Feedback from the 41st AIVC – ASHRAE IAQ joint Conference – Summary of the topical session on ventilative cooling

The 41st AIVC – ASHRAE IAQ joint Conference, co-organized by ASHRAE & AIVC, was held on 4-6 May 2022 in Athens. The event drew around 185 participants (in person and remotely) – academic researchers, engineering and consulting firms, industry representatives, people involved in standardisation, policy makers, manufacturers & stakeholders and international organizations.

During the event, the 90 minutes topical session "Ventilative Cooling to Reduce Overheating in Buildings to Achieve Good Well-Being: Framing, New Design Approaches and Cases - It Works!" organized by Christoffer Plesner (VELUX, DK) & Jannick Roth (WindowMaster, DK) took place. The session included 7 presentations by international experts and focused on ventilative cooling (VC) and its importance and showed documented case studies. New developments were revealed such as the implementation of VC in international standards, findings of recently finished research projects, etc. Furthermore, the workshop highlighted the aspects to be aware of to get a well-performing VC system and some recommendations going along with this.

Christoffer Plesner (VELUX, DK) provided the reasons behind and the objectives of the workshop. He informed the audience of the new CEN Technical Specification "Ventilative Cooling Systems Design" and the proposed (draft) definition of Ventilative Cooling System as *"An air system that cools a building using ventilation air from outside at its actual temperature and humidity. Air transfer may be by natural, mechanical or hybrid means"*. The presenter also listed the types of ventilative cooling (natural, mechanical & hybrid) and highlighted that VC is part of the well-being agenda, being able to deliver a good thermal comfort: at reduced energy use during times when there is a cooling demand; in a sustainable and renewable way; and possibly eliminating or reducing the need for mechanical cooling systems. Jannick Roth (WindowMaster, DK) took over to stress the importance of VC showing figures of the global energy needs for space cooling, expected to triple by 2050.

The next speaker, Per Heiselberg (Aalborg University, DK), introduced ventilative cooling and its relevance at these times. He highlighted the fact that the current developments towards nearly-zero energy buildings have led to an increased need for cooling which is present in buildings and residences all over Europe; elevated temperature levels and thus the need for cooling seem to appear all year round and even in the "heating season" when there are sunny conditions. The speaker presented temperature figures of the living room of a single-family house, the first NZEBs in Denmark, to conclude that periods of high temperatures are more frequent in the winter season; people use the windows to cool down the building during the summer but not during the winter. He concluded that we mainly need solutions to cool the buildings during wintertime when we cannot use VC directly (due cold outdoor conditions and draught). According to the speaker, the reasons we experience overheating are the fact that there is more focus on saving energy than on documenting acceptable indoor environment, the simplified methodologies used to estimate the cooling needs; the lack of standards and market available technical solutions especially for dwellings and the limited user experience on handling of overheating problems. Another issue stressed by Heiselberg is that while it is quite easy to decrease a building's heating needs (increasing the envelope insulation, building airtightness, etc), addressing the cooling needs is far more difficult as it requires the application of technologies that are variable in time

and have a high degree of user interaction and user control. The speaker concluded that VC is an attractive and energy efficient passive solution to cool buildings and avoid overheating as long as there is more design flexibility (a broader range of design solutions) to fulfil both human needs and implementing these needs into future standards and legislation.

Christoffer Plesner (VELUX, DK) followed up to inform on the work of CEN/TC 156 and ISO/TC 205 related to the upcoming European and international technical Documents on "Ventilative Cooling Systems - Design". He presented the status of these new CEN & ISO projects, their overall purpose, scope and approaches as well as their interaction with existing standards. The speaker concluded that even though the benefits of VC are widely acknowledged, its use by e.g., designers or architects depend strongly on: the adequate modelling of natural ventilation and especially air flows; adequately predicting the expected "thermal comfort and cooling requirements", and the "energy performance" when using ventilative cooling in buildings (for static models & adaptive models); ensuring that the full effects of ventilative cooling are evaluated – to reflect the real conditions for the building, control, use and climate and; addressing the human needs into standards and legislation.

Hilde Breesch (KU Leuven, BE) introduced venticool, the platform for resilient ventilative cooling and its position and went through the EBC Annex 62 “ventilative cooling” deliverables.

Per Heiselberg (Aalborg University, DK) presented a new simplified design methodology, the “Ventilative Cooling” design guide for single family houses in Denmark (based on the Danish climate, the typical construction ways, the typical use profiles of houses etc.) aimed to encourage designers and contractors to integrate VC technologies in their designs. The study involved 600 annual simulations on configurations similar to the typical single family Danish house, investigating different loads, different window openings, in different directions, with different thermal mass etc; The researchers performed lots of calculations with variants of the typical variables influencing the cooling need of the building and calculated the number of hours above 27 ˚C (Danish building regulation has a requirement of max 100 hours >27 ˚C in residences) for different airflow rates. Based on the retrieved results, the diagram in Figure 1 was developed providing the design airflow rate depending on the effective area of solar supply (%/m^2 floor area); once the required airflow rate is decided, one can choose the type of airing strategy to be applied and then based on the EU standard EN 16798-7: 2017 to determine the typical design conditions in the summer for VC and also the required opening area as a percentage of the floor area. The guide also provides information on how to transfer the effective opening area into window opening area depending on the type of window. The speaker also presented a design process to assist in the decision making i.e.: identify where the challenge is; calculate the solar effective area; find the airflow rate needed; choose the strategy for ventilation (single-sided, cross etc.); use the diagram to decide what the effective opening area is; choose an opening type and determine its size; compare the opening type to the design or pre-design already made and if it doesn’t match; make iterations.

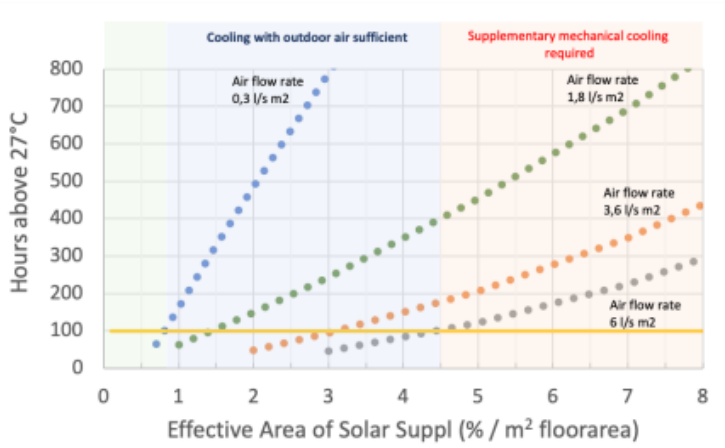

Figure 1: Design airflow rate for outdoor air cooling by natural ventilation (Per Heiselberg, “Danish Design Guide on “Ventilative Cooling” for Natural Ventilative Cooling: Example from a Danish Residential Building in Ry”, 41st AIVC – ASHRAE IAQ – 9th TightVent/ 7th venticool joint Conference, Athens Greece, 2022)

Hilde Breesch (KU Leuven, BE) presented a case study of a single-family dwelling in Belgium with high insulation and light thermal mass designed for night cooling. Based on the monitoring results performed, there is a cooling potential especially in typical weather conditions (temperature can drop up to 2 ˚C in the living room area). Moreover, the first monitoring results showed that automated control of windows increases the cooling potential as compared to manual control while opening windows during daytime has a negligible cooling effect.

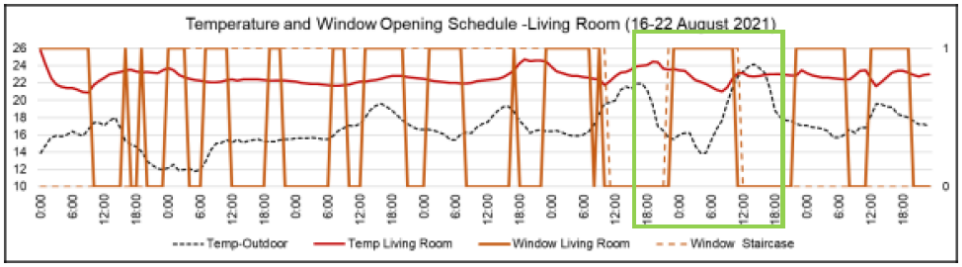

Figure 2: Monitoring results of the living room area of a single-family dwelling in Belgium (Hilde Breesch. 2022, "Night Cooling as a Ventilative Cooling Solution for a Belgian Residential Building", 41st AIVC – ASHRAE IAQ – 9th TightVent/ 7th venticool joint Conference, Athens Greece, 2022)

Jannick Roth (WindowMaster, DK) showed two case studies of municipality & court office buildings located in Denmark. The municipality office building is a zero-energy building making use of hybrid ventilation (mechanical during winter and natural during summer) while the court office building combines mechanical- and natural ventilation depending on the needs. Both buildings use controls for the hybrid ventilation system and solar shading (occupants can also manually control the systems); the court office building includes also controls for natural & mechanical ventilation, heating and smoke. As expected, making use of a mixed-mode ventilation decreases the capital cost of the systems when compared to mechanical only ventilation. Moreover, the results of temperature measurements (all year long) during occupied hours for both buildings are in line with the Danish thermal requirements.

During the last presentation, Annamaria Belleri (Eurac, IT) presented a tool which can be used at early design stages and assesses the potential effectiveness of ventilative cooling strategies by considering besides external climate conditions, building envelope thermal properties, occupancy patterns, internal heat gains and heat losses through envelope thermal transmission and ventilation. It provides building designers information on potential number of hours when ventilative cooling can be effective and with a design airflow rate for ventilative cooling. The 1st version of the tool was released in 2018 and is currently available on the venticool platform website and there is an improved 2nd version currently under testing and validation process. The new version includes a new interface and features such as implementing the use of a lumped capacitance model to consider building thermal mass, adapting the balance calculation methodology to EN ISO 52016-1 on building energy performance calculation and potential integration in the new standard on ventilative cooling systems (CEN/TC156/WG21) and ensuring compliance with the standard EN 16798-1: 2019 regarding airflow rates for indoor air quality and adaptive thermal comfort model.

Since overheating of buildings is nowadays present all year long, ventilative cooling through openable windows as well as night cooling are attractive and energy efficient passive solutions to limit it.