2018 ROOMVENT VENTILATION

JUNE 2–5 2018, HELSINKI (FINLAND), ROOMVENTILATION2018.ORG

WORKSHOPS

WS 1:
PERSONAL COMFORT SYSTEMS (PCS): PERSPECTIVES, CHARACTERIZATION PROCEDURES AND RESEARCH CHALLENGES

BACKGROUND

The pursuit of the energy efficiency in buildings is leading towards a future where the buildings will be ZEB or NZEB. This will have a number of consequences in the way the built environment is designed and operated. The first and most significant result will be a reduction of the energy consumption and of the environmental impact. Along with these benefits a likely change will also occur on the share of energy sources that will be used to satisfy the energy demand and on the type and structure of the mechanical systems adopted to provide a satisfactory indoor thermal comfort. On the one hand, the thermal loads that the HVAC systems will have to cope with will become quite small. On the other hand, the energy required to feed the mechanical systems (being small) could be covered, for a large quota, by means of a local and distributed PV production. Such features suggest that in a near future the use of large, centralized HVAC systems will not be so profitable, especially in case of residential buildings. Highly flexible and small personalized devices for thermal comfort, in fact, could control the indoor environment in a more efficient way.

Personal Comfort Systems (PCS) are appliances aimed at controlling the indoor environmental parameters just in the near field of a person. The ultimate goal is to create a “comfort bubble” around the occupants, without noticeably modifying the temperature, relative humidity and IAQ in the rest of the room.

These kind of electric appliances are available on the market since long time, but so far their use was mainly limited as a backup system when the centralized HVAC system had a fault or as a “reinforcement” (corrective power) when the user wanted an extra and localized heating/cooling. For such reasons the design procedures so far adopted for the development of these products were not particularly sophisticated and rarely the comfort performances have been used as a leading concept.

Moreover, standards, traditional design approaches and comfort theories have been, so far, focused mainly on centralized, general HVAC systems, which provide uniform and steady-state thermohygrometric conditions. Instead, a limited scientific research has been developed for the personalized devices.

OBJECTIVE

The proposed workshop aims at highlighting the present day limitations as far as the typical design and analysis procedures for PCS are concerned and at identifying suitable analysis methods and performance metrics able to effectively characterize the PCS.

ATTENDEES

HVAC consulters, researchers, ventilation manufactures, manufactures and others interested to airflow distribution are welcomed to the workshop.

DISCUSSION TOPICS

1. Discuss the differences about the thermal perception of the occupants in relation to PCS and general/centralized systems;
2. Share the experience about the study and development of PCS;
3. Highlight the weak points that will need further insight and research.

EXPECTED RESULTS

Through the discussion, the workshop will try to identify a road map for developing shared analysis tools/procedures for characterizing the performances (energy, comfort and fluid dynamic) of PCS.

PANEL

Prof. Marco Perino, Politecnico di Torino - Department of Energy, DENERG – TEBE, Research group, Italy.

Stefano Vit, Comfort Laboratory Manager, De'Longhi Appliances, Italy.

Prof. Bjarne Olesen, Technical University of Denmark - Department of Civil Engineering, Denmark.

Prof. Wim Zeiler, Technische Universiteit Eindhoven - Department of the Built Environment, The Netherland.

WS 1 – TENTATIVE PROGRAMME (Sunday, June 3 @ 16:00—17:30 in room U119)

Chair: Marco Peroni
Secretary: Janne Hirvonen

Time	Topic	Speaker(s)	Organisation
	Opening		
10 min	General introduction of the subject, Objective of the WS. The PCS: today and future perspectives. The point of view of the academic research	Marco Perino	Politecnico di Torino, Italy
10 min	The point of view of the industrial research and the needs of the stakeholders.	Stefano Vit	De'Longhi Industries, Italy
5 min	*Questions and discussion*		
10 min	Objective and subjective methodologies to assess the performance of PCS. A case study: bladeless fan heater/coolers and their performance analysis	Marco Perino	Politecnico di Torino, Italy
5 min	*Questions and discussion*		
10 min	Research ongoing at DTU and Technical Standards EN TR 16798-2 and ISO TR 17772-2	Bjarne Olesen	DTU, Denmark
5 min	Questions and discussion		
10 min	Personal heating, personalized cooling and thermo physiological models and control	Wim Zeiler	Tue, The Netherland
25 min	*Questions and discussion*		

WS 2:
TYPICAL DIMENSIONLESS NUMBERS IN ROOM AIRFLOWS

BACKGROUND

To ensure the thermal comfort in a room, it is of particular interest to know the airflow structure in a room. Isothermal airflows in ventilated rooms are controlled by the momentum fluxes from all inlet and outlet devices. The Reynolds number is the characteristic dimensionless number in the case of isothermal airflows. In contrast, in the case of non-isothermal flow conditions, the Archimedes number is used to give information about the airflow. The Ar number contains information on both, forced and free, convection. Hence, this dimensionless number is of particular interest for many practical applications.

Results from experimental and numerical investigations related to dimensionless numbers will be presented.

OBJECTIVE

The main objective of this workshop is to discuss the different phenomena in room airflows like the stability of room airflow structures and the Reynolds number independence.

ATTENDEES

Researchers, ventilation manufacturers, HVAC consulters, manufacturers and others interested in airflow distribution are welcome to the workshop.

DISCUSSION TOPICS

1. It is obvious that different types of inlets cause different airflow patterns. Are there any phenomena of room airflows that can be assigned to specific supply air inlets?
2. What could be a useful reference length by using a dimensionless number?
3. Should the room be divided into different areas in order to be able to make clear statements?
4. What can be practical applications?

EXPECTED RESULTS

Through the discussion, it is expected, to derive new information regarding the dimensionless numbers in room airflows by using the existing data. It is aimed to prepare an article together with all panel members.

PANEL

Dr.-Ing. Claudia Kandzia, Technical University of Dresden.

Prof. Peter V. Nielsen, Aalborg University, Denmark.

Prof. Dirk Müller, RWTH Aachen, Germany.

Dr.-Ing Thomas Sefker, TROX GmbH, Germany

PhD Candidate Sami Lestinen, Aalto University, Finland.

WS 2 – TENTATIVE PROGRAMME (Sunday, June 3 @ 16:00—17:30 in room U4)

Chair: Claudia Kandzia
Secretary: Sami Lestinen

Time	Topic	Speaker(s)	Organisation
	Opening		
10 min	Objective of the workshop Stability of large room airflow structures in a ventilated room	Claudia Kandzia	Technical University of Dresden, Germany
5 min	*Questions and discussion*		
10 min	Air distribution systems and the presence of transitional and fully developed flow	Peter V. Nielsen	Aalborg University, Denmark
5 min	*Questions and discussion*		
10 min	Application examples for using dimensional numbers as reference	Dirk Müller and Thomas Sefker	RWTH Aachen, Germany TROX GmbH
5 min	*Questions and discussion*		
10 min	Results of the effect of convection load and office layout on air distribution	Sami Lestinen	Aalto University, Finland
5 min	*Questions and discussion*		
30 min	*Questions and discussion*		

WS 3:
AIRFLOW VISUALISATION AND TRACER METHODS/APPLICATIONS TO INVESTIGATE INFECTIOUS AEROSOL MOVEMENT IN THE BUILT ENVIRONMENT

BACKGROUND

Although engineering tracer methods are useful to track and quantify bulk airflow movements, the real-time visualisation of airflows in specific situations can be very valuable when trying to identify sources of possible contamination and/or containment leakage, to allow customised interventions to be implemented. In addition, airflow visualisation can have a much greater direct impact on an audience when attempting to convey a message regarding potential risk situations (e.g. like infectious patients who are coughing or using oxygen masks on a ward). Airflow visualisation methods (e.g. qualitative smoke tracers) are also useful to give immediate feedback when examining the effects of altering ventilation parameters or geometries (e.g. relative supply and exhaust vent positions in a room), and allows researchers to alter and reassess various ventilation settings in real-time.

OBJECTIVE

This workshop will consider a variety of physical and virtual airflow visualisation techniques, their applications and potential future developments, within the context of studying infectious aerosol movement in the built environment and improving indoor air quality.

ATTENDEES

HVAC consultants, researchers, HVAC System manufacturers, health-care professionals, policy makers and others interested to airflow distribution are welcomed to the workshop.

DISCUSSION TOPICS

1. Which methods/tracers for which phenomena? Human exhaled flows vs mechanical ventilation flows vs human/fomite motion-induced airflows;
2. Temporal-Spatial resolution issues – for all the above?
3. Manikins aren’t humans and particle tracers aren’t mucus droplets. Relating tracer results to true infectious bioaerosols – and using experimental results to assist hospital ward infection control issues;
4. Where next? Virtual approaches? Inhaled airflow dynamics? How can we track/quantify exactly what we inhale – even if we know what is airborne, and how much of that is viable? And how to assess this exposure – infection – disease risk?

EXPECTED RESULTS

Through the discussion, the workshop will try to define the optimal flow visualisation/tracer methods appropriate for the type of airflow under investigation and where techniques could be developed or applied to enhance understanding of indoor air quality.

PANEL

Same as the speakers and their teams.

WS 3 – TENTATIVE PROGRAMME (Sunday, June 3 @ 16:00—17:30 in room U5)

Chair: Julian Tang
Secretary: Petri Kalliomäki

Time	Topic	Speaker(s)	Organisation
	Opening/ Introductions/Objective of the workshop	Julian Tang	University of Leicester Hospitals NHS Trust/ University of Leicester, Leicester, UK
15 min	Examples and applications of various airflow visualisation methods	Peter V. Nielsen and Team	Aalborg University, Denmark
5 min	*Questions and discussion*		
15 min	Colour Sequence Particle Streak Velocimetry(CSPSV) to measure the movements of seeding bubble in room scale 3D space accurately.	Huan Wang, Xianting Li	Tsinghua University, Beijing, China
5 min	*Questions and discussion*		
15 min	Smoke visualisation, gas and live vaccine virus tracers of airflows generated by human exhalation in a two manikin doctor-patient model in different ventilation geometries	Petri Kalliomaki, Pekka Saarinen, Hannu Koskela, Julian Tang	Turku University of Applied Sciences, Turku, Finland; University of Leicester Hospitals NHS Trust/ University of Leicester, Leicester, UK
5 min	*Questions and discussion*		
15 min	Bioaerosol surrogates: physical and virtual approaches	Cath Noakes and Team	School of Civil Engineering, University of Leeds, Leeds, UK
5 min	*Questions and discussion*		
5-10 min	Panel/audience discussion (may be shorter or longer depending on the presentations)		

WS 4:
INDUSTRIAL VENTILATION GUIDEBOOK

BACKGROUND

The Industrial Ventilation Design Guidebook has represented a single source off the major scientific information available on the subject of the industrial ventilation. Covering the basic theories and science behind the technical solutions for industrial air technology, the book has been highly respective tool for both practical engineering and scientists.

The Guidebook addresses the design of air technology systems for the control contaminants in industrial workplaces such as factories and manufacturing plans. It addresses the scientific approach to improving air quality inside the plant and to reduce emissions to the outside environment.

However, the book is now almost 20 years old and it is time to update the contents according the latest research findings and the cutting-edge technology solutions.

OBJECTIVE

The objective of this workshop is to introduce the plans to update the industrial ventilation handbook and discuss possible new technologies available that are important to include in the new book.

EXPECTED RESULTS

Through the discussion, the workshop will find out some effective and efficient methods of airflow distribution to reduce indoor exposure to various pollutants.

PANEL

Risto Kosonen, Aalto University, Finland.

Howard Goodfellow, University of Toronto, Canada.

Guyangyu Cao, NTNU, Norway.

Angui Li, Xi'an, University of Architecture & Technology, China.

Xianting Li, Tsinghua University, China.

Pertti Pasanen, University of Eastern Finland.

WS 4 – TENTATIVE PROGRAMME (Monday, June 4 @ 13:30—15:00 in room U119)

Chair: Risto Kosonen
Secretary: Weixin Zhao

Time	Topic	Speaker(s)	Organisation
5 min	Opening	Risto Kosonen	Professor, Aalto University
20 min	What is Industrial ventilation handbook and what has been achieved to date?	Howard Goodfellow	Professor, University of Toronto
5 min	*Questions and discussion*		
15 min	The plans for the contents of the updated Volume 1: Industrial Ventilation Handbook	Risto Kosonen	Professor, Aalto University
5 min	*Questions and discussion*		
30 min	Discussion of the development during last two decades: 1) what are new research findings in the area of industrial ventilation? 2) What are new technologies and services?	Guangyu Cao	Professor, Norwegian University of Science and Technology
10 min	*Questions and discussion*		

WS 5:
THERMAL COMFORT – NEW CONTRIBUTIONS AND FUTURE OPTIONS

BACKGROUND

Humans in Europe spend 90% of their live time indoors. The quality of the indoor environment is a essential factor for our well-being and our physical health. Additionally, any reduction of our job performance caused by insufficient indoor comfort is not acceptable in high-wage countries. For this reason, the Heinz Trox Wissenschafts gGmbH supports different research activities related to thermal comfort, air quality and room acoustics. The gGmbH is willing to co-operate in large scale research projects and it is open to partner with other foundations and politics.

OBJECTIVE

The aim of this workshop is to present first results from four funded research projects with focus on thermal comfort. The discussion of these projects and other interesting research questions for future projects is highly appreciated.

ATTENDEES

HVAC consultants and companies, researchers, policy makers are invited to take part in the workshop.

DISCUSSION TOPICS

1. What are the main challenges of combining comfort and ergonomic requirements with increasing energy efficiency measures for buildings?
2. What kind of indoor airflow distribution system will increase the quality of the indoor environment?
3. Do we have new contributions or future options for the design of air distribution systems?

EXPECTED RESULTS

Through the discussion, the workshop should provide impulses for further research topics supporting the well-being in rooms.

PANEL

Prof. Dr.-Ing. Clemens Felsmann, Institute of Power Engineering, TU Dresden, Germany.

Prof. Dr.-Ing Dirk Müller, RWTH Aachen University, E.ON Energy Research Center, Institute for Energy Efficient Buildings and Indoor Climate, Germany.

Dr.-Ing. Thomas Sefker, Heinz Trox Wissenschafts gGmbH, Germany.

M. Sc. Paul Seiwert, RWTH Aachen University, E.ON Energy Research Center, Institute for Energy Efficient Buildings and Indoor Climate, Germany.

Dipl.-Ing. Benjamin Zielke, TU Berlin, Hermann-Rietschel-Institut, Germany.

WS 5 – TENTATIVE PROGRAMME (Monday, June 4 @ 15:30—17:00 in room U119)

Chairs: Dirk Müller and Thomas Sefker
Secretary: Behrang Alimohammadi

Time	Topic	Speaker(s)	Organisation
5 min	Opening, introduction of the Heinz Trox Wissenschafts gGmbH and objective of the workshop	Dirk Müller and Thomas Sefker	Heinz Trox Wissenschafts gGmbH
10 min	Degree of turbulence as a driver and uncertainty factor of draft risk during transient ventilation	Benjamin Zielke	TU Berlin
5 min	*Questions and discussion*		
15 min	Comparison of conventional and personal ventilation in offices Outlook on the topic: Influence of radiation asymmetry on thermal comfort	Claudia Kandzia	TU Dresden
5 min	Questions and discussion		
15 min	Subject experiments on thermal comfort with displacement air flow as a function of the vertical temperature gradient at freely selectable mean room temperature Outlook on further projects	Paul Seiwert and Dirk Müller	RWTH Aachen University
5 min	Questions and discussion		
30 min	Discussion and Suggestions		

WS 6:
HALTON: ADVANCED AIRFLOW DISTRIBUTION METHODS FOR PROTECTION OF OCCUPANTS FROM EXPOSURE TO INDOOR AIRBORNE POLLUTION

BACKGROUND

A wide range of pollutants has been found indoors and the adverse effect of various indoor pollutants on occupants' health has been recognized as well. In addition, both gaseous pollutant and particulate matter pollutants may spread indoors from one zone to another though improperly designed airflow distribution system. Sometimes, even flu viruses may spread from person to person through coughing or sneezing by people with influenza in public spaces using various traditional ventilation methods, like natural ventilation and mixing ventilation (MV). The fact of the increasing exposure of occupants to various indoor pollutants shows that there is an urgent need to develop advanced airflow distribution methods to reduce indoor exposure to various indoor pollutants.

OBJECTIVE

The main objective of this workshop is to discuss various ventilation methods to improve indoor air distribution to prevent and reduce human exposure to various indoor pollutants.

ATTENDEES

HVAC consulters, researchers, ventilation manufactures, manufactures, policy maker and others interested to airflow distribution are welcomed to the workshop.

DISCUSSION TOPICS

1. What are the challenges to reduce personal exposure indoors?
2. How to design indoor airflow distribution to reduce the indoor exposure?
3. What are these advanced airflow distribution methods to reduce exposure to indoor pollutants?
4. Where these advanced airflow distribution methods may be applied?

EXPECTED RESULTS

Through the discussion, the workshop will find out some effective and efficient methods of airflow distribution to reduce indoor exposure to various pollutants. An article may be prepared together with all panel members.

PANEL

Prof. Guangyu Cao, NTNU, Norway.

Prof. Emeritus Peter V. Nielsen, Aalborg University, Denmark.

Prof. Arsen Melikov, DTU, Denmark.

Dr. Panu Mutakallio, Halton, Finland.

WS 6 – TENTATIVE PROGRAMME (Monday, June 4 @ 15:30—17:00 in room U4)

Chair: Guangyu Cao
Secretary: Natalia Lastovets

Time	Topic	Speaker(s)	Organisation
	Opening		
10 min	Objective of the workshop Application of downward plane jets for reduction of personal exposure	Guangyu Cao	Norwegian University of Science and Technology
5 min	*Questions and discussion*		
10 min	Advanced airflow distribution for reduction of exposure to indoor pollutants	Arsen Melikov	DTU, Denmark
5 min	*Questions and discussion*		
10 min	Zonal airflow distribution by using chilled beams	Panu Mustakallio	Halton, Finland
5 min	*Questions and discussion*		
10 min	Advanced airflow distribution methods for hospitals and health care facilities	Peter V. Nielsen	Aalborg University, Denmark
5 min	*Questions and discussion*		
30 min	*Questions and discussion*		

WS 7:
TRENDS IN DEMAND-ORIENTED NON-UNIFORM AIR DISTRIBUTIONS

BACKGROUND

Ventilation is intended primarily to provide occupants with clean air for breathing and good microclimate for thermal comfort. Therefore, air distribution (or to where the conditioned clean air is distributed) is important. The conventional total volume ventilation is inefficient, in terms of both thermal comfort and indoor air quality, because (1) The entire space, including the unoccupied volume is targeted; (2) Large airflow rate is needed to vent the space, which implies much energy, big systems, and high cost; (3) The contaminants are transported from the unoccupied volume into the occupied zone; and (4) The ventilation systems are slow in response and the occupants have very limited control.

The ventilation technology of the next generation should be able to provide:

1. Healthy, comfortable and work stimulating environment (not just one of these elements);
2. Best possible environment for each and every occupant;
3. Reduction in energy consumption;
4. Increased flexibility in space use;
5. Reduction of HVAC system size, space occupation and cost, and
6. Simplicity in HVAC system configuration.

These cannot be achieved with the present approach of total volume indoor environment design. Therefore, paradigm shift is needed from the total volume air distribution, which supplies clean and cool air to nobody, to the advanced air distribution, which supplies clean and cool air to everybody. The occupants must be in the centre of the technological development.

Occupants at different locations often require different microclimates. These requirements have not been well satisfied. What really needed is to inversely determine the optimal airflow pattern and supply parameters to meet the requirements. As a preliminary effort to solve this inverse problem, the optimization of supply parameters under a given flow pattern should be studied first. A proposed optimization model can determine the optimal supply parameters to meet different parameter requirements in multiple locations. It is able to optimize the supply boundary conditions for accommodating individual requirements even if the number of locations with individual requirements is more than that of the supply air terminals.

The optimization model for the inverse problem can only function when it is coupled a room air distribution system. For good controllability of temperature, speed, etc., the air distribution should be fast in response and have a short time constant, i.e. lower non-linearity. Advanced air distributions should have fast response and shortest time constant. To implement this new concept, the demonstrable needs lie on two aspects:

1. Wireless communication technology, and
2. Software implementing the optimization model.

To address the differentiated individual preferences, it is necessary to add an occupancy sensor and a human machine interface into each node. Wireless sensor and human machine interface network can be easily installed and organized to provide more accurate distribution of the air parameters around the

occupants and attain feedbacks from the occupants. In order to achieve a differentiated microclimate, an automatic control system is needed to:

1. measure individual micro-thermal environments;
2. collect each occupant's complaints on her/his thermal sensations, and
3. control the air parameters at the supply terminals.

The control system includes sensors, human machine interfaces, actuators and a control computer.

Current practice regulates a thermal environment by a building management system with several fixed sensors. Because of the non-uniformity of the advanced air distribution, the building management system is unable to adequately reflect and to modulate the environment with limited number and locations of the sensors in a room. On the other hand, similar to the wall temperatures/heat fluxes that are presently used as inputs, by the first principle, the exit air condition also results from the internal, ambient and supply air conditions. Both supply and exit air conditions are readily monitored and/or controlled by the building management systems. Therefore, this workshop will introduce the original idea of modelling the non-uniform indoor environments with conditions of supply and exit air as inputs.

OBJECTIVE

This workshop aims at discussing the recent developments on demand-oriented non-uniform air distributions as workable technical solutions. This workshop will help researchers further develop advanced air distribution technologies, which provide purposefully-differentiated thermal comfort and air quality in the occupied zone. Design related issues for the practical application of advanced air distributions will be discussed.

ATTENDEES

HVAC consulters, researchers, ventilation manufactures, manufactures, policy maker and others interested to airflow distribution are welcomed to the workshop.

DISCUSSION TOPICS

The issues that need to be discussed with regard to non-uniform environment are:

1. methods to achieve demand controlled non-uniform environment;
2. methods to optimize it;
3. methods to control it;
4. available and needed sensor technologies; and
5. innovative technology to minimize the number of sensors.

EXPECTED RESULTS

Through the discussion, the workshop will find out methods to provide demand-oriented non-uniform environment in the occupied zone for improving occupants' thermal comfort and inhaled air quality at reduced energy consumption. An article may be prepared together with all panel members.

PANEL

Dr. John Zhang Lin, City University of Hong Kong, China.

Prof. Xianting Li, Tsinghua University, China.

Prof. Arsen Melikov, DTU, Denmark.

Mr. Zhixiang Cao, Xi'an University of Architecture and Technology, China.

Dr. Xiaoliang Shao, University of Science and Technology Beijing, China.

WS 7 – TENTATIVE PROGRAMME (Tuesday, June 5 @ 10:30—12:00 in room U119)

Chair: Zhang Lin
Secretary: Hassam Rehman

Time	Topic	Speaker(s)	Organisation
1 min	Opening and objective of the workshop	Zhang Lin	City University of Hong Kong, China
10 min	Insights on individually controlled micro-environment	Arsen Melikov	DTU, Denmark
5 min	*Questions and discussion*		
10 min	Theory of demand-oriented non-uniform indoor environments	Xianting Li	Tsinghua University, China
5 min	*Questions and discussion*		
10 min	Demand-oriented environment by using vortex ventilation in industrial buildings	Zhixiang Cao	Xi'an University of Architecture and Technology, China
5 min	*Questions and discussion*		
10 min	Potential of stratum ventilation for providing a demand-oriented non-uniform indoor thermal environment	Xiaoliang Shao	University of Science and Technology Beijing, China
5 min	*Questions and discussion*		
	Coupled optimization of non-uniform air distributions and air conditioning system	Zhang Lin	City University of Hong Kong, China
30 min	*Questions and discussion*		

WS 8:
ACCURACY OF INDOOR AIRFLOW MEASUREMENT

BACKGROUND

Indoor airflow measurements are needed to assess thermal comfort of occupants, inhaled air quality, efficiency of air distribution methods, etc. The results are used to improve the performance of the systems for generating indoor environment in occupied spaces, in spaces with requirements for industrial processes, etc. Measurements are also used to control indoor environmental systems and improve their energy performance. Several parameters, including air velocity and temperature, tracer gas concentration, particle transport and distribution, etc. are measured. Different methods and measuring techniques are used.

During the workshop measurement of different indoor airflow parameters, including air velocity, tracer gas concentration, particle distribution, etc. and their dynamics will be discussed. Recommendations for their accurate measurements will be outlined. The selection of optimal measurement methods, instruments with appropriate characteristics (response time, sampling frequency, etc.), measuring procedures and data analyses needed for reliable assessment of indoor airflow distribution with regard to occupants' thermal comfort, exposure to pollution, airborne cross-infection as well as process requirements will also be in the focus.

OBJECTIVE

The objective of the workshop is to address the importance of reliable indoor airflow measurement and to outline recommendations for improving their accuracy.

ATTENDEES

HVAC consultants, researchers, ventilation manufactures, manufactures of measuring instruments, policy maker and others interested of indoor airflow measurements are welcomed to the workshop.

DISCUSSION TOPICS

1. Why it is important to perform correct indoor airflow measurements?
2. What is important when the measuring instruments are selected?
3. What can be the error sources during field and laboratory measurements?
4. How to improve the measuring accuracy?
5. How can we increase awareness of the HVAC community on the importance of measuring accuracy?
6. Are the requirements for indoor measurement and instruments in the standards sufficient?

EXPECTED RESULTS

The workshop will increase awareness of researchers and consultants for the importance of accurate indoor airflow measurement. The workshop will motivate manufactures to develop new and more accurate instruments for indoor airflow measurement.

PANEL

Arsen Melikov, Technical University of Denmark (DTU), Denmark.

Sami Lestinen, Aalto University, Finland.

Zhengtao Ai, DTU, Denmark.

Mariya Bivolarova, DTU.

Kaho Hajimoto, Waseda University, Japan.

Xiaoliang Shao, University of Science and Technology Beijing, China.

Simo Kilpeläinen, Aalto University, Finland.

WS 8 – TENTATIVE PROGRAMME (Tuesday, June 5 @ 13:30—15:00 in room U119)

Chair: Arsen Melikov
Secretary: Sami Lestinen

Time	Topic	Speakers	Organisation
5 min	Opening and objective of the workshop	Arsen Melikov	Technical University of Denmark, Denmark
10 min	Indoor airflow measurement in a multipurpose arena	Sami Lestinen	Aalto University, Finland
5 min	*Questions and discussion*		
10 min	Accurate prediction of human exposure using tracer gas technique	Zhengtao Ai	Technical University Denmark, Denmark, Denmark
10 min	Accurate assessment of exposure using thermal manikins and tracer gas measurements	Mariya Bivolarova	Technical University of Denmark, Denmark
5 min	*Questions and discussion*		
10 min	Particle Concentration measurement in a cleanroom	Kaho Hashimoto Xiaoliang Shao	Waseda University, Japan University of Science and Technology Beijing, China
5 min	*Questions and discussion*		
10 min	Ventilation measurements in a laboratory: How to choose your instruments?	Simo Kilpeläinen	Aalto University, Finland
20 min	*Overall discussion*		

WS 9:
SCANVAC: SMART INDOOR CLIMATE CONTROL: HOW TO UTILIZE SMART READINESS INDICATOR APPROACH IN INTELLIGENT BUILDINGS

BACKGROUND

Intelligent technologies for buildings are technologies that are intended to increase the service capability of the premises, to improve the use and maintenance of buildings and to improve the energy efficiency of buildings. In addition, intelligent technologies should generate financial added value for both building owners, users of the premises, and multiple service providers on buildings and premises. New IoT technologies offer opportunities for new services.

The recently launched Smart Readiness Indicator (SRI) is a voluntary component of EU's Energy Efficiency Directive. The SRI concept can be seen as a framework for developing new knowledge-intensive services. The emerging SRI indicator enables to identify more intelligent building technology solutions that improve energy efficiency, indoor air quality and technical performance of buildings or building stock. In the SRI concept, the "intellectual capability" of buildings is considered in three areas, all of which are value-added factors for property management:

1. Readiness to adapt to users, needs regarding indoor climate;
2. Readiness improves the use of the building and ensures optimum operation of the building system;
3. The ability to adapt to energy services produced outside the buildings.

OBJECTIVE

The main objective of this workshop is to discuss future expectations, challenges and opportunities as well as implications of new IoT enabled indoor climate control solutions to meet users' needs and reduction of energy demand in a balanced way. The idea is to see SRI as an enabler of solution development rather than a legislative boundary.

ATTENDEES

Real estate owners, property managers, HVAC and lighting consulters, researchers, HVAC and lighting manufactures, policy makers and others interested in smart indoor climate control to airflow distribution are welcomed to the workshop.

DISCUSSION TOPICS

1. What is a smart building from users, perspective?
2. What are the technical challenges/opportunities to realize buildings increasingly smarter?
3. What is the add value of buildings, smartness to various stakeholders?
4. What is the foreseen paradigm shift of businesses to provide building services and what is the beef of new businesses?

EXPECTED RESULTS

Through the discussion, the workshop will find out some innovative approaches for future development of IoT based indoor climate control services.

PANEL

Markku J. Virtanen, Aalto University, Finland.

Ivo Martinac, KTH, Sweden.

Heikki Ihasalo, Aalto University, Finland.

Erkki Aalto, Retired from Rakli, Finland.

WS 9 – TENTATIVE PROGRAMME (Tuesday, June 5 @ 13:30—15:00 in room U4)

Chair: Markku J. Virtanen
Secretary: Janne Hirvonen

Time	Topic	Speaker(s)	Organisation
	Opening		
10 min	Objective of the workshop What SRI is and what it enables?	Markku J. Virtanen	Aalto University, Finland
5 min	*Questions and discussion*		
10 min	What to do with the huge amount of measured data of indoor climate performance?	Ivo Martinac	KTH, Sweden
5 min	*Questions and discussion*		
10 min	Measured data exists but is it available and usable?	Heikki Ihasalo	Aalto University, Finland
5 min	*Questions and discussion*		
10 min	Adding Value by Building Smartness (Owner & User Perspectives)	Erkki Aalto	Retired from Rakli, Finland
5 min	*Questions and discussion*		
30 min	*Questions and discussion*		

WS 10:
WHAT WILL BE THE DESIRED AIRFLOW DISTRIBUTION SOLUTIONS IN OPERATING ROOMS: THEORETICAL AND PRACTICAL CHALLENGES?

BACKGROUND

Earlier studies have shown that bacterial concentration in operating rooms (ORs) with vertical

laminar airflow (LAF) systems can be up to 20 times lower compared with ORs that are equipped without LAF systems, and many existing national standards prefer LAF systems to be installed in the ORs. However, an earlier CFD study demonstrated that higher supply velocities than 0.3 m/s in operating rooms with LAF may deteriorate the thermal comfort sensation experienced by the surgical staff. Another numerical study showed that surgical lights with higher heat generation increase the concentration of MCPs close to the operating table. This workshop will discuss various airflow distribution methods in operating rooms.

OBJECTIVE

In this session, we want to consolidate the state of the art on airflow distribution solutions in operating rooms regarding theoretical and practical challenges.

ATTENDEES

HVAC consulters, researchers, ventilation manufactures, manufactures, policy maker and others interested to airflow distribution are welcomed to the workshop.

DISCUSSION TOPICS

1. What are the challenges to design airflow distribution systems in operating rooms?
2. How these advanced airflow distribution methods may be applied?

EXPECTED RESULTS

Through the discussion, the workshop will find out some effective and efficient methods of airflow distribution in operating rooms. An article may be prepared together with all panel members.

PANEL

Prof. Guangyu Cao, NTNU, Norway.

Prof. Sture Holmberg, KTH, Sweden.

Prof. Martin Kriegel, Technical University of Berlin, Germany.

Dr. Kim Hagström, Halton Group, Finland.

Consultant, Frank Mills, Technical Director of Frank Mills Consulting, UK.

WS 10 – TENTATIVE PROGRAMME (Tuesday, June 5 @ 13:30—15:00 in room U5)

Chair: Guangyu Cao
Secretary: Hassam Rehman

Time	Topic	Speaker(s)	Organisation
10 min	Field measurements of effect of surgical lights on airflow distribution in an operating room	Guangyu Cao	Norwegian University of Science and Technology
5 min	*Questions and discussion*		
10 min	CFD simulation of airflow distribution in operating rooms	Sture Holmberg	KTH, Sweden
5 min	*Questions and discussion*		
10 min	Experimental investigation of airborne particle distribution in operating theatres	Martin Kriegel	Technical University of Berlin, Germany
5 min	*Questions and discussion*		
10 min	Validation of vita or space solution using simulated operation	Kim Hagström	Halton Group, Finland.
5 min	*Questions and discussion*		
10 min	UK approach to ventilation systems for operating rooms including recent specialized ORs.	Frank Mills	Frank Mills Consulting, UK
5 min	*Questions and discussion*		
20 min	Open panel discussion and Questions and Answers session.		

WS 11:
IEA: SUPPLEMENTING VENTILATION WITH GAS-PHASE AIR CLEANING, IMPLEMENTATION AND ENERGY IMPLICATIONS. *A PROPOSED IEA-EBC ANNEX*

BACKGROUND

Ventilation accounts for approximately 20% of the global energy use for providing an acceptable indoor environment. The requirements for ventilation in the most standards and guidelines assume acceptable quality of (clean) outdoor air.

Worldwide, there is an increasing number of publications related to air cleaning and there is also an increasing sale of gas phase air cleaning products. This puts a demand for verifying the influence of using air cleaning on indoor air quality, comfort, well-being and health. It is thus important to learn whether air cleaning can supplement ventilation with respect to improving air quality i.e. whether it can partly substitute the ventilation rates required by standards. Finally, the energy impact of using air cleaning as supplement of ventilation needs to be estimated. This project will focus on gas phase air cleaning. The project will not include particle filtration.

In many locations in the world, the outdoor air quality is so bad that it is better to avoid supplying outdoor air to the buildings. In such cases, the alternative to use ventilation is to substitute supply of outdoor air with air cleaning so that the indoor air can be kept at high quality. Even when outdoor air is of a good quality, the use of air cleaning substituting ventilation air could reduce the rate of outdoor air supplied indoors and thereby energy for heating/cooling the ventilation air and for transporting the air (fan energy) can be saved.

Since it is expected that air cleaning may in parallel improve the indoor air quality and reduce energy use for ventilation, it should be considered as a very interesting technology that can be used in the future. There is however a need for better evaluation of its potential to improve indoor air quality (and substitute ventilation rates) and the energy implication of using gas phase air cleaning. There is also a need to develop standard test methods of the performance of air cleaning devices. Consequently, it is proposed to form a new annex on the use of gas phase air cleaning technologies.

The proposed Annex should bring researchers and industry together to investigate the possible energy benefits by using gas phase air cleaners (partial substitute for ventilation) and establish procedures for improving indoor air quality or reduced amount of ventilation by gas phase air cleaning. The project shall also establish a test method for air cleaners that considers the influence on the perceived air quality and substances in the indoor air.

OBJECTIVE

The main objective of this workshop is to discuss the concept of a new IEA-EBC annex. The discussion will be taken into account during the planning of a new annex.

ATTENDEES

HVAC consultants, researchers, ventilation manufactures, air cleaner manufactures, policy maker are welcomed to the workshop.

DISCUSSION TOPICS

1. What are the risks and benefits of using gas-phase air cleaning? Do benefits outweigh the risks or the other way around?
2. Should perceived air quality be the only major performance criteria for air cleaners?
3. What are the additional benefits of starting the annex?

EXPECTED RESULTS

Through the discussion, the workshop will give input to a possible new IEA-EBC annex. More experience with gas phase air cleaning will be obtained from the participants.

PANEL

Prof. Bjarne W. Olesen, International Centre for Indoor Environment and Energy, Technical University of Denmark.

Prof. Pawel Wargocki, International Centre for Indoor Environment and Energy, Technical University of Denmark.

Prof. Alireza Afshari, SBi, AAU-Copenhagen, Denmark.

WS 11 – TENTATIVE PROGRAMME (Tuesday, June 5 @ 13:30—15:00 in room U6)

Chair: Bjarne W. Olesen
Secretary: Behrang Alimohammadi

Time	Topic	Speaker(s)	Organisation
	Opening		
15 min	Background and Objective of the workshop	Bjarne W. Olesen	International Centre for Indoor Environment and Energy, Technical University of Denmark
5 min	*Questions and discussion*		
10 min	Standard measurement of perceived air quality (PAQ)	Pawel Wargocki	International Centre for Indoor Environment and Energy, Technical University of Denmark
5 min	*Questions and discussion*		
10 min	Example of testing of a gas phase air cleaner	Alireza Afshari	SBi, AAU-Copenhagen, Denmark
45 min	*Questions and discussion*		