44th AIVC
12th TightVent & 10th venticool Conference

Retrofitting the Building Stock: Challenges and Opportunities for Indoor Environmental Quality

CONFERENCE ORGANISERS

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the platform for resilient ventilative cooling

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October **9-10** 2024

Croke Park **Dublin** Ireland

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FINAL **PROGRAMME**

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Congress Venue

Croke Park Jones' Road, Dublin 3, D03 E5Y8, Ireland

➜ Venue website

Registration Desk Hours

Registration Desk will be open during the following dates and times:

- **Tuesday, October 8, 2024: 18:00 – 20:00 @Croke Park Hotel**
- **Wednesday, October 9, 2024: 08:00 – 18:30**
- **Thursday, October 10, 2024: 08:30 – 18:00**

Please note that onsite registration will be provided (upon availability) via the conference website https://aivc2024conference.org/
Payment will be available only via online payment. No cash registration payment available.

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Poster display information

- Posters should be set up on **Wednesday 9 October, 2024 from 09:00**
- Dismantling of posters should be finished by **Thursday 10 October 2024 from 16:30 till 18:00**

Professional Congress Organizer and Organizers have no liability for posters left behind

Poster dimensions

A0) size, 120CM Height x 80CM Width

Poster presentation session

Wednesday October 9, 2024 at 18:30 – 20:30

Authors are kindly requested to be in front of their poster to be able to reply to any questions

Long & Short Oral Presentation information

- Long Oral Presentations (indicated within the programme) are expected to last 12 minutes; another 3 minutes are foreseen for questions and answers (15 minutes in total)
- Short Oral Presentations (as noted in the program) should be limited to 5 minutes. Questions and answers will be addressed during the poster session

Social Events

Welcome Reception

Tuesday 8 October, 2024
19:00 – 20:00
Croke Park Hotel

Poster presentations – Industry stands – Cocktail reception with snacks

Wednesday 9 October, 2024
18:30 – 20:30
Croke Park Stadium

Gala Dinner

Thursday 10 October, 2024
19:00 – 23:00
URBAN BREWING (entrance only by ticket)

Tuesday October 8th, 2024

18:00-20:00	Registration
19:00	Welcome Reception

Wednesday October 9th, 2024

08:00-09:00	Registration

HOGAN MEZZANINE SUITE

09:00-10:30 Opening - Plenary session

Chairs: **Peter Wouters** *(INIVE vzw, Belgium),* **Marie Coggins** *(University of Galway, Ireland)*

Welcome on behalf of AIVC, venticool, TightVent
Arnold Janssens, *INIVE vzw – AIVC Operating agent - Ghent University, Belgium*
Peter Wouters, *AIVC Operating agent, Belgium*

Welcome on behalf of the Sustainable Energy Authority of Ireland
Ciaran Byrne, *Director of National Retrofit, Ireland*

The Recast Energy Performance of Buildings Directive: a green light for clean air?
Ciarán Cuffe, *Green Party, Ireland*

What do we know about the current state of indoor air in buildings and associated human health effects?
Corinne Mandin, *Institute for Radiation Protection and Nuclear Safety (IRSN), France*

Risk mitigation for indoor air quality on example of construction products
Ana Maria Scutaru, *German Environment Agency, Germany*

Guidance on damp and mould: understanding and addressing the health risks in the home
Sani Dimitroulopoulou, *UK Health Security Agency, United Kingdom*

10:30-11:00	Coffee Break

Wednesday October 9th, 2024

HOGAN MEZZANINE SUITE

11:00-12:30

Session 1A - Topical Session: Exploring Challenges and Opportunities in Decarbonizing Buildings through Building Ventilation (Workshop)

Chairs: **Nuria Casquero-Modrego** *(LBNL, United States of America)*
Iain Walker, LBNL *(United States of America)*

As the urgency to address climate change intensifies, the decarbonization of buildings emerges crucial for substantial CO_2 reduction. This imperative task, particularly relevant for the ventilation sector and needs a holistic approach.This workshop will delve into the challenges and opportunities of implementing effective building ventilation for building decarbonization with a focus on existing buildings. Participants will explore current hurdles and potential breakthroughs, fostering dynamic discussions. The workshop evaluates the important role of regulations and policies in promoting decarbonization efforts within building ventilation. Emerging technologies will spotlight their potential to enhance ventilation for decarbonization purposes through cutting-edge solutions. The discourse widens to encompass social and behavioral aspects, recognizing the need for holistic approaches to promote sustainable ventilation practices. This collaborative workshop serves as a platform for dynamic discussions on cutting-edge innovations, regulatory frameworks, and global best practices. Through active promotion of collaboration among experts, the session aims to bridge understanding gaps, and foster a comprehensive exchange of ideas. Ultimately, the event aspires to be a catalyst for transformative change in sustainable building ventilation practices on a global scale.
This will be an interdisciplinary, facilitated workshop with break-out groups and discussion, where participants will consider questions to understand how building ventilation is currently impacting in this energy transition, and how we should address our work and future research.
The objectives of the session include:

- *Identifying the potential approaches, we can use to reduce CO_2 emissions related to building ventilation.*
- *Outlining current gaps and/or barriers for building ventilation strategies to meet climate goals and develop suggestions on how to address those gaps and/or barriers.*
- *Understanding why these strategies are necessary for meeting the climate goals and how we can improve them and integrate them into our projects.*

Introduction
Iain Walker & Nuria Casquero-Modrego, *LBNL, United States of America*

Retrofitting and Ventilation: Challenges, Benefits and Lessons Learnt
James McGrath, *Maynooth University, Ireland*

Decarbonization Within the Path of Sustainable Development Goals
Constanza Molina, *PUC, Chile*

Group discussion

Summary and conclusions

NALLY SUITE

11:00-12:30

Session 1B - Long Oral Presentation Session: Building airtightness

Chairs: **Pilar Linares-Alemparte** *(IETcc-CSIC, Spain)*
Manfred Plagmann *(Branz, New Zealand)*

Evaluating the airtightness of the existing GB housing stock
Ben Roberts, *Loughborough University, United Kingdom*

Building airtightness for renovations Leaflets (Germany)
Stefanie Rolfsmeier, *Blowerdoor Gmbh, Germany*

Proposal for improving the linear regression method and uncertainty calculation in building airtightness tests
Valérie Leprince, *Cerema, France*

Test facility for building envelope leakage type analysis and improvement of acoustic and thermographic airtightness measurement methods
Markus Diel, *Deutsches Zentrum Für Luft- Und Raumfahrt, Germany*

Air Pressure Differences over the Building Envelope: Case Studies
Kevin Verniers, *Agoria/Renson, Belgium*

Examining the Impact of Improving the Airtightness of the Building Envelopes on Differential Pressures and Contaminant Dispersion in Temporary Negative Pressure Isolation Rooms
Jooyeon Roh, *Seoul National University, Republic of Korea*

DAVIN SUITE

11:00-12:30

Session 1C - Topical Session: Ventilative Cooling – latest and greatest. Importance of early design in the world of overheating mitigation using ventilative cooling

Chairs: **Christoffer Plesner** *(VELUX A/S, Denmark)*
Jannick Roth *(WindowMaster International A/S, Denmark)*

This dynamic session will delve into the latest breakthroughs for overheating mitigation using ventilative cooling and cutting-edge findings from new projects. Experts from various disciplines will converge to explore the impact, applications, and advancements on how to design ventilative cooling systems in upcoming standards, while also leaving good time for discussions in the latter part of the session.

The purpose of this session is to:

1. *Give an overview of how ventilative cooling fits in the standardisation world. What are the gaps and how can it fit in future European standards.*
2. *Give examples on how to apply the design route in the upcoming ventilative cooling standard for your next project. We will go through the various design steps in the standard and explain the rationale behind these. These should secure a robust and resilient VC design.*
3. *Highlight the differences between the theoretical predictions using the VC potential method/tool versus data from a case study. This will enlighten the participants and make them aware of the potential of the method, and more importantly, become aware of its limitations.*
4. *Have an interactive discussion on the design paths to secure an optimal VC design and receive input from the audience on subjects to be included in these design paths.*

The objective of this session is to provide participants with a comprehensive understanding of the latest developments in ventilative cooling evolutions, while also having time to contemplate on relevant questions.

Wednesday October 9th, 2024

11:00-12:30

Introduction
Christoffer Plesner, *VELUX A/S, Denmark*
Jannick Roth, *WindowMaster International A/S, Denmark*

A comprehensive overview of ventilative cooling and its role in the standardisation
Christoffer Plesner, *VELUX A/S, Denmark*
Jannick Roth, *WindowMaster International A/S, Denmark*

Early Stage Design of VC: A standardised approach to improve robustness and avoid vulnerability lock-in at the later design stages
Paul D. O'Sullivan, *Munster Technological University, Ireland*

Design of ventilative cooling systems using Ventilative cooling standards; design steps within the flow diagram
Beat Frei, *FREI WÜEST EXPERT INGENIEURBÜRO, Switzerland*

Discussions on relevant questions and workshop mode
Christoffer Plesner, *VELUX A/S, Denmark*
Jannick Roth, *WindowMaster International A/S, Denmark*

12:30-13:30 Lunch Break

HOGAN MEZZANINE SUITE

13:30-14:45

Session 2A - Long Oral Presentation Session: Smart ventilation strategies

Chairs: **Willem de Gids** *(ventGuide, The Netherlands)*
Gaëlle Guyot *(Cerema, France)*

Health-Equivalent Energy Efficiency Factor, Combined Metric of Harm and Energy Use
Klaas De Jonge, *Ghent University, Belgium*

The protection from harm to populations of people provided by Exposure Limit Values
Benjamin Jones, *University of Nottingham, United Kingdom*

IEQ and energy performance of residential smart ventilation strategies in France
Raissa Andrade, *Cerema, France*

Optimization of airflow rate in a displacement-ventilated room to minimize particle inhalation risk and control energy consumption
Makoto Tsubokura, *Kobe University, Japan*

Adaptive comfort technology for temperature control in balanced ventilation systems
Bart Cremers, *Zehnder Group, The Netherlands*

NALLY SUITE

13:30-14:45

Session 2B - Topical Session: Durability of the building airtightness

Chairs: **Bozena Dorota Hrynyszyn** *(NTNU, Norway)*
Valérie Leprince *(Cerema, France)*

Air leakages have an increasing impact on the overall energy performance of new buildings. Therefore, since the early 2000's, regulations in many countries explicitly account for airtightness, sometimes with mandatory requirements, as a consequence of Europe's ambition to generalize nearly zero energy buildings by 2030. However, having a requirement on building airtightness is relevant only if the airtightness level is durable. Nevertheless, studies have shown that a mandatory level of airtightness leads to last-minute taping and mastic setting that is most probably not durable. The durability of airtightness products and assemblies at mid- and long-term scales is, therefore, a pending question. Indeed, this subject remains very complex, since it covers in the meantime:

- *the modelling of the mechanisms of buildings' and products' loads and deformations,*
- *the accelerated ageing in laboratory-controlled conditions and,*
- *the performance characterization from field measurements results.*

In the past years, several studies have focused on this issue using two different approaches. Some studies seek to characterize the evolution over time of the airtightness by field measurements in real buildings.The other studies are based on laboratory measurements in order to test the accelerated ageing of airtightness products.
Two topical sessions have already been organised on this subject in 2017 and 2022, the objective of this one is to give an update of recent works performed on this subject, more precisely on what happen the first year of life of the building and on the impact of implementation conditions.

Introduction: presentation of the session
Valérie Leprince, *Cerema, France*

Impact of dust build-up on building airtightness durability - preliminary results of the Durabilitair 2 project (2021-2025)
Andrés Litvak, *Cerema, France*

On the potential of HAMSTER's bi-climatic chamber for testing building component airtightness durability
Martin Prignon, *Buildwise, Belgium*

Research on airtightness durability in Norway
Bozena Dorota Hrynyszyn, *NTNU, Norway* & **Tore Kolstad Linløkken,** *NTNU, Norway*

Evaluating the long-term performance of air barrier systems in modern buildings
(Short Oral Presentation)
Sean O'Brien, *Simpson Gumpertz & Heger, Inc., United States of America*

Wednesday October 9th, 2024

DAVIN SUITE

13:30-14:45 — Session 2C - Long Oral Presentation Session: Climate change resilience

Chairs: **Hilde Breesch** *(KU Leuven, Belgium)*
Yun Gyu Lee *(Korea Institute of Construction Technology, Republic of Korea)*

Intervention study of climate correlation model predictions for occupant control of indoor environment
Maria Kolokotroni, *Brunel University London, United Kingdom*

Assessing the level of adaptation to heat waves in Parisian housing
Letizia Roccamena, *CSTB, France*

Are Irish Low Energy School Designs Resilient Against Overheating?
Elahe Tavakoli, *MTU, Ireland*

Summertime Resilience in an L-Shaped Long-Term Care Facility with Mixed Natural Ventilation and Pressurized Corridors
Chang Shu, *National Research Council Canada, Canada*

Optimizing design of retirement homes concerning the indoor environment, energy efficiency, and climate change resiliency
Jakub Kolarik, *Technical University of Denmark, Denmark*

14:45-15:00 — Room Change

HOGAN MEZZANINE SUITE

15:00-16:30 — Session 3A - Topical Session: Performance-based IAQ regulations in dwellings: present and future

Chairs: **Sonia García-Ortega** *(IETcc-CSIC, Spain)*
Pilar Linares-Alemparte *(IETcc-CSIC, Spain)*

The main objective of the topical session is to highlight the importance of performance-based regulations to achieve adequate IAQ in line with advanced energy efficiency requirements.
Performance-based regulations enable high quality standards by characterising and quantifying the required performance of buildings. These performances can be met in a flexible way with different solutions, thus allowing for innovation. In contrast, prescriptive regulations impose fixed solutions in order to comply with the necessary requirements, which can be a barrier to innovation. Furthermore, performance-based regulations allow requirements to be met in a more optimised and tailored way adapted to the particular conditions of each case.
Regarding IAQ requirements, performance-based regulations promote the use of smart ventilation systems, which facilitates the desired balance between IAQ and energy efficiency.
The topical session will provide an update on the state of the art of IAQ regulations in dwellings. It will review the most advanced performance-based regulations in Spain and France, and highlight obstacles and difficulties in their implementation, such as their use in naturally ventilated dwellings. Additionally, an IAQ estimation model for naturally ventilated dwellings will be presented to help overcome this issue. Finally, potential future changes to the performance-based IAQ regulations will be discussed, including new challenges such as the consideration of harm to people.

15:00-16:30

The importance of performance-based regulations for residential ventilation. State of the art
Gaëlle Guyot, *Cerema, France*

The IAQ performance-based regulation in Spain: description, identified problems for its application, and foreseen changes
Pilar Linares-Alemparte, *IETcc-CSIC, Spain*

Assessing IAQ in existing residential buildings within a performance-based regulatory framework through a predictive model
Sonia García-Ortega, *IETcc-CSIC, Spain*

Methodology to define new performance indicator for ventilation regulation in France
Valérie Leprince, *Cerema, France*

How a harm budget can be used to regulate Indoor Air Quality in Dwellings
Benjamin Jones, *University of Nottingham, United Kingdom*

Uncertainty of IAQ and energy performance schemes for residential smart ventilation
Baptiste Poirier, *Cerema, France*

NALLY SUITE

15:00-16:45

Session 3B - Long Oral Presentation Session: IAQ in schools

Chairs: **Marie Coggins** *(University of Galway, Ireland)*
Simon Jones *(Air Quality Matters, Ireland)*

The Influence of Outdoor Conditions on Indoor Air Quality: Case Study of Norwegian Schools
Azimil Gani Alam, *Norwegian University of Science & Technology, Norway*

Particulate matter in UK school classrooms – building an evidence base for improving classroom air quality
Alice Handy, *Imperial College London, United Kingdom*

Impact of filtration class and airflow control on the indoor airborne particle in a nursery school
Mirela Robitu, *Cetiat, France*

Application strategies and effectiveness of CO2 signal lights for improving indoor air quality in classrooms
Simon Beck, *University of Innsbruck, Austria*

Achieving suitable airflow rate in New Zealand classrooms: a CFD approach to inform on potential retrofitting solutions
Mikael Boulic, *Massey University, New Zealand*

Cognitive well-being in classrooms: A holistic investigation into Indoor Environmental Quality in New Zealand elementary schools
Mikael Boulic, *Massey University, New Zealand*

Thermal comfort of adolescent children in classrooms: Some reflections on the state-of-the-art
Asit Kumar Mishra, *University College Cork, Ireland*

Wednesday October 9th, 2024

DAVIN SUITE

15:00-16:30

Session 3C - Topical Session: Resilient Indoor Thermal Environments: Findings & Future Policy from an Irish National Study on Non-Residential Buildings

Chairs: **Adam O'Donovan** *(Munster Technological University, Ireland)*
Paul D. O'Sullivan *(Munster Technological University, Ireland)*

The following session will discuss the outcomes of a 3 year national study on indoor thermal resilience and overheating risk in low energy non-residential buildings. The study, entitled project RESILIENCE, is near completion and this topical session will form the basis to discuss the policy implications around overheating and thermal resilience in non-residential buildings in Ireland and for temperate climates more generally. The project monitored overheating risk in 33 high performance non-residential buildings and evaluated factors of influence in building designs that were thought to have a high leverage effect on overheating. The aim is to foster an opportunity for international experts to debate the appropriate direction of regulations and policy to reduce vulnerability lock-in in building designs, using Project RESILIENCE as a framework for the discussion. There will be two collaborative engagement parts to the session; a workshop and an open discussion aided with interactive tools to collect opinions, ideas, recommendations from participants. The outcome will be a position on how research can better support policy initiatives that are needed to address thermal vulnerability in the built environment.

The session will have four key objectives including:

- *To explore how designers can achieve indoor thermal resilience in the context of non-residential buildings and national regulations.*
- *To critically evaluate existing vulnerabilities in a sample of high performance low energy Irish buildings and assess the presence of any recurring trends.*
- *To develop a position on the future direction of regulatory policy designed to mitigate overheating in temperate climates and also assess adaptation measures.*

INTRODUCTION:

Project RESILIENCE: Overview & Workshop Planning
Adam O'Donovan, *Munster Technological University, Ireland*

Overheating Mitigation Policy: Current Trends and Future Outlook
Paul D. O'Sullivan, *Munster Technological University, Ireland*

WORKSHOP:

Assessing the Vulnerability of Existing Building Design related to Regulations: Ireland as a case study
Paul D. O'Sullivan, *Munster Technological University, Ireland*

– Describe the planned activity
– Break into groups
– Complete activity
– Findings from workshop

STUDY RESULTS:

Indoor Thermal Resilience in Irish Schools, Office and Healthcare Buildings
Adam O'Donovan, *Munster Technological University, Ireland*

Overall outcomes from the project and next steps
Adam O'Donovan, *Munster Technological University, Ireland*

DISCUSSION:
Connecting Resilient Overheating Mitigation Policy to Research

CLOSE: Closing Summary

16:30-17:00 Coffee Break

HOGAN MEZZANINE SUITE

17:00–17:50

Session 4A - Short Oral Presentation Session: IAQ and ventilation

Chairs: **Wouter Borsboom** *(TNO, The Netherlands)*
Pilar Linares-Alemparte *(IETcc-CSIC, Spain)*

Filling the Indoor Air Quality Data Gap: Research challenges and opportunities
Grainne Mcgill, *University Of Strathclyde, United Kingdom*

Trends in Indoor Environmental Quality in Non-Domestic Energy-Efficient Buildings in Ireland: the BENEFIT Project
Jorge Fernandes, *University Of Galway, Ireland*

Performance of smart ventilation in residential buildings: A literature review
Daniela Mortari, *Cerema, France*

Utilization of ventilation systems to maintain selected environmental comfort parameters at the required level
Joanna Kubiak, *Poznan University Of Technology, Poland*

Assessment of PM2.5 particulate matter exposure under different ventilation and air filtration strategies in a kindergarten
Manuel Ruiz de Adana, *Universidad de Córdoba, Spain*

Log-normal distribution for radon measurements in one room
Joanna Kubiak, *Poznan University Of Technology, Poland*

Sensor based: ventilation performance in cultural centres in Flanders
Niels De Kempeneer, *Flemish Planning Bureau for the Environment and Spatial Development, Belgium*

Estimation of Airborne Particle Removal Efficiency in Personal Isolation Room based on Full-scale Experiment
Shinhye Lee, *Seoul National University, Republic of Korea*

Numerical simulation guided design of novel experimental chamber used to assess the effectiveness of ventilation strategies with hygro-regulated air terminals
Jean-Paul Harouz, *Cerema, France*

Assessment of in-situ aging and maintenance impact on Relative Humidity-Controlled Mechanical Extract Ventilation (RH-MEV) Systems: A Case study in multi-family social housing buildings
Juan Rios, *AERECO, France*

Wednesday October 9th, 2024

NALLY SUITE

17:00–17:45

Session 4B - Short Oral Presentation Session: IEQ, HVAC and airtightness

Chairs: **Willem de Gids** *(ventGuide, The Netherlands)*
Iain Walker *(LBNL, United States of America)*

Experimental evaluation of the bidirectional filtration efficiency of respirators and face masks against airborne particles during cyclic breathing
Dennis Derwein, *RWTH Aachen University, Germany*

Assessment of the indoor/outdoor dynamic of some air pollutants in three buildings located in the valley city of Chambéry, France (Student Competition)
Diana Decilap, *Cerema, France*

Temperature, Relative Humidity and Indoor Air Quality in Office Buildings and its Subjective Evaluation
Yoshinori Honma, *National Institute of Public Health, Japan*

Using Indoor Carbon Capture System in Hotels and Schools to support onsite decarbonization (Student Competition)
Sunny Lam, *Carbon Capture Solutions, Hong Kong*

Semantics-based expert system for fault detection in air handling units
Sebastian Blechmann, *RWTH Aachen University, Germany*

Review and analysis of existing diagnostic methods for characterizing air transfers in existing homes
Bassam Moujalled, *Cerema, France*

A novel method for the characterization of infiltration airflow using infrared thermography
Diego Tamayo-Alonso, *Valladolid University, Spain*

On the estimate and reduction of the zero-flow pressure estimation uncertainty in fan pressurization measurement
Martin Prignon, *Buildwise, Belgium*

Assessment of thermal environment and thermal comfort in air traffic control towers
Bassam Moujalled, *Cerema, France*

DAVIN SUITE

17:00–17:45 — Session 4C - Short Oral Presentation Session: Natural ventilation and cooling

Chairs: **Sonia García-Ortega** *(IETcc-CSIC, Spain)*
Bjarne Wilkens Olesen *(Technical University of Denmark, Denmark)*

Design and performance verification methods for naturally ventilated buildings from the experience of ABC 21 EU Project
Izabella Milto, *Polytechnic University of Milan, Italy*

A Longitudinal Study to Assess Indoor Environmental Quality in Naturally Ventilated Dwellings
Ibrahim Alhindawi, *University of Galway, Ireland*

Particle concentration and indoor air quality in naturally ventilated patient rooms-A field study in a hospital building in Bucharest, Romania
Mohamed Elsayed, *Tampere University, Finland*

Experimental assessment of a resilient air-cooling system under extreme heat events in southern European climate conditions (Student Competition)
María Jesús Romero-Lara, *University of Cordoba, Spain*

Direct adiabatic cooling systems – Resilience to climate change for industrial building applications in a Mediterranean climate
Antoine Breteau, *University of La Rochelle, France*

Proposal of a design method for Radiant Ceiling Cooling System using CFD analysis (Student Competition)
Rio Matsumoto, *The University of Kitakyushu, Japan*

Incomplete resistance; ventilation, mould growth and built in furniture in a 1930's Dublin clinker concrete apartment building.
Gearoid Carvill, *TUD, Ireland*

Exploring the use of TABS and Peak-Shift Control in Office Buildings (Student Competition)
Honoka Kyozuka, *The University of Kitakyushu, Japan*

Room integrity tests and registration of the actual situation regarding the fire protection and holding times in fire compartments in Greece
Theodoros Sotirios Tountas, *FUV, Greece*

HOGAN MEZZANINE SUITE

17:45–18:30 — Industry Presentations

Chairs: **Valérie Leprince** *(Cerema, France)*
Iain Walker *(LBNL, United States of America)*

Industy Presentations: **Acin Instrumenten, Aranet, BCCA, BlowerDoor, Build Test Solutions Ltd, DooApp, Lindab, Mez-Technik, Renson, Retrotec, WindowMaster**

18:30–20:30 — Poster presentations – Industry stands – Cocktail reception with snacks

Thursday October 10th, 2024

HOGAN MEZZANINE SUITE

09:00-10:30

Session 5A - Long Oral Presentation Session: IAQ assessment

Chairs: **Marie Coggins** *(University of Galway, Ireland)*
Susan Vickers *(Cluid Housing, Ireland)*

Assessing the Prediction of Human CO2 Emissions for IAQ Applications
Oluwatobi Oke, *NIST, United States of America*

Quantifying ventilation rates in heterogeneous rooms based on point measurement(s) of carbon dioxide
Joshua Finneran, *Loughborough University, United Kingdom*

Airborne transmission in a meeting room with mixing and displacement ventilation
Risto Kosonen, *Aalto University, Finland*

Control of airborne particle concentrations in a meeting room with stand-alone air cleaners: influence of type, air flow rate, flow pattern and position in the room
Alain Ginestet, *Cetiat, France*

Assessment of Airborne Cross-infection Risk Across Various Body Orientations in Indoor Airflow Environments
Hee Won Shin, *University of Seoul, Republic of Korea*

NALLY SUITE

09:00-10:30

Session 5B - Topical Session: Ventilation regulations in various countries

Chairs: **Simon Jones** *(Air Quality Matters, Ireland)*
Valérie Leprince *(Cerema, France)*

The current trend in most European countries regarding building ventilation is to follow the "build tight, ventilate right" strategy. New energy efficient buildings are indeed getting more and more airtight to avoid energy losses through uncontrolled air leakages. Therefore, mechanical ventilation systems are installed to ensure a good indoor air quality (IAQ) with controlled ventilated air flowrates. In 2008 a series of VIP (from VIP 17 to VIP 27) were published by the AIVC, detailing the "Trends in the building ventilation market and drivers for changes" for 10 countries. Regulations have however evolved a lot in most countries since then. Two new series of VIPs is being published to get an update on the current regulations in European countries one series regarding building and ductwork airtightness and another series regarding ventilation regulation.
They include information regarding national trends in:
• IAQ requirement and market (including requirements for residential and non-residential buildings)
• Energy requirements and market
• Inspection of ventilation systems
• Innovative systems and market
And it provides an example of mandatory flowrate of typical buildings.
The objective of this session is to present three of the published (or under revision) AIVC VIPs on ventilation regulations, giving a view of the current situation in different countries.

09:00-10:30

Introduction: Presentation of the new VIP series: objective and lay-out
Valérie Leprince, *Cerema, France*

Trends in building ventilation requirements and inspection in Spain
Pilar Linares-Alemparte, *IETcc-CSIC, Spain*

Trends in building ventilation requirements and inspection in Ireland
Simon Jones, *Air Quality Matters, Ireland*

Building ventilation requirements and inspection in Belgium
Arnold Janssens, *Ghent University, Belgium*

Trends in building ventilation requirements and inspection in France
Gaëlle Guyot, *Cerema, France*

Discussion

Ventilation guidelines for Flemish childcare and psychological care centres
Maarten De Strycker, *BCCA, Belgium*

DAVIN SUITE

09:00-10:30

Session 5C - Topical Session: ReCOver++: Improving resilience of buildings to overheating

Chairs: **Hilde Breesch** *(KU Leuven, Belgium)*

One of the effects of climate change is that heatwaves are getting longer more frequent. This increases the risk of human thermal stress in indoor environments where people spend most of their times. This is even more prominent in well-insulated and air-tight buildings in the EU that are more vulnerable to overheating. Moreover, heatwaves are often accompanied by other unexpected extreme events or "shocks" such as power outages, which can render some buildings unhabitable during shock events and long after these shocks are over. Thus, it is critical to design future-proof buildings and systems that can withstand such shocks and reduce their detrimental impact on human wellbeing in a building. This performance characteristic of a building is known as resilience to overheating.

Currently, in practice, resilience is not included as a building design parameter. There is also no framework in current building standards to consider these shocks. A reliable indicator to assess the resilience of buildings is missing. Moreover, knowledge is lacking to design buildings and size systems (e.g., ventilation, cooling, solar shading, smart building control) to guarantee their resilience to overheating.

The aim of the ReCOver++ project is to improve the resilience of residential and non-residential buildings to overheating by making resilience a more actionable concept for architects, engineering companies and manufacturers. ReCOver++ defines a new holistic resilience indicator integrating the building and systems' most influential parameters to classify their resilience on a point-scale system. Moreover, ReCOver++ demonstrates resilient strategies of building and HVAC system design and product innovations.

The objectives of this session are to:

- *Present the novel resilience indicator to classify buildings and their systems.*
- *Discuss the use in practice of resilience to design buildings and systems*

Thursday October 10th, 2024

09:00-10:30

ReCOver++ project: wrap up
Hilde Breesch, *KU Leuven, Belgium*

A novel indicator to assess thermal resilience of buildings to overheating
Hilde Breesch, *KU Leuven, Belgium*

How to design a resilient building? Lessons learnt from an architectural view
Joost Declercq, *Archipelago, Belgium*

Exploring the effect of different measures on thermal resilience: implications for design of HVAC systems and energy use
Debora Resta, *Arcadis, Belgium*

Impact of solar shading & ventilative cooling control strategies on the resilience of residential buildings to overheating
Ivan Pollet, *Agoria/Renson, Belgium*

Discussion

10:30-11:00 Coffee Break

HOGAN MEZZANINE SUITE

11:00-12:30

Session 6A - Topical Session: The Challenges of Radon and Energy Retrofitting: Unravelling Complexities and Interaction within the Built Environment

Chairs: **Janet Gaskin** *(National Research Council Canada, Canada)*
James McGrath *(Maynooth University, Ireland)*

This workshop will explore the intricate relationship between radon and the built environment, in the context of ventilation and indoor environmental quality. Radon, a naturally occurring radioactive gas, is a leading cause for concern as it accumulates within indoor environments. However, unlike other indoor air pollutants, the infiltration of radon cannot be assumed to be a constant flow rate, but instead, it is a dynamic process which depends on various factors, including the depressurisation rates within buildings. This is especially crucial in the context of energy retrofits, where ventilation and retrofit strategies have the potential to further increase the radon flux into buildings. In this session, presentations will delve into the complexities and interactions that the indoor built environment plays in altering the radon concentrations within residential buildings. Speakers will present recent research findings, discuss the implications different ventilation strategies can have, and discuss challenges and opportunities associated with the context of energy retrofit.

The session will start with a presentation that explores the predictive capability of radon infiltration within residential buildings by analysing existing radon datasets. An understanding of the radon flux will be presented by exploring the underlying physical mechanisms. The second presentation will follow by presenting a research study that investigated how different ventilation approaches and building structures impact the depressurisation rates within buildings and the consequence for the radon flux. These findings will be supported by a separate study that conducted field measurements in Canada that examined radon measurements under varying building characteristics, including ventilation strategies. While the first three presentations highlight the challenges and risks associated with radon. By contrast, the fourth presentation will be complemented by recent research published by the Irish EPA that examined the effectiveness of radon remediation measures. These findings will be vital in discussing their implications for various mitigation measures and offer opportunities to meet the challenge of radon during energy retrofit.

Following the presentations, speakers will form a panel including an industry representative (Simon Jones, Industrial Advisor to the AIVC) and a representative from SEAI (Brain McIntyre, previously coordinated the national energy retrofit pilot programme) that will address the audience's questions to stimulate an interactive discussion. Each speaker will contribute to how their unique insights can manage the challenges of radon during energy retrofits. The panel comprises academic and policy members, so attendees will gain insights from multiple perspectives. The session will be designed to stimulate discussion and raise awareness, providing an interactive platform for insights from the audience. Attendees and speakers will contribute to discussing how these practices can be incorporated into retrofit strategies.

Moreover, the session will contrast Canada and Ireland, offering unique insights into how different countries, climatic conditions, and national policies influence radon. Special attention will be given to understanding the retrofit context, aiming to identify risks and the best appropriate to develop a risk matrix that can be implemented into practice. Ultimately, the session will highlight how radon considerations should be integrated into retrofit measures rather than only considering it post-retrofit. These insights could lead to cost-effective measures, utilising policy incentives to protect and seize opportunities during energy retrofits. Attendees will emerge with valuable insights into the dynamic interplay of radon, construction, and ventilation systems, fostering a deeper understanding of the challenges and opportunities in mitigating radon-associated risks.
The objectives of the session are to:

- *Explore the dynamic processes of radon infiltration, recognising the complexities and interactions the indoor built environment has in altering radon concentrations.*
- *Analyse the implications of different ventilation strategies, national policies, and their relevance in the energy retrofit context.*
- *Assess the implications of these findings for various mitigation measures and explore opportunities to integrate radon considerations into retrofit strategies.*
- *Quantify the potential cost-effective measures and policy incentives for mitigating radon risks during energy retrofits.*
- *Review a list of crucial issues from various stakeholders and compile data to develop a radon risk matrix.*
- *Compile and formulate the ideas for the discussion to write a position paper.*

11:00-12:30

Introduction and Overview
James McGrath, *Maynooth University, Ireland*

Quantify factors influencing radon flux in dwellings
Mohsen Pourkiaei, *Maynooth University, Ireland*

Challenges and opportunities arising from different ventilation approaches: Controlled experiments conducted at the Canadian Centre for Housing Technology
Liang Grace Zhou, *National Research Council, Canada*

Field study measurements evaluating radon concentrations under different ventilation scenarios
Janet Gaskin, *National Research Council Canada, Canada*

Passive sumps as a method of reducing radon levels in Irish dwellings
James McGrath, *Maynooth University, Ireland*

Thursday October 10th, 2024

NALLY SUITE

11:00-12:30 — Session 6B - Long Oral Presentation Session: Performance evaluation of ventilation systems

Chairs: **Arnold Janssens** *(Ghent University, Belgium)*
Laure Mouradian *(CETIAT, France)*

Numerical performance evaluation of ventilation systems for energy-efficient retrofitting of existing houses in France
Daniela Mortari, *Cerema, France*

Evaluating the IAQ and energy performance of two types of ventilation systems in multifamily buildings
Zohreh Kiani, *La Rochelle University, France*

Performance 2 project - Analysis of the interactions between the Humidity-based DCV systems and IAQ in homes 15 years after their construction
Juan Rios, *AERECO, France*

Performance evaluation of humidity-based decentralized ventilation systems in social housing in Chile
Gilles Flamant, *Ghent University, Belgium*

Balanced ventilation - energy efficient and healthy
Wouter Borsboom, *TNO, The Netherlands*

Breathing Better: Evaluating the Impact of Personalized Ventilation in Daycare Baby Beds
Hailin Zheng, *Eindhoven University of Technology, The Netherlands*

DAVIN SUITE

11:00-12:30 — Session 6C - Topical Session: State of the art of PECS (Personal Environmental Control Systems)

Chairs: **Bjarne Wilkens Olesen** *(Technical University of Denmark, Denmark)*
Rajan Rawal *(CEPT Research and Development Foundation, India)*

Personal Environmental Control System (PECS) has the capabilities of providing thermal, air quality, luminous, and acoustic comfort along with controlling the localized environment in occupant's immediate surroundings. This session is based on the works of IEA-EBC Annex 87,Energy and Indoor Environmental Quality Performance of Personalized Environmental Control Systems and will emphasis on a large literature review.The90-minute session will after a short introduction to the annex have four presentations from four subtasks of five subtasks of Annex 87.For each of the subtasks an extensive literature review has been performed and the results will be presented in this session. After each presentation there will be time for questions and at the end time for an overall discussion of the work of Annex 87.
The primary objective of the session on Personal Environmental Control Systems (PECS) is to elevate the technical dialogue on the work carried out by IEA-EBC Annex 87 in the domain of PECS. The objective of this session is to present state of the art regarding PECS.

Introduction to IEA-EBC Annex 87
Bjarne Wilkens Olesen, *Technical University of Denmark, Denmark*

Effect of Personalized Environmental Control Systems on Occupants' Health, Comfort and Productivity
Bjarne Wilkens Olesen, *Technical University of Denmark, Denmark*

Personalized environmental control systems (PECS): Overview of applications, technology classification and KPIs
Kai Rewitz, *RWTH Aachen University, Germany*

Personalized environmental control systems (PECS): Overview of evaluation methods
Kai Rewitz, *RWTH Aachen University, Germany*

Policy Strategies and Market Perspective of Personalized Environmental Control Systems
Rajan Rawal, *CEPT Research and Development Foundation, India*

12:30-13:30 Lunch Break

HOGAN MEZZANINE SUITE

13:30-14:30

Session 7A - Long & Short Oral Presentation Session: IAQ in retrofit buildings

Chairs: **Gaëlle Guyot** *(CEREMA, France)*
Laure Mouradian *(CETIAT, France)*

Indoor air quality post deep energy retrofit in social homes in Ireland (HAVEN)
Marie Coggins, *University Of Galway, Ireland*

Data Analysis of Indoor Air Quality and Thermal Comfort in Dwellings in Santiago, Chile
Constanza Molina, *PUC, Chile*

RENOVAIR: Study of the evolution of airtightness, ventilation, comfort and indoor air quality in 7 energy renovation operations of social housing in France
Andrés Litvak, *Cerema, France*

Perceptions of thermal comfort following deep energy retrofit in social homes in Ireland (HAVEN) (Short Oral Presentation)
Victoria Hogan, *University Of Galway, Ireland*

Investigating the Impacts of New Energy Renovation Strategies on Indoor Environmental Quality (Short Oral Presentation)
Buddila Wijeyesekera, *University of Galway, Ireland*

A Pre-Post Retrofit Evaluation on Indoor Air Quality and Comfort in Classrooms and Offices: Pre-Retrofit Findings (Student Competition)
Adam Killian Collison, *University of Galway, Ireland*

Thursday October 10th, 2024

NALLY SUITE

13:30-14:30 — Session 7B - Long Oral Presentation Session (Ductwork & windows airtightness)

Chairs: **Manfred Plagmann** *(Branz, New Zealand)*, **Iain Walker** *(LBNL, United States of America)*

Leakage in Large-Building Duct Systems: Modelling the Savings for Various Applications
Mark Modera, *UC Davis, United States of America*

Proposal of a more reliable model and procedures for estimating operational leakage in air systems
Federico Pedranzini, *Politecnico Di Milano, Italy*

Literature Review on Windows Airtightness Performances: Insights and Gaps
Martin Prignon, *Buildwise, Belgium*

Measurements in Greece of installed windows and comparison between the given air permeability classification and the classification applied to the building envelope
Theodoros Sotirios Tountas, *FUV, Greece*

DAVIN SUITE

13:30-14:30 — Session 7C - Long Oral Presentation Session: IAQ monitoring

Chairs: **James McGrath** *(Maynooth University, Ireland)*, **Simon Jones** *(Air Quality Matters, Ireland)*

Estimating the health impact of exposure to indoor PM2.5 concentrations in Irish deep energy retrofitted residential dwellings - ARDEN
Hala Hassan, *University of Galway, Ireland*

Assessment of SARS-CoV-2 and other IAQ parameters in 11 Belgian elderly care homes
Sarah Paralovo, *VITO, Belgium*

IAQ-label for Belgian public spaces: monitoring in 11 public spaces
Klaas De Jonge, *Ghent University, Belgium*

14:30-14:45 — Room Change

HOGAN MEZZANINE SUITE

14:45-16:15 — Session 8A - Topical Session: What is new in the EPBD recast 2024 with respect to indoor environmental quality and ventilation?

Chairs: **Jaap Hogeling** *(EPB Center, The Netherlands)*, **Peter Wouters** *(INIVE vzw, Belgium)*

There are within the European Union multiple requirements for the building sector with respect to energy use and CO2 impact. A major legislative piece for buildings is the Energy Performance of Buildings Directive (EPBD), of which the first version was approved in 2002.Since then, there have been several revisions. All member states must transpose this directive into national legislation, which means that in practice there might be major differences in national legislation between the member states(calculation methods, requirements, compliance, …).On April 24, a revised version of the EPBD has been approved. This revised version was published on May 8,2024. In comparison with the 2018 edition, there are substantial changes.Among others, indoor environmental quality as well as the inspection of large HVAC installations receives increased attention.

This session aims to provide an in-depth view of the changes in the EPBD with relevance for the themes of this conference.

What does it mean in terms of indoor environmental quality? What role for inspection and what type of requirements? Also, the relevant CEN standards under development will be presented. Also, there will be an exchange of views regarding potential future AIVC actions with respect to this EPBD recast.

14:45-16:15

Introduction to EPBD revision
Jaap Hogeling, *EPB Center, The Netherlands*

Related CEN-standards on IEQ
Bjarne Wilkens Olesen, *Technical University of Denmark, Denmark*

Related CEN-standards on inspection
Valérie Leprince, *Cerema, France*

Experiences with existing inspection schemes – Belgium
Maarten De Strycker, *BCCA, Belgium*

The new Dutch approach for quality management
Wouter Borsboom, *TNO, Netherlands*

Discussion

NALLY SUITE

14:45-16:15

Session 8B - Long Oral Presentation Session: IEQ-Analysis and assessment methods

Chairs: **Andrew Persily** *(NIST, United States of America)*
Susan Vickers *(Cluid Housing, Ireland)*

Calibration methodology for combined heating and ventilation models
Wouter Borsboom, *TNO, The Netherlands*

Applying a composite indoor environmental quality indicator to Danish office spaces: The TAIL rating scheme
Asit Kumar Mishra, *University College Cork, Ireland*

Exploring the Effect of Post-Pandemic Behaviour of Occupants on Indoor Air Quality and Comfort Conditions in Existing Residential Buildings in Türkiye
Büşra Karadeniz Akkoç, *Çankaya University, Turkey*

The Impact of Simplified Window and Exhaust Fan Assumptions on Model-Based Predictions of Inter-Zonal Air Flow and Contaminant Transport in Multifamily Buildings
Nuria Casquero-Modrego, *Carleton University, Canada*
Cara Lozinsky, *LBNL, United States of America*

Evaluation of the impact of window use on the heating energy use and IEQ in dwellings based on simulations
Arnold Janssens, *Ghent University, Belgium*

Experimental study on the dehumidification performance of a window-type liquid desiccant ventilation system
Jabin Goo, *University of Seoul, Republic of Korea*

Thursday October 10th, 2024

DAVIN SUITE

14:45-16:15 Session 8C - Long Oral Presentation Session: Natural ventilation analysis

Chairs: **Dong Hwa Kang** *(University of Seoul, Republic of Korea)*
Maria Kolokotroni *(Brunel University London, United Kingdom)*

On the impact of night ventilation through motorized windows on the energy and thermal performance of office buildings
Sabrina Romano, *Enea, Italy*

Effects of closed vertical void on natural ventilation in double-loaded apartment building
Tetsu Kubota, *Hiroshima University, Japan*

Evaluation of Indoor Environmental Quality and Thermal Environment in Airtight Energy-Efficient Naturally Ventilated Dwellings
Ibrahim Alhindawi, *University of Galway, Ireland*

On the impact of the urban modified albedo on the indoor temperature and the ventilative cooling potential in a typical Italian residential building
Sabrina Romano, *Enea, Italy*

Experimental and simulation analysis of different natural ventilation scenarios and their relation with IAQ in office buildings
Giannis Papadopoulos, *University of Western Macedonia, Greece*

Performance optimization of a university building with a dynamic façade system
Zhijian Wang, *Eindhoven University of Technology, The Netherlands*

16:15-16:45 Coffee Break

HOGAN MEZZANINE SUITE

16:45-18:15 Closing session

Chairs: **Arnold Janssens** *(Ghent University, Belgium),*
James McGrath *(Maynooth University, Ireland)*

Perfect Mixing or Imperfect Terminology
Andrew Persily, *NIST, United States of America*

Summing up of the "Smart ventilation, IAQ & Health" track
Benjamin Jones, *University of Nottingham, United Kingdom*

Summing up of the "Airtightness" track
Valérie Leprince, *Cerema, France*

Summing up of the "resilient ventilative cooling" track
Hilde Breesch, *KU Leuven, Belgium*

Best paper/poster award & Student Competition awards
Andrew Persily, *NIST, United States of America*

Announcement of 2025 conference
Iain Walker, *LBNL, United States of America*

19:00-23:00 Gala Dinner at Urban Brewing (entrance only by ticket)

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