



38th AIVC Conference

6th TightVent Conference

4th venticool Conference

Ventilating healthy
low-energy buildings

13 - 14 September, 2017

● Crowne Plaza Hotel, Nottingham UK

FINAL PROGRAMME



ROYAL SUITE

09:00-10:45

Opening – Plenary Session (Part 1)*Chairpersons: François Rémi Carrié, Benjamin Jones*

- **Welcome on behalf of AIVC, venticool, TightVent**
Peter Wouters, Manager, INIVE EEIG, Belgium
- **Welcome on behalf of the University of Nottingham**
Sam Kingman & Benjamin Jones, University of Nottingham, UK
- **Welcome on behalf of Brunel University**
Maria Kolokotroni, Brunel University London, UK
- **Making an impact: Tailoring academic research to support government policy**
Peter Rankin, Department for Communities and Local Government, UK
- **Indoor air pollution and ventilation: are we at risk?**
Sani Dimitroulopoulou, Public Health England, UK
- **Adapting ventilation to a changing environment**
Tadj Oreszczyn, Chartered Institution of Building Services Engineers, UK

10:45-11:15

Coffee Break

11:15-12:45

Parallel Session 1A - Topical session: Durability of airtightness*Chairpersons: Valérie Leprince, Arnold Janssens*

Over the last thirty years, much progress has been made to increase our knowledge about mechanisms governing building's airtightness and the impact of air infiltrations on energy efficiency, health effects and construction quality related issues. As a matter of fact, 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 the end of 2020. Nevertheless, less expertise is available today about the durability of airtightness products, at mid- and long- term scales.

Studies are made to assess the airtightness durability:

- *On site through airtightness testing after few years of operation*
- *On laboratory with artificial ageing*
- *Of products and assembly of product*

However, studies give inconsistent results. On site measurement miss keys to explain why some buildings degrade while others do not change or even improve over the years. Laboratory testing misses a standard ageing protocol.

The objective of this session is to have an overview of work performed to assess the durability of building airtightness and discuss them.

- **Durability of building airtightness, review and analysis of existing studies**
Valerie Leprince, France (p.1)
- **Long-time durability of passive house building airtightness**
Paul Simons, Germany (p. 15)
- **Assessment of the durability of the airtightness of building elements via laboratory tests**
Christophe Delmotte, Belgium (p. 24)

- **Airtightness durability: sealants and coatings**
Filip Van Mieghem, Belgium

HAMPTON @ WINDSOR

11:15-12:45

Parallel Session 1B – Long Oral Presentation Session: Natural and hybrid ventilative cooling

Chairpersons: Pilar Linares Alemparte, Jae-Weon Jeong

- **Will naturally ventilated dwellings still be safe under heatwaves?**
Jean-Marie Alessandrini, France (p. 26)
- **Effectiveness of Ventilative Cooling Strategies in Hot and Dry and Temperate Climates of India**
Devna Vyas, India (p. 38)
- **Hybrid ventilation in new and refurbished school buildings – the future of ventilation**
Jannick Roth, Denmark (p. 49)
- **Ventilative cooling potential based on climatic condition and building thermal characteristics**
Hwataik Han, Korea (p. 61)
- **The Reintroduction of Natural Ventilation to a 19th Century Opera House, Utilising Calibrated Computer Simulation and User Operation**
Julia Thompson, New Zealand (p. 70)

HIGHGROVE

11:15-12:45

Parallel Session 1D – Long Oral Presentation Session: Ventilation system performance and air quality

Chairpersons: Willem De Gids, Sani Dimitroulopoulou

- **Assessing Occupant and Outdoor Air Impacts on Indoor Air Quality in New California Homes**
Iain Walker, USA (p. 80)
- **From EN 779 to ISO 16890: a new worldwide reference test method for general ventilation filters**
Alain Ginestet, France (p. 91)
- **Preventing condensation and frosting in an energy recovery ventilator using a preheat coil**
Won-Jun Kim, Korea (p. 97)
- **Characterising the actual performance of domestic mechanical ventilation and heat recovery systems**
Rajat Gupta, UK (p. 106)
- **Comparing extracting and recirculating residential kitchen range hoods for the use in high energy efficient housing**
Gabriel Rojas, USA (p. 117)

- **How loud is too loud? Noise from domestic mechanical ventilation systems**
Jack Harvie-Clark, UK (p. 129)

12:45-13:45

Lunch Break

ROYAL SUITE

13:45-15:15

Parallel Session 2A – Long Oral Presentation Session: Field measurements and building airtightness performance

Chairpersons: *Paula Wahlgren, Peter Rankin*

- **Air leakage of defects in the vapour barrier of compact roofs**
Petra R  ther, Norway (p. 140)
- **Air leakage variations due to changes in moisture content in wooden constructions - magnitudes and consequences**
Fredrik Domhagen, Sweden (p. 148)
- **Summary of data from 270,000 tests**
Barry Cope, UK (p. 160)
- **A comparison study of the blower door and novel pulse technique on measuring enclosure airtightness in a controlled environment**
Xiaofeng Zheng, UK (p. 168)
- **Natural Pressure Differential – Infiltration through Wind. Results of a Long-Term Measurement**
Stefanie Rolfsmeier, Germany (p. 180)
- **Building and ductwork airtightness requirements in Europe – Comparison of 10 European countries**
Val  rie Leprince, France (p. 192)

HAMPTON @ WINDSOR

13:45-15:15

Parallel Session 2B – Topical Session: IEA-EBC Annex 62: Ventilative Cooling: Lessons learnt from case-studies

Chairpersons: *Paul O’Sullivan, Hilde Breesch*

Annex 62 on Ventilative Cooling is an international project being carried out within the IEA EBC program. Its main goal is to make ventilative cooling an attractive and energy efficient cooling solution to avoid overheating of both new and renovated buildings. Ventilation is already present in buildings through mechanical and/or natural systems and it can remove excess heat gains as well as increase air velocities and thereby also widen the thermal comfort range. However, the current development in building energy efficiency towards nearly-zero energy buildings represents a number of new challenges to design and construction. One of the major new challenges is the increased need for cooling arising in these highly insulated and airtight buildings, which is not only present in the summer period but also in the shoulder seasons and in offices even in midwinter during periods of occupation.

In order to address these cooling challenges of buildings, the research focus of the annex will be on development of design methods and compliance tools related to predicting, evaluating and eliminating the cooling need and the risk of overheating in buildings as well as on the development of new attractive energy efficient ventilative cooling solutions.



The Annex 62 research work is divided in three subtasks. One of the subtask focusses on the demonstration of the performance of ventilative cooling through analysis and evaluation of well-documented case studies. This topical session will present some of the developed energy performance indicators for VC methods and applications in residential and non-residential new or renovated buildings control strategies of components for VC.

- **Ventilative Cooling on the test bench - Learnings and conclusions from practical design and performance evaluation**
Peter Holzer, Austria (p. 202)
- **Bulk airflow measurements in a large naturally ventilated atrium in a mild climate**
Marta Avantaggiato, Italy (p. 211)
- **Delivery and performance of a ventilative cooling strategy: the demonstration case of a shopping centre in Trondheim, Norway**
Annamaria Belleri, Italy (p. 220)
- **Ventilative cooling in a single-family active house from design stage to user experience**
Christoffer Plesner, Denmark (p. 230)
- **The future of hybrid ventilation in office buildings – energy simulations and lifecycle cost**
Jannick Roth, Denmark (p. 238)
- **Design and performance of ventilative cooling: a review of principals, strategies and components from International case studies**
Paul O'Sullivan, Ireland (p. 251)

HIGHGROVE

13:45-15:15

Parallel Session 2C – Topical Session: Health outcomes of ventilation

Chairpersons: Pawel Wargocki, Max Sherman

- **The effect of outdoor pollution and ventilation on Indoor Air Quality**
Martin Liddament, UK
- **A New Approach to Estimating Carbon Dioxide Generation Rates from Building Occupants**
Andrew Persily, USA (p. 263)
- **Methodology for assessing the air-exchange performance of residential ventilation systems**
Rob Van Holsteijn, Netherlands (p. 270)
- **Quantitative relationships between classroom CO2 concentration and learning in elementary schools**
Pawel Wargocki, Denmark (p. 279)
- **The impact of the quality of homes on indoor climate and health: an analysis of data from the EU-SILC database**
Peter Foldbjerg, Denmark (p. 288)

15:15-15:30 Room change

ROYAL SUITE

15:30-16:30 Parallel Session 3A – Topical Session: Ventilation measurements and ductwork airtightness*Chairpersons: François Rémi Carrié, Paula Wahlgren*

In many countries, there is a growing concern for the actual energy performance of new buildings and the improvement of the energy performance of existing buildings. Facts supporting this trend include the uptake of building commissioning or retro-commissioning as well as initiatives to foster or require performance checks.

The objective of this session is to discuss how science and technology will influence ventilation measurement and how the data, including spot measurements and continuous monitoring, can be used by building owners, building managers and policy makers.

- **Assessment of airflow measurement uncertainty at terminal devices**
Adeline Bailly Melois, France (p. 295)
- **The industries vision and activities for better buildings in the future**
Lars-Åke Mattsson, Sweden (p. 306)
- **About 1,000 ductwork airtightness measurements performed in new French buildings: database creation and first analyses**
Adeline Bailly Melois, France (p. 310)
- **Impact of ductwork airtightness on fan energy use: calculation model and test case**
Valérie Leprince, France (p. 319)

HIGHGROVE

15:30-16:30 Parallel Session 3B – Topical Session: Smart Overheating Prevention & Resilient Cooling in Changing Urban Climate*Chairpersons: Peter Holzer*

HAMPTON & WINDSOR

15:30-16:30 Parallel Session 3D – Topical Session: Utilization of heat recovery in residential ventilation systems*Chairpersons: Arnold Janssens, Jelle Laverge*

The methods used to assess the influence of heat recovery ventilation on the energy use of buildings in energy labelling and certification are typically based on single zone energy balance equations. Multi-zoning is often not considered although heating behaviour and set-points differ in different rooms of a dwelling. As a result of this the energy savings of heat recovery ventilation as assessed with single zone methods may be larger than when the spatial variations in dwellings are taken into account. This is related to the fact that the recovered heat supplied to the dwelling through the ventilation system is not 'useful' to reduce space heating and cooling demand at all time and in every room (eg in unheated rooms like bedrooms). This session provides information to



quantify the utilization of heat recovery ventilation on the energy use of buildings. Results of multi-zone simulation studies and field studies are presented to define influencing parameters and metrics to quantify the utilization of heat recovery.

- **Utilization of heat recovery ventilation: problem statement based on steady-state two-zone energy use analysis and field studies**
Arnold Janssens, Belgium (p. 333)
- **Influence of the zoning, the climate, and the airtightness on the energy needs of a building with mechanical ventilation system with heat recovery**
José Manuel Salmeron Lissen, Spain (p. 335)
- **A ‘use factor’ for HRV in intermittently heated dwellings**
Jelle Laverge, Belgium (p. 337)

Interactive discussion

16:30-17:00

Coffee Break

ROYAL SUITE

17:00-18:15

Parallel Session 4A – Short Oral Presentation Session

Chairpersons: *Andrew Persily, Manfred Plagmann*

- **Methodology for the characterization of the envelope airtightness of the existing housing stock in Spain**
Irene Poza-Casado, Spain (p. 342)
- **On the design and testing of Airtightness Modifier dedicated to the TIPEE IEQ House**
Marc Abadie, France (p. 352)
- **Component leakage: types of “airpaths” and Potential Improvement Graphs**
Martin Prignon, Belgium (p. 361)
- **The effect of refurbishment and trickle vents on airtightness: the case of a 1930s semi-detached house**
Ben Roberts, UK (p. 369)
- **Impact of airtightness on the heat demand of passive houses in central European climate**
Jiri Novak, Czech Republic (p. 381)
- **Demand controlled ventilation in school and office buildings: lessons learnt from case studies**
Hilde Breesch, Belgium (p. 391)
- **Experimental and Numerical Investigation of Air Distribution in a Large Space**
Ali Alzaid, UK (p. 400)
- **Development of protocol for sub-metering for ventilation models and verification for shopping centres**
Matthias Haase, Norway (p. 410)

- **Heat Recovery Hybrid Ventilation System with a Thermal Storage**
Akira Fukushima, Japan (p. 422)
- **A study of panel ridges effect on heat transfer and pressure drop in a ventilation duct**
Thiago Santos, UK (p. 430)
- **Development and measurement results of a compact Counterflow Heat Recovery Fan for single/double room ventilation**
Christoph Speer, Austria (p. 440)
- **Full-scale experimental study of ceiling turbulent air jets in mechanically ventilated rooms**
Chi-Kien Nguyen, France (p. 448)
- **Technologies to overcome effects of condensation in exchangers of ventilation units - analysis of monitored field studies**
Rick Bruins, Netherlands (p. 458)
- **A Method to Measure Emission Rates of PM2.5s from Cooking**
Catherine O'Leary, UK (p. 463)
- **An Experimental Validation of an Indoor Radon Model that examines Energy Retrofit Buildings**
James McGrath, Ireland (p. 474)

HAMPTON @ WINDSOR

17:00-18:15

Parallel Session 4B – Short Oral Presentation Session

Chairpersons: Maria Kolokotroni, Ben Hughes

- **Evaluating natural ventilation cooling potentials during early building designs**
Andrew Persily, USA (p. 482)
- **Challenges of using passive ventilation to control the overheating of dwellings in noisy environments**
Nick Conlan, UK (p. 491)
- **Natural ventilation systems in Mediterranean schools. A prototype experience in Andalusia as an alternative to mechanical ventilation**
Maite Gil-Baez, Spain (p. 504)
- **Impact assessment of natural ventilation on thermal comfort levels in sustainable residential buildings**
Elli Tsirintoulaki, Greece (p. 517)
- **Inter-model comparison of indoor overheating risk prediction for English dwellings**
Giorgos Petrou, UK (p. 527)
- **Towards Real-Time Model-Based Monitoring and Adoptive Controlling of Indoor Thermal Comfort**
Ali Youssef, Belgium (p. 536)



- **Application of open-source CFD software to the indoor airflow simulation**
Cong Wang, Sweden (p. 544)
- **Experimental study on the in-situ performance of a natural ventilation system with heat recovery**
Paraskevi Vivian Dorizas, UK (p. 554)
- **An interface of night ventilation and mass structure for passive cooling design strategy in Ghadames traditional dwellings**
Jamal Alabid, UK (p. 565)
- **Indoor Air Quality and Thermal Comfort, in Irish Retrofitted Energy Efficient Homes**
James McGrath, Ireland (p. 572)
- **Evaluation of thermal comfort in an office building served by a liquid desiccant-assisted evaporative cooling air conditioning system**
Hye-Jin Cho, Korea (p. 578)
- **Energy Efficiency in a Thermal Comfort Field Work in Spain**
Pablo Aparicio-Ruiz, Spain (p. 588)
- **The influence of occupancy behaviour on the performance of mechanical ventilation systems regarding energy consumption and IAQ**
Nicolas Carbonare, Germany (p. 594)
- **Thermal performance of ventilated solar collector with energy storage containing phase change material**
Hu Yue, Denmark (p. 604)
- **Energy performance prediction of thermoelectric ceiling radiant panels with a dedicated outdoor air system**
Hansol Lim, Korea (p. 614)

HIGHGROVE

17:00-18:15

Parallel Session 4C - Short Oral Presentation Session

Chairpersons: Wouter Borsboom, Martin Liddament

- **Microorganism Contaminants removal in a liquid desiccant Dehumidification system**
Joon-Young Park, Korea (p. 623)
- **The Development of Archetypes to Represent the Chilean Housing Stock**
Constanza Molina, UK (p. 631)
- **The Cleanliness Classification of Air-handling Components- A success Story in Finland**
Laura Sariola, Finland (p. 642)
- **Circadian House: a vision for homes designed to be healthy and human-centric**
Peter Foldbjerg, Denmark (p. 641)

- **Contaminant stratification in displacement ventilated spaces - a two zone model approach. Model prediction compared to experimental data**
Tor Helge Dokka, Norway (*p. 657*)
- **Study of variants to classical mechanical exhaust ventilation systems by using mechanical exhaust in habitable rooms**
Ivan Pollet, Belgium (*p. 666*)
- **The effectiveness of mechanical exhaust ventilation in dwellings**
Samuel Caillou, Belgium (*p. 672*)
- **Investigation of future ventilation flow rate requirements for dwellings in Belgium: from the application of FprEN16798-1:2016 to proposed robust rules**
Samuel Caillou, Belgium (*p. 682*)
- **Advanced airflow distribution methods for reducing exposure of indoor pollution**
Amar Aganovic, Norway (*p. 692*)
- **Towards the definition of an indoor air quality index for residential buildings based on long- and short-term exposure limit values**
Louis Cony, France (*p. 698*)
- **Pollutant exposure of the occupants of dwellings that complies with the Spanish indoor air quality regulations**
Sonia García Ortega, Spain (*p. 710*)
- **Method development for measuring volatile organic compound (VOC) emission rates from spray foam insulation (SPF) and their interrelationship with indoor air quality (IAQ), human health and ventilation strategies**
Dzhordzhio Naldzhiev, UK (*p. 717*)
- **The effect of enhanced stove design on ‘real life’ exposure to PM2.5 and CO in rural dwellings in Salambu, Nepal**
Binaya KC, UK (*p. 729*)
- **Field measurement of carbonyl compound and particles in South Korea residential spaces**
Kyungmo Kang, Korea (*p. 738*)
- **Indoor air quality in mechanically ventilated residential dwellings/low-rise buildings: A review of existing information**
Amar Aganovic, Norway (*p. 746*)

18:15-19:30

Poster and Industry Exhibition
(Beverages in the poster area)

ROYAL SUITE

09:00-10:30

Opening – Plenary Session (Part 2)*Chairpersons: Peter Wouters, Maria Kolokotroni*

- **Controlling Infection Risk through Ventilation Design**
Cath Noakes, University of Leeds, UK
- **Ventilation Design: what has changed in the last 35 years**
Ant Wilson, AECOM, UK
- **IEA Energy in Buildings and Communities Overview**
Paul Ruysssevelt, University College London, UK

10:30-11:00

Coffee Break

ROYAL SUITE

11:00-12:30

Parallel Session 5A – Topical Session: Integrating uncertainties due to wind and stack in declared airtightness results*Chairpersons: Valérie Leprince, Iain Walker*

Building airtightness tests have become very common in several countries, either to comply with minimum requirements of regulations or programmes, or to justify input values in calculation methods. This raises increasing concerns for the reliability of those tests.

There are four key sources of uncertainty in airtightness testing:

- *Measurement devices (accuracy and precision);*
- *Calculation assumptions (e.g. reference pressure, regression analysis method);*
- *External conditions (wind and stack effect impact); and*
- *Tester's behaviour.*

While competent tester schemes and independent checking procedures show potential to contain errors due to the tester's behaviour, there have been extensive yet sterile debates about how the building pressurisation test standard ISO 9972 should address other sources of uncertainties. As a result, no change has been made on these aspects on the new version of the standard which was published in September 2015.

With the present standard, the zero-flow pressure shall not exceed 5 Pa for the test to be valid. Consequently, in moderately windy conditions, it may be impossible to perform a pressurisation test in accordance with the standard, even using precautions with a careful uncertainty analysis. The objective of this session is to better understand how wind can affect the results of buildings pressurisation tests and to discuss recent work to quantify or contain the uncertainty.

- **Reducing Uncertainty in Air Tightness Measurements**
Iain Walker, USA (p. 756)
- **On the contribution of steady wind to uncertainties in building pressurisation tests**
Valérie Leprince, France (p. 758)
- **The impact of wind gusts on air infiltration in buildings**
Dimitrios Kraniotis, Norway (p. 764)
- **Airtightness of Buildings – Considerations regarding the Zero-Flow Pressure and the Weighted Line of Organic Correlation**
Christophe Delmotte, Belgium (p. 770)

HAMPTON & WINDSOR

11:00-12:30

Parallel Session 5B – Topical Session: IEA-EBC Annex 62: Ventilative Cooling: Strategies and componentsChairpersons: *Peter Holzer, Theofanis Psomas*

Annex 62 on Ventilative Cooling is an international project being carried out within the IEA EBC program. Its main goal is to make ventilative cooling an attractive and energy efficient cooling solution to avoid overheating of both new and renovated buildings. Ventilation is already present in buildings through mechanical and/or natural systems and it can remove excess heat gains as well as increase air velocities and thereby also widen the thermal comfort range. However, the current development in building energy efficiency towards nearly-zero energy buildings represents a number of new challenges to design and construction. One of the major new challenges is the increased need for cooling arising in these highly insulated and airtight buildings, which is not only present in the summer period but also in the shoulder seasons and in offices even in midwinter during periods of occupation. In order to address these cooling challenges of buildings, the research focus of the annex will be on development of design methods and compliance tools related to predicting, evaluating and eliminating the cooling need and the risk of overheating in buildings as well as on the development of new attractive energy efficient ventilative cooling solutions. The Annex 62 research work is divided in three subtasks. One of the subtask focusses on solutions by investigating the cooling performance of existing mechanical, natural and hybrid ventilation systems and technologies and typical comfort control solutions as a starting point for extending the boundaries for their use. Based upon these investigations the subtask also aims to develop recommendations for new kinds of flexible and reliable ventilative cooling solutions that create comfort under a wide range of climatic conditions. This topical session will present some of the developed energy performance indicators for VC methods and applications in residential and non-residential new or renovated buildings control strategies of components for VC.

- **Energy Performance Indicators for Ventilative Cooling**
Flourentzos Flourentzou, Switzerland (p. 781)
- **Experimental evidence of effective single sided natural ventilation beyond 20ft or 2.5 floor to ceiling heights in open plan office spaces**
Nuno Mateus, Portugal (p. 792)
- **Automated window opening control system to address thermal discomfort risk in energy renovated dwellings. Summertime assessment**
Theofanis Psomas, Denmark (p. 794)
- **Experiences regarding draught effects for ventilative cooling in cold**
Maria Justo Alonso, Norway (p. 796)
- **Coupling night ventilative and active cooling to reduce energy use in supermarkets with high refrigeration loads**
Zoi Mylona, UK (p. 807)
- **Mixed-mode ventilative cooling opportunity for an existing shopping mall retrofit**
Marta Avantaggiato, Italy (p. 817)

HIGHGROVE

11:00-12:30

Parallel Session 5C – Topical Session: Towards better understanding of needs and challenges related to residential ventilation (EBC Annex 68: Design and Operational Strategies for High IAQ in Low Energy Buildings)Chairperson: *Carsten Rode*



To achieve nearly net zero energy use, all buildings in future will need to be more efficient and optimized. As new buildings are already well insulated in certain industrialised countries, the focus is shifting to limiting space heating energy consumption by reducing ventilation demand. Low energy buildings need to be airtight and energy demand for ventilation is often reduced by lowering the ventilation rate to the minimum necessary. This can have an adverse impact on indoor air quality (IAQ). This project is therefore investigating how to ensure that future low energy buildings are able both to improve their energy performance and to provide comfortable and healthy indoor environments. The aim of the three year project IEA EBC Annex 68 project on Indoor Air Quality Design and Control in Low Energy Residential Buildings is to find the ideal balance between energy efficiency and the need for ventilation. Existing data and tools will be used in combination to give an integrated picture of the air flow, hygrothermal and air quality conditions in residential buildings with a focus on optimising the use and operation of the buildings. This should achieve energy efficiency alongside providing healthy and comfortable indoor environments.

The two main objectives of the project are:

- To provide a scientific basis for the design and operational strategies of buildings that use only a minimal amount of energy, and at the same time maintain very high standards regarding indoor environmental quality based on the control of sources, sinks and flows of heat, air, moisture, and pollutants under in-use conditions.

- To collect and provide data about properties for transport, retention and emission of chemical substances in new and recycled materials under the influence of heat and moisture transfer.

This session will give a midway status of the work in the project by presenting preliminary findings and ongoing work in each of the five subtasks of the project:

- Subtask 1 – “Defining the Metrics”
- Subtask 2 – “Pollutant loads in residential buildings”
- Subtask 3 – “Modelling - review, gap analysis and categorization”
- Subtask 4 – “Strategies for design and control of buildings”
- Subtask 5 – “Field measurements and case studies”

After presenting the subtasks, the session will focus on a discussion with the audience on how the ambitions of the project can be accomplished in practice.

- **Defining the metrics to assess the Indoor Air Quality in low-energy residential buildings**
Marc Abadie, France (p. 868)
- **Combined effects of temperature and humidity on formaldehyde emissions from manufactured fiberboards**
Carsten Rode, Denmark
- **On the use of co-simulating modelling tools to enhance our understanding and optimization of heat and mass flow effects in whole buildings**
Carsten Rode, Denmark (p. 830)
- **Design and operation of ventilation in low energy residences – A survey on code requirements and building reality from six European countries and China**
Daria Zukowska-Tejsen, Denmark (p. 832)
- **A tiered set of reference experiments for Low Energy dwelling IAQ modelling**
Jelle Laverge, Belgium

12:30-13:30

Lunch Break

ROYAL SUITE

13:30-15:00

Parallel Session 6B – Long Oral Presentation Session: Indoor environmental quality

Chairpersons: *Don Weekes, Cath Noakes*

- **Numerical analysis of the potential of using light radiant ceilings in combination with diffuse ventilation to achieve thermal comfort in NZEB buildings**
Marie Rugholm Krusaa, Denmark (p. 843)
- **Influence of night ventilation on the cooling demand of typical residential buildings in Germany**
Johannes Schrade, Germany (p. 852)
- **Affordable and replicable renovation of social housing fulfilling indoor climate and energy targets thanks to seven replicable renovation elements**
Peter Foldbjerg, Denmark (p. 862)
- **Facade Improvements to Avoid Draught in Cold Climates –Laboratory Measurements**
Maria Justo Alonso, Norway (p. 869)
- **Cool materials in the urban built environment to mitigate heat islands: potential consequences for building ventilation**
Maria Kolokotroni, UK (p. 879)

HAMPTON & WINDSOR

13:30-15:00

Parallel Session 6C – Long Oral Presentation Session: IAQ field data and Demand Controlled Ventilation

Chairpersons: Andrew Persily, Ant Wilson

- **TVOC concentrations measured in Belgium dwellings and their potential for DCV control**
Jelle Laverge, Belgium (p. 890)
- **Possible UK residential demand-controlled ventilation assessment methodology**
Simon Jones, Ireland (p. 898)
- **A novel algorithm for demand-control of a single-room ventilation unit with a rotary heat exchanger**
Kevin Michael Smith, Denmark (p. 909)

HIGHGROVE

13:30-15:00

Parallel Session 6D – TOP- Effects and performance of cooker hoods in dwellings

Chairpersons: Wouter Borsboom, Peter Wouters

- **Evaluating the Performance of Island Kitchen Range Hoods**
Iain Walker, USA (p. 919)
- **Efficiency of Recirculation Hoods**
Wouter Borsboom, Netherlands (p. 928)
- **Personal monitoring of exposure to particulate matter of residents**
Yvonne Kluizenaar, Netherlands
- **Emission source strength of cooking and reduction of a typical hood**
Catherine O'Leary, UK (p. 935)

15:00-15:20

Coffee Break

ROYAL SUITE

15:20-16:20

Parallel Session 7B – Long Oral Presentation Session: Ventilative cooling potential and performance*Chairpersons: Hilde Breesch, Samuel Caillou*

- **The effect of adjustable cooling jet on thermal comfort and perception in warm office environment – a laboratory study**
Henna Maula, Finland (p. 937)
- **A Case Study assessing the impact of Shading Systems combined with Night-Time Ventilation strategies on Overheating within a Residential Property**
Andrew Chalk & Elizabeth J Newton, UK (p. 944)
- **The flow interaction of air distribution with thermal plumes and the effect on the air velocity fluctuation under increased heat load conditions**
Sami Lestinen, Finland (p. 957)

HAMPTON @ WINDSOR

15:20-16:20

Parallel Session 7D – Topical Session: Low energy ventilation network*Chairpersons: Henry Burridge, Cath Noakes*

- **Determining the venting efficiency of simple chimneys for buoyant plumes**
Daniel Fiuza Dosil, UK (p. 968)
- **Effect of human walking on air curtain sealing in the doorway of an airtight building**
Jha Narsing, UK (p. 984)

Discussion

ROYAL SUITE

16:30-18:00

Closing session**Best paper & poster award**

Max Sherman, USA

Summing up of ventilative cooling track

Maria Kolokotroni, Professor, Brunel University London, London

Summing up of IAQ & health track

Benjamin Jones, University of Nottingham, UK

Summing up of airtightness track

Arnold Janssens, Professor, University of Ghent, Belgium

Indoor Environmental Quality – Global Alliance: Future Collaborations and Co-operation

Don Weekes, President, IEQ-GA, Canada

Announcement of AIVC 2018 conference**Announcement of other events**

18:00

End of conference

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