



TITRE DE LA THESE:

Contribution of building ventilation conditions and mitigation actions on improving the TAIL IEQ rating score and well-being

Direction de thèse :

Valérie Héquet (IMT Atlantique, campus de Nantes, Fr) et Pawel Wargocki (Denmark Technical University, Dk)

Co-encadrant-es :

Cécile Raillard (Nantes Université, Fr) et Wenjuan Wei (CSTB, Paris, Fr)

Laboratoire(s): GEPEA

Equipe(s) de recherche : TEAM

Département(s) IMT Atlantique : DSEE

S'agit-il d'une thèse en cotutelle internationale ?

Oui **Non**

Si oui, organisme avec lequel la cotutelle est envisagée :

Le sujet proposé présente-il un caractère interdisciplinaire ?

Oui **Non**

Si oui, expliquer brièvement pourquoi (2 ou 3 lignes) : Le sujet proposé repose sur des disciplines du Génie des Procédés, de métrologie et de traitement de données, de statistique ainsi que sur des disciplines plus transversales de sciences sociales.

La source du co-financement est-elle identifiée ?

Oui **Non**

Si oui, préciser quel co-financement est envisagé : co-financement CSTB

Autres informations :

Le projet porté dans cette thèse s'inscrit dans une démarche globale de développement de compétences et accroissement de la visibilité de l'IMT au sein de la communauté nationale et internationale travaillant dans le domaine de la qualité environnementale intérieure des bâtiments. Cette démarche s'illustre par des projets de recherche collaboratifs, dans lesquels IMT Atlantique est partie prenante, passés, en cours ou déposés, tels que les projets MITRIDAT, PHARAON et ERR-IN, ou travaux de thèse tels que le travail mené par Minh-Tien TRAN en collaboration avec le CSTB et DUT.

Contexte ou état de l'art scientifique :

Along different EU initiatives, the Mission on Adaptation to Climate Change has been launched to support EU regions, cities, and local authorities in their efforts to build resilience against the impacts of climate change. A resilient indoor environment relates to the ability of a building to maintain or improve the indoor environmental quality (IEQ) facing climate change.

In France, In 2021, the French Government, represented by the Ministry of the Ecological Transition and the Ministry of Solidarity and Health launched the 4th National Health Environment Plan (PNSE4). The PNSE4 makes indoor air quality a requirement to be met, as it has been identified by public authorities as a major health and social expectation, as well as poor indoor environmental quality (IEQ) leads to discomfort and health problems and, consequently, lower productivity and increased absenteeism in working environments. In addition to this, a recent ANSES report itemizes mechanisms of mass transfer and the effect of ventilation on IAQ by pollutant categories and suggests that outdoor air pollutants must be systematically considered for optimal IAQ management. The air quality in the building is largely conditioned by the quality of the outside air and its contribution on health appears highly significant.

Many studies have developed IEQ metrics to evaluate buildings' performance and occupants' perceived comfort. These metrics have been used in standards, such as EN16798, and certifications such as Level(s), for assessments under present building and climate conditions. To anticipate the influence of climate change on the indoor environment, the IEQ metrics and the assessment methods should evolve to account for perception of building users and the impact of indoor air quality (IAQ) improvement solutions.

Objectifs de la thèse :

This research work aims to implement protocols for assessing the impact of building ventilation schemes and additional technical and non-technical mitigation solutions on improving air quality, based on assessment indicators, and to confront IEQ rating schemes to demonstrate their ability to assess improvements in IEQ and air quality.

The proposed thesis focuses on the IAQ component of the TAIL rating scheme. The questions to be addressed are 1) is it possible to recommend ventilation and remediation scenarios according to building typology and use, 2) is it possible to demonstrate IAQ and IEQ improvement through the use of a global rating scheme like TAIL rating system under real conditions?

The program of the work can be divided into several objectives:

- Drawing a flowchart of possible solutions available to improve IAQ while offering user comfort in terms of thermal and airflow perception. Based on a complete literature review, all possible combinations of ventilation (natural, mechanical, HVAC, opening doors and/or windows) and air purification systems (included in HVAC, standalone air cleaners, using mono or combined techniques, etc.) will be surveyed.
- Carrying out measurement campaigns and testing the selected scenarios (including blank tests when buildings are unoccupied) in two higher education establishments. At the meantime, measurements will be carried out in accordance with TAIL protocols, and additional sensors will be used to monitor parameters such as temperature, relative humidity and CO₂ levels, enabling specific events to be identified. These measurement campaigns will be carried out during both heating and non-heating periods. From these measurements, TAIL indicators will be estimated (light and noise indicators not considered).
- Assessing the efficiency of tested combinations of ventilation and air purification systems on IAQ, both from physico-chemical measurements and from satisfaction and perception questionnaires. A questionnaire, based on the IEQ questionnaire of the CBE without questions concerning acoustics and lighting, will be used to collect users' perceived indoor environment quality and satisfaction. A particular focus will be made on the users' perception and satisfaction before and after implementation of IAQ improvement solutions.
- Correlating perceived indoor environment quality and satisfaction with evaluated TAIL indicators. From the obtained results, improving the TAIL indicators for future protocols assessing indoor environment quality for more resilient buildings and occupants' well-being.

Compétences attendues du ou de la candidat·e :

The candidate must show an interest in experimental work and demonstrate knowledge and skills in physico-chemical analysis and statistical data processing. Writing and communication skills are essential. Knowledge in process engineering would be appreciated.