed Work-Plan

No.	Date (planned end)	Situation end of may	Situation end of june	Activity	Result	Annex
1	31.05.2004	finished	finished	Description of the system of noise limits present and planned	Tables	A3
2	31.05.2004	in progress	finished	Proposal of Lden, Ln threshold values for conflict maps	Actuating levels	page 7
3	31.05.2004	in progress	finished	Description of alternative possible methods and necessary input data	A1-1 - A1-7	A1
4	31.05.2004	in progress	finished	Recherche of measurement results with controlled conditions	will be reported with final report	
*				New: Measurements and evaluation		
5	31.05.2004	-	in progress	Modelling of measured scenarios	computer models used	A2
6	31.05.2004	-	in progress	Test examples developed for comparison of methods	not yet reported	
7	30.06.2004	-	in progress	Calculation of test examples and measured scenarios	not yet reported	
8	30.06.2004	-	> 6.8.2004	Proposal of used method for road, railway, aircraft and industry	not yet reported	
9	30.06.2004	-	finished	Proposal of an appropriate institutional framework	Fig. A1-1	A1
10	01.07.2004	-	in progress	Interim report		
11	31.08.2004	-		Example for calculation and evaluation of total noise	not yet reported	
12	31.08.2004	in progress		Analysis of data availability and frame for data acquisition	not yet reported	
13	30.09.2004	-		4-days training of 10 responsible NPI employees (administrative aspects of EU directive	not yet reported	
14	30.09.2004	-		Development and proposal for complete slovak methodology	not yet reported	
15	30.09.2004	-		2-days training of relevant NPI employees about technical aspects	not yet reported	
16	31.12.2004	-		Final report		

Measurements and evaluations to decide about method:
road: 3 measurements 12 hours
road: 54 pass by measurements
railway: data acquisition
railway: 10 pass by measurements
industry: data acquisition
industry: modeling, calculation and comparison
aircraft: data acquisition
aircraft: modeling, calculation
measuremants finished 15. July
assessment, evaluation and comparison till 31.07.2004

This work plan was agreed between the beneficiary and the experts during the meeting 27th – 30th April, 2004 in Bratislava to be the best approach to fulfil activity 2.
The progress in the different steps is indicated for end of May and end of June.

The point about "Measurements and evaluation" is more extended and time consuming as it was planned at the projects start. The reason is the necessary decision about the calculation method for noise mapping and the lack of existing measurement results that could be used for this decision.

These measurements should help:
- to select the best adapted calculation method
- to find corrections and modifications related to national needs (e.g. road surfaces, train type corrections etc.)
- to know about accuracies and possible deviations measurement – calculation.

5. INFRASTRUCTURAL LOGISTICS AND BENEFICIARY SUPPORT

The beneficiary supports the work of the experts as it was intended. An office room in the NPHA with computer, telephone and Internet access is provided.

6. DURATION OF CONTRACT

It is planned to complete the project end of September. Dependent on the progress with the necessary measurements and therefore also on weather conditions this completion may be shifted about one month to end of October. This can be decided till end of July. The final report will be submitted no later than 3 months after completion.

7. REQUIRED ADJUSTMENTS TO THE WORK PROGRAMME AND STAFFING INPUTS

The end of the preliminary phase has brought to light the necessity for changes to the contract. In terms of travel, staff input…which required AGRIFOR Consortium to submit an Offer Bis. This offer has been accepted by the MoH, but we are still awaiting the answer from the CFCU. It is expected this Offer Bis will be accepted as it is considered duly necessary to the achievement of the mission.

7.1. Work program

The work program has been modified as described above.

7.2. Inclusion of a fourth expert

Bratislava is the only city where noise maps have to be calculated till 2007. The above mentioned measurements should therefore be made with roads, railway tracks and the airport in Bratislava.
It was therefore necessary to include an expert with specific knowledge in noise measurement in Bratislava.
It was therefore applied to approve Mr. Milan Kamenicky as forth expert, because he is situated in Bratislava, well equipped to do such measurements and working with all noise types road, railway and aircraft noise.

7.3. Staffing inputs

The distribution of workdays of the experts has been modified in the Offer Bis. The table 2 describes the distribution as it was agreed in the contract.

Table 2:

Exp.	Name of the expert	Position	Number of days
1.	Dr. PROBST Wolfgang	Team Leader Noise Directives Expert	22
2.	Mr. BUNA Béla	Noise Expert	92
3.	Mr. PAVLIK Peter	Local Noise Expert	92

The table 3 shows the redistribution of the working days as it is proposed in the Offer bis, including the forth expert.

Table 3: Working days re-distribution

Exp.	Name of the expert	Position	Number of days
1.	Dr. PROBST Wolfgang	Team Leader Noise Directives Expert	41
2.	Mr. BUNA Béla	Noise Expert	30
3.	Mr. PAVLIK Peter	Local Noise Expert	65
4.	Mr. KAMENICKY Milan	Local Noise Expert	70

ANNEX 1: Frame of expert work and necessary measurements

A1-1. Scope

This short instruction describes the papers that should be produced and some necessary measurements that should be made for a straightforward implementation of the EU-Directive about environmental noise (END) in the environmental administration in Slovakia.

Generally it is recommended to use a completely described, published and well approved guideline or standard to calculate noise maps according to the END. If no national standards exist, the Interim methods published in END should be used.

If it is not clear if and how well a calculation method fits with local environmental conditions, it is recommended to undertake some basic measurements of road and railway traffic noise. These measurements are carried out with the normal traffic. The results can only be used, if all parameters needed to calculate the levels with all the methods under test are known. A comparison of calculated and measured result gives some hints about the usability of the method.

If a method has been selected, some adaptations according to typical road surfaces and train types may be necessary to fulfil local requirements. This is best be done with pass by measurements under controlled conditions. During pass by of a car or train the levels are integrated. The resulting time dependent levels and the mean level from pass-by of a car on smooth asphalt or concrete surface is compared with the mean level of pass-by with the surface under test – from this the necessary corrections are derived. From pass-by measurement of train the corrections for train types are developed.

Generally the selected standard should be used with as few modifications as possible.

A1-2. Recommendation for end adaptation in Slovakia

Figure A1-1 shows the documents that should be developed.

Papers 1b, 2b, 3b and 4b are exact and certified Slovakian editions of the original papers describing the Interim methods NMPB-Routes, SRMII, ISO 9613-2 and ECAC-CEAC doc. 29 (if these have been selected as basic framework). The translation of the original documents should be organized by the Slovakian administration.

Papers 1a, 2a, 3a and 4a describe all modifications and interpretations that are necessary to apply the Interim methods in Slovakia. They don't repeat, but reference the original papers 1b – 4b and contain additional information about road surface corrections, train type corrections and other influences and parameters that are national interpretations of the original documents.

Paper 5 describes measurements that can be used to verify calculated noise levels and maps.

Finally paper 6 gives specifications for the process of noise mapping related to personnel and software to ensure the necessary quality of the determined data.

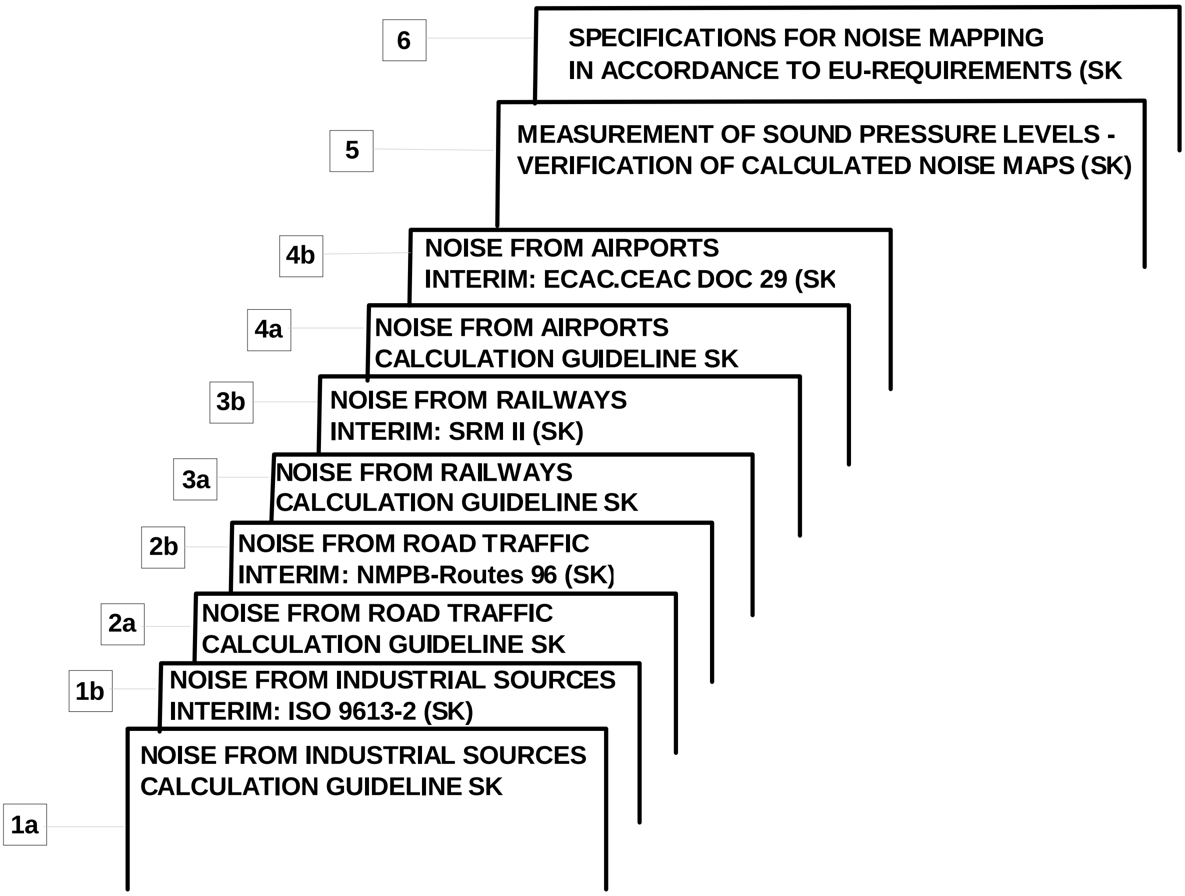


Figure A1-1Documents necessary to implement the Noise Mapping Procedures in Slovakia

A1-3. Measurement of fluctuating road traffic noise

The interim calculation method of road noise is based on the French NMPB Routes 96. With measurements at roads under controlled conditions, but with usual traffic and with controlled pass-by measurements it is evaluated if adaptations of the road surface corrections are necessary.

About 3 measurements with usual traffic flow – minimum 3 hours each – are planned (preferably more hours with registration of the Leq each hour separately).

The measurement situation and all acoustically influencing objects and object properties must be modelled parallel with a calculation software – it is therefore necessary to do the measurements at positions where all these parameters can be controlled. The comparison measurement – calculation shall be possible for all calculation methods under test. The parameters used by these methods must therefore be evaluated.

In a layout plan where with all acoustically relevant objects the position of the microphone should be indicated.

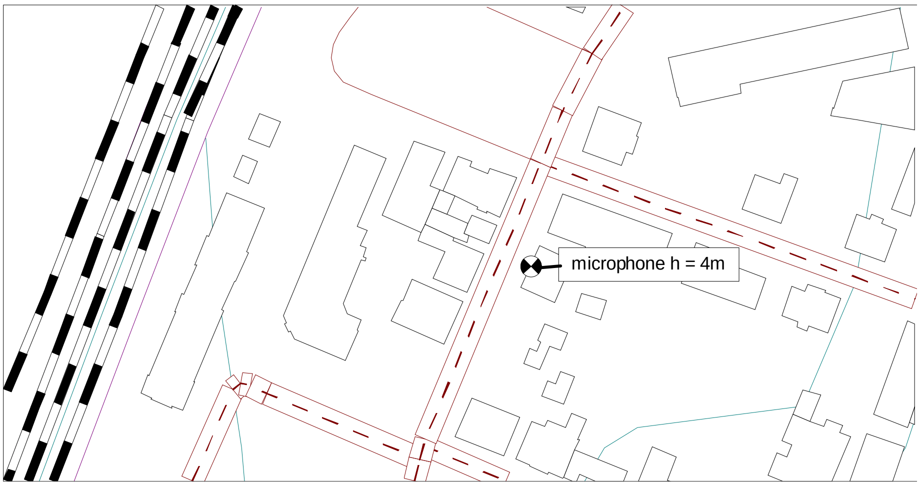


Figure A1-2 Layout of environment with location of microphone

All parameter values that are used to calculate road traffic noise with the procedures under test must be determined and registered. The same with properties of the environment that may influence the measured level at the microphone position.

For each of these measurements at one location Tables A1-1, A1-2 and A1-5 have to be completed. In Table 5 data are entered only on the line – or the lines – of the relevant time intervals

Table A1-1 Information

MEASUREMENT INFORMATION	
Person responsible	
Location of measurement	
Date of measurement	
Type of Sound Level Meter	

Table A1-2 Parameters

PARAMETER	VALUE
Bredth of road (acoustically relevant cross section)	
Max. speed light vehicles	
Max. speed heavy vehicles	
Type of traffic flow (from Table 1b)	
Road surface (from Table 1c)	
Gradient % if > 5	
mean hight of flanking houses (if gaps < 30%)	
mean distance of opposite facades	
Crossing with traffic lights (active during measurement)	

Table A1-3 Code for Flow-Type

TYPE OF FLOW	TYPE No.
continuous	1
pulsating	2
accelerating	3
decelerating	4
not defined (varying)	5

Table A1-4 Code for road surfaces

ROAD SURFACE	SURFACE No.
smooth mastix asphalt	1
concrete	2
smooth pavement	3
other pavement	4
concrete w/ steelbrushed	5
concrete with jute cloth	6
Asphalt concrete <=0/11	7
porous asphalt 0/11	8
porous asphalt 0/8	9
other - short description:	10

Table A1-5 Results

TIME INTERVAL	VEHICLES < 3,5 t	> 3,5 t (trucks)	BUSES	VEH/Hour	p % heavy	Leq dB(A)
0 - 1						
1 - 2						
2 - 3						
3 - 4						
4 - 5						
5 - 6						
6 - 7						
7 - 8						
8 - 9						
9 - 10						
10 - 11						
11 - 12						
12 - 13						
13 - 14						
14 - 15						
15 - 16						
16 - 17						
17 - 18						
18 - 19						
19 - 20						
20 - 21						
21 - 22						
22 - 23						
23 - 24						
Total:.............						

In Table 5 also different time intervals can be used (e.g. 15:30 h – 17:45 h). In 2nd, 3rd and 4th column the real counts are entered. Column 5 contains the sum of columns 2, 3 and 4. Column 6 is the percentage of heavy vehicles:

p = (Column 3 + Column 4)/(Column 2 + Column 3 + Column 4) * 100 % (1)

The content of the last line in column 5, 6 and 7 is calculated with (1) from the data in the same line (not averaged from the hourly values in the column).

A1-4. Pass-by-measurements at roads

These measurements are necessary to determine the usability of the given road surface classification and to find the correction for road surfaces not mentioned in the existing scheme. The following shows that a tremendous lot of measurements is necessary to create new road surface corrections – it is recommended to accept a given scheme and to concentrate on absolutely necessary modifications.

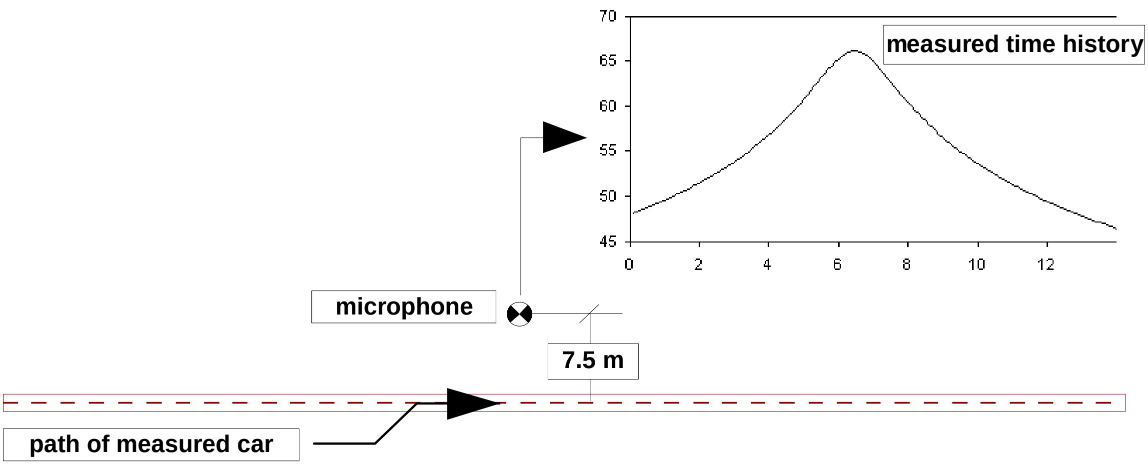


Figure A1-3Measurement setup for pass by measurements at a road (level history artificial)

The measurements at roads are taken at a distance of 7.5 m preferably – other distances are possible but must be indicated in the protocol. The road should be straight 150 m minimum at both sides.

Figure A1-4 shows the level-time-diagram for a pass by with 30 km/h (background noise 53 dB(A) fluctuating with standard deviation 3 dB and 50 dB(A) steady noise). Figure A1-5 is a similar recording with car speed 120 km/h (both presentations are artificial and calculated for demonstration purposes).

With each parameter setting (car type, speed, road surface) such a dataset and diagram is produced for the A-weighted total level registered as L_{AFm} with sample time 125 ms (also for the A-weighted octave band levels 125 Hz – 8000 Hz, if frequency dependent corrections shall be developed). With this investigation only A-weighted Leq levels are taken into account.

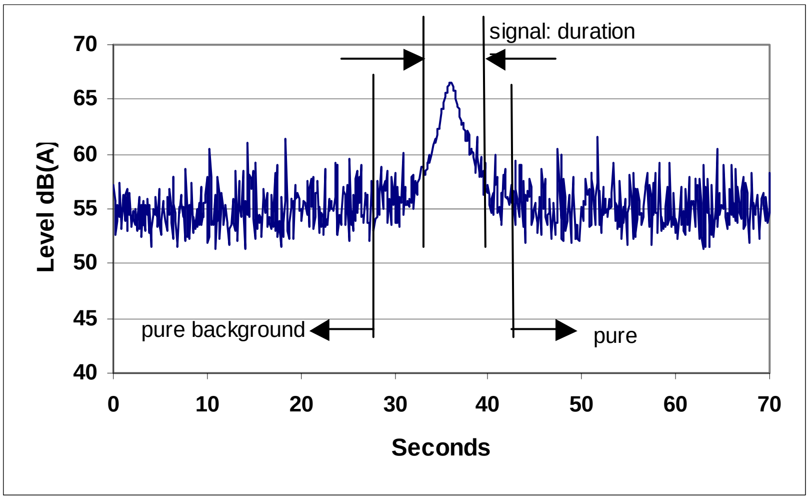


Figure A1-4Pass-by of a light car with 30 km/h

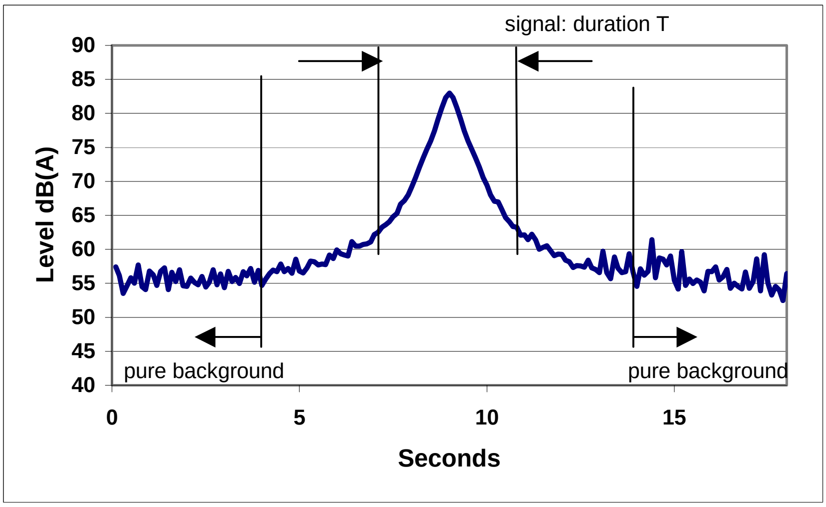


Figure A1-5Pass-by of a light car with 120 km/h

The following steps are necessary if the influence of a road surface X related to a speed v of a car type y shall be determined:

1) Recording of measurement setup and information according to Table 6 and Table 7

Table A1-6 Information (once for one scenario)

MEASUREMENT INFORMATION	
Person responsible	
Location of measurement (attach drawing or file)	
Date of measurement	
Type of Sound Level Meter	

Table A1-7 Parameters (separately for each car type – speed combination)

PARAMETER	VALUE
Car type	
Car weight (kg)	
Car speed (km/h)	
Gradient % if > 5	
Road surface	

2) Pass-by measurement as shown in Figure A1-3 with sampling of 125 ms Leq levels.

The result is recorded with the form Table A1-8. For each car type – speed combination the measurement is repeated 3 times.

Table A1-8 Recording of the pass-by measurement results – each line is a 125 ms sample

Sample	A-Total
1	
2	
558	
559	
560	
Mean	

3) Background noise correction (if necessary). Each pass-by measurement results in the values

L’ mean sound pressure level of the signal during time T – uncorrected for background noise

L_B mean sound pressure level of background noise

T averaging time to get the mean level L’ of the signal from 125 ms samples table A1-6

The signal duration T is the time where the A-weighted signal is more than 6 dB above background level.

The result of one pass-by-measurement is the mean level corrected for background noise

$$L = 10 \cdot \lg\left(10^{0,1 \cdot L'} - 10^{0,1 \cdot L_B}\right) dB \qquad (2)$$

and
the duration T of the pass-by.

Table A1-9 Correction for background noise according to (2)

Quantity	A-Total	T (s)
L'		
LB		
L		

Steps 2, 3 and 4 are repeated 5 times.

4) The single event level is determined using

$$L(1s) = L + 10 \cdot \lg\left(T/_{1s}\right) \qquad (3)$$

for each of the 5 pass-by measurements. The results are averaged arithmetically.
.

Table A1-10 Determining the single event level L(1s) – minimum 3 pass-by measurements

Pass-by	A-Total	T (s)	L(1s)
1			
2			
3			
4			
5			
	Mean L(1s)		

This procedure is done for a smooth reference surface (asphalt) and then for the surface under test (X).

5) The road surface correction for surface X is the difference dL(X) of the single event level determined with surface X and the single event level determined with the smooth reference surface.

Table A1-11 Determination of the correction for surface X

Surface	L(1s)
Smooth	
X	
dL(X)	

6) This procedure is repeated with three speeds 30 km/h, 50 km/h and 100 km/h

With n surfaces and 3 car-types this procedure needs

3 * 3 * 3 * (n + 1)

pass-by measurements. Therefore the method should only be used to find the correction for a surface type that cannot be found in existing schemes.

To evaluate the surface correction for one surface type needs 54 pass-by measurements. Each additional surface needs 27 more measurements.

A1-5. Railways

Preliminary investigations
To come to a decision about the applicability of the train classification as described in SRMII, the traffic on one single railway track – preferably in or near Bratislava – should be acquired completely. This needs to investigate all train movements at one cross section of this track. Each train during one 24 hours period should be qualified using the classification table 14. Number of wagons, length, speed and all parameters used in this classification scheme must be ascertained for each train movement.

If there are trains that cannot be classified it is necessary to make pass-by measurements at this train type. The result should help to find one of the existing classes or to create a new class for this train type.

A1-5.1. Pass-by measurements

The interim calculation method of railway noise is based on the Dutch SRMII. With pass-by measurements and a comparison of measured and calculated results the correct adjustment of trains running in Slovakia in the classification scheme of this standard is evaluated.

About 10 pass-by measurements should be used. They should cover the main train types running in Slovakia.

The measuring distance with trains is preferably 25 m.

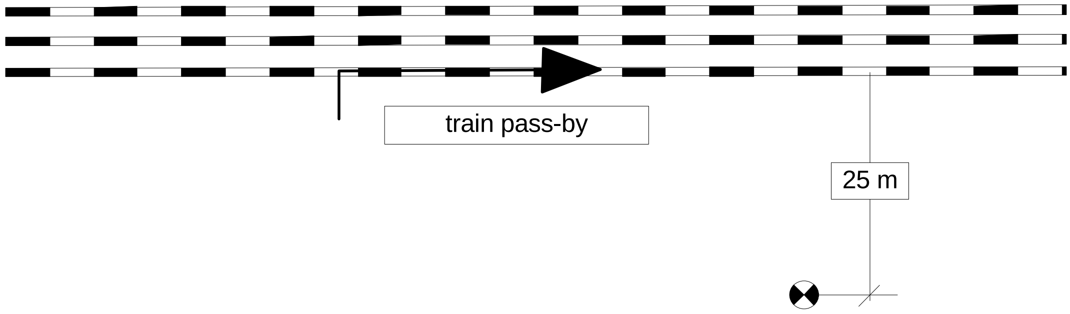


Figure A1-6Measurement setup for train pass-by

The railway track should be straight minimum 300m, preferably more than 500 m each side of the microphone. Microphone height is 4 m.

The environment of the measurement position should be free from reflecting surfaces. If a train is passing the signal should be recorded sampling the 125 ms Leq.

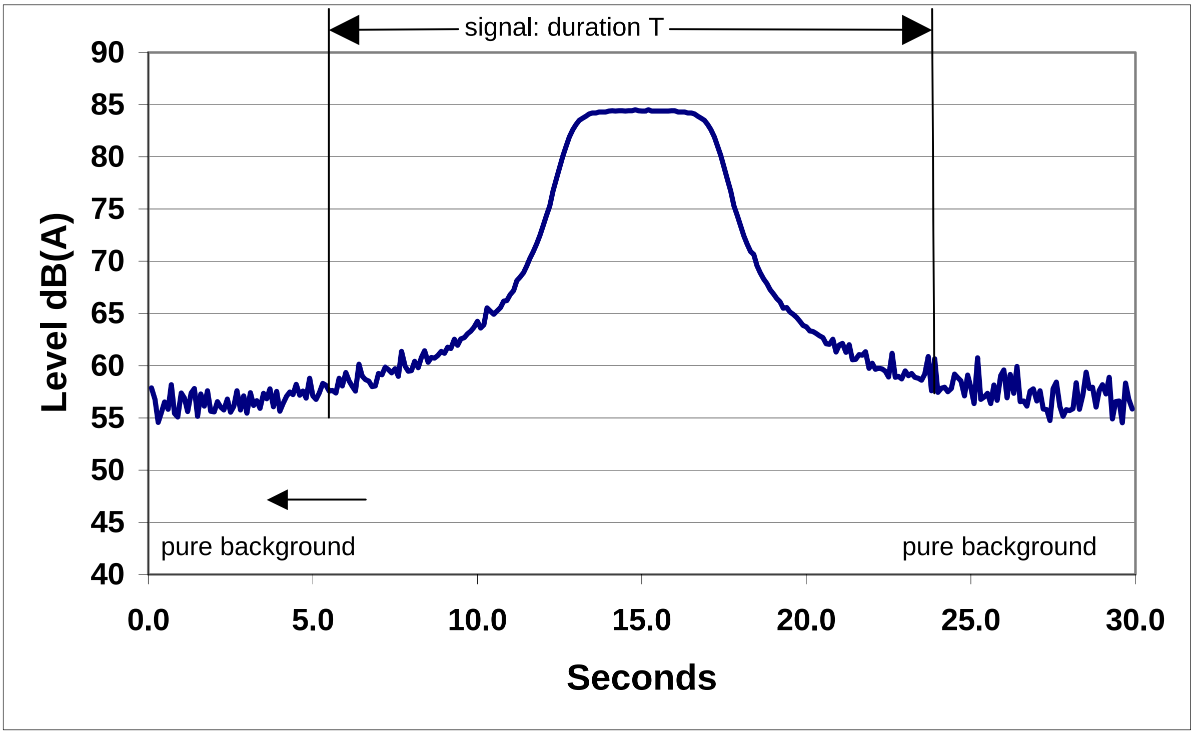


Figure A1-7Typical train pass-by in 25 m distance from microphone (calculated)

The level should be high enough that a correction for background-noise is superfluous. The following steps are necessary:

1) Recording of measurement setup and information according to Table 12 and Table 13

Table A1-12 Information (once for each scenario)

MEASUREMENT INFORMATION	
Person responsible	
Location of measurement (attach drawing or file)	
Date of measurement	
Type of Sound Level Meter	

All information has to be recorded that is necessary to model the scenario for the purpose of noise calculation. Ground heights if not flat, ground structure (grassland, concrete etc.) and geometry of screening and reflecting objects.

Table A1-13 Parameters

PARAMETER	VALUE
Train type according to classification (Table 14)	
braking/ non braking	
Trains qualify as braking when the brake gear has been activated.	
mean speed [kmh^{-1}]	
number of units	
type of track construction (Table 15)	
evaluation of the occurrence of track disconnections (index m) • jointless rails (fully welded tracks) with or without jointless switches or crossings (index code m = 1); • rails with joints (= tracks with joints) or an isolated switch (m = 2); • switches and crossings with joints, 2 per 100 meters (m = 3); • more than 2 switches per 100 meters (m = 4)	

Table A1-14 Train classification

	CATEGORY	TRAIN TYPE
1	Block braked passenger trains	• Exclusively electric passenger trains with cast-iron blocks including the corresponding locomotive, as well as trains from the Dutch 1964 series and passenger trains belonging to Deutsche Bahn (DB); • Electrical motor mail vehicle.
2	Disc braked and block braked passenger trains	• Electric passenger trains primarily with disc brakes and additional cast-iron blocks, including the corresponding locomotives, as for example the InterCity-Material of the IMC-III, ICR and DDM-1 types • Passenger trains belonging to the French Railway Society (SNCF) and the Trans Europe Express (TEE); • Electric locomotives such as those from the 1100, 1200, 1300, 1500, 1600 and 1700 series of the Belgian Railway Society (B)
3	Disc braked passenger trains	• Exclusively passenger trains with disc brakes and engine noise, as for example the municipal material (SGM, sprinter).
4	Block braked freight trains	• All types of freight trains with cast-iron block brakes.
5	Block braked diesel trains	• Exclusively diesel-electrically driven passenger trains with cast-iron block brakes including the corresponding locomotive as for example the DE I, DE II, DE III types; • Diesel – electric locomotives as for example the locomotives of the 2200/2300 and 2400/2500 series.
6	Diesel trains with disc brakes	• Exclusively diesel–hydraulically driven passenger trains with disc brakes and engine noise.
7	Disc braked urban subway and rapid tram trains	• Urban subway and rapid tram trains.
8	Disc braked InterCity and slow trains	• Exclusively electric passenger trains with disc brakes including the corresponding locomotives, as for example InterCities of the ICM-IV, IRM and SM90 types; • Electric passenger trains with primarily disc brakes and additional sinter and ABEX cast-iron blocks including the corresponding locomotives as for example the InterCities of the ICM-III and DDM-2/3 types.
9	Disc braked and block braked high speed trains	• Electric trains with primarily disc brakes and additional cast-iron blocks on the engine car, as for example the TGV PBA or Thalys (HST) types.
10	Provisionally reserved for high speed trains of the ICE-3 (M) (HST East) type	• Vehicles not mentioned here are allocated to the next appropriate category based on their drive unit, wheel brake system or maximum speed.

Table A1-15 Track construction

TRACK CONSTRUCTION	CODE bb
Single block or double block (concrete) sleepers, in ballast bed	1
Wooden or zigzag concrete sleepers, in ballast bed	2
in ballast bed with non-welded tracks, tracks with joints or switches	3
with blocks	4
with blocks and ballast bed	5
with adjustable rail fixation	6
with adjustable rail fixation and ballast bed	7
with poured in railway lines	8
with level crossing	

2) Pass-by measurement as shown in Figure A1-6 with sampling of 125 ms Leq levels.

The result is recorded with the form Table A1-8.

Table A1-8 Recording of the pass-by measurement results – each line is a 125 ms sample

Sample	A-Total
1	
2	
558	
559	
560	
Leq	
T (s)	

A1-6. INDUSTRIAL FACILITIES

A1-6.2. Principles of modeling

The interim calculation method of industrial noise is based on ISO 9613 part 2.
This method is used worldwide and there is no serious alternative – it is therefore not necessary to do validation measurements or to adjust corrections.

Experience shows that the evaluation of industrial noise by including all sources of a plant into the model of a city is by far to costly if the importance of this source type relative to traffic sources is taken into account.

An acceptable compromise is to simulate industrial and commercial areas with area sources. If it is obvious that parts of a factory or plant radiate quite different the whole area is split up in more parts with different emission.

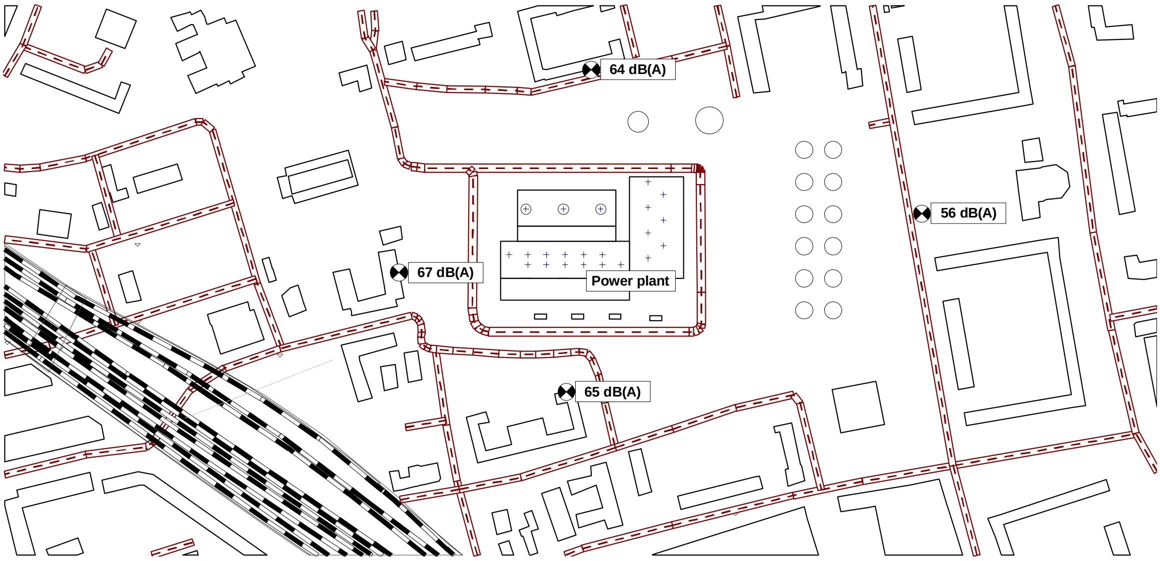


Figure A1-8Power plant with residential buildings neighboured

Figure A1-8 shows a power plant with residential areas in the neighbourhood – the sound pressure levels produced by the plant are shown at 4 receiver points. Figure A1-9 is a 3D-view to this model.

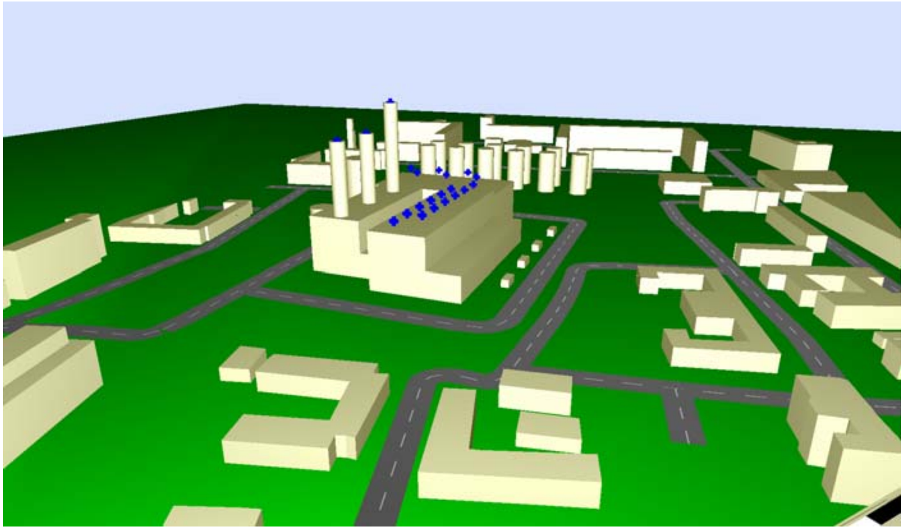


Figure A1-93D-view of the detailed model with power plant

As it is mentioned above, it is by far to costly to create such detailed models in preparation of a city noise map.

In such cases it is the best procedure to replace the area of the plant by area sources as it is shown in Figure A-10.

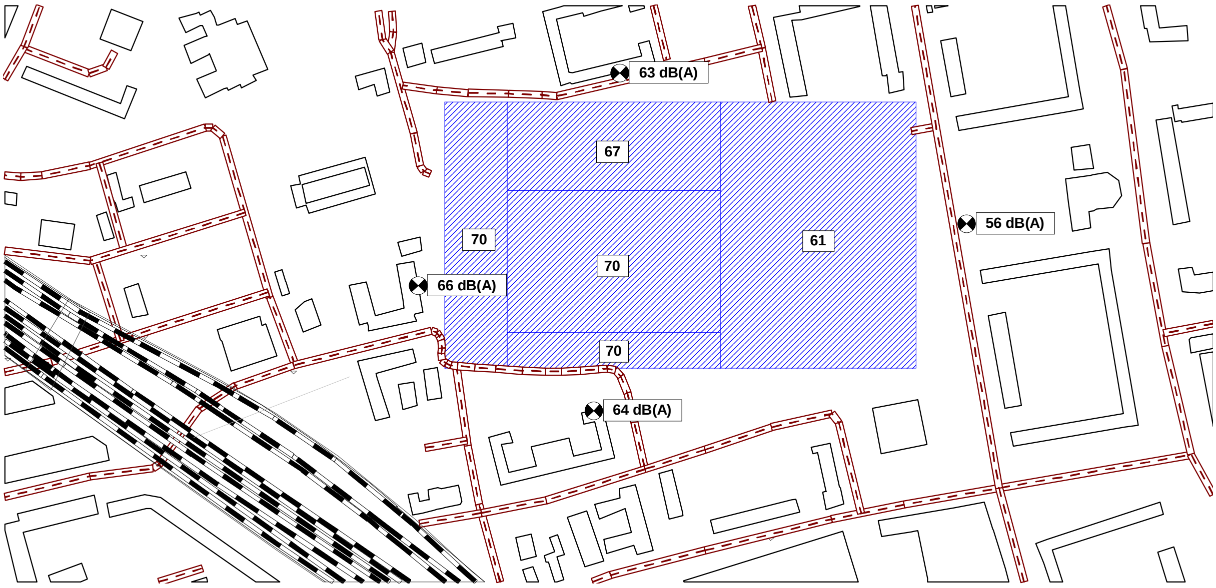


Figure A1-10 Replacement of the plant by 5 area sources (numbers L''_{WA} in dB(A))

As it is shown, these area sources produce nearly the same sound pressure levels at the 4 receiver points.

A1-6.3. Measurements

It is recommended to test this procedure with an industrial area in or near Bratislava. If there is an area where measurements have been made and noise levels are known, step 1 can be omitted.

Measure the sound pressure levels in the neighbourhood of the industrial area. These levels must be determined totally by the industrial area. If other sources influence the result another microphone position should be used or the levels must be corrected for background noise. Create a computer model of the whole environment as far it may influence the levels at these defined receiver points. The industrial area is simulated by a pattern of area sources. The size of all these sources should be adapted to the distribution of the real sources and to the distribution of levels in the neighbourhood.

The area related sound power levels are optimized – this means that they are adjusted so that the differences of calculated and measured sound pressure levels at the receiver points are minimized.

A1-7. AIRCRAFT NOISE
A1-7.4. Principles of modeling

The interim calculation method of aircraft noise is based on ECAC CEAC DOC.29. This method should be used in all Europe and there is no serious alternative – it is therefore not necessary to do validation measurements or to adjust corrections.

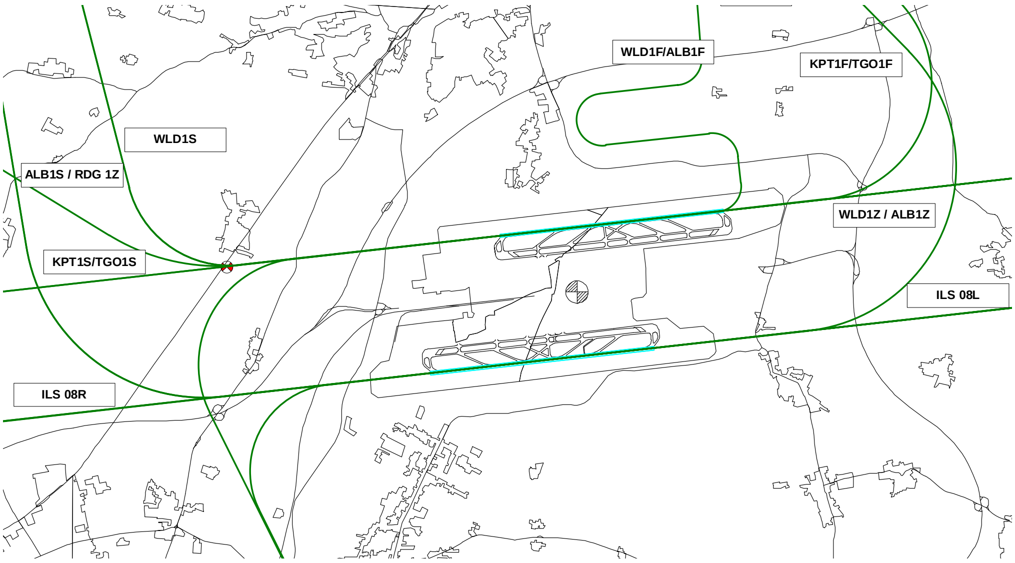


Figure A1-11 Runways and air-routes of Munich airport

It should be noted that the aircraft groups for the ECAC method have been recently been published. It is therefore necessary to examine if it is possible to describe the aircraft mix at Bratislava airport using this classification.

The following data must be acquired:

- geometry of runways
- geometry of flight paths (air-routes)
- number of aircraft of each group for day, evening and night for each flight path

Air Route

Close | Sync. Graphic | Copy... | Print... | Font... | Help

Name	M.	ID	Airport	Type	Runway	Height	Descent Angle w (°)	Fade-In Range		Percentage (%)		Apps/Deps	
						h0 (m)	w (°)	Begin	End	Day	Night	Day	Night
WLD1S		FLG_S26L	München	Departure	26L	0.00				100.00	100.00	4.98	1.00
WLD1Z / ALB1Z		FLG_S26L	München	Departure	26L	0.00				100.00	100.00	292.00	8.00
ALB1S / RDG 1Z		FLG_S26L	München	Departure	26L	0.00				100.00	100.00	724.00	24.00
TULSI/CHIEM2S/SBG1S		FLG_S26L	München	Departure	26L	400.00				100.00	100.00	21476.00	629.00
KPT1S/TGO1S		FLG_S26L	München	Departure	26L	0.00				100.00	100.00	8156.00	208.00
WLD1N		FLG_S26R	München	Departure	26R	0.00				100.00	100.00	24.00	1.00
WLD1F/ALB1F		FLG_S26R	München	Departure	26R	0.00				100.00	100.00	9498.00	278.00
ALB1N/RDG1N		FLG_S26R	München	Departure	26R	400.00				100.00	100.00	24509.00	785.00
TULSI1/CHIEM1/SBG1N		FLG_S26R	München	Departure	26R	0.00				100.00	100.00	632.00	20.00
KPT1F/TGO1F		FLG_S26R	München	Departure	26R	0.00				100.00	100.00	2151.00	65.00
ILS 26R		FLG_L26R	München	Approach	26R	076.00	3.00	0000.00	0000.00	100.00	100.00	33014.00	1727.00
ILS 26L		FLG_L26L	München	Approach	26L	076.00	3.00	0000.00	0000.00	100.00	100.00	33013.00	1727.00

Figure A1-12 Table of air-routes

A1-7.5. Investigation

It is recommended to acquire all the data for Bratislava airport based on one of the last years or on 2004 using the ECAC classification, to create a computer model, to calculate the levels and to compare them with measured levels if available.

Starting point is a listing of all aircraft types moving at Bratislava airport in one year. The next step is to attach one of the aircraft classes of AzB-99 to each of these aircraft types. On the basis of the distribution of these aircraft groups on the flight paths the model can be created using a computer program.

ANNEX 2: Measurement results - 1

A2-1. Scope

This document is a short summary of measurements that have been undertaken.

A2-2. Railway

A2-2.1. Measurement setup

Pass-by-measurements have been undertaken near Martin by Mr. Pavlik in accordance to the specification in chapter “Railways” of document 3209_6. Modelling and calculation of this same situation and determination of difference calculation – measurement based on the standards SRMII and Schall03 where made by Mr. Probst.
A straight railway track was selected with free sound propagation between track and the microphone in 25 m distance and 4 m height.

Figure A2-1 Position for measurements at straight railway track

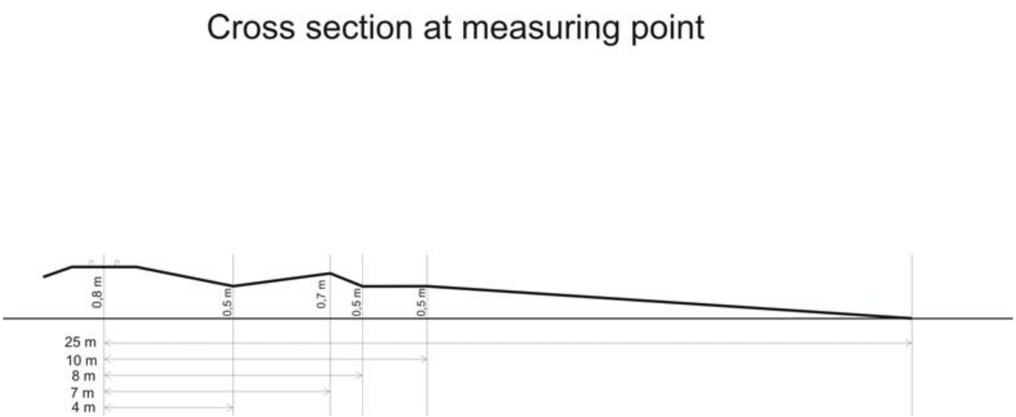


Figure A2-2 Cross section railway track – measuring position

For each train measurement the spectral and overall sound pressure levels L_{AF} were saved all 125 milliseconds. The plot of these levels versus time show the time dependent signal at the microphone position. For each pass-by a time interval was defined where the signal to background ratio was large enough to get sound emission information undisturbed by background noise.
By integration the average Level L_{AFm} related to the time interval T was determined from all 0.125 sec. samples.
From track and all trains all parameters have been registered that are needed to calculate this same average level L_{AFM} with standards SRMII and Schall03.
For the situation shown in figures A2-1 and A2-2 a computer model was created – this allows to calculate the levels during pass-by of any train and with the defined properties of the track.

A2-2.2. Measurements and assessment

1 Express Train Ex 120, 11-50

Electric block braked passenger train, 8 carriages including the locomotive HDV 163
Total mass - 570 t, total length - 216 m.
Real train speed - 81 km/h

Figure A2-3Measured LAF levels – Leq = 76,6 dB(A) with T = 35,6 s (1618 trains/16h)

SRMII – 75,6 dB(A)
Schall03 – 76,6 dB(A)

2 Slow train Os 7855, 11-06
Electric block braked passenger train, 6 carriages including the locomotive HDV 162
Total mass - 350 t, total length - 139 m.
Real train speed - 87 km/h

Figure A2-4Measured LAF levels – Leq = 76,3 dB(A) with T = 30,9 s

SRMII – 75,8 dB(A)
Schall03 –75,9 dB(A)

3 Slow train Os 7855, 11-06
Electric block braked passenger train, 6 carriages including the locomotive HDV 162
Total mass - 350 t, total length - 139 m.
Real train speed - 88 km/h

Figure A2-5Measured LAF levels – Leq = 77,1 dB(A) with T = 42 s

SRMII – 74,6 dB(A)
Schall03 – 74,6 dB(A)

4 Slow train Os 7853, 09-10
Electric block braked passenger train, 6 carriages including the locomotive HDV 162
Total mass - 350 t, total length - 164 m.
Real train speed - 97 km/h

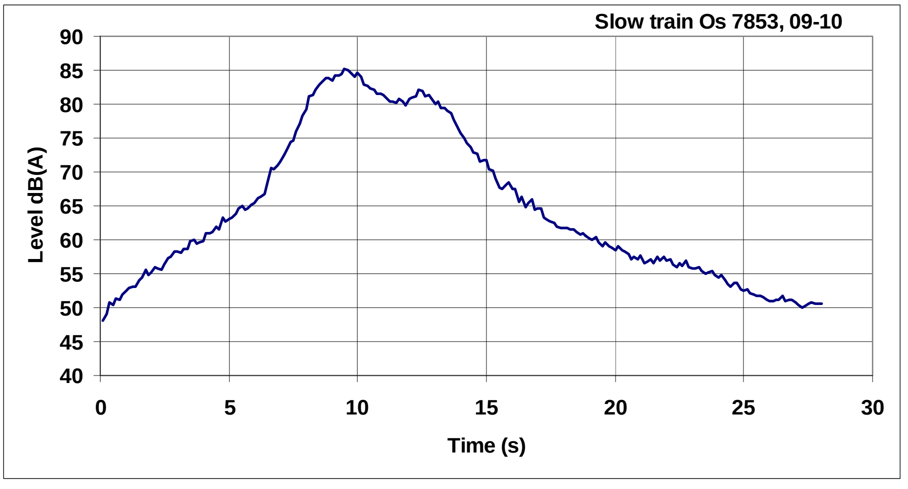


Figure A2-6Measured LAF levels – Leq = 75,8 dB(A) with T = 28 s

SRMII – 77,4 dB(A)
Schall03 – 78 dB(A)

5 Slow train Os 7839, 15-20
Electric block braked passenger train, 5 carriages including the locomotive HDV 162
Total mass - 350 t, total length - 139 m.
Real train speed - 86 km/h

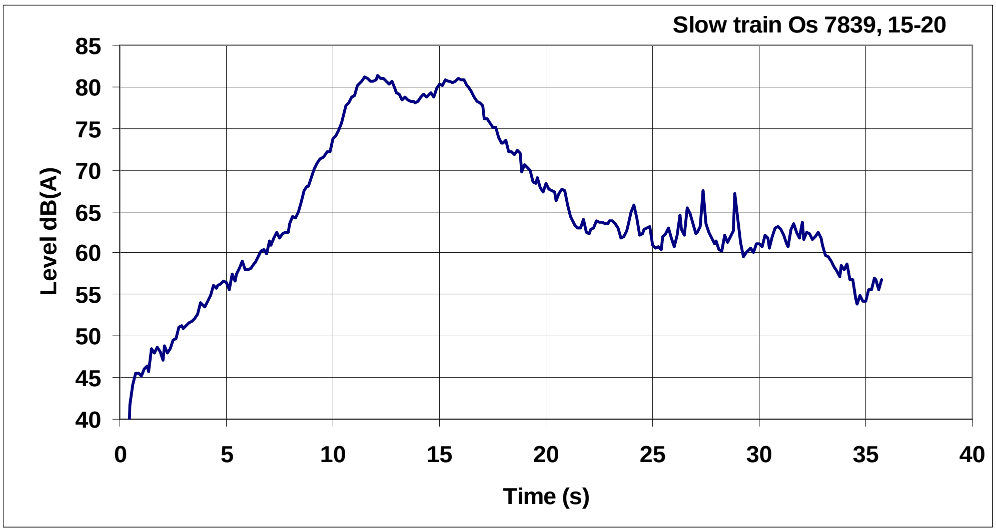


Figure A2-7Measured LAF levels – Leq = 73,2 dB(A) with T = 35,8 s

SRMII – 74,2 dB(A)
Schall03 – 75,1 dB(A)

6 Slow train Os 7832, 08-24
Electric block braked passenger train, 5 carriages including the locomotive HDV 162
Total mass - 350 t, total length - 139 m.
Real train speed - 84 km/h

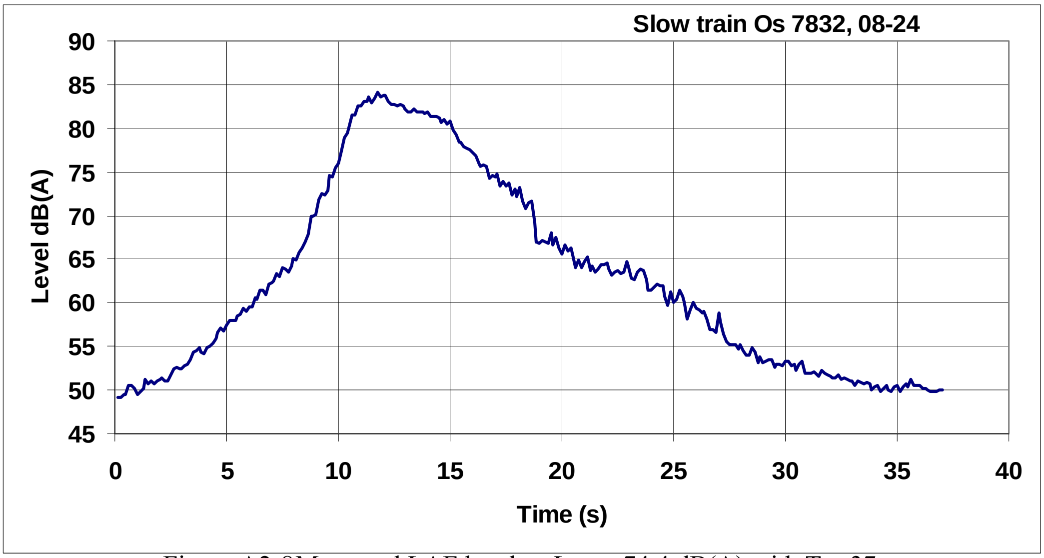


Figure A2-8Measured LAF levels – Leq = 74,4 dB(A) with T = 37 s

SRMII – 73,8 dB(A)
Schall03 – 74,8 dB(A)

7 InterCity IC 405, 12-09

Electric block braked passenger train, 7 carriages including the locomotive HDV 350
Total mass - 400 t, total length - 189 m.
Real train speed - 87 km/h

Figure A2-9Measured LAF levels – Leq = 71,5 dB(A) with T = 36 s

SRMII – 75,8 dB(A)
Schall03 – 76,5 dB(A)

8 InterCity IC 404, 16-18

Electric block braked passenger train, 6 carriages including the locomotive HDV 350
Total mass - 400 t, total length - 164 m.
Real train speed - 91 km/h

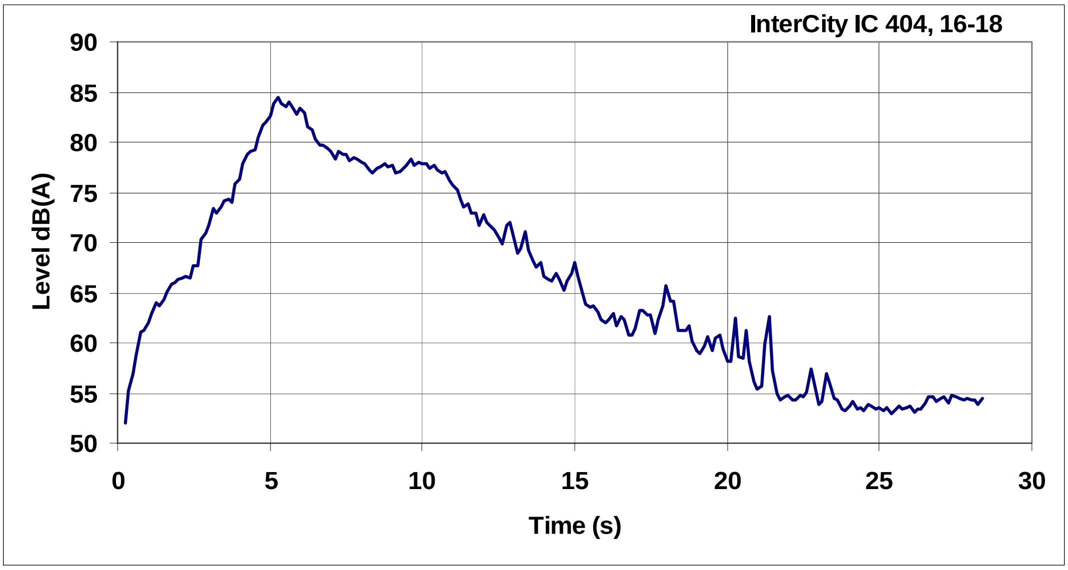


Figure A2-10 Measured LAF levels – Leq = 74,5 dB(A) with T = 28,4 s

SRMII – 76,6 dB(A)
Schall03 – 77,3 dB(A)

9 InterCity IC 404, 16-18

Electric block braked passenger train, 6 carriages including the locomotive HDV 350
Total mass - 400 t, total length - 164 m.
Real train speed - 92 km/h

Figure A2-11 Measured LAF levels – Leq = 74,4 dB(A) with T = 31,0 s

SRMII – 76,4 dB(A)
Schall03 – 77,1 dB(A)

10 Fast Train R 609

Electric block braked passenger train, 9 carriages including the locomotive HDV 350
Total mass - 610 t, total length - 281 m.
Real train speed - 100 km/h

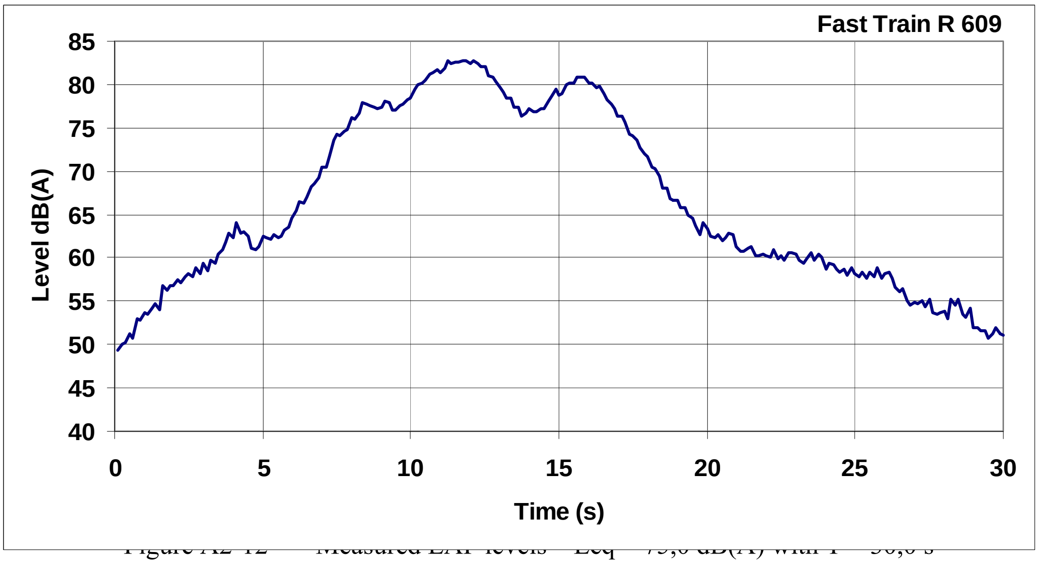


Figure A2-12 Measured LAF levels – Leq = [illegible] dB(A) with T = 30,0 s

SRMII – 79,2 dB(A)
Schall03 – 80,3 dB(A)

11 Fast Train R 607
Electric block braked passenger train, 9 carriages including the locomotive HDV 362 ČD
Total mass - 610 t, total length - 243 m.
Real train speed - 100 km/h

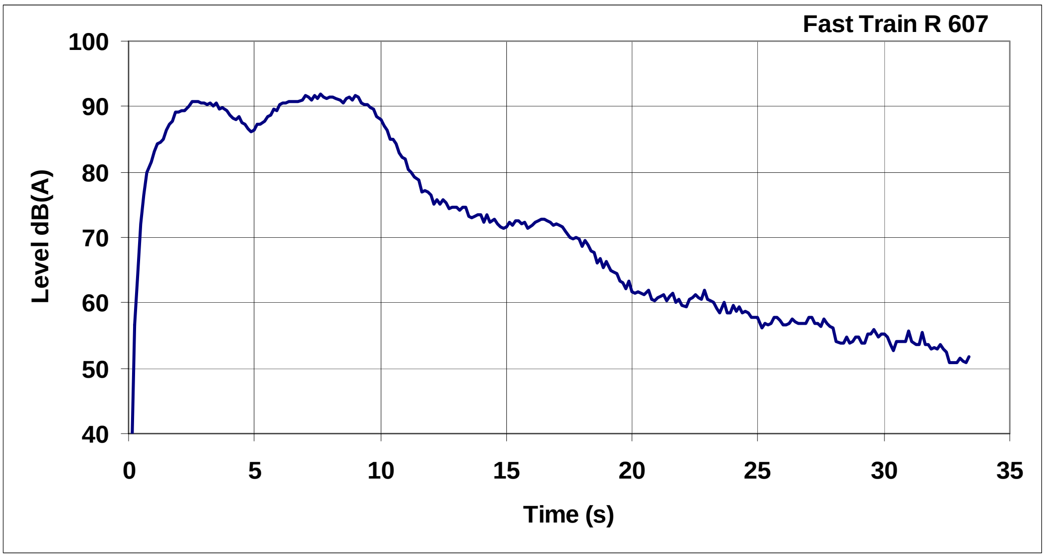


Figure A2-13 Measured LAF levels – Leq = 84,5 dB(A) with T = 33,4 s

SRMII – 78,8 dB(A)
Schall03 – 79,2 dB(A)

12 Fast Train R 605
Electric block braked passenger train, 10 carriages including the locomotive HDV 362
Total mass - 610 t, total length - 273 m.
Real train speed - 101 km/h

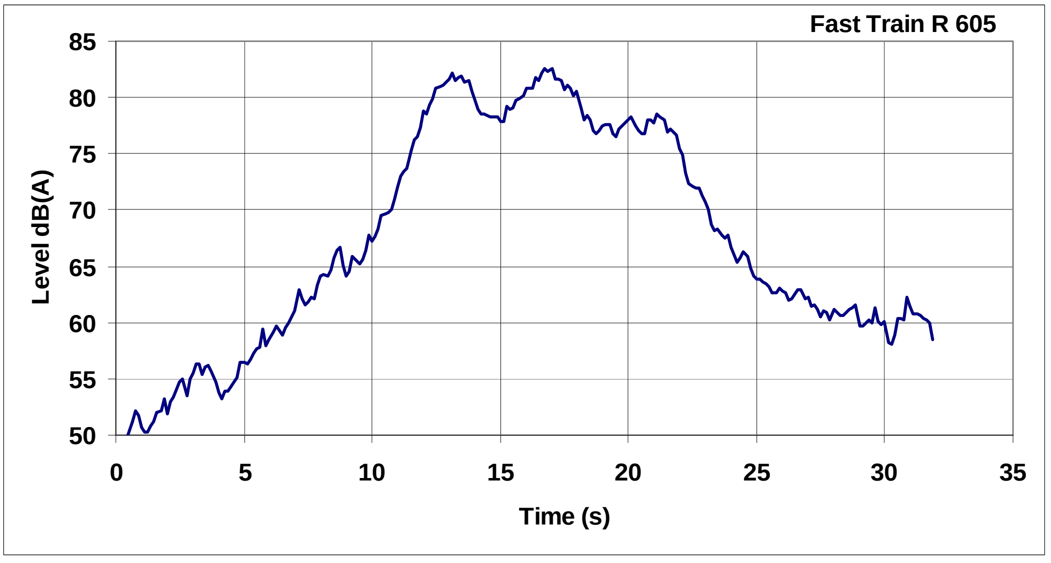


Figure A2-14 Measured LAF levels – Leq = 75,0 dB(A) with T = 31,9 s

SRMII – 79,5 dB(A)
Schall03 – 79,5 dB(A)

13 Fast Train R 605

Electric block braked passenger train, 10 carriages including the locomotive HDV 362
Total mass - 610 t, total length - 273 m.
Real train speed - 103 km/h

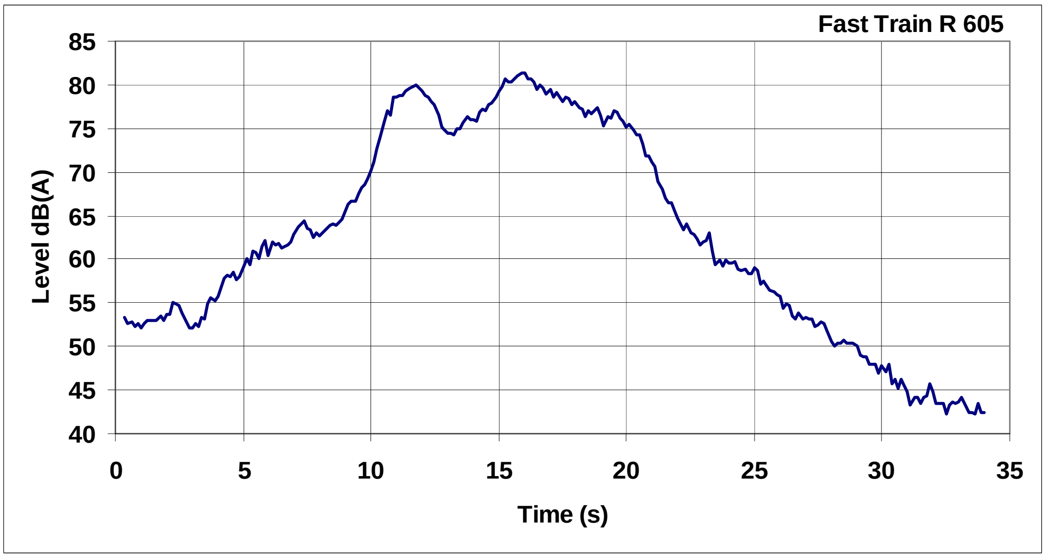
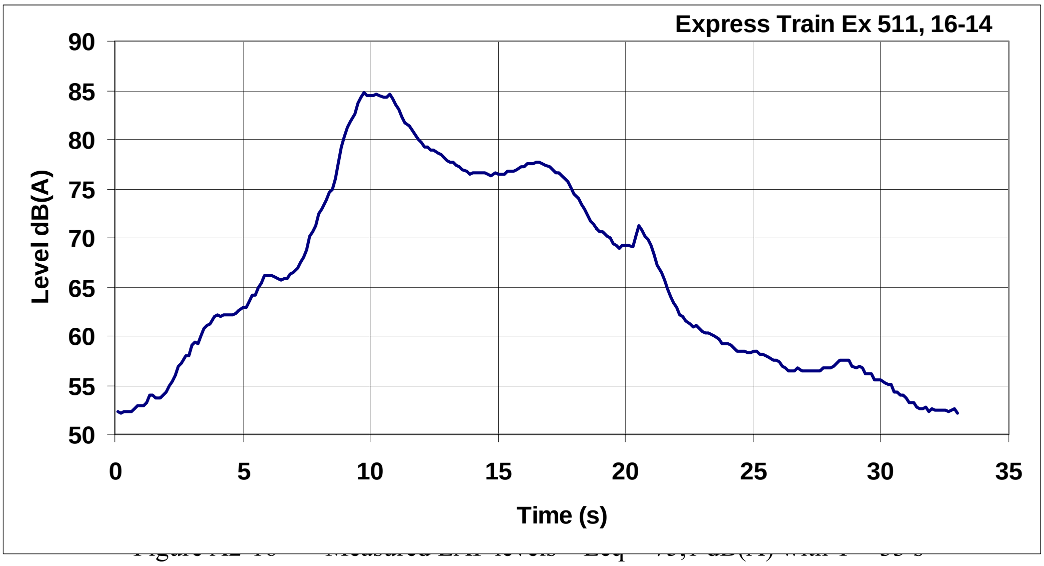


Figure A2-15 Measured LAF levels – Leq = 73,1 dB(A) with T = 34 s

SRMII – 79,5 dB(A)
Schall03 – 79,9 dB(A)

14 Express Train Ex 511, 16-14

Electric block braked passenger train, 10 carriages including the locomotive HDV 362
Total mass - 570 t, total length - 266 m.
Real train speed - 100 km/h



SRMII – 79,3 dB(A)
Schall03 – 79,6 dB(A)

15 Fast Train R 421

Electric block braked passenger train, 12 carriages including the locomotive HDV 163 - ČD

Total mass - 610 t, total length - 311 m.
Real train speed - 101 km/h

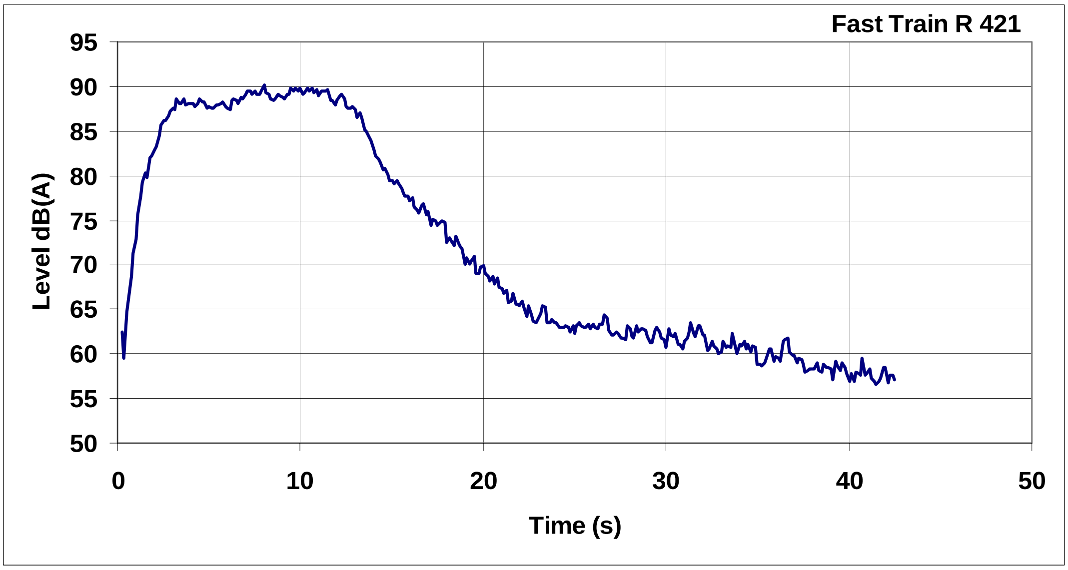


Figure A2-17 Measured LAF levels – Leq = 83,1 dB(A) with T = 42,5 s

SRMII – 79,1 dB(A)
Schall03 – 79,3 dB(A)

A2-2.3. Summary and preliminary conclusions

Table A2-1 Statistical analysis of deviations

No	L - Meas.	L - SRMII	L-S03	d(SRMII)	d(S03)
1	76.6	75.6	76.6	-1.0	0.0
2	76.3	75.8	75.9	-0.5	-0.4
3	77.1	74.6	74.6	-2.5	-2.5
4	75.8	77.4	78.0	1.6	2.2
5	73.2	74.2	75.1	1.0	1.9
6	74.4	73.8	74.8	-0.6	0.4
7	71.5	75.8	76.5	4.3	5.0
8	74.5	76.6	77.3	2.1	2.8
9	74.4	76.4	77.1	2.0	2.7
10	75.0	79.2	80.3	4.2	5.3
11	84.5	78.8	79.2	-5.7	-5.3
12	75.0	79.5	79.5	4.5	4.5
13	73.1	79.5	79.9	6.4	6.8
14	75.1	79.3	79.6	4.2	4.5
15	83.1	79.1	79.3	-4.0	-3.8
		Mean deviation		1.1	1.6
		Standard deviation		3.4	3.5

The table shows, that the calculation overestimates with 1 dB mean value – the standard deviation is about 3.5 dB. The calculation methods are comparable.

This investigation is based on measurements in 25 m distance – barrier attenuations and other effects reducing the levels are not included. But it is a satisfactory aspect that the Slovakian trains and track conditions don't need special calculation methods.

This investigations will be continued.

ANNEX 3: EXISTING NOISE LIMITS

There is a system of existing noise limits in Slovakia. The following is a short summary of this system.

The noise limits shown in table A3-1 depend on area types (related to land use) and on noise type (traffic and other sources).

Table A3-1 Limiting values of noise levels in slovakia (L_{aeq} outside)

CATEGORY	LAND USE	LIMITING VALUES (L_{aeq} dB)			
		TRAFFIC SOURCES		OTHER SOURCES	
		DAY	NIGHT	DAY	NIGHT
I.	particularly protected area	45	35	40	35
II.	recreation, residential, school	50	40	50	40
III.	near main roads, airports, in cities	60	50	50	40
IV.	industrial and commercial used areas	70	70	70	70

There are some exceptions and particularities (if the noise contains pure tones, if the levels are varying in time, if the noise comes from speech and music etc.+ 5 dB) related to the type of noise or related to the type of source (measured levels are reduced 10 dB with construction noise).

If it is not possible to reduce the noise to limits as shown in Table A3-1, there is a second set of noise levels inside the buildings. These interior limiting values are requirements that can be fulfilled by improving the building construction.

Table A3-2 Limiting values inside the buildings

TYPE OF ROOM	VALUE	LIMITING VALUE dB	
		DAY	NIGHT
hospital	L_{Aeq}	35	25
hospital	L_{Amax}	35	25
concert hall	L_{Aeq}	35	
concert hall	L_{Amax}	35	
living room, hotel	L_{Aeq}	40	30
living room, hotel	L_{Amax}	40	30
library	L_{Aeq}	40	40
conference rooms	L_{Aeq}	45	45
restaurants	L_{Aeq}	50	50
business rooms	L_{Aeq}	55	55
sporting facilities	L_{Aeq}	60	60

Also in this case there are some exceptions and particularities with corrections of measured or limiting values related to the type of noise or the type of source.