Gaetano Licitra
ARPAT

NEREiDE
Noise Efficiently REduced by recycle pavements

INNOVATIVE MONITORING ACTIVITIES ON IMPLEMENTATION URBAN SITES

Firenze 11 Luglio 2017
I progetti LIFE svolti in Italia sul tema dell’inquinamento acustico ambientale: risultati conseguiti, esperienze in corso e sviluppi futuri
Project objectives

• The project wants to investigate the use of new porous asphalt pavements and low noise surfaces composed by recycled asphalt pavements and crumb rubber from scrap tires.

• These materials will be mixed with binders at warm temperatures with specific benefits:
  1. to reduce the disposal of waste materials;
  2. to achieve a significant reduction of noise in urban areas and health improvement;
  3. to improve safety in urban areas;
  4. to reduce pollution due to asphalt laying.
Main actions

• The project is expected to lay:
  ➔ a first site 2400 m long, with 6 different 400 m long stretches, and
  ➔ a second site 2800 m long made of 7 different mixtures including rubber from end-of-life tyres (including PERS technology) and recycled asphalts.

• The effectiveness of the new pavements will be evaluated by measurements of surface characteristics, acoustical and psychoacoustical properties and by surveys submitted to the exposed population, based on a before-after evaluation

• Guidelines on monitoring activities will be developed in order to upgrade and to improve the methods to assess the effectiveness in urban areas.
• Standard and innovative monitoring techniques;
• Ante vs Post approach;
Technical actions

A. Preparatory actions

A1 State of the art Review

A2 Analysis of candidate sites and selection for experimental laying

B. Implementation actions

B1 Mix design of new warm asphalt mixtures and Life Cycle Assessment

B2 PERS mixture design

B3 Selection of the acoustical and psychoacoustical parameters based on the measurements performed on site

B4 Evaluation of structural properties of existing pavements

B5 Noise monitoring of pre-existing road surface on the chosen locations

B6 Psychoacoustical monitoring campaign and social survey in action planning sites (ante-operam)

B7 Structural specifications of new pavement sections

B8 PERS laying in Belgium
Technical actions

B9 Surfaces laying tender and their implementation
B10 Set up of the new methodology for urban Pass-By
B11 Development and realization of an in situ acoustical absorbing measurement method on a mobile laboratory
B12 Validation of the new methodologies for noise measurements
B13 Field evaluation of structural properties and surface characteristics of new test sections
B14 Noise monitoring of properties of the new realized surfaces
B15 Psychoacoustical monitoring campaign and social survey on new experimental surfaces (post operam)
B16 Analysis of all acquired parameters (structural, acoustical and psychoacoustical)
B17 Drawing up of guidelines on the implementation of new mitigation actions: tenders, design and monitoring

- As coordinator
- As contributor
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Implementation context

- A preliminary analysis was necessary to drive Regione Toscana in the selection of the 2 sites within all available ones from its action plan, following the list of most prioritized sites according the Italian regulations.

The consequent list is sufficiently long to require a proper filtering procedure and on-site visits.

- Following candidate sites analysis, the implementation context is defined in the SR 439 for the first implementation site with 6 stretches (approved) and in SR 71 for the 7 stretches site (feasibility to be verified).
Implementation context

• The selected areas characteristics:

<table>
<thead>
<tr>
<th>Sites</th>
<th>Inhabitants</th>
<th>Inhabitants exceeding limits</th>
<th>Sensitive buildings</th>
<th>AADT 2016</th>
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<tr>
<td></td>
<td></td>
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<td>SR71</td>
<td>5963</td>
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Implementation context

- The first site is going to be layed with the following mixtures in September:
B3 Selection of the acoustical and psychoacoustical parameters

Indicators and measurement protocols have been agreed, e.g. for acoustical:

<table>
<thead>
<tr>
<th>Method</th>
<th>Ante-Operam</th>
<th>Post-Operam</th>
<th>Indicators</th>
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<tr>
<td>Noise levels at road side</td>
<td>X</td>
<td>X</td>
<td>$L_{DEN}$, $L_{night}$, $L_D$, $L_N$, Spectrum, $L_{C-L_A}$, other (NA)</td>
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<tr>
<td>Urban Pass By</td>
<td>X (test)</td>
<td>X</td>
<td>To be defined</td>
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<td>CPX</td>
<td>X</td>
<td>X</td>
<td>$L_{CPX}$</td>
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<td>Absorption ISO 13472-1*</td>
<td>X</td>
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<td>Absorption spectra</td>
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<td>Running Absorption*</td>
<td>X</td>
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<td>To be defined</td>
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*Only on open pavements

*NEW*
B5 - Noise monitoring
ante operam first site

• 6 continuous monitoring stations – 1 week + 1 spot measurement
• CPX along 6 test stretches
• Analysis of CPX: report incoming
ARPAT will oversee laying and will learn laying techniques of PERS to understand best monitoring techniques.

ARPAT will also assist Toscana to verify technical requirements included in tender and eventual efficiency monitoring requirements to be specified in tender.

Experience suggests realization in September.

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Innovative techniques

• **SPB method** is not viable in urban context:
  - **So why?** to evaluate efficiency in terms of noisiness of single vehicle category
  - **So how?** ARPAT is developing a procedure that allows this evaluation in urban context, measuring single vehicles passing by at night without a manned measurement.

• **Absorption** coefficient is measured with ISO 13472 at single points:
  - **So why?** It is not enough to establish laying accuracy
  - **So how?** A device for continuous measurements with PV sensors is under development by CNR.
B10 – urban Pass-by

• Absence of free field conditions in urban context avoids the use of SPB standard approach.

• A new protocol is under development in order to obtain a SPB index in urban context taking data from night levels at continuous monitoring stations without manned measurements and gathering categories from traffic counter.

Steps forward:

• Test performed on available measurement data.

• New tests performed on 2 sites (in Pisa province).

• Analysis are ongoing to define protocol and indicators.
Urban pass-by (first test)

First results show the need of analysis of these differences.

Measurements in this site were not exactly in the same place so speed and road shape might have affected the results.
**B12 Validation of the new methodologies**

- Pass By in urban context procedure (B10) and in situ absorption device developed by CNR (B11) will be tested on mitigation sites where standard procedure values are available;
- Validated procedures will be used in post operam monitoring.

### Validation Process

- Test on mitigated sites
- Comparison with standard techniques
- Definition of measurement and analysis protocol

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B14 Post operam noise monitoring

- Indicators will be evaluated to represent post operam values of each special pavements.

- Measurements will be carried out at least 3 months after the laying, in winter 2018 (first site) and 2019 (second site).
B16 Analysis (structural, acoustical and psychoacoustical)

- Structural, acoustical and psychoacoustical campaigns are carried out simultaneously. → Correlate the results of these analysis to identify common trends within indicators and to evaluate differences between experimental pavements.

- In the 1st phase, ARPAT will verify if the lowering of noise levels acquired in noise monitoring will also correspond to a lowering of psychoacoustical indicators elaborated by CNR, and if requirements in terms of structural properties are still met.
B16 Analysis (structural, acoustic and psychoacoustical)

The results will lead the guidelines for implementing the 2nd step of the laying especially regarding homogeneity evaluations.

A comparison between the expected ranking of surfaces' performance and the on-site ones will point out possible gaps between theoretical considerations and on-site implementation.

Strategies for implementing the developed surfaces and methods in different contexts in order to enhance transferability of the project actions will be detailed.
### B17 Drawing up of guidelines

- The Guidelines will be constituted by 3 documents developed coherently by 3 partners on:

1. **the definition of the tenders** for the implementation of mitigation actions (edited by RegioneToscana)
2. the implementation of mitigation actions: **design and construction of low noise pavement sections** (edited by University of Pisa - DICI)
3. the implementation of new mitigation actions: **acoustics performances and monitoring methods** (edited by ARPAT)

#### Table: Timeline

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Dissemination: general

- ARPAT newsletter issues 3/11/16, 8/3/17
- Notice board installed
- Speech at Radio Cusano Campus 27/2/17
- 6/5/17 article on “Io Donna”, weekly magazine of newspaper
Dissemination: technical

- Paper at Convegno Nazionale Associazione Italiana di Acustica – Pavia June 2017

- Special session and papers at International Congress of Sound and Vibration – London July 2017
  Theme Area T15 Policy, Education and European Projects
  T15 SS2 – Life Nereide – EU Project
Dissemination: stakeholders

- Speach at Ecomondo 9/11/16
- Speach at Asphaltica 24/2/17
- Speach at Workshop - Ancona 6/7/17

Today

- Speach at Workshop - Firenze 11/7/17
Conclusions

NEREiDE project could be an opportunity to introduce a green economy example for an effective noise mitigation action in urban areas, using ELT.

About 3000 citizens will benefit of new pavements with different performances, evaluated by structural, acoustical and psychoacoustical parameters that will permit to drive up other future actions.

New methods will be developed and performed for a better evaluation of acoustical parameters, also focusing on the safety of the road (aquaplaning detection).

For the first time citizens will directly participate in the evaluation of performances with more than 2400 questionnaires before and after the pavement laying.
Thanks