Radon Exhalation from Structural Walls in Heritage Buildings: Health Risks and Innovative Monitoring Approaches

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ABSTRACT

The presence of radon in historic buildings represents an emerging challenge for both public health and heritage preservation. Recent studies have shown that, in these constructions, the main source of radon is not only the ground but also the building materials that make up their walls, typically granite with high structural mass. This condition leads to high radon exhalation rates, resulting in elevated indoor concentrations and posing a significant risk to occupants such as faculty, students, administrative staff, museum guides, and tourists. Furthermore, the architectural nature and heritage protection of these buildings complicate the application of conventional mitigation techniques.
The authors have documented this issue in emblematic cases such as the Tower of Hercules (A Coruña), the Cathedral and several university buildings in Santiago de Compostela, as well as historic constructions located in the Sierra de Madrid. Recorded radon exhalation rates range between 150–250 Bq/m²·h, values that are two orders of magnitude higher than those observed in conventional building materials and comparable to soils with high natural radon concentrations.
To address this challenge, the RADIANT project (Radon Assessment and monitoring using robotics, Digitization, and Artificial Intelligence techNologies in heriTage buildings, PID2024-159276OB-C41), funded under the Spanish Research Plan, is being developed. In its initial phase, the project investigates experimental methodologies for measuring wall exhalation using specific chambers and associated gamma radiation detection. Complementarily, simulation models are being implemented in COMSOL Multiphysics to analyze radon behavior in different construction configurations. Once calibrated with experimental data obtained from demonstrator buildings, these models will be used to evaluate mitigation strategies tailored to the identified source and compatible with the high level of architectural protection of these structures.

Preliminary results lay the groundwork for developing non-invasive measurement protocols and the future integration of digital, robotic, and artificial intelligence technologies in radon monitoring within heritage buildings, contributing to both health protection and the conservation of architectural heritage.

KEYWORDS

Radon exhalation, Heritage buildings, Health risk, Simulation