# MAGIC CIRCULAR

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**Envisaging a world with zero carbon cities**

Welcome to the spring edition of the MAGIC Circular.  As the days get lighter we are focused on finding a new test site for the summer—the key season for natural ventilation in the UK. Ideally, we'd find somewhere we can monitor both with and without traffic and we're considering looking at newly introduced 'school streets' in London, where traffic is only allowed through at certain times of day.  We'd welcome your suggestions regarding any suitable buildings. They must be naturally ventilated and we'd need to monitor both in and outdoors. You can contact us with your ideas **here**.

It's been a busy few months since Christmas. We're refining the focus of our work by developing end-user cases for the MAGIC tool and you can read more about this in Dr Tania Sharmin's piece on Urban Scenarios. Tania is a new member of the MAGIC team and we're excited to have her working on this crucial area, bridging the gap from our scientific experiments and modelling to the architects and designers we hope will be using our final product.

We've also just had our most recent partners meeting—the best attended so far with over 50 delegates. We were inspired by the discussion and you can find out more in our update overleaf. I would like to say a warm thank you to everyone who attended and made it such a productive day.

***The MAGIC project is a collaboration between the Universities of Cambridge, Surrey and Imperial College London, looking at the impact of urban flow on the potential for the increased use of natural ventilation in buildings. The project is supported by a number of academic and industrial partners, such as Dyson, Arup, Breathing Buildings, Reading University and IAP China, but we continue to look for collaborators and to develop our relationships with current partners.***

Professor Paul Linden,

Lead Investigator

University of Cambridge

# MAGIC PARTNERS MEETING

Our most recent MAGIC Partners Meeting was a great success, with over 50 participants joining the discussion about natural ventilation.

The morning session looked in detail at pollution monitoring.  MAGIC Research Assistant Dr Shiwei Fan presented the latest findings from our monitoring experiments at the London South Bank University, followed by presentations from Philip Cunningham from AirLabs, who discussed the monitoring of particulate matter conducted alongside the MAGIC experiments, and Jim Mills from Air Monitors who talked about the potential for monitoring to inform the design and operation of ventilation systems in buildings and help improve energy performance.

Dr Laetitia Mottet then presented the latest findings from MAGIC's Fluidity modelling and outlined the work planned and underway to make the MAGIC model as realistic as possible—including considering the impact of trees, traffic movement and roof-shape on urban pollution.

After lunch our new Research Assistant Dr Tania Sharmin presented her recent work developing scenarios that describe the key issues that end-users (architects, designers, planners etc.), will need the MAGIC tool to address as they consider how and whether to use natural ventilation in their developments and buildings. As Tania outlines overleaf, we think that the impact of (i) green and blue spaces, (ii) urban form and (iii) traffic patterns are the most relevant considerations in this context. But we're keen to get the input of potential end-users to see if they agree, and you can send us your suggestions **here**. The Partners Meeting gave us some useful initial insights, including the need for the final MAGIC tool to be flexible, so it can be used from the earliest stages of the design process when many variables are still under consideration.

In our afternoon session we were excited to have presentations from Stephen Inch, Air Quality expert at the GLA and Brett Ormrod from Foster and Partners. Stephen outlined various initiatives to tackle air pollution in London such as 'healthy streets' schemes to encourage people to travel by foot, bike and public transport. He also explained how the Mayor is aiming to integrate air quality into the design of all new developments. Of course, these measures have strong synergies with uptake of natural ventilation in London's buildings.

Finally, Brett Ormrod gave us a run-down of lessons learnt from the naturally ventilated (and recently completed) Bloomberg Building in London. Although this bespoke building is not going to give 'plug and play' solutions for natural ventilation, there is optimism that knowledge and learning will filter down. Brett noted that, retrospectively, it would have helped the design process for the natural ventilation system if there had been a better way of modelling pollution. Of course, that's something that we at MAGIC are aiming to deliver.

**To Download the presentations from the meeting, please click** here**.**

# UPDATE: LSBU EXPERIMENTS

Early in the new year, a team of MAGIC researchers went back to our test room in the LSBU building at Elephant and Castle, to look in more detail at temperature and $CO_2$ under different naturally ventilated conditions.

Where previously we had kept the monitors in for a period of weeks to track what was happening over time, now we wanted to dig down into specific events and see how they could impact temperature and air pollution in the room under controlled conditions.

Eight postdocs packed into the test room on a Saturday. We let the $CO_2$ and temperature increase for an hour and then did three tests, letting the $CO_2$ and temperature increase between each one:

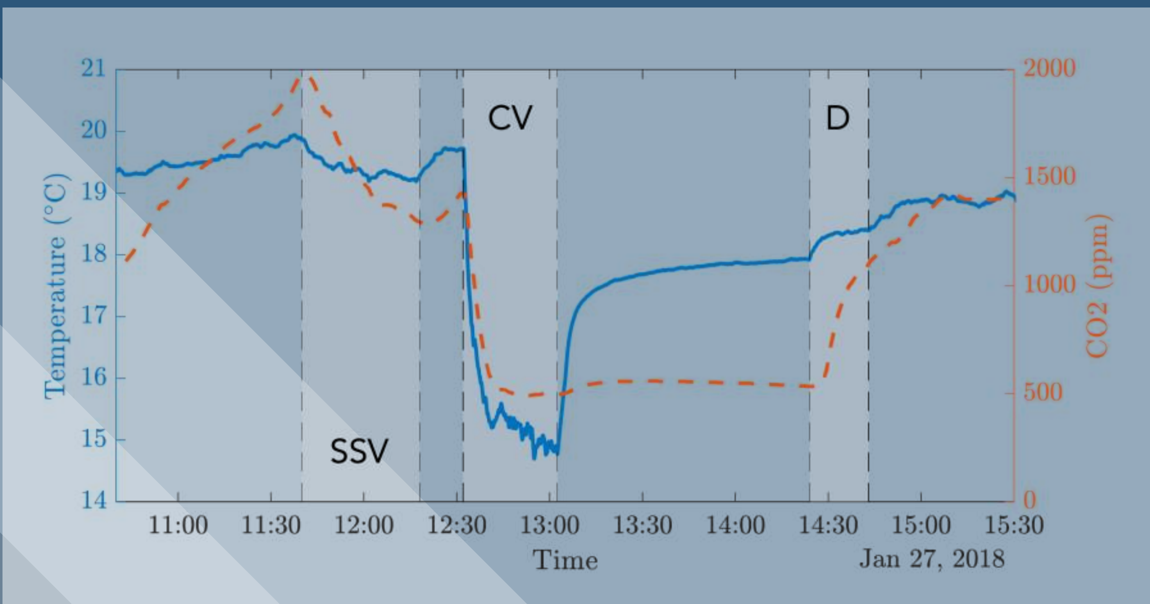
1. Single-sided ventilation (SSV): We opened a single window on the courtyard side and measured the drop in temperature and $CO_2$ levels;

2. Cross ventilation (CV): We opened windows on each side of the room and measured the drop in temperature and $CO_2$ levels;

3. Doorway exchange (D): We closed all windows and moved into the adjacent room, sealing the doorway behind us. After a period of time where the $CO_2$ levels and temperature increased in the adjacent room, we opened the door between the two rooms, examining the increase in $CO_2$ and temperature in the test room.

We found that $CO_2$ levels with eight people in the room were very high - almost 2000 ppm. As shown in the results figure, below, the drop in temperature and $CO_2$ was much more dramatic for CV than for SSV. We also observed differences in the vertical and horizontal thermal stratification. We carried out additional 'comfort' surveys, and under the CV scenario people reported that the room felt cold.

We found it helpful to do the experiments this way—the number of people in the room was constant and we were able to carefully control which windows or doorways were open. Looking ahead, we're likely to combine long-running monitoring in buildings with this type of shorter-term, controlled testing. The spatial distribution of both temperature and $CO_2$ under single-sided and cross ventilation conditions are still unclear so we will certainly be carrying out additional experiments to look into that further.




**Results from weekend experiments at the LSBU test-room.**

# INTRODUCING URBAN SCENARIOS

***By Dr Tania Sharmin***

MAGIC is “an integrated suite of models and an associated management and decision support system” to investigate changes in air flow pattern and traffic flow in urban spaces and their impact on natural ventilation in flanking buildings.

Depending on the associated software and considering the key issues that we think the end-users (architects, designers, planners etc.) would be interested in, we are developing a series of urban scenarios that the MAGIC tool will be able to predict. The main purpose of the scenarios is to evaluate the performance of the MAGIC software system by comparing it with real situations.

We imagine that end-users would be mostly interested in using the MAGIC tool to examine the following three scenarios: the impact of (i) green and blue spaces, (ii) urban form and (iii) traffic patterns. These scenarios will help end-users determine the natural ventilation potential of future and refurbished buildings at an early design stage by considering the surrounding urban context. So, for example, we imagine that MAGIC will be able to predict the impact of incorporating a green space in an urban block, or show how external microclimate and pollution levels change with building height and separation, or the effect of pedestrianising a street, etc.

The first step towards predicting these impacts is to examine potential case study locations, where we will be able to see how green and blue spaces or urban form or traffic flow affect the urban microclimate and eventually, the indoor conditions in the surrounding buildings, which will then determine their possibilities for natural ventilation. For this purpose, we are considering on-site microclimatic measurements in London, Cambridge and surrounding areas.

The **‘Local Climate Zone’** (LCZ) classification of cities offers an effective system to choose our case study locations. LCZ is a widely used climate-based classification of cities, that is: “inclusive of all regions, independent of all cultures, and, for heat island assessment, quantifiable according to class properties that are relevant to surface thermal climate at the local scale”. The main variables of the LCZ system include sky view factor, aspect ratio, building surface fraction, roughness length, surface cover (pervious or impervious) and anthropogenic heat output. Considering the urban texture of London and Cambridge, we are specifically focussing on the following LCZ classifications: LCZ 1 (Compact high-rise), LCZ 2 (Compact mid-rise), LCZ 3 (Compact low-rise), LCZ 5 (Open mid-rise) and LCZ 6 (Open low-rise). These LCZ classes will enable us to capture the effect of the above three scenarios.

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