

ACOUSTIC EVALUATION RONDOCARTON / SANNICOARA



- **PROJECT NAME: RONDOCARTON**
- **OWNER / BENEFICIARY: RONDOCARTON SRL, SANNICOARA, 2A Aviatorilor Street, zip code 407042, CLUJ County**
- **PROJECT ADDRESS: SANNICOARA, 2A Aviatorilor Street**
- **ORDER NO./CONTRACT: S236/26.02.2025**
- **PERFORMED BY: SC REIN AKUSTIK SRL, Elev Stefanescu 63 Str., Bucharest**

- november 2025 -

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1. GENERAL CONSIDERATIONS

This acoustic study aims to evaluate the noise emissions generated by the operation of an industrial facility, namely RONDOCARTON SRL, with address at Sannicoara, 2A Aviatorilor Street, zip code 407042, CLUJ County, at the boundary of a mixed-use area comprising both residential and industrial zones. To achieve this, a series of on-site noise measurements will be conducted to identify and characterize significant noise sources within the existing acoustic environment. Given the project's location in a noise-sensitive mixed-use zone, the assessment focuses on both continuous and intermittent noise emissions. All measurement procedures, data analysis, presentation, and interpretation of results are performed in strict accordance with the applicable regulatory standards governing environmental noise assessment.

Subsequently, a noise mapping analysis will be conducted for the planned expansion of the production facility to assess the potential acoustic impact on the adjacent residential area. This modeling will identify zones where predicted noise levels exceed the permissible regulatory limits and will support the development of targeted noise mitigation measures for acoustically sensitive areas.

2. METHOD STATEMENT

The method statement for the acoustic evaluation is performed according with the following steps:

- identification and assessment of existing noise sources;
- identification and evaluation of noise propagation paths;
- topographical identification of the positions of interest for sound data acquisition;
- performing noise measurements at the property limits in order to evaluate the existing situation;
- data processing of acoustic signals;
- results interpretation and comparison with imposed legal limits;
- carrying out successive simulations to map the distribution of noise levels inside the facility and around the property boundary, but also next to the neighboring industrial/residential mixed area, in order to evaluate the impact of noise in the targeted areas of the planned facility with new extended zones;
- the implementation in simulations of noise mitigation measures for the proposed development scenario will be analyzed with the objective of identifying the optimal solution that minimizes acoustic impact on the areas of interest—namely, the project site and the adjacent industrial zone—while ensuring compliance with the legally prescribed noise limits.

3. DOCUMENTS, DATA AND INFORMATION USED

At our request, the following documents were provided by the client:

- cadastral plan;
- site plan;
- location plan and project delimitation;
- architecture technical memory;

- technical data of project equipment and installations.

The information and documents used were provided by the client, designers and by the manufacturers of equipment and materials and were used as such.

4. LEGISLATIVE REFERENCES

Table 1. Standards and laws

LAWS/STANDARDS	Document
SR ISO 1996-1:2016	<i>Acoustics — Description, measurement and assessment of environmental noise — Part 1: Fundamental values and assessment procedures</i>
SR ISO 1996-2:2018	<i>Acoustics - Description, measurement and evaluation of ambient noise. Part 2 – Determination of ambient noise levels</i>
SR ISO 1996-3	<i>Acoustics – Description and measurement of environmental noise. Part 3: Application to noise limits;</i>
MH Order No. 119/2014	<i>Hygiene and public health norms regarding the population's living environment;</i>
C125-2013	<i>The norms regarding acoustics in constructions in urban areas</i>
Law nr. 121/2019	<i>Assessment and management of ambient noise</i>
SR 10009/2017	<i>Acoustics. Admissible limits of the noise level in the ambient environment</i>
ISO 9613	<i>Acoustics. Attenuation of sound during propagation outdoors</i>

SR ISO 1996-1:2016 defines the basic quantities used to describe environmental noise and outlines the fundamental assessment methods. It also specifies the methods for evaluating environmental noise within community settings.

SR ISO 1996–2:2008 describes how sound pressure levels can be determined through direct measurement, by extrapolating measurement results using calculations, or solely through calculation, serving as a basis for the assessment of environmental noise. It provides recommendations on measurement or calculation conditions that can be applied in cases where no other regulations are in place.

Regulatory Framework on Environmental Noise Requirements (Maximum Permissible Limits) Ministry of Health Order No. 119/2014, as amended by Order No. 994/2018, approving the Public Health and Hygiene Norms concerning the Population's Living Environment

Article 16 – Provisions regarding permissible noise levels in protected areas and their vicinity

(1) The delineation of sanitary protection zones must be conducted in such a manner that the maximum permissible values of noise indicators within protected areas are observed as follows:

- a) During the daytime period (07:00–23:00), the equivalent continuous A-weighted sound pressure level (LA_{eqT}), measured outdoors, must not exceed 55 dB;
- b) During the nighttime period (23:00–07:00), the LA_{eqT} measured outdoors must not exceed 45 dB;
- c) For peak levels measured during nighttime, the maximum admissible value is 50 dB, assessed at the exterior of the dwelling.

- (2) If a facility is to be located adjacent to a protected area where the pre-existing background noise level does not exceed 50 dB(A) during the day and 40 dB(A) at night, the delineation of the sanitary protection zone must ensure the following limits are not exceeded:
 - a) 50 dB *L_{AeqT}* outdoors during daytime;
 - b) 40 dB *L_{AeqT}* outdoors during nighttime;
 - c) 45 dB for peak noise levels during nighttime, measured outdoors.
- (3) The establishment and operation of small-scale production, commercial, and service units, as defined under Article 5 paragraph (1), are prohibited within protected areas, except in residential zones.
- (4) Within residential areas, such units may operate only if the noise generated by their activity does not result in exceeding the following thresholds:
 - a) 55 dB *L_{AeqT}* outdoors during daytime;
 - b) 45 dB *L_{AeqT}* outdoors during nighttime;
 - c) 50 dB for peak levels at night, measured outdoors.

SR 10009:2017 – Permissible Noise Levels in the Ambient Environment

The **SR 10009:2017 standard** establishes permissible limits for environmental noise levels, differentiated by zones and functional areas, as defined in technical regulations concerning urban planning and environmental protection.

This standard applies in the following contexts:

- Development of urban planning studies (residential areas, socio-cultural facilities, recreational, rest, and sports areas, industrial zones, transport zones, etc.);
- Design of buildings;
- Modification of existing functional zones;
- Assessment of compatibility between adjacent areas with different functions;
- Environmental protection planning and assessment.

Terminology and Definitions:

- **Functional zone (Article 3.1)** – A section of an administrative territory assigned specific functions as established by the General Urban Plan (PUG).
- **Functional space** – An area designated for activities such as commerce, education, healthcare, sports, transport, or housing, located within a functional zone as defined by the PUG.

Permissible noise levels at the boundary of functional spaces (Article 4.1, excerpt from Table 1):

- **Industrial premises and spaces with activities comparable to industrial operations:** *Lech* = 65 dBA

Permissible noise levels at the boundary of functional zones (Article 4.3, excerpt from Table 3):

- **Industrial zones** (boundaries defined by the PUG): *Lech* = 65 dBA
- **Residential zones:** *Lech* = 60 dBA

Note: In cases where two or more functional zones are adjacent, the lower of the permissible limits shall apply at the shared boundary.

Permissible outdoor noise levels at the façade of the most exposed residential building (Article 4.8, Table 8):

- **All types of residential buildings:** *Lech* = 50 dBA

Note: If a residential building is located within a protected area established under public health and hygiene regulations approved by the central public health authority, the permissible outdoor noise limits are: 55 dBA between 07:00 and 23:00, and 45 dBA between 23:00 and 07:00.

Order No. 3384/2013 of the Deputy Prime Minister, Ministry of Regional Development and Public Administration - Approval of Norm C125-2013 on Acoustics in Buildings and Urban Areas

This order approves the technical regulation **Norm C125-2013**, which sets forth acoustic performance requirements for buildings and urban areas, with the goal of protecting occupants and residents from noise pollution.

Outdoor Noise Levels Near Residential Buildings – Part I (Table 3.2.3)

The **maximum allowable equivalent noise level outdoors** in the vicinity of residential buildings is **50 dBA**.

Acoustic Protection in Urban Areas – Part IV (C 125/4-2013)

This section provides guidance on **noise and vibration protection** in the context of:

- Designing new urban and rural settlements
- Redevelopment of existing areas
- Ensuring compliance with acoustic comfort criteria for urban users

Use in Urban Planning

These provisions are used in the development of:

- General Urban Plans (PUG)
- Zonal Urban Plans (PUZ)
- Detailed Urban Plans (PUD)
- And their associated urban planning regulations, in accordance with national legislation.

Measured noise levels will be evaluated against the most stringent applicable regulatory limits, with particular emphasis on interfaces with sensitive receptors, such as residential areas. In instances where these limits are exceeded, appropriate acoustic mitigation measures shall be integrated into the site's environmental management plan to ensure regulatory compliance and maintain the acoustic comfort of the surrounding community. The measured results will be used for calibration of subsequently noise mapping for the new designed facility configurations.

5. NOISE MEASUREMENTS PROCEDURE

The measurements and corresponding acoustic assessment were conducted to quantify existing noise levels at the property boundary. These recorded data provide a baseline for subsequent analyses, including simulation of the noise impact generated by the operation of the industrial facility and its associated equipment, situated within a mixed residential and industrial area.

The measurement time interval is selected to cover all significant variations in the emission and propagation of sound. If the noise is periodic, the measurement time interval must cover at least three complete periods. If continuous measurements cannot be made over such a period, the measurement time intervals should be chosen so that each represents a part of the cycle, and together, they represent the entire cycle. The sound level meter will be placed at the property limit, at 1,5 m high. The time interval for each measurement will be at least two minutes, repeated three times. For particular events, like passing-by trains or trucks, the time measurement will be according with each event. The equivalent continuous acoustic pressure level, L_{Aeq} , was measured in decibels [dB] and weighted on curve A, in 12 points at the boundary of the property and three point at the main noise sources, at a height of 1.5 m from the ground.

The building situated at 2A Aviatorilor Street is positioned in a heterogeneous residential/industrial context. Its Eastern boundary adjoins a residential zone, while the Southern side borders the Dezmir airfield, introducing potential exposure to aviation-related noise. The Western boundary lies adjacent to an industrial area, characterized by activities typically associated with elevated noise emissions. To the North, the

property faces Aviatorilor Street, a public roadway and railway, contributing to ambient urban noise levels and also prone to high noise levels. This configuration presents a complex acoustic environment with implications for both environmental noise assessment and urban planning compliance.

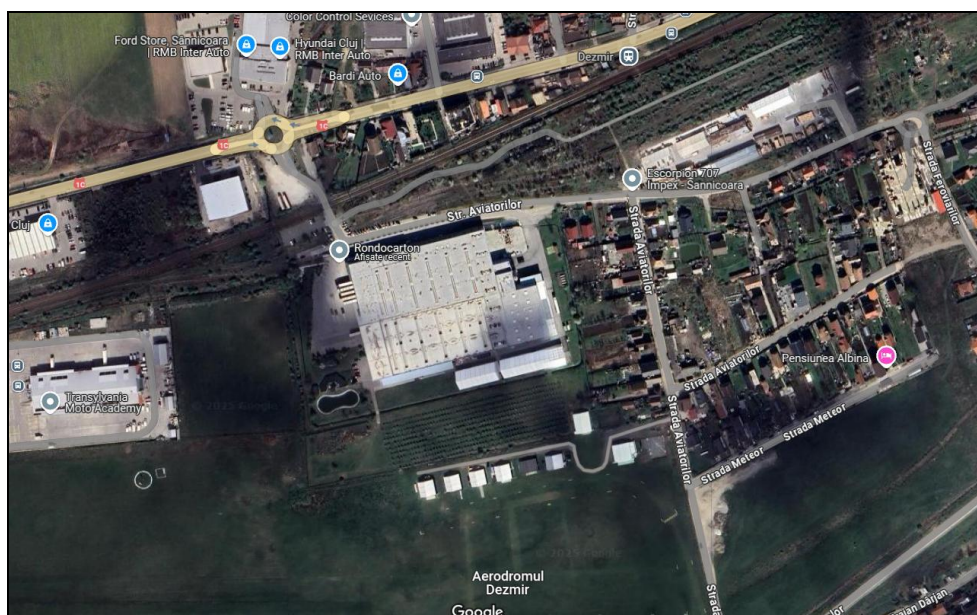


Figure 1. Facility location SC Rondocarton SRL Apahida (source Google Earth)

The positions at which noise level measurements were performed are illustrated in the accompanying *Figure 2*. The specific microphone placement points correspond to the designated measurement sites and have been selected in accordance with relevant acoustic assessment protocols to ensure accurate representation of the environmental noise exposure across the analyzed area.



Figure 2. Measurement points (source Google Earth)

- P1 – at the entrance gate, at 1.5 m high on the concrete ground;
- P2 - North-West corner limit at 1.5 m high on the concrete ground;
- P3 - West middle limit at 1.5 m high on the grass covered ground;
- P4 - South-West corner limit at 1.5 m high on the grass covered ground;
- P5 - South limit at 1.5 m high on the grass covered ground;
- P6 - South middle limit at 1.5 m high on the grass covered ground;
- P7 - South corner limit at 1.5 m high on the grass covered ground;
- P8 - South-East corner limit at 1.5 m high on the grass covered ground;
- P9 - East middle limit at 1.5 m high on the grass covered ground;
- P10 – In front of factory open door, 50 cm distance from the door, with concrete ground, multiple measuring points;
- P11 – East limit at 1.5 m high on the grass covered ground;
- P12 – In front of heating unit door, 1m away, with concrete ground, multiple measuring points;
- P13 - North-East corner limit access gate, at 1.5 m high on the concrete ground;
- P14 – In front of exhaust grill, 1m away, at 1.5 m high on the concrete ground, multiple measuring points;
- P15 - North middle limit, at 11.5 m high on the concrete ground.

6. MEASUREMENT EQUIPMENTS

The following instruments were used for noise measurements:

- sound level meter and processing software to measure, analyze, and visualize sound pressure levels in compliance with international standards (IEC 61672 Class 1, IEC 60651/60804, and ANSI S1.4, calibration certificate no. 93442/2025);
- free-field microphone with wind-protection shield, (comply with IEC 61094 WS2F and IEC 61672 Class 1);
- acoustic calibrator (comply with ANSI S1.40:2006 and IEC 60942:2003 Class 1);
- thermohygrometer.



Figure 3. Sound level meter, Thermohygrometer

7. ATMOSPHERIC CONDITIONS

The following atmospheric parameters were recorded during the noise measurements:

Temperature	16 ⁰ C
Humidity	52%
Wind speed	8.5 m/s

8. EXISTING NOISE SOURCES

Before noise measurements, a series of significant exterior and interior noise sources were identified.
Exterior sources:

- trains and vehicles traffic;
- sporadic light planes;
- airport noise;
- neighboring industrial noise sources.

In *Figure 4* is presented the noise map of international airport „Avram Iancu” Cluj.

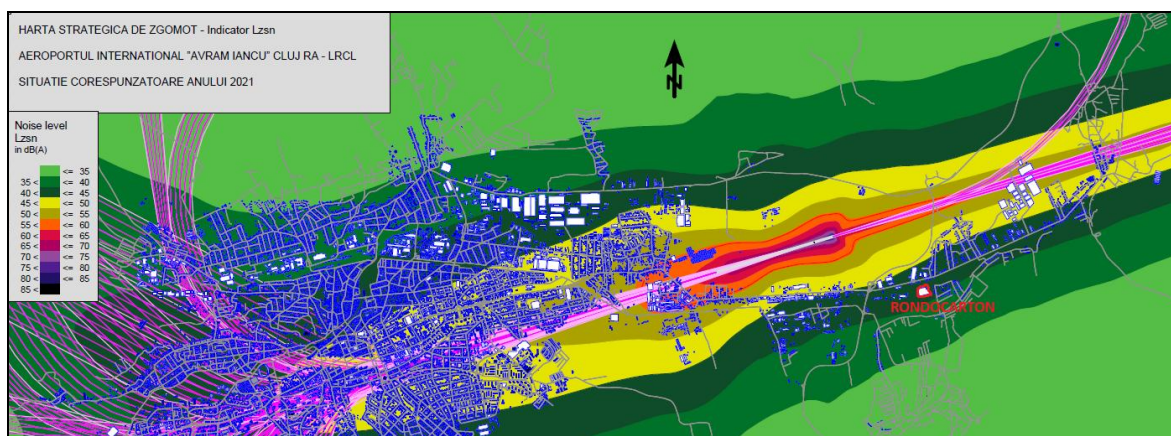


Figure 4. Noise map Airport „Avram Iancu” Cluj (source: www.airportcluj.ro)

According with airport „Avram Iancu” Cluj strategic noise map, the noise levels produced by the landing/departure or passing planes in the Rondocarton area are under 45 dBA level (*Lden*).

In *Figure 5* is presented the noise map of Cluj-Napoca railway (year available 2021). Although the railway noise map of Cluj-Napoca does not cover also the Rondocarton area, we can appreciate that the same noise levels are applicable also in Rondocarton area, like in the closed area from Cluj-Napoca administration limit, which is less than 59 dBA, according with their noise simulation (*Lden* – should be taken into consideration that this parameter is an averaged one, calculated over an entire day, which contains frequent train operations).

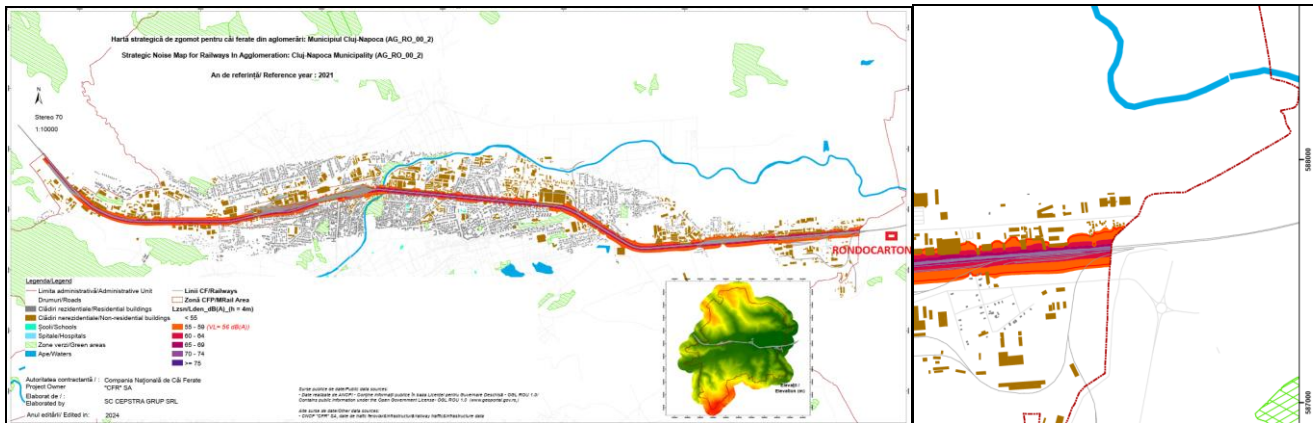


Figure 5. Noise map Cluj-Napoca railway (source: [www. https://cfr.ro/harti-strategice-de-zgomot/](https://cfr.ro/harti-strategice-de-zgomot/))

Interior sources:

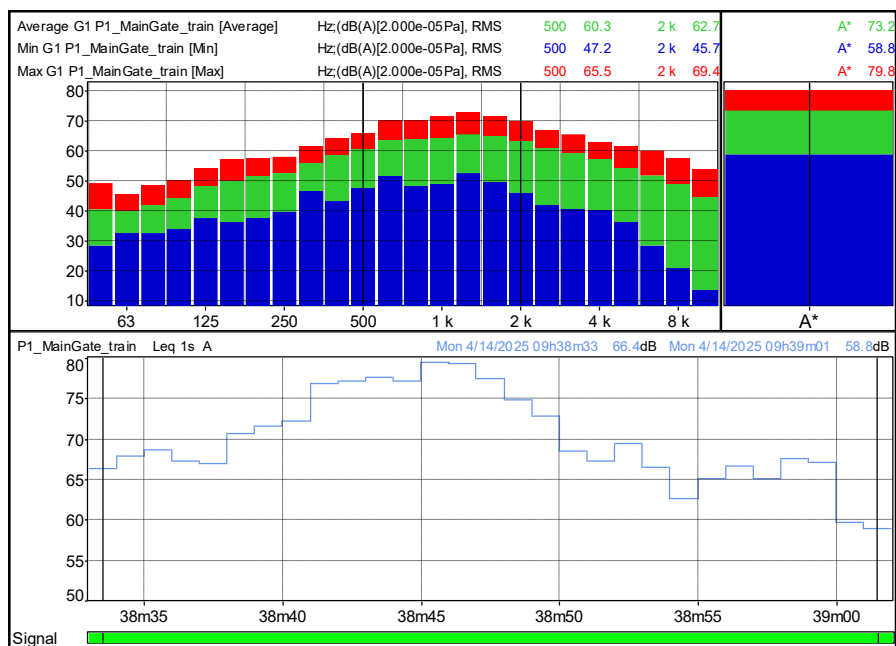
- production related noise;
- passing-by, loading/unloading trucks;
- forklifts;
- significant local noise sources (open doors, air exhaust grills).

9. NOISE MEASUREMENT RESULTS

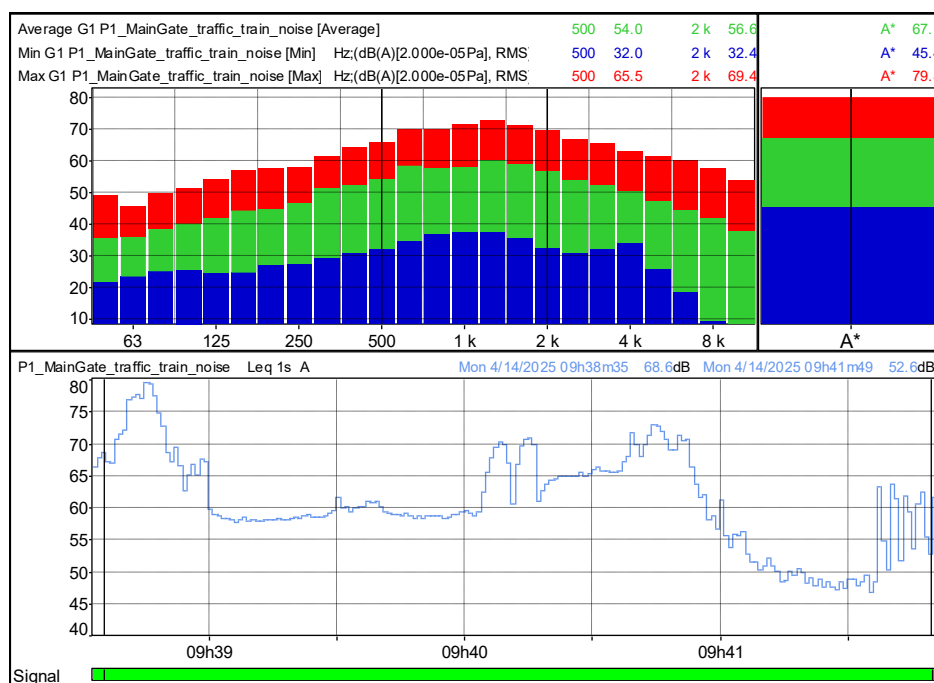
Below, are presented the measurements results recorded on each defined point.



Figure 6. Measuring point P1 – Entrance gate 1
P1_gate_factory background noise level – 52.5 [dBA]
top: 1/3 octave time averaged noise level [dBA] (green-averaged; blue-min; red-max level)
bottom: – 1sec. time averaged LAeq [dBA]



*Figure 7. P1_gate_train noise level – 73.2 [dBA]
 top: 1/3 octave time averaged noise level [dBA] (green-avaraged; blue-min; red-max level)
 bottom: – 1sec. time averaged LAeq [dBA]*



*Figure 8. P1_gate_traffic&train noise level – 67.1 [dBA]
 top: 1/3 octave time averaged noise level [dBA] (green-avaraged; blue-min; red-max level)
 bottom: – 1sec. time averaged LAeq [dBA]*

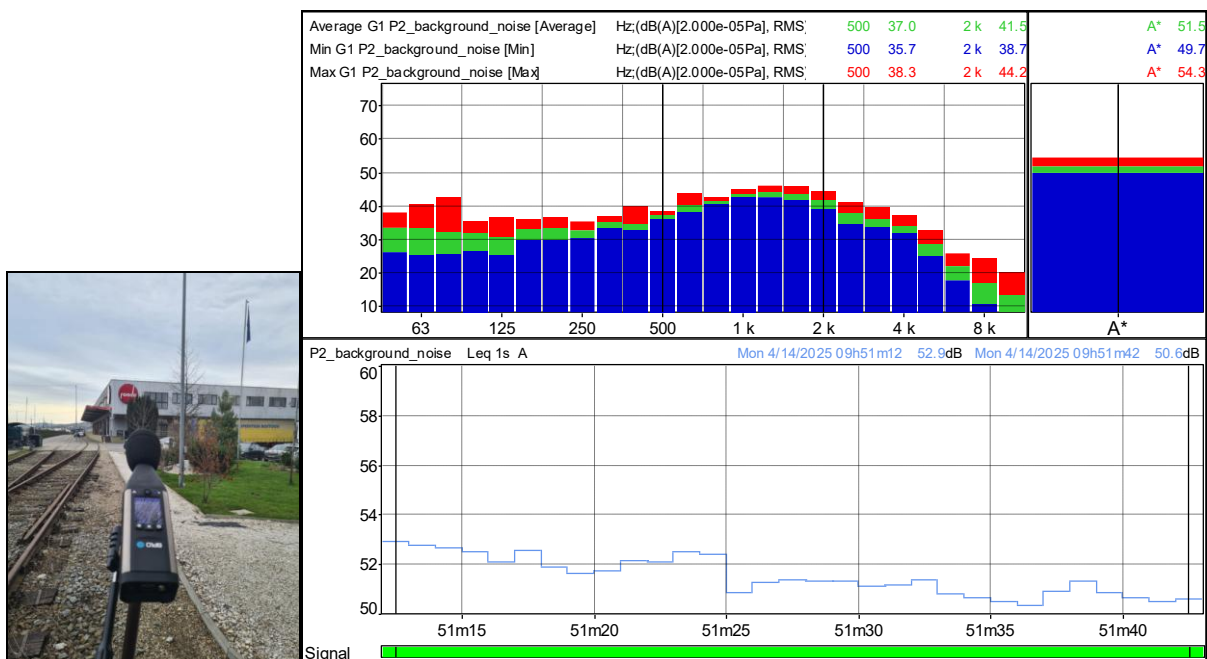


Figure 9. Measuring point P2 – West corner limit
P2_factory background noise level – 51.5 [dBA]
top: 1/3 octave time averaged noise level [dBA] (green-averaged; blue-min; red-max level)
bottom: – 1sec. time averaged LAeq [dBA]

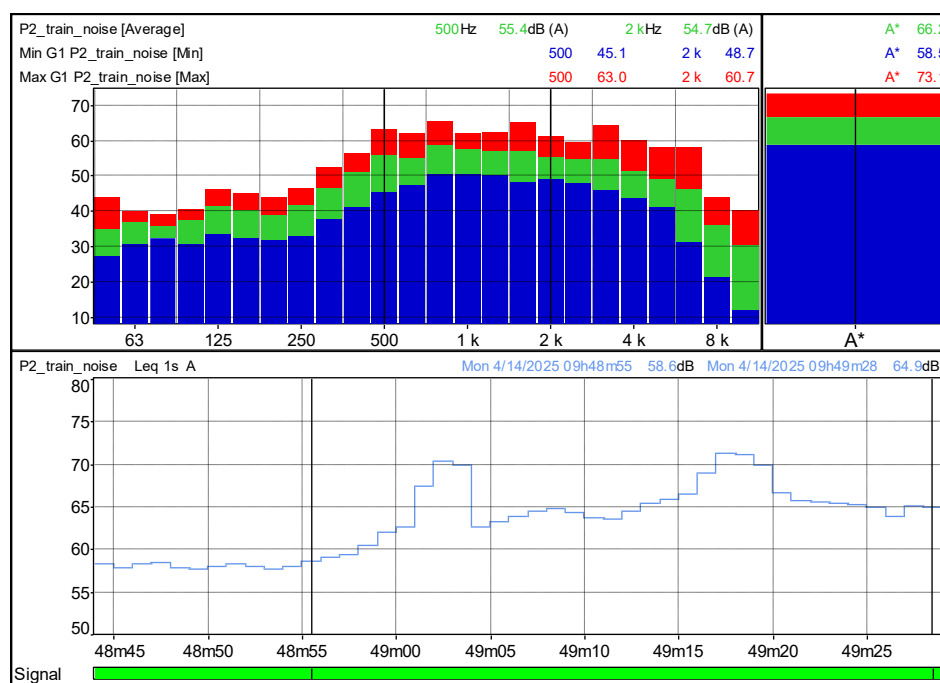


Figure 10. P2_train noise level – 66.2 [dBA]
top: 1/3 octave time averaged noise level [dBA] (green-averaged; blue-min; red-max level)
bottom: – 1sec. time averaged LAeq [dBA]

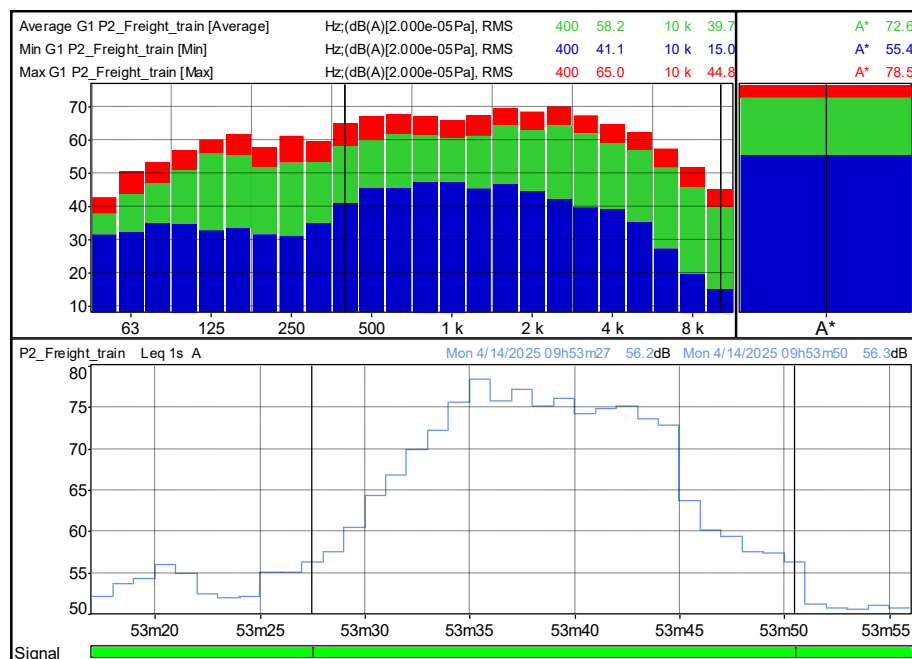


Figure 11. P2_freight train noise level – 72.6 [dBA]
top: 1/3 octave time averaged noise level [dBA] (green-averaged; blue-min; red-max level)
bottom: – 1sec. time averaged LAeq [dBA]

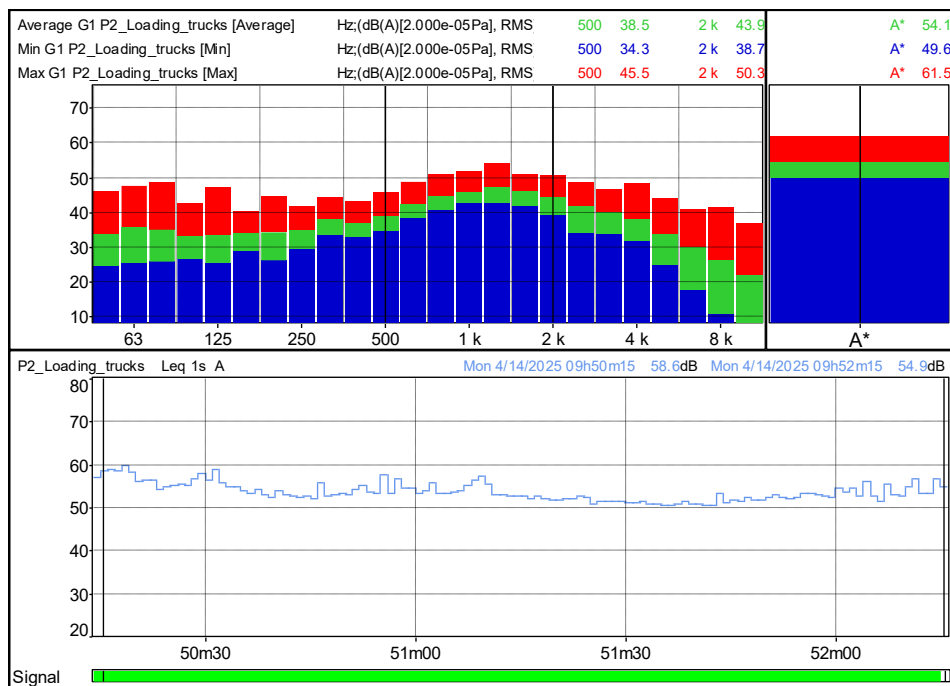


Figure 12. P2_loading trucks noise level – 54.1 [dBA]
top: 1/3 octave time averaged noise level [dBA] (green-averaged; blue-min; red-max level)
bottom: – 1sec. time averaged LAeq [dBA]

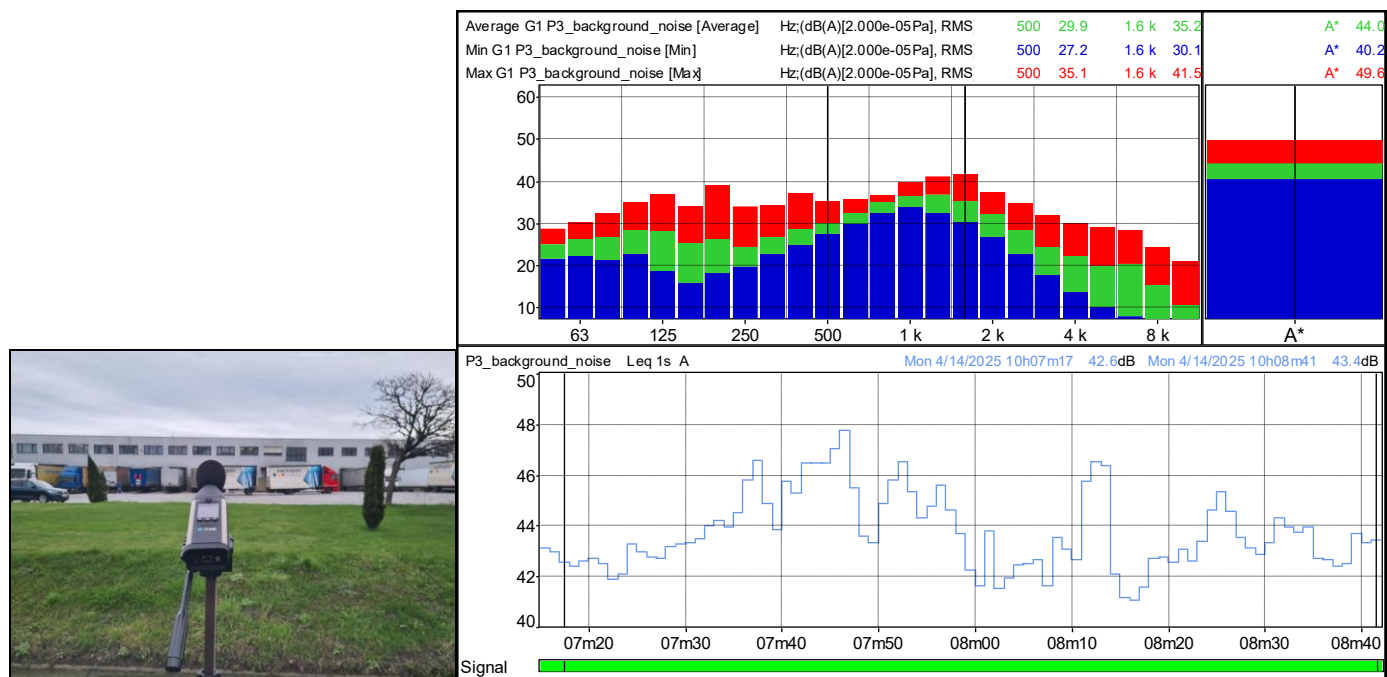


Figure 13. Measuring point P3 – West middle limit

P3_factory background noise level – 44 [dBA]

top: 1/3 octave time averaged noise level [dBA] (green-averaged; blue-min; red-max level)

bottom: – 1sec. time averaged LAeq [dBA]

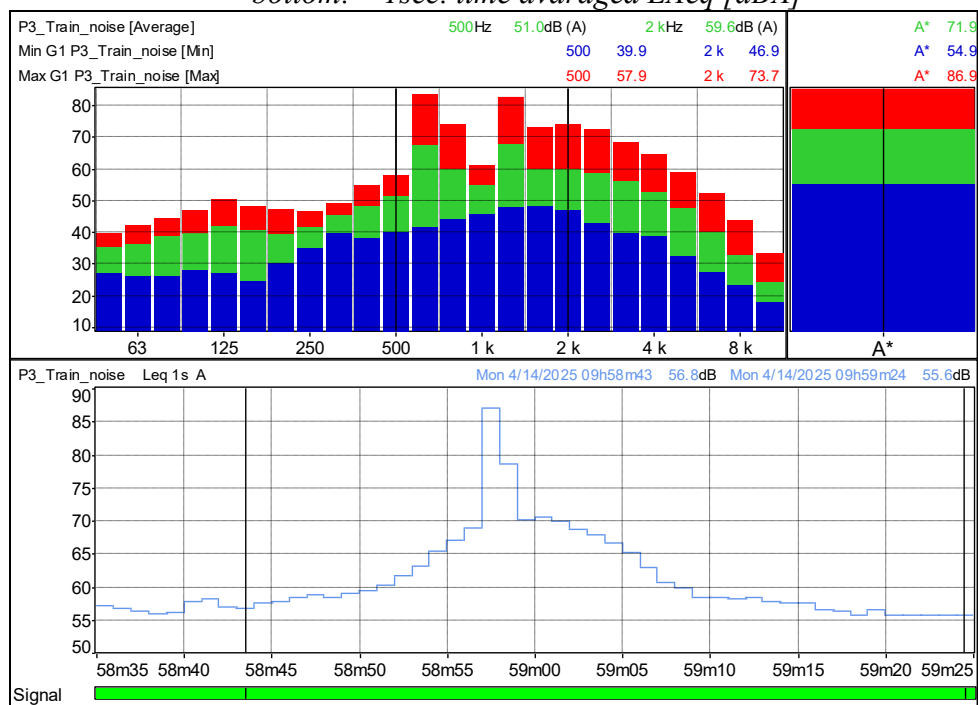


Figure 14. P3_train noise level – 71.9 [dBA]

top: 1/3 octave time averaged noise level [dBA] (green-averaged; blue-min; red-max level)

bottom: – 1sec. time averaged LAeq [dBA]

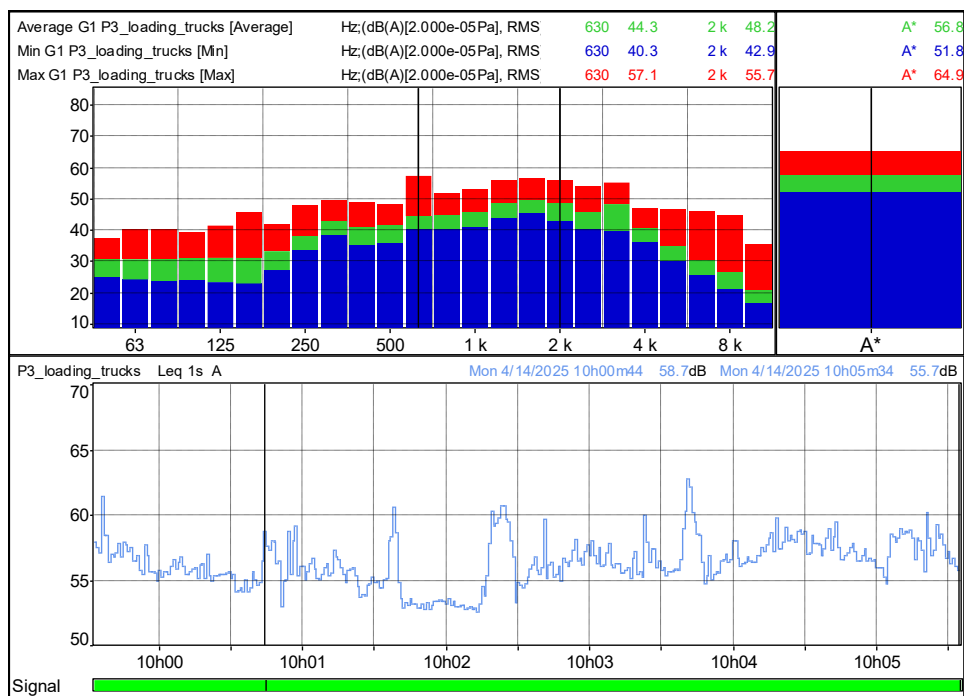


Figure 15. P3_loading trucks noise level – 56.8 [dBA]
top: 1/3 octave time averaged noise level [dBA] (green-averaged; blue-min; red-max level)
bottom: – 1sec. time averaged LAeq [dBA]

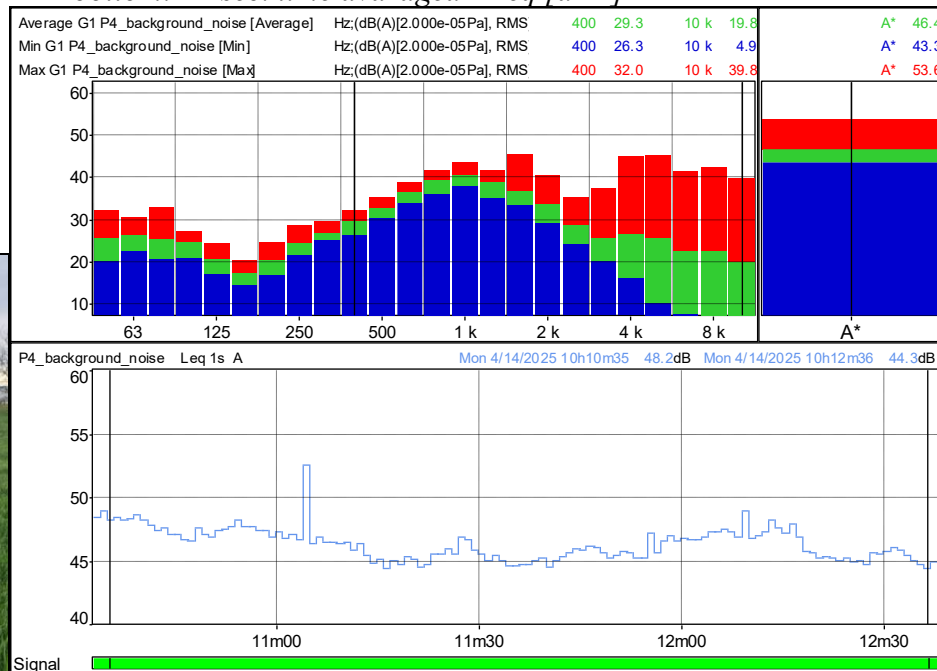


Figure 16. Measuring point P4 – South-West corner
P4_factory background noise level – 46.4 [dBA]
top: 1/3 octave time averaged noise level [dBA] (green-averaged; blue-min; red-max level)
bottom: – 1sec. time averaged LAeq [dBA]

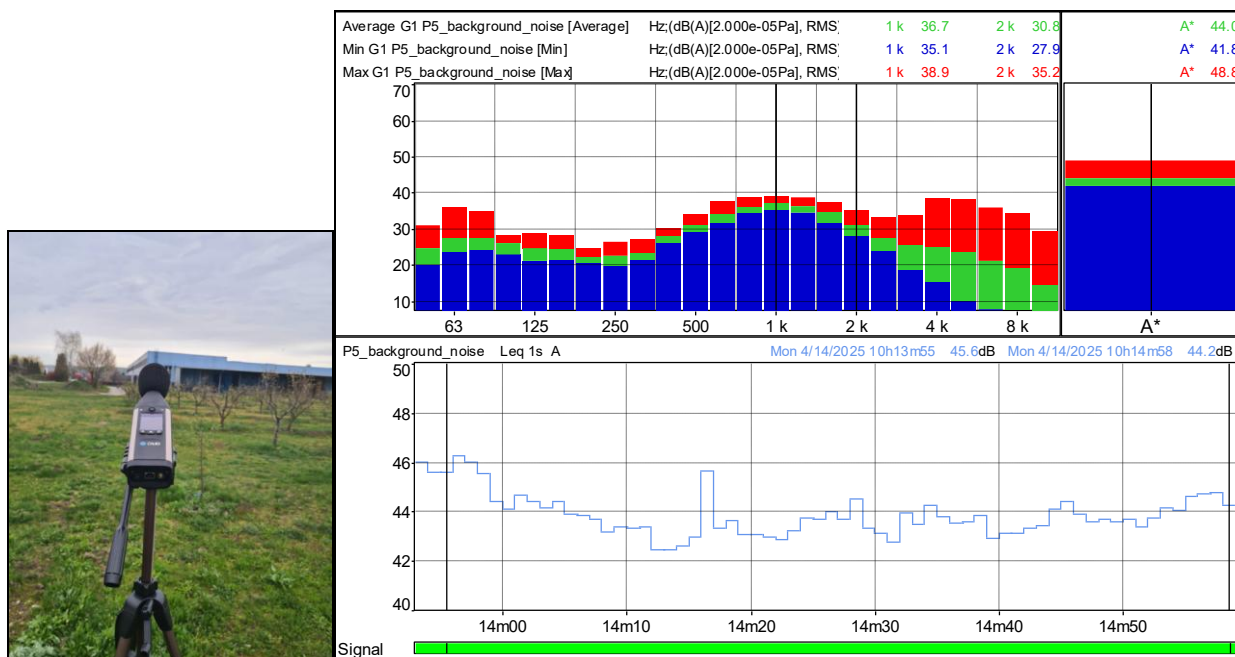


Figure 17. Measuring point P5 – South limit
P5_factory background noise level – 44 [dBA]
top: 1/3 octave time averaged noise level [dBA] (green-averaged; blue-min; red-max level)
bottom: – 1sec. time averaged LAeq [dBA]

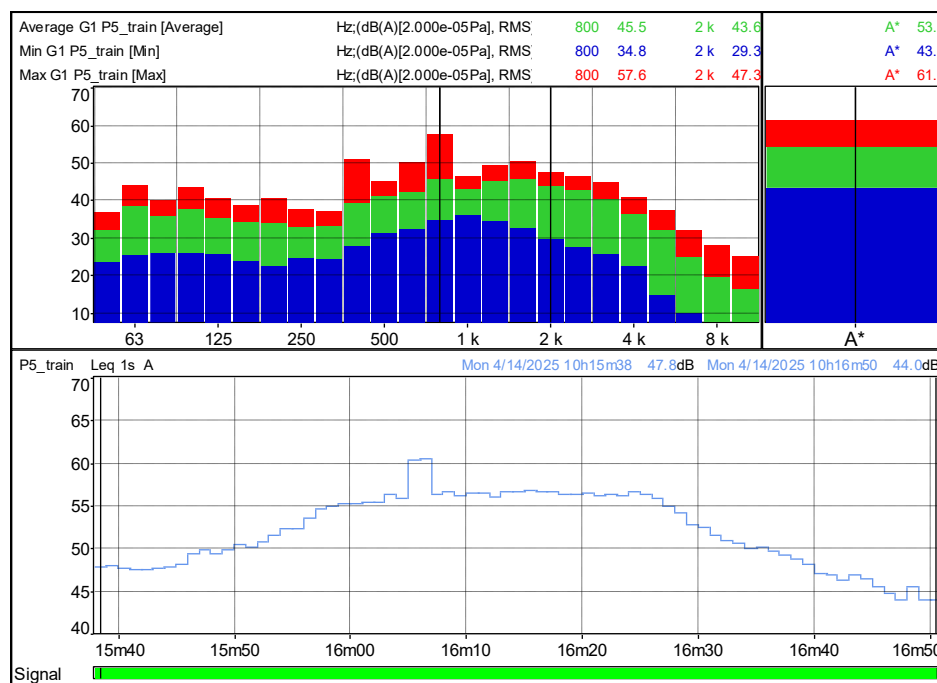


Figure 18. P5_train noise level – 53.9 [dBA]
top: 1/3 octave time averaged noise level [dBA] (green-averaged; blue-min; red-max level)
bottom: – 1sec. time averaged LAeq [dBA]

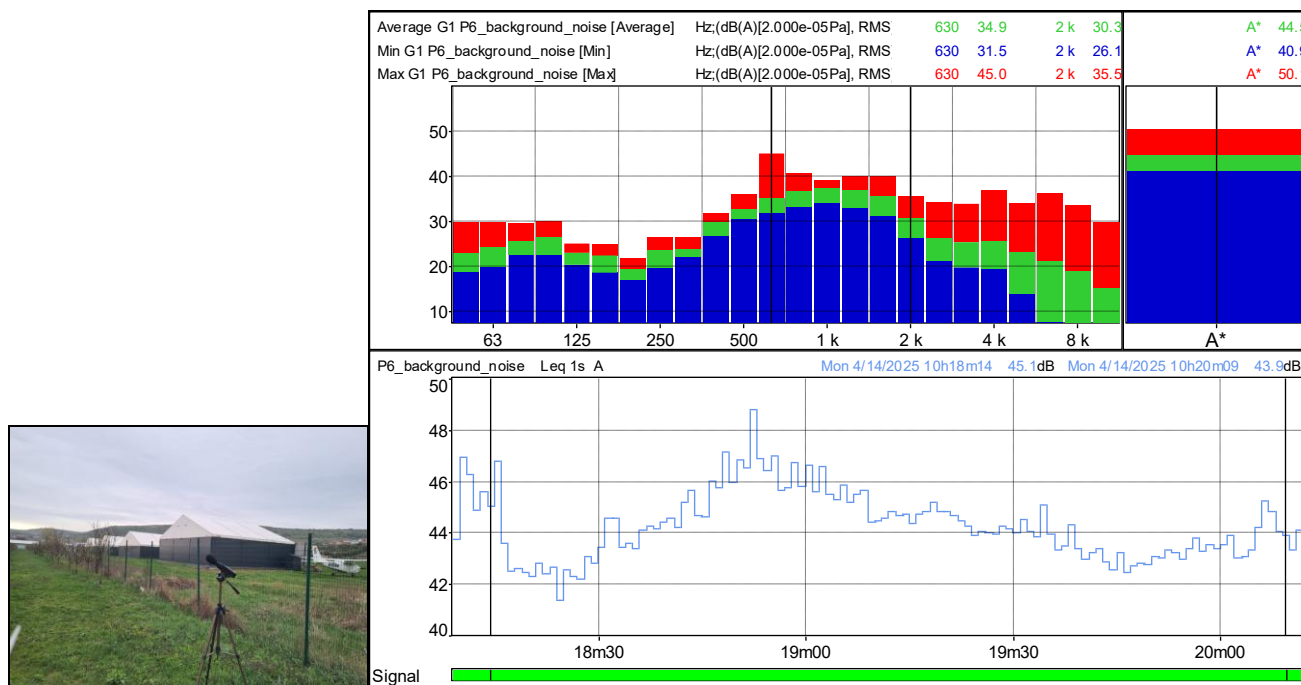


Figure 19. Measuring point P6 – South middle limit

P6_factory background noise level – 44.5 [dBA]

top: 1/3 octave time averaged noise level [dBA] (green-averaged; blue-min; red-max level)

bottom: – 1sec. time averaged LAeq [dBA]

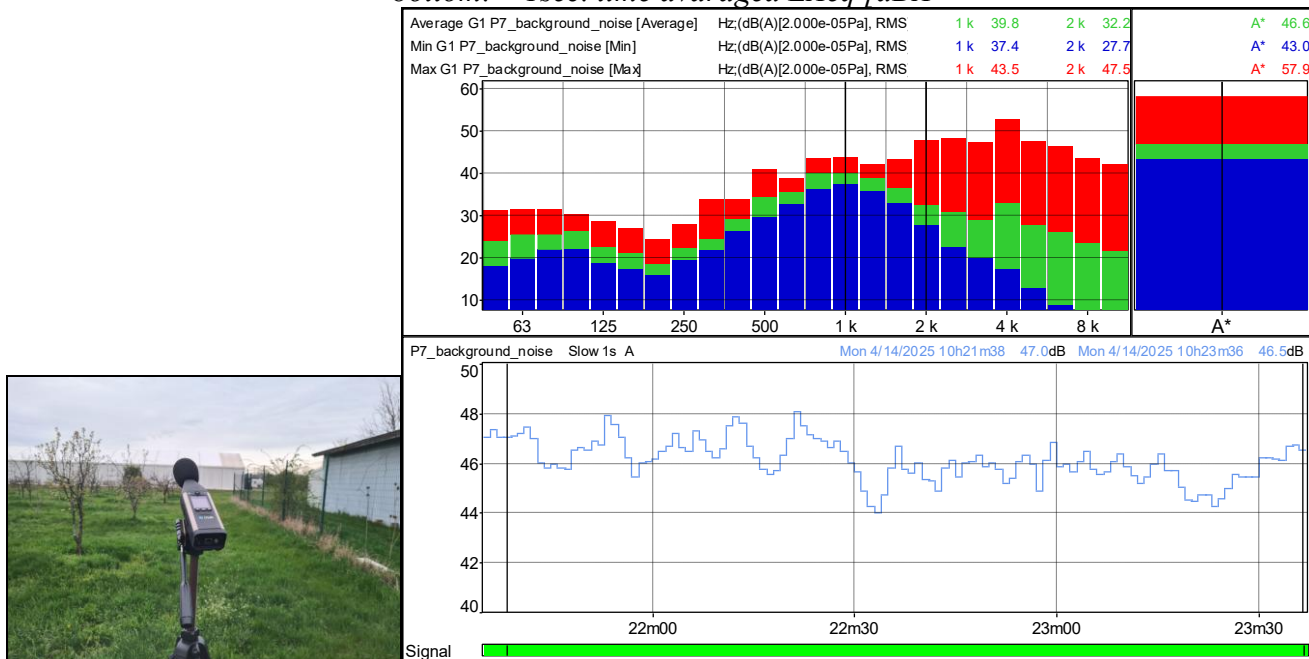


Figure 20. Measuring point P7 – South corner limit

P7_factory background noise level – 46.6 [dBA]

top: 1/3 octave time averaged noise level [dBA] (green-averaged; blue-min; red-max level)

bottom: – 1sec. time averaged LAeq [dBA]

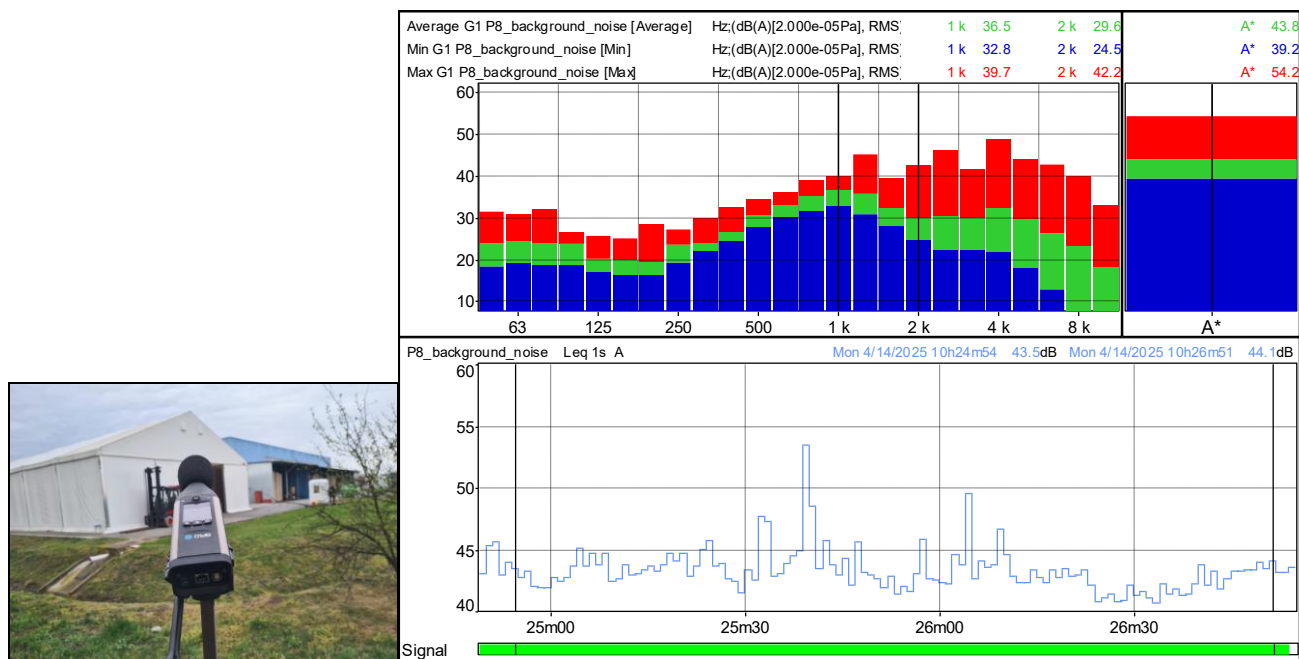


Figure 21. Measuring point P8 – South corner limit

P8_factory background noise level – 43.8 [dBA]

top: 1/3 octave time averaged noise level [dBA] (green-averaged; blue-min; red-max level)

bottom: – 1sec. time averaged LAeq [dBA]

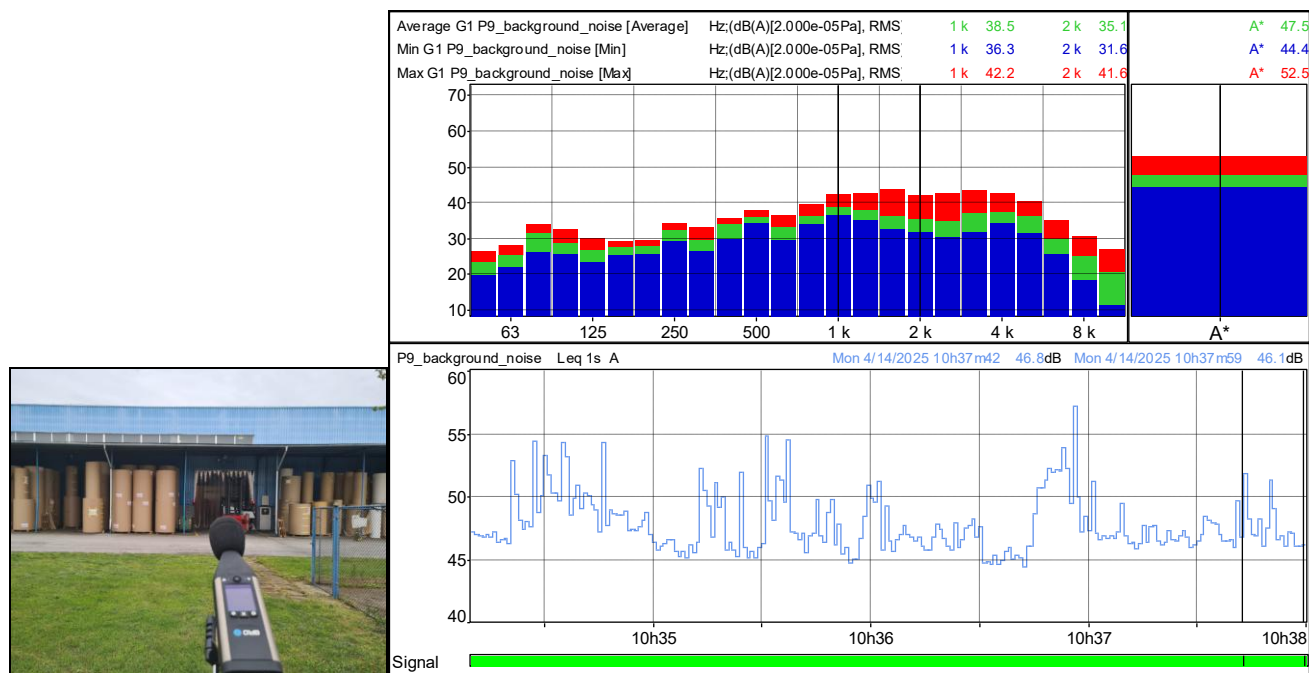


Figure 22. Measuring point P9 – East middle limit

P9_factory background noise level – 47.5 [dBA]

top: 1/3 octave time averaged noise level [dBA] (green-averaged; blue-min; red-max level)

bottom: – 1sec. time averaged LAeq [dBA]

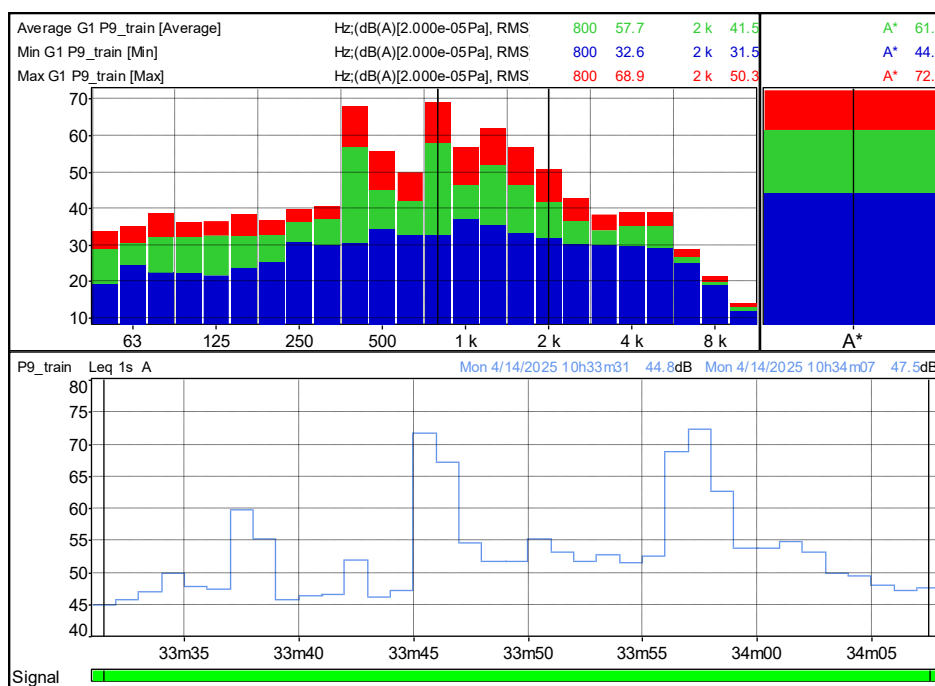


Figure 23. P9_train noise level – 61.2 [dBA]
top: 1/3 octave time averaged noise level [dBA] (green-averaged; blue-min; red-max level)
bottom: – 1sec. time averaged LAeq [dBA]

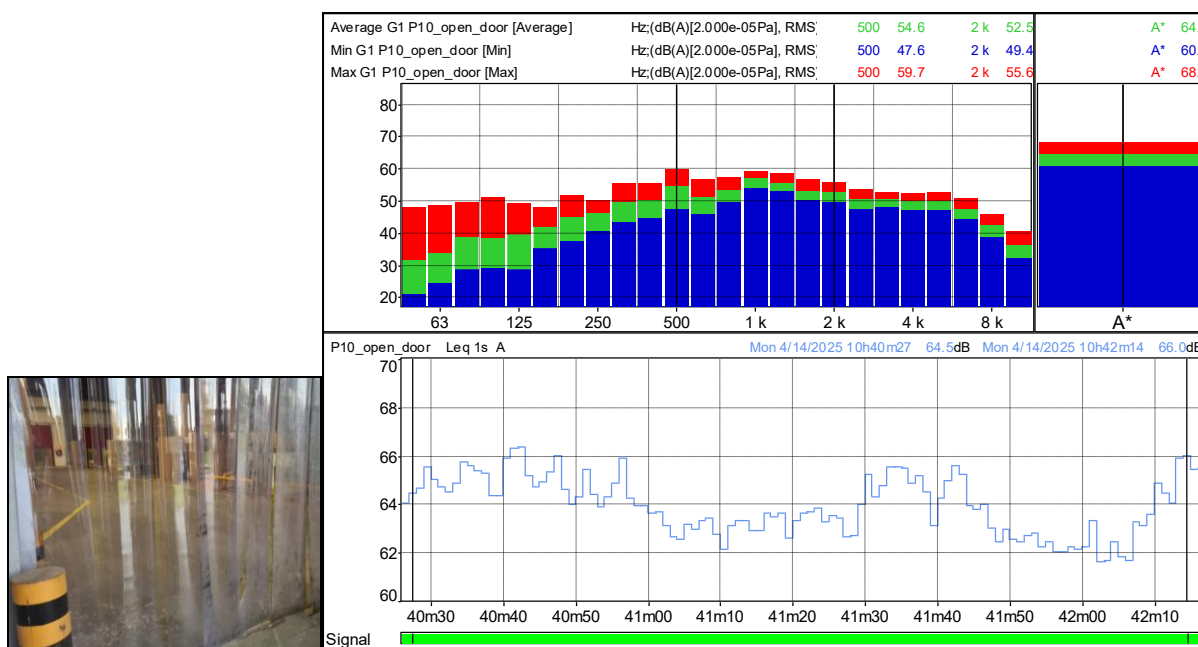


Figure 24. Measuring point P10 – Open door – 50 cm continuous measurement
P10_open door noise level – 64.1 [dBA]
top: 1/3 octave time averaged noise level [dBA] (green-averaged; blue-min; red-max level)
bottom: – 1sec. time averaged LAeq [dBA]

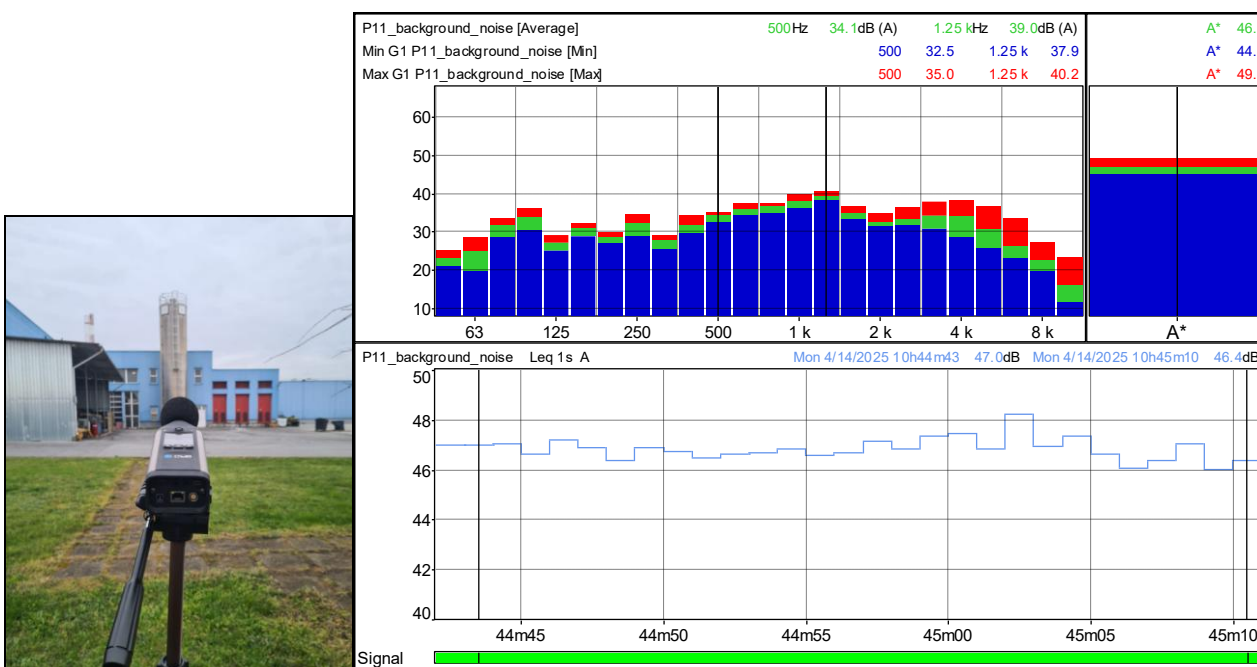


Figure 25. Measuring point P11
P11_factory background noise level – 46.8 [dBA]
top: 1/3 octave time averaged noise level [dBA] (green-avaraged; blue-min; red-max level)
bottom: – 1sec. time avaraged LAeq [dBA]

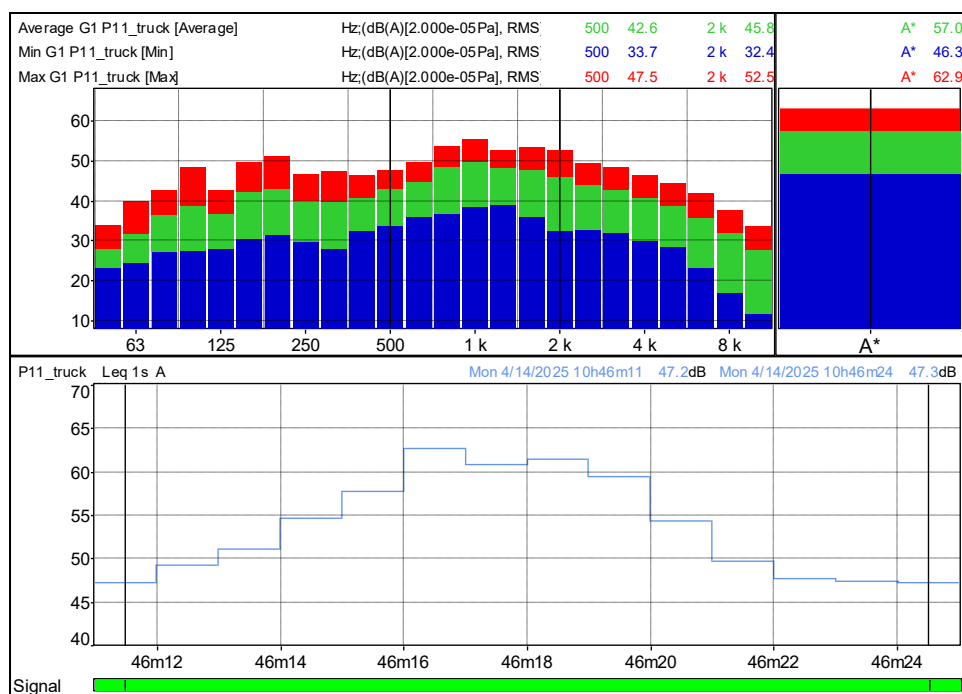


Figure 26. P11_train noise level – 57 [dBA]
top: 1/3 octave time averaged noise level [dBA] (green-avaraged; blue-min; red-max level)

bottom: – 1sec. time avaraged LAeq [dBA]

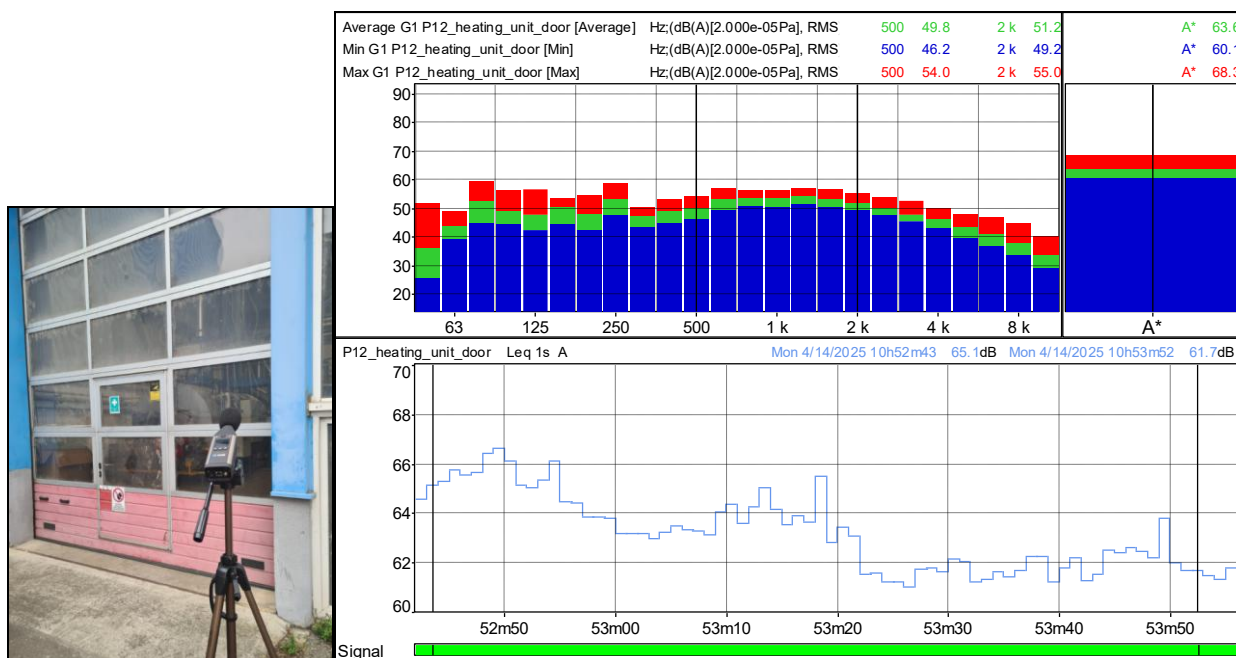


Figure 27. Measuring point P12 – heating unit door – 1m

P12_heating unit door noise level – 46.8 [dBA]

top: 1/3 octave time avaraged noise level [dBA] (green-avaraged; blue-min; red-max level)

bottom: – 1sec. time avaraged LAeq [dBA]

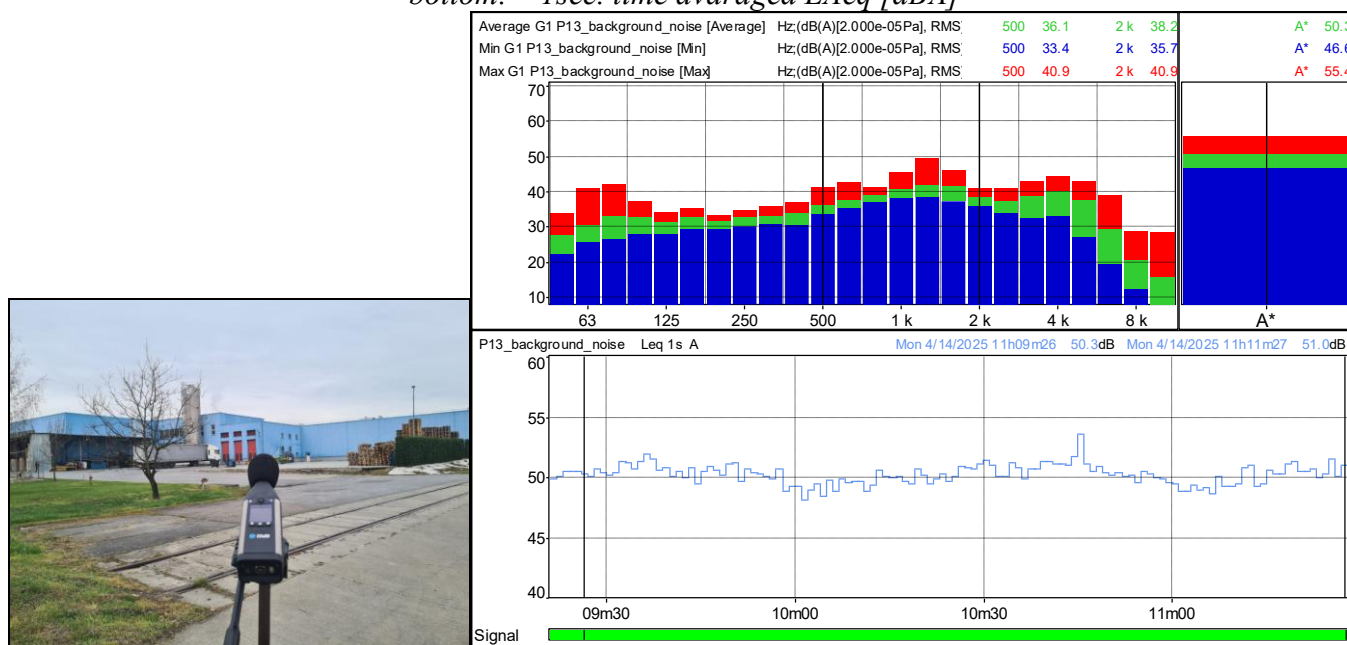


Figure 28. Measuring point P13 – East corner, access gate

P13_factory background noise level – 50.3 [dBA]

top: 1/3 octave time avaraged noise level [dBA] (green-avaraged; blue-min; red-max level)

bottom: – 1sec. time avaraged LAeq [dBA]

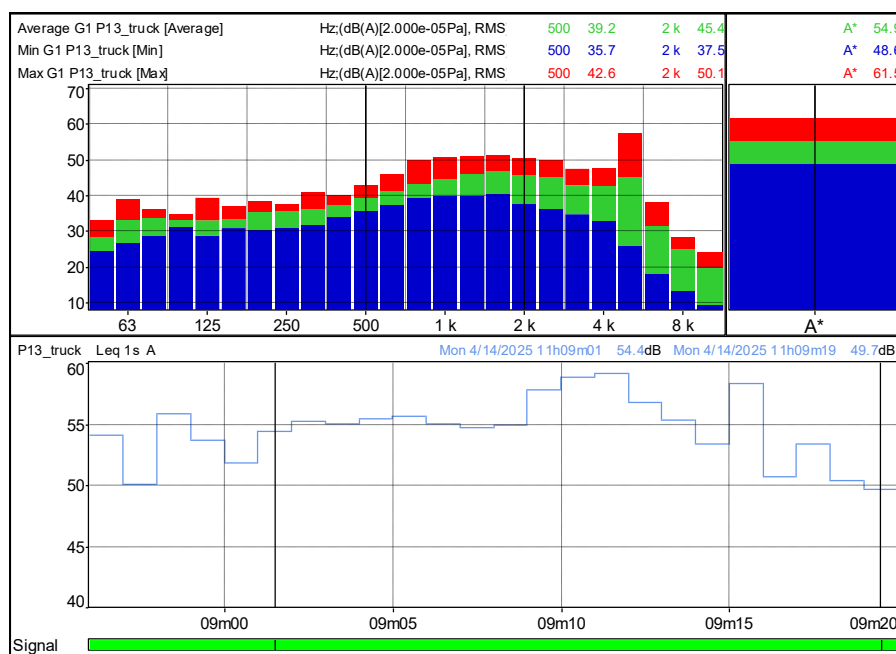


Figure 29. P13_truck noise level – 54.9 [dBA]
top: 1/3 octave time averaged noise level [dBA] (green-averaged; blue-min; red-max level)
bottom: – 1sec. time averaged LAeq [dBA]

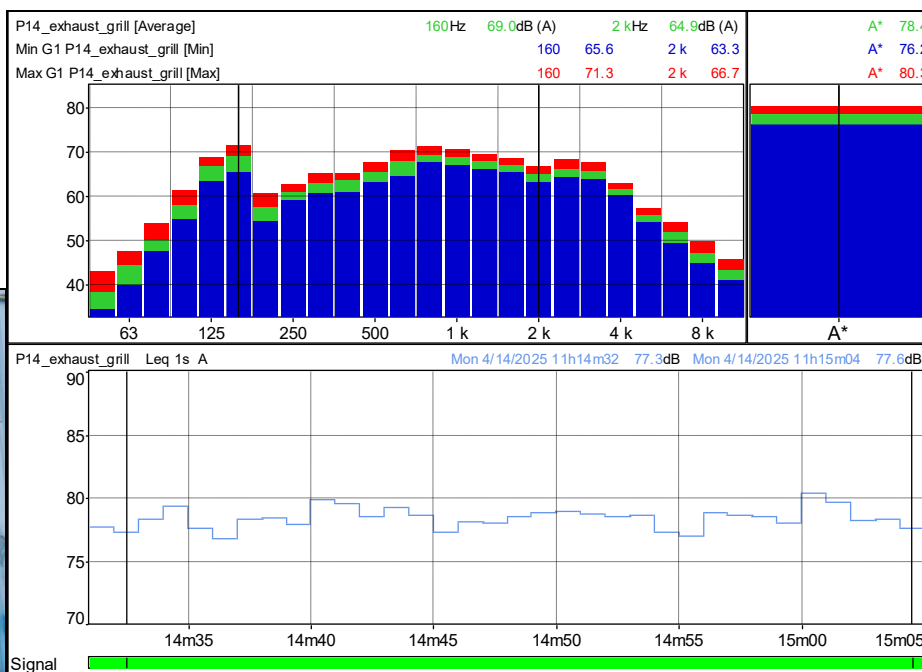
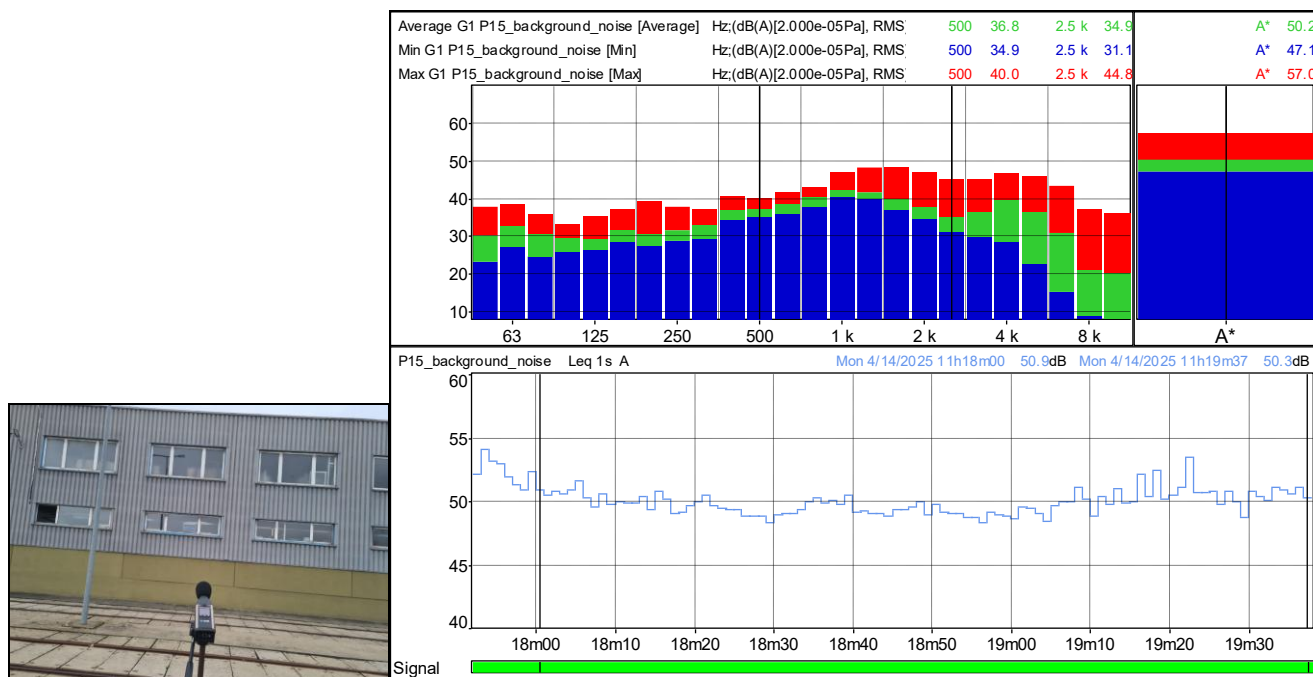


Figure 30. Measuring point P14 – exhaust grill – 1m
P14_exhaust grill noise level – 78.4 [dBA]
top: 1/3 octave time averaged noise level [dBA] (green-averaged; blue-min; red-max level)
bottom: – 1sec. time averaged LAeq [dBA]



*Figure 31. Measuring point P15 – North middle limit
P15_factory background noise level – 50.2 [dBA]
 top: 1/3 octave time averaged noise level [dBA] (green-averaged; blue-min; red-max level)
 bottom: – 1sec. time averaged LAeq [dBA]*



Figure 32. Noise levels at property limit

Table 12 is presented the centralized values obtained in the defined points of measurement at the property limits.

Table 2. Centralized values

Measuring point	Location	Factory background noise level L_{Aeq} [dBA]	Factory background noise level L_{Amax} [dBA]	Passing-by train noise level L_{Aeq} [dBA]	Trucks noise levels L_{Aeq} [dBA]
P1	Main entrance gate	52.5	58.4	73.2	
P2	West corner limit	51.5	54.3	72.6	54.1
P3	West middle limit	44	49.6	71.9	56.8
P4	South-West corner limit	46.4	53.6		
P5	South limit	44.0	48.8	53.9	
P6	South middle limit	44.5	50.1		
P7	South corner limit	46.6	57.9		
P8	South-East corner limit	43.8	54.2		
P9	East middle limit	47.5	52.5	61.2	
P11	East limit	46.8	49.1	57	
P13	East corner limit access gate	50.3	55.4		54.9
P15	North middle limit	50.2	57		

10. NOISE MAPPING SIMULATIONS AND IMPACT ASSESSMENT

Rondocarton's production facility is planning a construction expansion, and an acoustic noise distribution assessment will be conducted to evaluate the impact of noise on the targeted sensitive areas.

The activity of predicting the noise generated inside the facility and around consists in mapping the distribution of cumulated noise levels from all relevant sources. This assessment will use its methodology to identify the noise-sensitive areas surrounding the Rondocarton industrial facility, which is situated in a mixed-use zone that includes both industrial operations and nearby residential neighborhoods. Also, the study aims to assess the acoustic impact of facility operations, identify areas of potential exceedance of permissible noise levels, and establish and integrate mitigation strategies where necessary. The potential noise reduction measures aim to achieve levels that do not exceed the limits allowed by the local legislation.

Objectives:

The main objectives of the noise mapping study are:

- to quantify predicted noise levels generated by the facility during representative operational scenarios;
- to evaluate the spatial distribution of noise propagation in surrounding areas using advanced simulation tools;
- to compare the results with applicable national and international noise regulations (e.g., ISO 9613-2, local environmental standards);
- to identify noise sensitive receptors, including residential buildings;
- to recommend noise control measures to minimize environmental impact;
- to re-evaluate the predicted noise propagation in the new configuration, with noise reduction measures applied on proper locations.

Area Description

The study area encompasses the industrial site and its surrounding mixed-use zone, typically within a radius of 1–2 km.

Key features:

- Rondocarton industrial zone (with machinery, manufacturing units, transport activity, external equipment, etc.);
- adjacent residential neighborhoods at the eastern limit;
- flat field local topography; no significant vegetation; residential and sparse industrial buildings influencing sound propagation;
- meteorological conditions typical for the area.

Given the proximity of residential receptors, a detailed noise mapping simulation is required to understand the potential propagation of industrial noise into these areas.

11. ADMITTED LIMITS

According to local standard SR 10009/2017 (Acoustics. Admissible limits of the noise level in the ambient environment.) and the norm regarding noise protection C125, the maximum noise level allowed at the limit of the:

- **industrial zone:** $L_{eq} = 65$ dB(A), noise curve CZ60.
- **residential zones:** $L_{eq} = 60$ dBA

Note: In cases where two or more functional zones are adjacent, the lower of the permissible limits shall apply at the shared boundary.

Permissible outdoor noise levels at the façade of the most exposed residential building (Article 4.8, Table 8):

- **All types of residential buildings:** $L_{eq} = 50$ dBA

Note: If a residential building is located within a protected area established under public health and hygiene regulations approved by the central public health authority, the permissible outdoor noise limits are: 55 dBA between 07:00 and 23:00, and 45 dBA between 23:00 and 07:00.

12. TOPOGRAPHY OF THE PROJECT

The project is placed in Apahida/Cluj, Str. Aviatorilor Nr. 2a, and the topographic parameters were imported from Google Earth to create the GIS map of the area, the map containing the existing buildings in the work area, respectively industrial buildings. The Stereo 70 coordinate system, Dealul Piscului, was used. To delimit the property of the project, the limits provided by the cadastral plan of the client were taken into account. The location on the plan of the sources and receivers was carried out in Cartesian coordinates. An area of 2.65 km² was chosen in order to cover the industrial facility and sensitive surrounding buildings.

A calculation grid with dimensions of 3 x 3 m (524 pts. x 526 pts. – 295.536 pts.) was used, and the position of the receivers were chosen in the +1.5 m plane. The buildings in the area of interest and the acoustic sources were digitally modeled.

13. CALCULATION MODEL AND PARAMETERS

The following parameters and characteristics were used as data inputs for simulations:

Sound source data

- equipments: heating pumps, AHU Corrugator, AHU Converting, AHU Office, Cooling tower, fans;
- operational conditions: hours of operation, duty cycles;
- sound power levels: obtained from manufacturer data (according with clients „Plan terasă cu echipamente și nivel de zgomot” file), literature or on-site sound pressure measurements converted to sound power level.

Environmental and geographic data

- site layout and building dimensions (CAD and GIS format);
- topographic and ground cover data (digital terrain and land use);

- meteorological data: prevailing wind speed/direction, temperature gradients, humidity;
- surface characteristics: ground absorption coefficients for grass, asphalt, concrete, etc.

Modeling and simulation

Noise modeling will be conducted using environmental noise simulation software, using ISO 9613-2 propagation algorithms.

Parameters and conditions imposed for software simulations are presented below.

Project Properties	
Topic:	Noise
Type of prediction:	Noise (acc. to 2002/49/EC)
Rating following::	Lden

Work area				
Coordinate system:	Romanian Stereo70 Stereographic Coordinates			
Coordinate datum:	Stereo70 (RO <±3m), Dealul Piscului, Krassowski			
	from ...	to ...	Dimensions	Area
x /m	401070.00	402640.00	1570.00	2.65 km ²
y /m	586880.00	588570.00	1690.00	
z /m	-10.00	20.00	30.00	

Available calculation areas											
Name	x min	x max	y min	y max	dx	dy	nx	ny	Refer	Height/	Range
Grid	401622.0	402372.0	587454.0	587872.0	3.0	3.0	524	526	relativ	1.50	Rectangl

Calculation parameters		
Calculation model: General	Point	Grid calculation
Adapt assessment area seamlessly to the receiver		
Terrain ridges as obstacles	Yes	Yes
Improved interpolation in boundary areas	Yes	Yes
Free field in front of refl. surfaces/m		
acc. to sources	1.0	1.0
acc. to immission points	1.0	1.0
Calculation model: Parameters	Optimised	Optimised
Projection of line sound sources	Yes	Yes
Projection of area sound sources	Yes	Yes
Limit projection	No	No
Minimum length for sections /m	1.0	1.0
Add. factor for distance criterion	1.0	1.0
Calculate attenuation for ISO9613		
* Lateral pathway	Yes	Yes
Reflection (max. order)	3	3
Limit the search radius (distance source-IP):	No	No
Image source from projection	Yes	Yes
No refl. if entirely screened	Yes	Yes
Multiple reflections	Yes	Yes
Angle increments (x-y)°	1.00	1.00
Angle increments (z)°	1.00	1.00
maximum reflection pathway length		
* as a multiple of the direct distance	10.00	10.00
Ray splitting on refl. area	1	1
requested accuracy /dB:	0.1	0.1

Global parameters	
Temperature /°C	19
Relative humidity /%	70

Living area per inhab-/m ² (=0.8*gross)	40.00
Average storey height /m	2.80

Parameters of library: ISO 9613-2	
Downwind conditions	Yes
Simplified equation (Nr. 7.3.2) for ground effect for frequency-independent calculation	Yes
Evaluating the mean height h_m	according to ISO 9613-2 unmodified
"Additional recommendations" - ISO TR 17534-3	Yes
Accounts for vegetation	Yes
Accounts for housing	Yes
Accounts for ground effect	Yes

Rating periods	
T1	Day (12h)
T2	Evening (4h)
T3	Night (8h)

Model setup

- input all identified sources with corresponding sound power levels and operational periods;
- topography, buildings, and reflective surfaces;
- meteorological corrections and ground absorption;
- grid resolution (3 m × 3 m) and receptor heights (1.5 m above ground);
- scenarios modeled; day and night configurations;
- actual and potential operational profile;
- mitigation scenarios – with proposed barriers, enclosures, or process optimizations.
- noise contour maps (dB(A)) showing propagation across the study area (1 dB contour lines);
- receptor-specific predicted levels (L_{day} , L_{night});
- comparing results with applicable limits.

The software prediction/simulation model of acoustic immissions took into account both the propagation of direct acoustic waves from the source, as well as the waves reflected by the surfaces of physical bodies found on their propagation path, so that in each point of the grid of the computing space the amplitude of the direct sound waves was added logarithmically to the amplitude of the reflected acoustic waves.

The calculations were performed according to ISO 9613. and the following physical effects were taken into account:

- geometric divergence;
- atmospheric absorption;
- ground effect;
- surface reflections;
- screening of obstacles;
- sound absorption.

Related standards:

ISO 1996-1 1982 Acoustics – Description and measurements of ambient noise – Part 1, 3, 3;

ISO 9613-1:1993 Acoustics. Attenuation of sound propagated outdoors. Part 1: Calculation of atmospheric absorption. The noise sources were modeled according to the situation, as point or linear

sources, and the acoustic power level specified by the manufacturer was assigned to them as an emission parameter. If the manufacturer mentioned in the technical sheet a sound pressure level relative to a distance from the source, it was converted into a sound power level, for a unitary calculation model.

The calculations were performed in open field acoustic conditions, the calculation volume being defined at a distance of 1 m from the reflective surfaces. The order of multiple reflections applied was 3, on a radius of 200 m, taking into account the image sources. No important vegetation was identified to be taken into account.

A temperature of 19° C and a relative humidity of 70% was taken into account. The soil absorption used was 0.3 calculated considering that it will be asphalt space and green area.

The average applied wind speed was 5 m/s, at a virtual anemometer located at a height of 10 m.

14. NOISE DISTRIBUTION RESULTS

A series of simulations were carried out in order to arrive at the more representative placement option for both the noise sources and the methods to reduce it (trucks operation management, sound barriers, etc.). Below are presented the optimal noise mapping and mitigation solutions for the planning situation proposed to be designed, authorized and executed.

The first simulations were done for the situation with no sound reduction measures. The simulation incorporated both fixed noise sources—such as heat pumps, air conditioning units, cooling towers, and ventilation fans—and mobile or intermittent sources, including truck movements within the site.

The simulation model included two trucks positioned in the eastern sector—one in transit and one stationary during loading operations—and three trucks in the western sector, comprising one in transit and two engaged in loading or unloading activities.

During the acoustic modeling and noise impact simulation, the state of access doors to the production area at the eastern part was considered a critical factor influencing external noise propagation. Specifically, two of the industrial doors that provide direct access to the production hall were kept closed throughout the measurements and simulation. When doors are closed, sound transmission to the exterior is significantly attenuated due to the sound reduction index of the door structure and its sealing performance. However, even closed industrial doors are not acoustically airtight; minor sound leakage occurs through structural gaps, door joints, and material transmission. This residual transmission was accounted for in the model to represent partial emission of interior noise into the external environment.

In contrast, one similar industrial door was assumed to remain open during operation—a scenario commonly encountered in facilities where continuous loading/unloading or ventilation is required. An open door provides a direct acoustic path between the noise-generating sources inside the production hall (e.g., machinery, compressors, conveyors) and the exterior environment. Consequently, it acts as a dominant emission point, allowing the internal production noise to propagate freely to the outdoor area, thereby contributing substantially to the overall sound pressure levels measured or predicted near the building façade and at the property boundary. The noise radiation values in this case were considered the ones obtained from previous measurement session.

In the following figures are presented the noise mapping for the day and night periods. During the night shifts, only the fixed noise sourced were taken into consideration, without any trucks or other logistic movements.

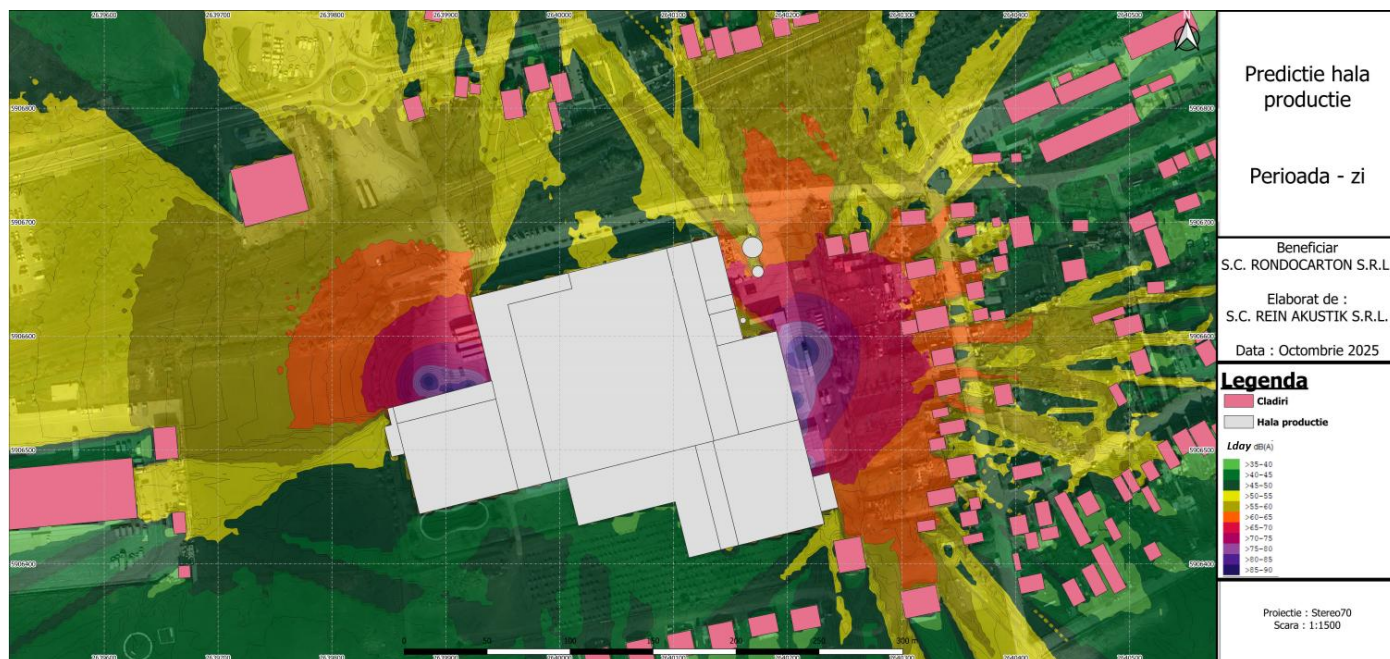


Figure 33. Noise levels map during the day period L_{day} [dBA]

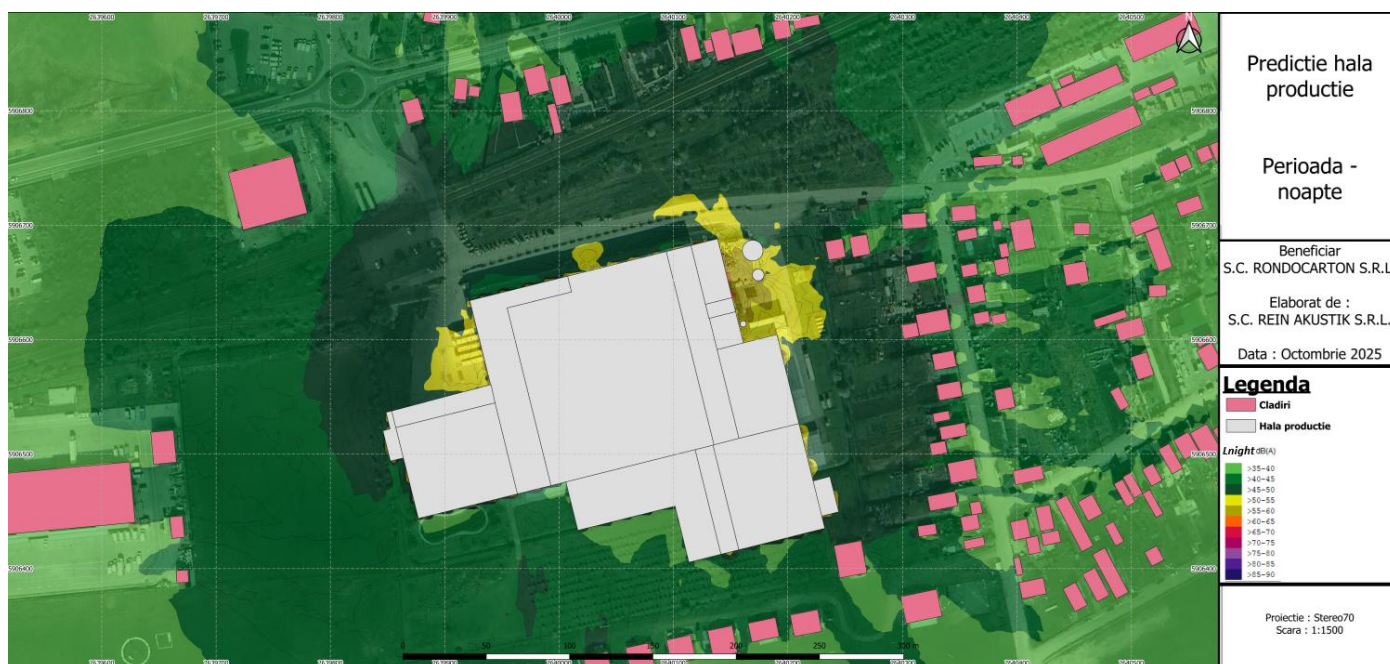


Figure 34. Noise levels map during the night period L_{night} [dBA]

15. NOISE REDUCTION MEASURES

Acoustic barriers are proposed to be used at the interface between industrial facilities and neighboring residential areas, at the eastern property limit, to reduce the transmission of noise from machinery, vehicle movements, and production activities with impact on residential zone. By blocking the direct path of sound waves, these barriers significantly lower the noise levels reaching nearby homes, helping the facility comply with environmental noise regulations and protect residents from disturbances such as stress, sleep disruption, and reduced quality of life. They represent a practical and cost-effective solution for minimizing the impact of industrial operations, improving living conditions in adjacent communities, and demonstrating the company's commitment to environmental responsibility and good neighbor relations.

In Rondocarton's case, the main influence of the sound is coming from the trucks which are in operation of loading/unloading or just passing-by (see *Figure 33* – with trucks activities, comparative with *Figure 34* – no trucks activities).

The noise generated only by the industrial facility operations, without the presence of trucks in operations, is not exceeding the admissible limits, as in this configuration of noise sources with trucks.

Acoustic barriers (*Figure 35*) must meet the following conditions:

- sound insulation $R'w = 30$ dB;
- sound absorption assessed by the laboratory on one of the parts of at least 10 dB;
- mineral wool density 80 kg/m^3 ;
- one side perforated surface 35%;
- perforated face directed towards the sound source;
- modular system of metal modules of minimum thickness 120 mm made of galvanized steel;
- resistance to wind speeds of 170 km/h;
- reaction to fire A2-s1, d0 (EN 13501-1);
- protective against humidity;
- the height of the sound barrier is at least 5 m.



Figure 35. Sound barriers

In the following figures are presented the noise mapping for the day and night periods in the case of placing an acoustic barrier at the eastern property limit, between Rondocarton's facility and the residential area.



Figure 36. Noise levels map during the day period, with acoustic barrier L_{day} [dBA]

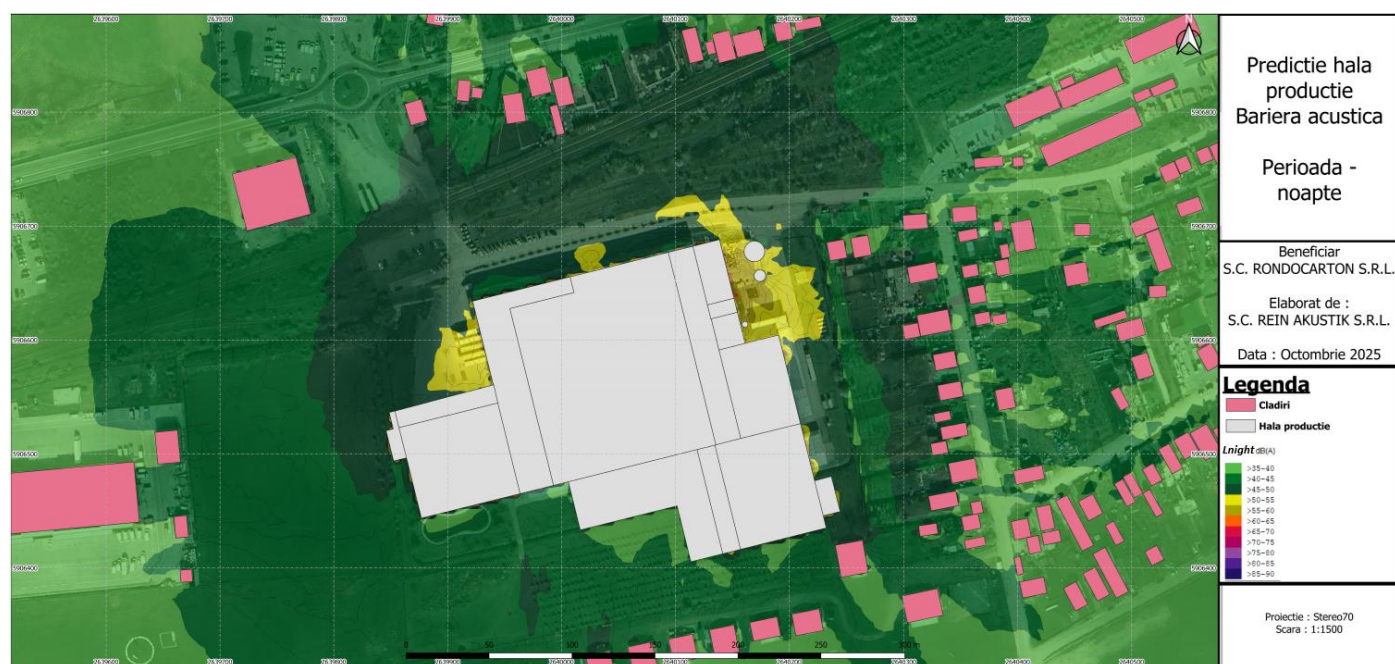


Figure 36. Noise levels map during the night period, with acoustic barrier L_{night} [dBA]

16. CONCLUSION

The acoustic measurements and noise mapping simulations conducted at the Rondocarton industrial facility located at 2A Aviatorilor Street indicate a complex interaction between multiple noise sources arising from the site's proximity and interior distinct functional zones, including a residential area (to the east), an airfield (to the south), an industrial zone (to the west) and railway and road (to the north).

According to the provisions of SR 10009:2017, the maximum admissible equivalent continuous sound level (*L_{Aech}*) at the boundary of an industrial zone is 65 dBA, while at the interface with residential areas, the limit is reduced to 60 dBA, with the more restrictive threshold prevailing in cases of mixed-use boundaries. Additionally, Order No. 119/2014 imposes a limit of 55 dBA during daytime and 45 dBA at night in outdoor spaces of residential areas, and Order No. 3384/2013 (C125-2013) stipulates that noise levels near residential facades should not exceed 50 dBA. The measurement data must be interpreted in light of these regulatory thresholds. Where noise levels at the eastern property boundary (adjacent to the residential zone) exceed 60 dBA, mitigation measures are warranted to ensure compliance with both environmental and public health requirements. Similarly, if noise levels near the building facades of nearby dwellings exceed 50 dBA, the situation may necessitate targeted interventions such as noise barriers, source containment, or revised operational schedules to minimize acoustic impact (the noise levels at the neighborhood residential buildings will be further calculated and mapping).

As presented in *Table 2*, the factory operating noise levels are below the limit of 60 dBA, as imposed by the standard SR 10009:2017 for industrial areas with residential neighborhood. Elevated noise levels recorded on East, North and West side, closer to the main railway and vehicles roads are probably due to the fact that factory operation noise is drown in the background traffic noise. This conclusion is sustained also to the fact that on the South boundary, where no significant exterior noise is present, the noise levels are in the limit of 45 dB, which is the legal limit for nighttime noise, in which case the traffic noise influence will be also lower on the other sides.

Generally, the noise produced by passing-by trains, especially by the heavy ones is significantly higher than the factory operation noise, even on the far South boundary, practically covering all the noise produced inside the Rondocarton property (small personal trains are passing faster and quieter than the long heavy trains, and has lower impact on noise propagation on the property and around).

Trucks circulation inside the site has noise levels closed to the limit of 55 dB or higher at the property boundary imposed by the Ministry of Health Order 119/2014 for daytime and is expected not to operate during the night, when the limit of 45 dB is significant lower and would be exceeded. Anyway, due to the fact that could be present trucks which are louder than those few recorded and that their operation is closed or higher than the imposed limit, it is recommended to be taken into consideration applying the protective noise reduction methods at the boundary with residential area (this is a suggestion, to provide protection in case of obtaining environmental authorization or before the courts in case of complaints; however the noise made by trains on this residential area is significantly higher than that produced by trucks inside the factory on the same area, CFR representatives will actually claim that they do not exceed the imposed limits according to the standards that refer to their specific situation).

According with measurements results, the factory noise level, as a background noise produced by entire industrial facility and associated equipment (excluded the specific events which are the noise produced by loading/unloading trucks) do not exceed the imposed limits at the property boundaries.

Noise mapping simulations carried on the new planned extended facility and logistic activities indicate that the most significant noise source in the area, produced by sources placed inside the Rondocarton facility, is represented by passing-by or loading/unloading trucks which generate sound levels higher than

those produced by factory operations. The operation of other exterior noise sources associated with functionality of the Rondocartons building (fans, AHU units, cooling tower or noise leaking through industrial doors) at the planned construction will not exceed the imposed legal limits at any point on the surrounding sensitive areas, during day or night time.

Although the factory's continuous background noise, generated by fixed equipment and regular industrial processes, remains below the regulatory limits at the property boundaries, it is still advisable to implement preventive noise reduction measures—such as acoustic barriers—along the interface with the eastern residential zone. Also, an internal traffic and logistic movements management are advisable to be implemented, in order not to allow many trucks or other vehicles to operate at the same time (even if they are stationary but with engine running). This approach would provide additional protection in the event of future environmental permitting requirements or community complaints.

It should also be noted that the overall acoustic environment in the adjacent residential area is dominated by railway noise, which remains the primary contributor to total sound exposure levels.

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