ANCHOR LIFE:

Action B3 : Definition of a common Port Noise Impact Assessment (PNIA) method and application to Melilla port

1. INTRODUCTION

1.1. OBJETIVES

The objective of action B3 is to update the guide of good practices for the management and realization of port noise maps (Good Practice Guide on Port Area Noise Mapping and Management, NoMEPorts GPG), under the considerations included in Directive 2015 / 996 / EC establishing common noise assessment methods.

Specifically, the definition of a Port Noise Impact Assessment (PNIA) methodology will be defined, conceived as an improved version of the NoMEPorts GPG.

As a final objective, the methodology will be applied to the expansion project of the Port of Melilla.

TASKS

1.2. STEP 1, GEOGRAPHICAL DEFINITION AND LIMITS OF THE MODEL

1.2.1. Description of the task

A digital terrain model must be carried out, in which the study area is spatially defined, including data on all relevant aspects that may influence the propagation model. This point is divided into two sections:

- Geographic definition and characterization of the environment.
- Delimitation of the contour of the model.

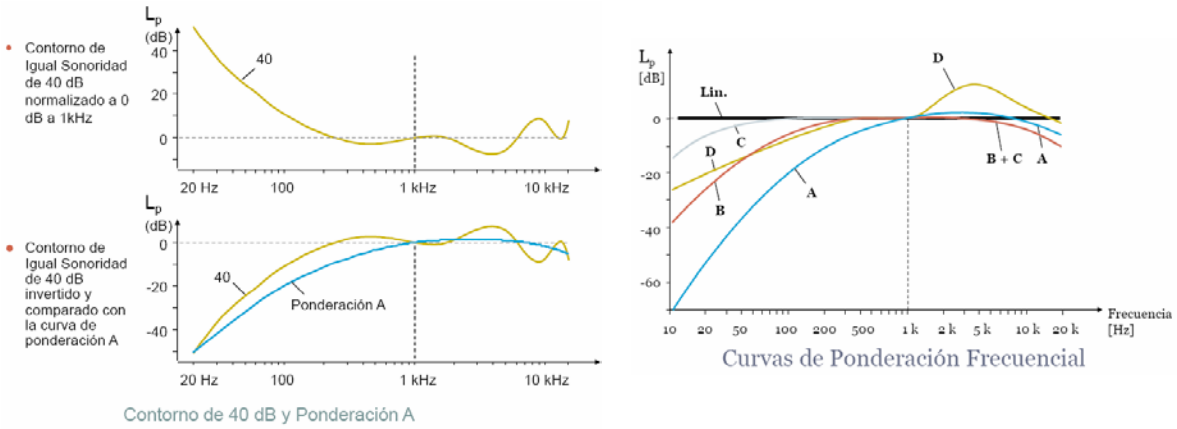
The characterization of the model, in relation to the geographical definition and characteristics of the environment, is specified in the following points:

- Three-dimensional topographic definition.
- Definition of height of buildings.
- Definition of obstacles and, where appropriate, their distribution and variability over time.
- Definition of ground absorption and obstacles.
- Configuration of noise sources.
- Definition of the main meteorological variables relevant to the model and its characterization.
- Definition of the main recipients as well as their characterization (affected population).
- Definition of sensitive receptors, if any (schools, hospitals ...).

In relation to the definition and delimitation of the study area (contour of the model), the guide NoMEPorts, establishes that the limit of the model must be sufficient to represent the areas in which the following levels are reached:

Average daily level weighted day-late-night, long-term, with frequency weighting A	L_{den}	55 dBA
Equivalent daily level in night period, long-term, with frequency weighting A	L_n	50 dBA

However, the frequency weighting A, which aims to adapt the noise measurement to the frequency sensitivity of the human ear, underestimates the effect of low frequencies, so it may be an indicator that does not represent well the discomfort due to port noise. (which is characterized by its low frequency).



Contorno de 40 dB y Ponderación A

To all this is added the low absorption by absorption (energy dissipation phenomenon) that affects the low frequency waves when they propagate through the air and the fact that the low frequency waves have a great capacity for diffraction (property that gives rise to the ability of low frequency waves to avoid obstacles that get in their way).

These two characteristics of low frequency waves, together with the fact that they are particularly annoying, make their consideration in the case of port noise convenient and relevant. For this, the extension of the model can be extended so that the following isophonic curves are represented:

Equivalent daily level in night period, in the short term, with frequency weight C	$L_{Ceq,n}$	60 dBA
Equivalent daily level in day period, in the short term, with frequency weight C	$L_{Ceq,d}$	65 dBA

In any case, the most appropriate criteria to define the limit of the model are the object of the study that must be carried out.

1.2.2. Information available

The main sources of data are the following:

- SoundPLAN acoustic modeling software user manual, downloaded from the SoundPLAN International LLC website:

  http://www.soundplan.com/soundplan_en-master.pdf

  June 2015 version.

  The availability of this manual facilitates the tasks of coordination between the APM and CIRIAF and allows all those involved to know, firsthand, the type of information that is required for the definition of the noise model.

- Special Plan for the Management of the Port of Melilla, drafted in September 2003 by Gestión Integral del Suelo, S.L.

  As more interesting data that can be obtained from this document we can mention the land uses, which define the potential uses of the soil in each area of the port.

- Strategic Noise Map of the port of Melilla, made in November 2017 by the company Estudio de Estudio y Control del Ruido S.L.

  In addition to the final result of the Strategic Noise Map, the input data of the model will be provided, in Geo Data Base format, so that they can serve as the basis for the realization of the new model.

- Construction project for the Exterior Extension of the Port of Melilla, carried out by the company Prointec in October 2017. Based on the information of the expansion project, the future state of the port will be modeled, adding all the necessary hypotheses for the correct definition of the model of acoustic prediction.

- • General Directorate of Land Registry, Ministry of Finance.
  https://www.sedecatastro.gob.es/
  Where there are several layers in Shape format among which the following ones have been selected:
  - ALTIPUN: Altimetry points with elevation and points of the geodesic and topographic networks.
  - CONSTRU: Urban subplots that represent the volumes built within a plot.
  - EJES: Axes of linear elements (streets, roads).
  - LIMITES: Administrative boundaries (of municipality, of soil of urban nature, etc).

- Orthophotography of the port area of Melilla, in its last update, made in March 2018 and acquired from AIRBUS DEFENSE AND SPACE - Intelligence.

- Download Center of the Spanish Agency of Meteorology.
  https://opendata.aemet.es/centrodedescargas/productosAEMET?

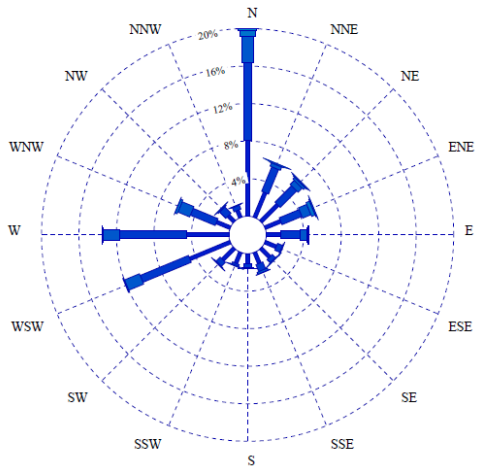
The use of the list called "Normal values for the reference period 1981-2010" is proposed, which provides statistical values of the main climatological variables. For this, the results corresponding to the following meteorological station will be considered:

Indicative	Name	Location		
		Latitude	Longitude	Altitude
6000A	MELILLA	351635N	025723W	52

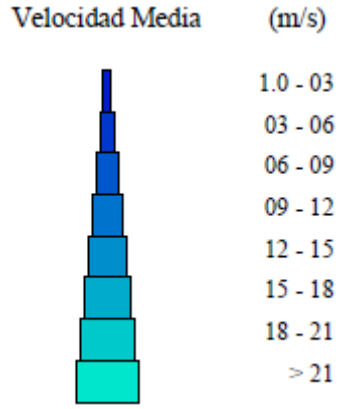
Con los siguientes resultados:

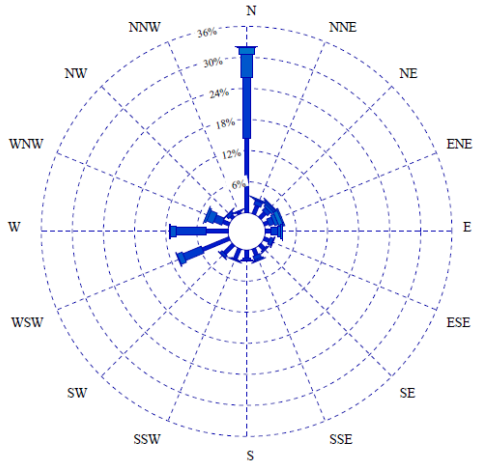
Period	Average Temperature (ºC)	Average relative humidity (%)	Average wind speed (Km/h)
January	13,3	72,0	12,8
February	13,8	74,0	14,2
March	15,2	73,0	14,7
April	16,6	69,0	15,3
May	19,1	67,0	15,0
June	22,4	67,0	15,1
July	25,3	66,0	14,3
August	25,9	69,0	13,5
September	23,8	72,0	12,9
October	20,4	75,0	11,6
November	17,0	74,0	12,6
December	14,6	73,0	12,4
Annual value	19,0	71,0	13,7

- Forecast data, real time and climate of Puertos del Estado
  http://www.puertos.es/es-es/oceanografia/Paginas/portus.aspx
  From where the climate report relative to the Mean Wind Climate is obtained, corresponding to the meteorological station of the Port of Melilla, through the analysis of series of data obtained in the period from November 1996 to December 2009.
  The most important results refer to the rose of the winds, which relates the frequency, origin and wind speed:

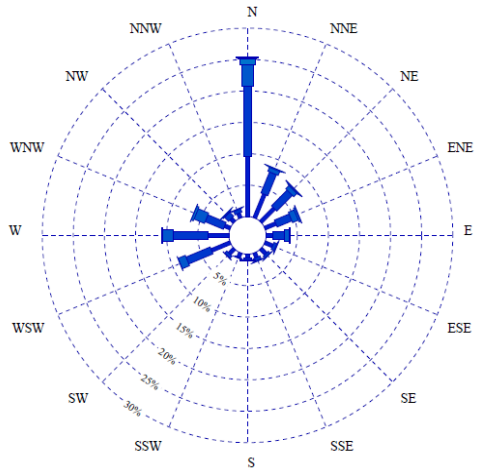


Anual

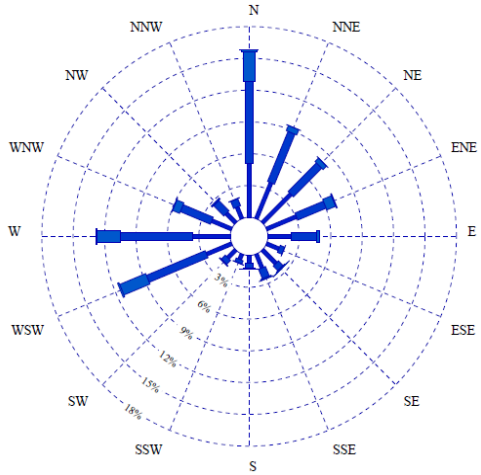




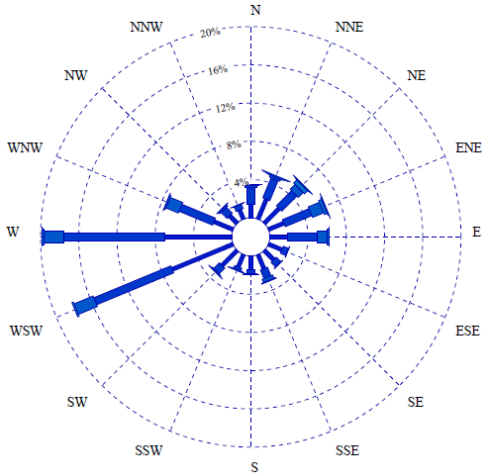
December – February



March – May



June – August



September – November

Compass Rose

- General Plan of Urban Planning of the Autonomous City of Melilla and, in particular, the Environmental Sustainability Report, written by the Project Laboratory, S.L.P in April 2012.

- Memory of the Strategic Noise Map of the Autonomous City of Melilla carried out in April 2014 by the company Centro de Estudio y Control del Ruido S.L.

- Update of the Acoustic Zoning of the Autonomous City of Melilla carried out in December 2017 by the company Centro de Estudio y Control del Node S.L.

- Municipal ordinance environmental protection against noise pollution and vibrations in the Autonomous City of Melilla.

- Data from the National Institute of Statistics, among which the Indicators for municipalities with more than 20,000 inhabitants stand out.

ES055C1 Melilla	2017	2015
Resident population (Persons)	86.120	85.584
Proportion of population 0-14 years old (Percentage)	23,25	23,12
Proportion of population aged 15-64 (Percentage)	66,91	67,2
Proportion of population> 65 years (Percentage)	9,84	9,68
Median age of the population (years)	34,33	33,92
Proportion of nationals over the total population (Percentage)	84,49	84,88
Proportion of national natives over the total population (Percentage)	76,19	76
Proportion of foreign-born over the total population (Percentage)	23,81	24
Proportion of foreigners over the total population (Percentage)	15,51	15,12
Total number of households (Number)	24.318	26.210
Average size of households (Number)	3,39	3,22
Proportion of households of one person over total households (Percentage)	18,91	21,92
Average annual net income of households (Euros)		35.196
Average annual net income per consumption unit (Euros)		16.674,49
Average annual net income per capita (Euros)		9.960,92

1.2.3. Information that is intended to be collected.

In addition to the information indicated in the previous section (which is currently available), it is planned to obtain additional information from the Autonomous City of Melilla in relation to:

- Population census data, population by districts ...

- Additional information on the Noise Map of the Autonomous City of Melilla, related to noise maps and on-site measurement campaigns.
- Preliminary documents of the new General Plan for Urban Planning, which is currently being drafted.

1.3. STEP 2, CHARACTERIZATION OF NOISE SOURCES

1.3.1. Task Description

As a preliminary step to the characterization of noise sources, an **inventory of significant noise sources** must be carried out. From this inventory and according to the information available, two types of noise sources are distinguished:

- Sources of noise that are characterized according to their operating regime: the most significant case is the case of traffic noise. In this type of source, the characterization of the emitter will be based on light and heavy traffic intensities, circulation speed, type of pavement... This definition can be complemented with long-term measurements.

- Noise sources that are characterized by noise measurements made on site: this section includes all those sources for which there is no emission model based on their characteristics or operating regime and among which are: the operation of ships, operation of cranes, industrial installations...

In the first case, the planning and execution of a data collection campaign should be carried out to obtain all the necessary characteristics of the emitter, including the temporary distribution of the modes of operation of the same.

In the second case, a campaign of noise measures should be designed, which will be structured in the four phases detailed below:

- Phase 1, definition of technical characteristics: The information available or that can be obtained in relation to the source of noise, encapsulation or isolations available, acoustic emission power and other technical specifications that may be useful should be collected

- Phase 2, definition of physical characteristics: The type of emitter must be determined, in order to assimilate it, in the model, to a predefined type of noise source. In this regard, it is necessary to specify, for each source, the need to obtain data in relation to its dimensions, position, location, height, outer perimeter and orientation (in the case of management emission patterns). It should also be specified if there are relevant aspects in relation to the environment in which it is located (presence of absorbent or reflective surfaces in the environment of the emitter, if it is inside a building and the characteristics of it) or the existence of background noise (from other transmitters) that may lead to the masking of noise from the emitter. The purpose of this phase is to determine the **spatial sampling** of the noise measurements

- Phase 3, definition of the mode of operation: The periods of operation of the source of noise and the load or variations of power that take place must be determined (daily, weekly, monthly and annual variations). The purpose of this phase is to determine the **temporal sampling** of the noise measurements. Additionally, for the definition of temporary sampling, the operating periods of other nearby sources should be taken into account, in order to make the measurement as representative as possible of the specific source that is intended to characterize.

- Phase 4, noise measurement: Based on the spatial and temporal sampling defined in the previous sections, the type of measurement to be made and the most appropriate indicators should be defined, in order to define the noise sources in relation to their acoustic characteristics (Intensity, tonality, content in low frequency, impulsivity, emission spectrum, directionality ...).

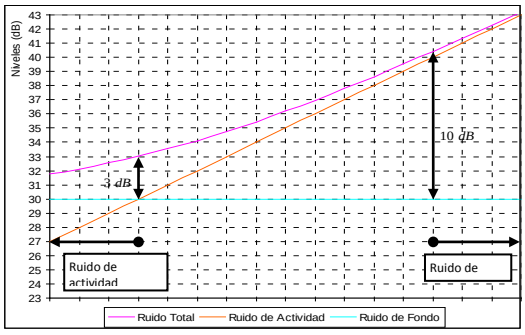
  To carry out the measurements, the previously defined protocol must be followed and data must be obtained of the meteorological conditions in which the measurement is made (they can be obtained from nearby meteorological stations).

  As a general rule, in the event that the measurement is made less than 2 m from reflecting surfaces, the measurement must be corrected according to the UNE-ISO 1996-2.

  The measurement of noise in wind situations that could have a significant influence on the representativeness of the measurement will be avoided.

  In relation to background noise, when considering the superposition of a background noise and an activity noise, three clearly differentiated zones are distinguished:

  - When the difference between the total noise and the background noise is less than 3 dB: In this case the activity noise is masked and the measurement cannot be made.
  - When the difference between the total noise and the background noise is greater than 10 dB: The background noise is negligible.



  - When the difference between the total noise and the background noise is between 3 and 10 dB: In this case, the activity noise measurement can be obtained as the energy difference between the total noise and the background noise.

  The measurement of characterization noise must represent both the stationary states of the machinery (as an example we can mention the different load conditions of the generator of a ship), as well as the characteristic events of the operation of the machine (berthing operations, operation of ramps ...).

As a final stage of this task, an **extrapolation of the results** will be carried out for the characterization of the emitters that will be installed in the **expansion of the Port of Melilla**. Likewise, we will proceed to the definition of **two hypotheses of location of the emitters** in

the expansion area. After making the noise maps, and their analysis, a **third hypothesis of location of emitters** will be made, to proceed with their modeling, as a final step to optimize the location of issuers in order to minimize the impact on the population.

1.3.2. Information available

As previous information for the accomplishment of this task, the Traffic and Mobility Study of Access to the Port of Melilla is available. This study was carried out by Tema Grupo Consultor, S.A. in November of 2017.

1.3.3. Needed Information.

The information that must be available for the realization of this task and that must be generated previously to the programming step of the same is the following:

- We must have a measurement protocol, which indicates how to proceed to perform the measurement (considerations in relation to time, height of measurement, background noise, indicators to store, integration time ...).
- In order to carry out the measurement protocol, we will take into consideration what is indicated in the ISO and UNE standards that are applicable, so this documentation must be available.

To perform this task we need the availability of at least one sound level meter and a class I calibrator. The sound level meter and the calibrator must have all the necessary elements (nameplate, seals, identification bulletin, verification certificates of the calibration and user manual).

Likewise, the collaboration of CIRIAF is essential to determine the best way to define the characteristics of the noise sources, according to the parameters required by the calculation program, for the modeling of these sources.

CIRIAF collaboration is essential with regard to the definition of the location of the issuers in the port expansion, since this task must be performed in an interactive manner. For this, as an initial step, it is proposed to model two emitter configurations; after the analysis of the results of the two previous models, a third definitive hypothesis would be made, which would correspond to an optimized situation

1.4. STEP 3, REALIZATION OF NOISE MAPS. DESCRIPTION OF THE TASK.

The realization of the noise maps is structured in the following phases:

- Validation of the geometric definition data of the model, provided by the Port Authority of Melilla, guaranteeing that the detail and concreteness of the same is sufficient for the purpose for which they are intended.
- Geometric definition of the Digital Terrain Model (DTM), including the terrain structure and geographical obstacles that affect the propagation of sound (current state).
- Inclusion in the model of buildings and structures (current state).

- Allocation of the resident population to the buildings with possible affection due to noise.
- Inclusion in the model of all those factors that may affect the propagation of sound.
- Validation of data related to the characterization of noise sources (current status).
- Integration of noise sources in the model (current state).
- Noise modeling (current state), using the algorithms provided by 2002/49 / EC and 2015/996 / EC.
- Analysis of discrepancies obtained between the modeling performed with the two algorithms.

Once all the necessary operations have been carried out in the current state, modeling of the future state (port extension) will be carried out, based on the geometric definition provided in the port expansion project, as well as on the emitters' hypothesis and the configuration of buildings provided by the Port Authority of Melilla.

For its part, the Port authority of Melilla will perform an analysis of the results obtained in the modeling of the future expansion (hypothesis 1 and 2), in order to design hypothesis 3, with which it is expected to obtain an optimization of the results and the impact of noise on the population is minimized.

In addition, a report describing the methodology used to prepare the maps is required, detailing the algorithms used, simplifications made, starting data, etc.

1.5. STEP 4, IMPACT ASSESSMENT. DESCRIPTION OF THE TASK

The purpose of impact evaluation is to define the population affected by noise and, specifically, the definition of the population affected by noise that exceeds the admissible limit values defined by legislation, or other limit values that are defined.

To carry out this task, noise maps of the facade must be made, which, combined with the definition of the population assigned to each building, provide results in relation to the affected population.

Once the task has been completed, the methodological guide for impact assessment due to port noise (Guideline for a Common Port Noise Impact Assessment method, PNIA) must be drawn up, which must collect the lessons learned throughout the entire project. process. This Guide will include the collection of previous information, methodology for the elaboration of measurement campaigns, methodology for the definition of the model and the realization of the acoustic modeling itself, as well as the definition of the methodology for the evaluation of the affected population.

Finally, the methodology will be applied in the evaluation of noise impact of the expansion of the Port of Melilla, defining its viability and suitability, concluding the work with the realization of a revision of the document that gathers the new lessons learned.

1.6. STEP 5, NOISE MANAGEMENT. TASK DESCRIPTION.

The final task of action B3 is the definition and evaluation of alternatives in relation to noise management. The measures to be adopted must be specified in an Action Plan

The task must include the following actions:

- Analysis of noise impacts in sensitive areas and in situations where legal limits are exceeded.
- Definition of alternatives in relation to the adoption of corrective measures.
- Economic valuation of corrective measures.
- Assessment of indicators related to the effectiveness of corrective measures.
- Carrying out a cost-benefit analysis, in order to define the optimal alternatives.
- Drafting of the Action Plan against noise.
- The next step is the presentation of the Action Plan to the agents responsible for the noise emitters, in order to obtain corrections and new proposals or suggestions, which allow optimizing the Action Plan.
- Similarly, we will proceed with the rest of the population, with special emphasis on residents in the areas most affected by noise.
- Analysis of the results of public participation and the agents responsible for noise emitters.
- Drafting of the final version of the Action Plan against noise.