

Postdoctoral fellowship offer

Experimental and numerical physical characterisation of evapotranspiration systems to reduce the Urban Heat Island phenomenon

Starting period	May 2023
Duration	24 months
Localisation	ISA BTP Bordeaux, ENSEGID, 1 allée Fernand Daguin, Pessac (33), France Vinci Construction Services Partagés, Mérignac (33), France
Monthly salary before taxes	3180 €

Available position

The proposed position is supported by a collaboration between Vinci Construction's international research laboratory and the SIAME laboratory within the framework of the Isite E2S project, and may lead to a partnership chair position (tenure track) at the end of the contract.

ISA BTP is an Engineering school of the University of Pau, the position is available on the campus of Bordeaux. The University of Pau distinguished by the I-SITE label of excellence, with - Inria - INRAE - CNRS research consortium creates a synergy with local public and private organizations.

Research

Research project

In collaboration with VINCI Construction France and the SIAME laboratory of the University of Pau and the Pays de l'Adour (refers to the annex for more details), this research project aims to improve the understanding of the evapotranspiration phenomenon through experimental and numerical studies. To do so, the aim is to develop experimental devices to capture runoff water. Then, this water would be transferred to the surface of the device through the capillarity phenomenon to cool the ambient air and therefore reduce the Urban Heat Island effect. In order to validate the use of the devices, a physical characterisation of the materials should be done as well as a study of its performance. This program is composed of three main parts: state of the art, numerical study and experimental study.

The objective of the project is to improve the knowledge on the ability to develop a horizontal urban paving to reduce the Urban Heat Island Effect.

The design principle is to reproduced the hygrothermal behaviour of a natural soil: runoff water absorption, storage and evaporation of the surface water. The paving would be above a water storage unit. The runoff water could pass through the materials thanks to its porosity to reach this storage unit. Finally, through evapotranspiration the ambient air could be cooled.

Research program

State of the art: the first part of the program is to do a state of the art on systems and materials able to reproduce the evapotranspiration phenomenon at urban scale:

- State of the art on existing systems (Japan, France...);
- Feedback on existing systems and study on their performance;
- Impact of the evapotranspiration compared to the permeability and the albedo;
- Study of the operating conditions (water consumption in m² per day, flow rate, power consumption, ...)
- Study of the feasibility compared to the objectives;
- Study on stored water management on sanitary issues;
- Life cycle assessment of the system and quantification of the parameters impact.

Numerical study: The numerical study will be based on a capillary transfer model in a saturated or non-saturated porous media subjected to a temperature and pressure gradient develop by the SIAME laboratory. These topics will be studied:

- Impact of a material hydrophobicity on the capillary rise and the evapotranspiration;
- Impact of the void geometry on the capillary rise in a media with different pore dimensions;
- Definition of the working domains for bituminous materials;
- Measurement of the pore distribution on different systems;
- Impact of the pore distribution and the surface tension on the systems performance.

Experimental study: the experimental study aims at characterizing the evapotranspiration properties of Eurovia's materials. To do so, the SIAME laboratory develop an experimental system consisting of a material with its inferior surface in contact with water, a heat source heating its superior surface and insulated lateral surfaces to control the heat flux. These topics will be studied:

- Evapotranspiration phenomenon of Eurovia's materials (paving, bituminous materials, ...)
- Understanding the mechanism driving evapotranspiration, moist growth, ...;
- Monitoring over time of: permeability, the evapotranspiration;
- Performance of the evapotranspiration system.

Teaching

The hired person will teach 96h of classes for students in 4th and 5th year at ISA BTP Bordeaux (equivalent to Master degree students) on the following topics:

- Dynamic of solids;
- Introduction to finite elements;
- Advanced mechanics;
- Viscoelasticity properties of bituminous materials

Some classes could be done at ISA BTP Anglet. Moreover, the hired person will monitor some students in apprenticeship.

Required competences

- Ph.D in Civil Engineering or Material Science Engineering ;
- Experience in numerical simulation with finite elements methods;
- Experience in experimental study;
- Teaching experience;
- Fluency in English;
- Teamwork and communication skills.

Application

Only one .pdf file containing:

- CV;
- Motivation letter;
- Summary of research work (2 pages);
- Summary of scientific publications;
- Summary of teaching experience (1 page);
- Possible letters of reference;
- Contact information for people in the professional community (minimum of two) to be contacted.

Selection jury: ISA BTP, SIAME and Vinci.

Deadline for application: February 26th 2023 – Job interview: week of March 6th 2023

Applications must be sent to Rudy BUI, manager of ISA BTP Bordeaux: rudy.bui@univ-pau.fr

Annex – Work environment

Research environment

The **Laboratory for applied sciences in mechanics and electrical engineering SIAME** is composed of four research team. Among them, the Geomaterials and Structure team is based in Anglet (64, France). This team is specialised in geomaterials and structures behaviour subjected to extreme conditions. Some of its research topics are: materials behaviour subjected to high temperature, damage induced by coupled phenomena and its modelling, cementitious materials subjected to chemical solicitations, partially-saturated soil behaviour and its modelling, decarbonated solutions for constructions.

In a 4000 m² building and close to the Bordeaux-Mérignac airport, the **Research Centre of Vinci Construction** houses exceptional experimental devices (more than 150) aimed at developing research on tomorrow's roads. While a lot of research is dedicated to sustainable development (recycling, life cycle analysis, energy transition), innovative projects are also addressed such as future, connected roads, ... The research topics addressed cover all of the company activities on roads:

- Qualification and innovation on raw materials;
- Improving the knowledge and the different products and processes;
- Development of low-carbon technologies;
- Technical innovation;
- Road engineering and services;
- Future road.

Teaching environment

The **Institut Supérieur Aquitain Bâtiment et Travaux Publics ISA BTP** is a public engineering school belonging to the University of Pau and Pays de l'Adour. It has trained specialised engineers in buildings and public work for 25 years. The strong relationships of the school with companies maintained through numerous internships participates to the excellency of the students training. Recently, the school opened an antenna in Bordeaux with a new apprenticeship training which contributes to the school growth.