Study of Porous Concrete Multifunctional Urban Surfaces

EIDEIC 2020

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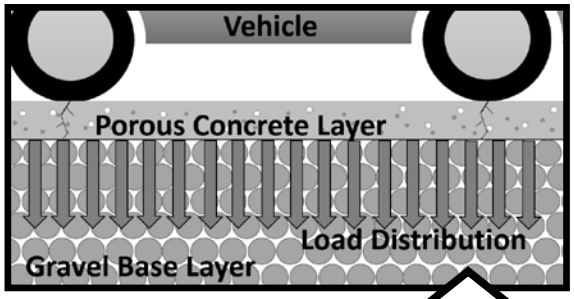
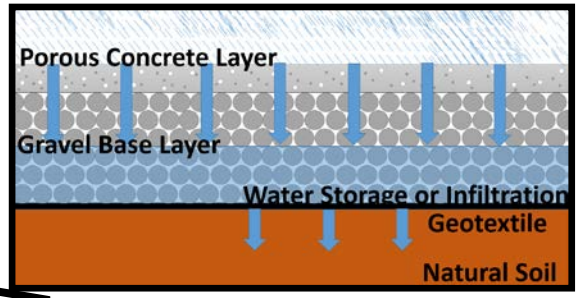
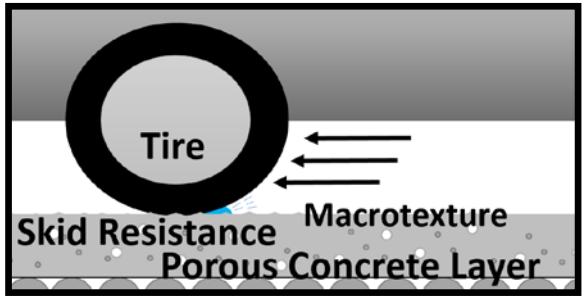
Introduction



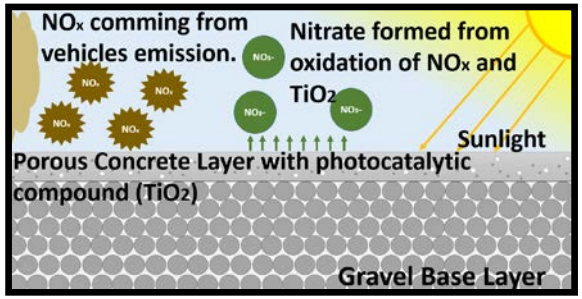
Traffic Resistance



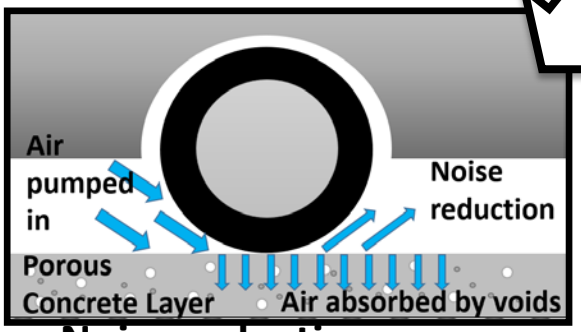
Permeability



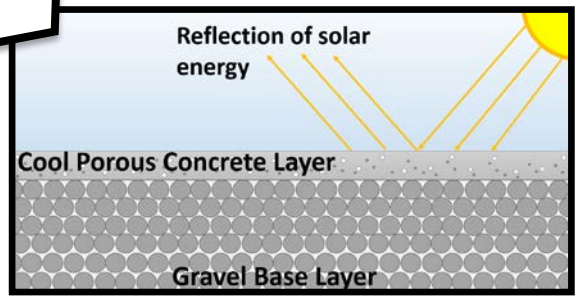
Skid resistance



Air quality improvement



Noise reduction



Temperature mitigation

Basic Skills	2. Science and Technique (bibliographic study)	3. Technology (tools and instruments)	4. Educational Activities (courses and seminars)	5. Results (publications)	6. Scientific Criticism (SWOT analysis)	7. Work Plan	8. Mobility	9. Funding	10. Ethics
CB11	✘	✘	✘						
CB12				✘		✘	✘		
CB13				✘					
CB14					✘				
CB15				✘			✘		
CB16				✘					✘

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CA01	✘	✘	✘						
CA02				✘					
CA03						✘		✘	
CA04			✘				✘		
CA05	✘	✘	✘						
CA06					✘				

Science and Technique (Bibliographic study)

- **State of the art review:** Over 700 reviewed to justify research and to identify areas and parameters.
- **Development of a new methodology to design porous concrete mixtures:** to improve characteristics.
- **Use of standards and laboratory techniques:** To compare results with other researches, materials, and adjust some norms to be used in porous concrete mixtures.

Technology (Tools and instruments)

- **Statistical analysis:** ANOVA, regression analysis, correspondance analysis, predictions, using softwares such as Microsoft Excel, Minitab, JMP and R.
- **Multi-criteria analysis:** To decide the best parameters and dosages.
- **Laboratory equipment:** To fabricate samples and perform tests (permeability, compression strength, indirect tensile strength, skid resistance…)

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CB11	✓	✓	✘						
CB12				✘		✘	✘		
CB13				✘					
CB14					✘				
CB15				✘			✘		
CB16				✘					✘

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CA01	✓	✓	✘						
CA02				✘					
CA03						✘		✘	
CA04			✘				✘		
CA05	✓	✓	✘						
CA06					✘				

Educational activities (courses and seminars)

Mandatory:

- EDUC basic training course.
- EDUC advanced training course.
- Laboratory regulation course (UNICAN and secondments).

Other courses:

- Sustainable Construction Course.
- Highway design with new materials.
- Green infrastructure and SUDS international course: Present and future of urban water management.
- Designing green infrastructure: Bioretention and permeable pavements.

Seminars:

- ERA career day (UNICAN, Santander, Spain).
- Sustainability in Pavement Construction (UNAM, Mexico city, Mexico).
- Fundamentals for innovative research in sustainable transportation (SIIV Winter School, Moena, Italy).

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CB11	✓	✓	✓						
CB12				✘		✘	✘		
CB13				✘					
CB14					✘				
CB15				✘			✘		
CB16				✘					✘

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CA02				✘					
CA03						✘		✘	
CA04			✓				✘		
CA05	✓	✓	✓						
CA06					✘				

Results (Publications)

Conference papers:

- Elizondo-Martínez, E.-J.; Andrés-Valeri, V.-C.; Juli-Gándara, L.; Rodríguez-Hernández, J. Multifunctional Porous Concrete Urban Pavements for a More Sustainable and Resilient Future. Proceedings 2018, 2, 1453.

- Elizondo-Martinez E.J., Andrés-Valeri V.C., Rodriguez-Hernandez J., Castro-Fresno D. (2020) A New Design Methodology for Improving Porous Concrete Properties to Achieve Multifunctional and Sustainable Pavements. In: Pasetto M., Partl M., Tebaldi G. (eds) Proceedings of the 5th International Symposium on Asphalt Pavements & Environment (APE). ISAP APE 2019. Lecture Notes in Civil Engineering, vol 48. Springer, Cham

International Research Conference on Sustainable Energy, Engineering, Materials and Environment

Published articles:

1. Elizondo-Martinez, E.J.; Andres-Valeri, V.C.; Rodriguez-Hernandez, J.; Castro-Fresno, D. Proposal of a New Porous Concrete Dosage Methodology for Pavements. *Materials* **2019**, *12*, 3100.

1. Elizondo-Martinez, E.-J.; Andrés-Valeri, V.C.; Jato-Espino, D.; Rodriguez-Hernandez, J. Review of porous concrete as multifunctional and sustainable pavement. J. Build. Eng. **2020**, 27, 100967.

1. Elizondo-Martínez, E.-J.; Andrés-Valeri, V.-C.; Rodríguez-Hernández, J.; Sangiorgi, C. Selection of Additives and Fibers for Improving the Mechanical and Safety Properties of Porous Concrete Pavements through Multi-Criteria Decision-Making Analysis. *Sustainability* **2020**, *12*, 2392.

1. Elizondo-Martínez, E.-J.; Andrés-Valeri, V.-C.; Juli-Gandara, L.; Rodríguez-Hernández, J. Multi-criteria optimum mixture design of porous concrete pavement surface layers. *International Journal of Pavement Engineering*, **2020.**

1. Elizondo-Martinez, E.J.; Tataranni, P.; Rodriguez-Hernandez, J.; Castro-Fresno, D. Physical and mechanical characterization of sustainable and innovative porous concrete for urban pavements. *Sustainability* **2020**, *12*.

Accepted/under review articles:

- Eduardo-Javier Elizondo-Martinez; Alexandra Ossa-Lopez; Jorge Rodriguez-Hernandez. Evaluation of the effect of different compaction methods on porous concrete pavements: Correlation with strength and permeability. **Journal of Materials in Civil Engineering.**

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CB12				✓		✗	✗		
CB13				✓					
CB14					✗				
CB15				✓			✗		
CB16				✓					✗

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CA02				✓					
CA03						✗		✗	
CA04			✓				✗		
CA05	✓	✓	✓						
CA06					✗				

Scientific criticism (SWOT analysis)

Personal

S STRENGTHS	W WEAKNESSES	O OPPORTUNITIES	T THREATS
• Tidy work space (laboratory). • Research and commitment with project and group. • Availability to help others.	• Self-organisation • Academic writing in english. • Shyness.	• Collaboration with other research groups in different universities and countries.	• Adaptation to a new country and culture.

Project

S STRENGTHS	W WEAKNESSES	O OPPORTUNITIES	T THREATS
• Good mechanical-hydraulic relation for use in pavements. • Light color (solar reflection). • Economic cost compared to conventional pavements.	• Cement production. • Economic cost compared to other methodologies (although results are better).	• Application of the developed methodology with alternative materials.	• Alternative materials to cement use. • New potential studies of porous concrete. • The place were is intended to be installed.

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CB13				✓					
CB14					✓				
CB15				✓			✗		
CB16				✓					✗

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CA04			✓				✗		
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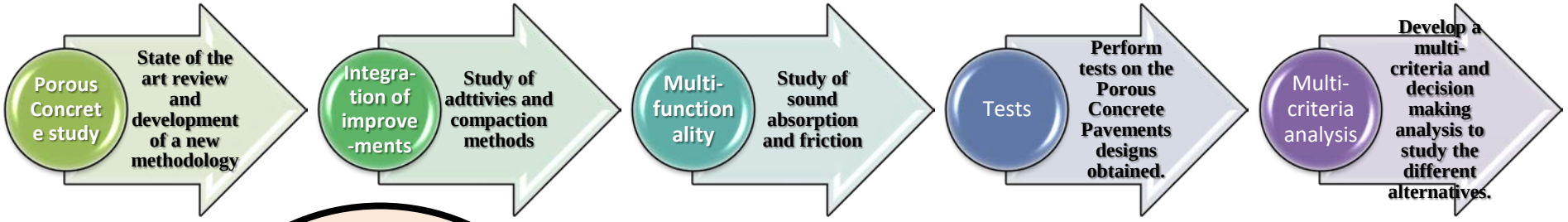
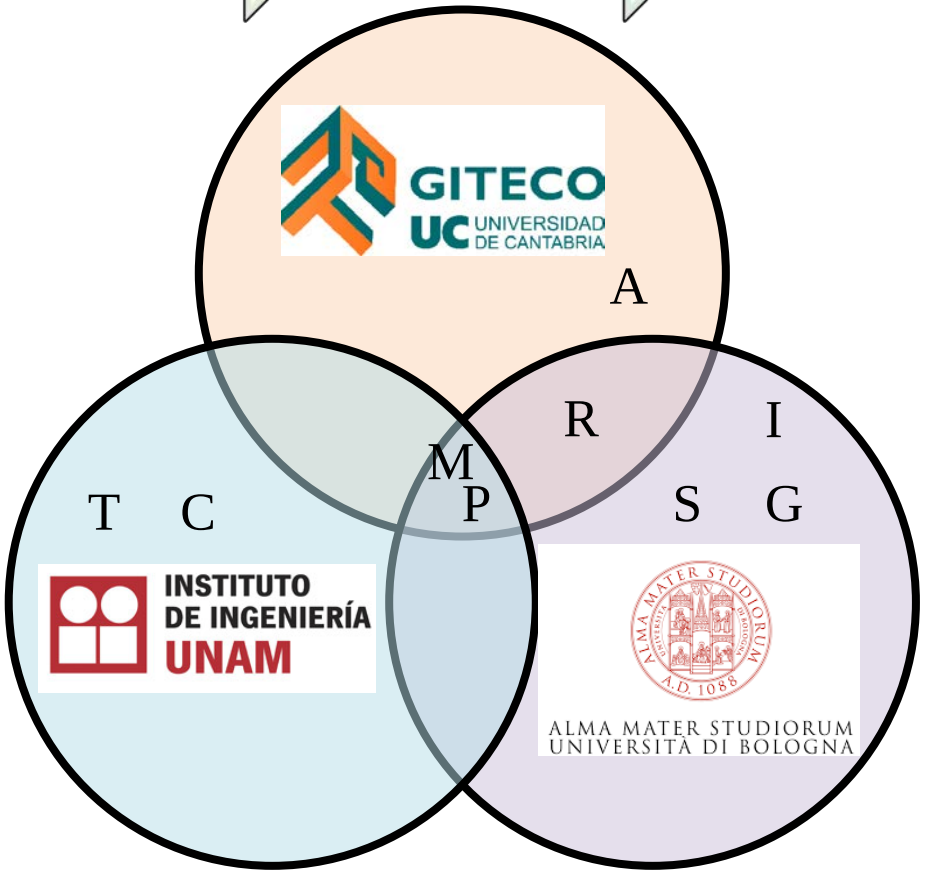
CA06					✓				

Work plan





Tests:
M- Mechanical resistance
P- Permeability
R- Skid resistance
S- Sound absorption
T- Titanium dioxide

Studies:
A- Additives study
C- Compaction methods
G- Geopolymer study
I- Magnetic resonance imaging

Progress: 100%
Thesis defense: July 2020.

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CA06					✓				

Mobility

International congresses:

- 2nd International Research Conference on Sustainable Energy, Engineering, Materials and Environment. **Oral presentation. Mieres, Spain, July 2018.**
- 5th International Symposium on Asphalt Pavements & Environment (APE). **Poster presentation Padova, Italy, september 2019**

Secondments:

- Engineering Institute of the National Autonomous University of Mexico (UNAM). **Mexico City, Mexico February-May 2019.**
- Civil, Chemical, Environmental and Materials Engineering Department (DICAM) of the University of Bologna. **Bologna, Italy, September-December 2019.**

Funding

- Support of the GITECO research group.
- Project Repara2.
- Engineering Institute UNAM.

Ethics

- Scientific research good practices code.
- Dissemination of results.

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Thank you for your attention

Time for questions