Summary of the ventilative cooling track

Around 150 participants attended the joint 35th AIVC – 2nd venticool – 4th TightVent conference held in Poznan, Poland September 24-25, 2014. The programme consisted of 3 parallel tracks with contributions from 27 countries and international organizations. Over 100 presentations were given covering topics ranging from ventilative cooling and thermal comfort, air infiltration through leaks in the building envelope and ductwork and ventilation in relation to IAQ and health. It has also been a major discussion place for on-going projects and initiatives such as the IEA EBC annex 62, the QUALICHeCK project and platform, the venticool and TightVent Europe platforms, the newly formed Indoor Environmental Quality – Global Alliance (IEQ-GA), etc., based on presentations of results and perspectives as well as interactions with the audience.
The ventilative cooling track of the conference consisted of 4 sessions with 29 presentations. Specific topical sessions dealing with ventilative cooling included the following topics:

- Ventilative cooling and Annex 62
- Comfort in sustainable buildings

This article summarizes the main trends and conclusions addressed during the presentations and discussions in the ventilative cooling track of the conference.

Several presentations introduced **ventilative cooling strategies.** Pazold et al. (2014) presented a model that couples hygrothermal whole building simulation with a multi-zone air-flow simulation to assess the combined effects of air-flow on building energy use, comfort conditions, indoor air quality (IAQ) and possible hygric issues (Pazold, Antretter, & Hermes, 2014) . Their results showed that in residences, an appropriate window opening strategy can both decrease energy use and improve IAQ and thermal comfort. They found that demand controlled opening strategies can both improve energy use and ensure high indoor air quality and comfort conditions, including controlling humidity indoors to avoid moisture damage.

Holzer et al. (2014) investigated various control systems (heating control systems, ventilative cooling control systems, natural and hybrid comfort ventilation systems, daylight supply and sun protection systems and building automation together with user information and individual control systems) of indoor climate in six Active Houses. They showed that the proper design of windows can contribute significantly to ensuring comfortable thermal conditions (Holzer & Foldbjerg, 2014). The combination of automated window openings and automated sunblinds, controlled by room temperature, outside temperature and solar irradiation proved to be successful (e.g., night ventilation during heat waves reduced temperatures up to five degrees). The authors highlighted the need for automated ventilative cooling control with combined operation of windows and sunblinds. They stressed the limits of individual operation; on the other hand, automated operation of both windows and sunblinds may be surprising to occupants and thereby cause discomfort and complaints as its action is instantaneously visible.

Another study addressed a methodology for the assessment of the ventilative cooling potential and the definition of a ventilative cooling strategy, applied to a historical market located in Valladolid (Spain) in line with its refurbishment project (Belleri, Noris, & Lollini, 2014). The work consisted of two parts: a) a climate suitability analysis to evaluate the ventilative cooling potential based on the building internal gains rate and the considered ventilation strategies options (e.g., night cooling, daytime direct ventilation); and b) coupled thermal and airflow simulations to assess energy savings in terms of cooling need and evaluate thermal comfort. The authors found that, depending on the internal gains level, direct ventilative cooling can be useful up to 90% of the hours when cooling is needed. Also, there is a potential cooling load reduction of up to 55% maintaining indoor temperatures lower than 25°C, resulting from the ventilative cooling strategy. In the same line with the aforementioned studies, the speaker pointed out the importance for ventilative cooling automated control to optimize energy use and thermal comfort (avoid undercooling).

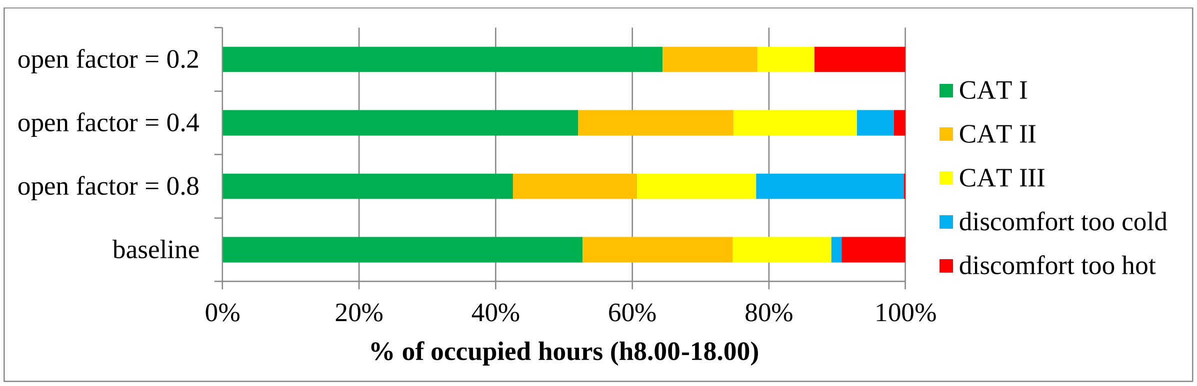

Figure 1: Percentage of occupied hours during which EN 15251:2008 requirements on thermal comfort are met by the baseline model and the models with ventilative cooling strategy (Belleri, Noris, & Lollini, Strategies for exploiting climate potential through ventilative cooling in a renovated historic market, 2014)

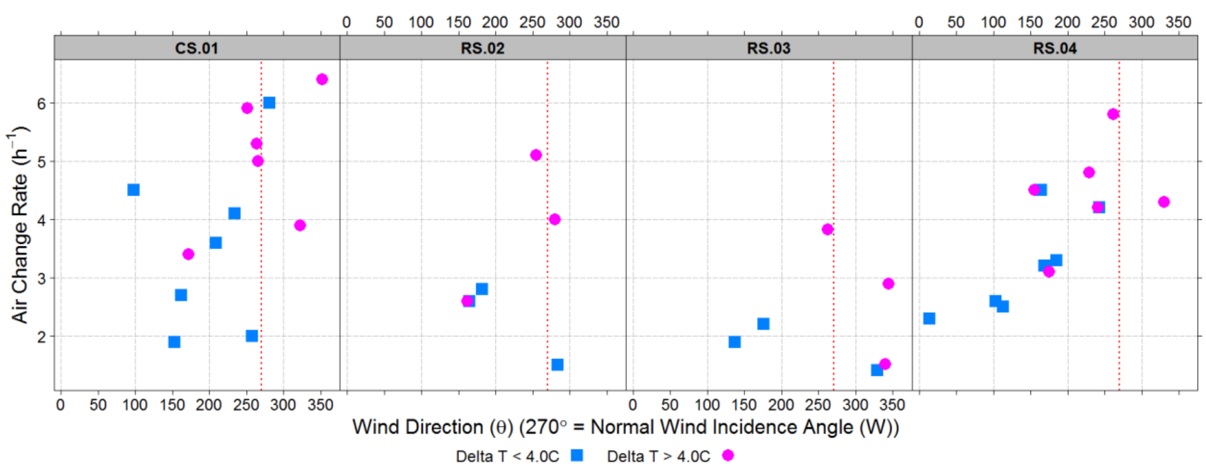

Figure 2: Test configuration ventilation rates (h^{-1}) as a function of wind direction grouped according to ΔT_{ie} (O' Sullivan & Kolokotroni, 2014)

A number of presentations included examples of **technical solutions for ventilative cooling**. More specifically, a single-sided slot louver ventilation system installed in a low energy retrofit application led to steadier ventilation rates compared to a pre-retrofit top hung window opening although its performance was found to be very dependent on wind direction and low wind patterns at the building envelope (O' Sullivan & Kolokotroni, 2014). Furthermore, the use of ventilation shafts in a Zero Energy residential building were investigated and proved to be a useful solution to enhance ventilative cooling (Guardigli, Cappellacci, & Barbolini, 2014). A presentation of an innovative thermal storage wall that utilizes night cooling gave interesting results derived from simulation; experiments are underway to validate the simulated potential for the reduction of cooling energy use (Domínguez, Lissén, Ruiz-Pardo, Sanchez Ramos, & García Ramos, 2014).

A discussion on **strategies to offset warm sensation in high temperature conditions** focused on the effect of a cooling jet from ceiling on thermal comfort, perception and subjective performance in a warm office environment (Maula, Koskela, Haapakangas, & Hongisto, 2014). The results showed that providing local cooling with a supply air jet improves the thermal comfort and the perception of the working environment in a warm office; however, differences found in the perception between different occupants suggest further research to include the effect of individual control.

Several presentations dealt with **calculation methods to predict ventilative cooling performance.** A review on existing design and analysis methods for ventilative cooling, pointed out the need for: 1) reliable simple predictions methods for energy compliance tools; and 2) guidelines for the use of appropriate tools in different design stages (useful results at appropriate accuracy) (Belleri, 2014). Pollet et al. (2014) gave examples of the implementation of ventilative cooling in the national energy performance regulations of the Netherlands, Belgium and France, including a sensitivity analysis to assess the impact of ventilative cooling in those regulations by means of openable windows (Pollet, Germonpre, & Vens, 2014). Although ventilative cooling by means of openable windows can be taken into account in all three countries, the regulatory Energy Performance (EP) calculation results are sometimes inconsistent.

Olesen (2014) reviewed if and how ventilative cooling was accounted for in 5 existing international standards (ISO EN 7730-2005, ASHRAE 55-2013, ASHRAE 62.1 and 62.2-2013, EN15251, EN 13779) (Olesen, 2014). The discussion pointed out that there is no need for a separate standard ventilative cooling; however, the speaker stressed the needs for a technical guide for ventilative cooling and simple methods to predict air velocity levels in rooms.

To conclude, the presentations showed that ventilative cooling can be an effective way to reduce or even eliminate the cooling need in buildings. Discussions showed progress in understanding and evaluating ventilative cooling performance and the effectiveness of control strategies. They also suggested further investigations on strategies combining automation and the individual control (e.g., to increase air velocities). Standards and regulations remain a concern for widespread application of ventilative cooling solutions: although they might support the use of ventilative cooling, performance evaluation in EPBD compliance tools is not consistent from one country to another and integration of ventilative cooling components is often difficult.

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