Implementing technologies in a kindergarten

IEA EBC Annex 62 The IEA project on ventilative cooling

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Kindergarten design developed by Natural Works

Location	Lisbon, Portugal
Building Type	Kindergarten
Retrofit (Y/N)	N
Surroundings (Urban / Rural)	Urban
Ventilative Cooling Strategy	SS and DV
Year of Completion	2013
Floor Area (m^2)	680
Shape Coefficient (%)	32
Openable Area to Floor Area Ratio (%)	8
Window to Wall Ratio (%)	18
Sensible Internal Load (W/m^2)	53
STA KPI	-
Climate Zone (KG)	Csa
No. of Days with T_e max > 25	120
Cooling Season Humidity	Low
Heating Degree days (Kd)	215

2 Building Information

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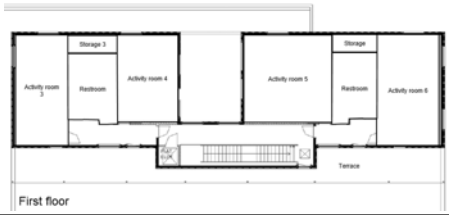

Parameter	Level of Influence
Initial Costs	●
Maintenance Costs	•
Energy costs	•
Solar Loads	●
Internal Loads	●
External Noise	•
Internal Noise Propagation	•
Air Pollution	•
Rain Ingress	●
Insect prevention	●
Burglary prevention	●
Privacy	●

4 Ventilative Cooling

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5 Control Strategies

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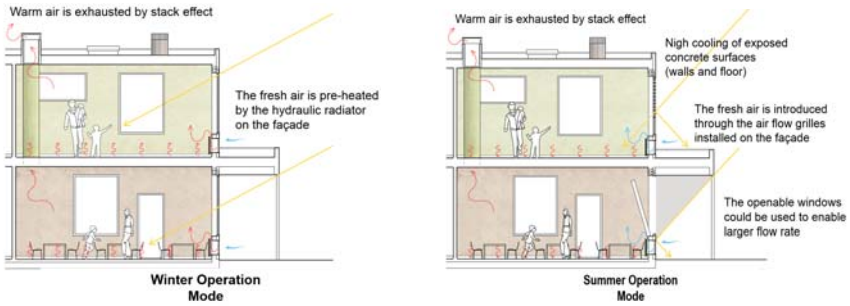

Season		Grille 0%= closed, 100% = open	Chimney 0º= closed, 90º = open	Window 0%= closed, 100% = open
Winter/Autumn	Day Night	30% 0%	30º 0º	30% 0%
Spring	Day Night	50% 50%	45º 45º	50% 0%
Summer	Day Night	100% 100%	90º 90º	100% 100%

6 Design Simulation

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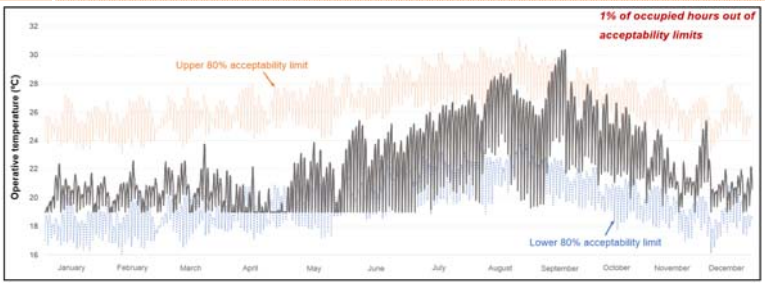

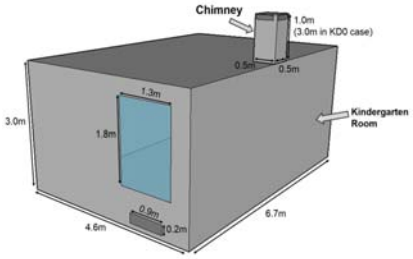

Parameter	Value
T_e , Summer External Temp	30
T_z , Summer Operative Temp	26ºC
Overheating criteria	Adaptive comfort model (80% acceptability limit) for 99% hr_{occ}
Min IAQ air supply rate	7l/s/occupant
Cooling air supply rate	-
Noise Level Rating	-

7 Performance Evaluation

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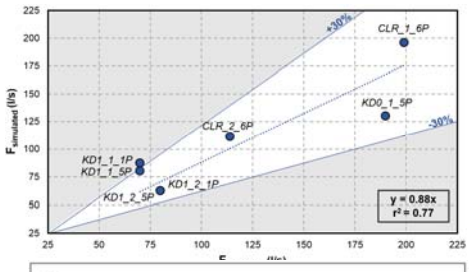
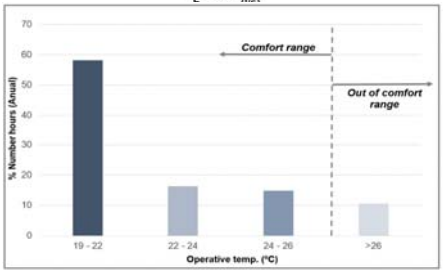
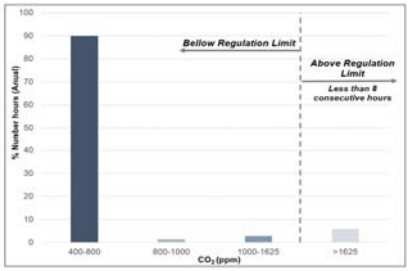


Parameter	Typical year (TMY)
Total Hours > 25°C	12%
Occ Hours > 25°C	16%
Total Hours > 26°C	7%
Occ Hours > 26°C	10%





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Performance Evaluation

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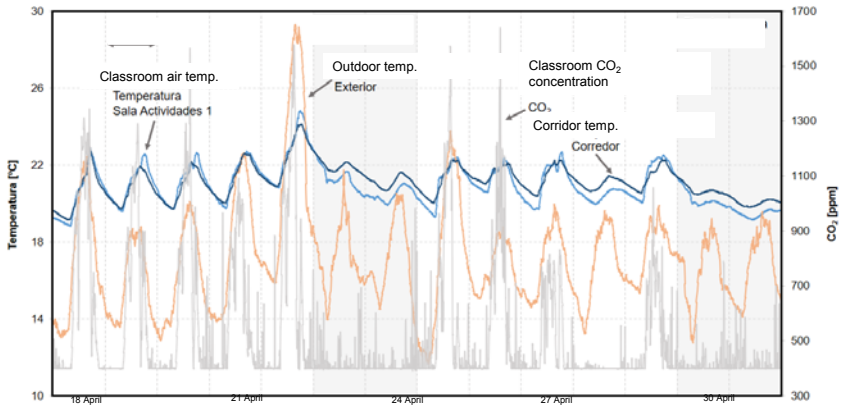
on ventilative cooling



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Performance Evaluation

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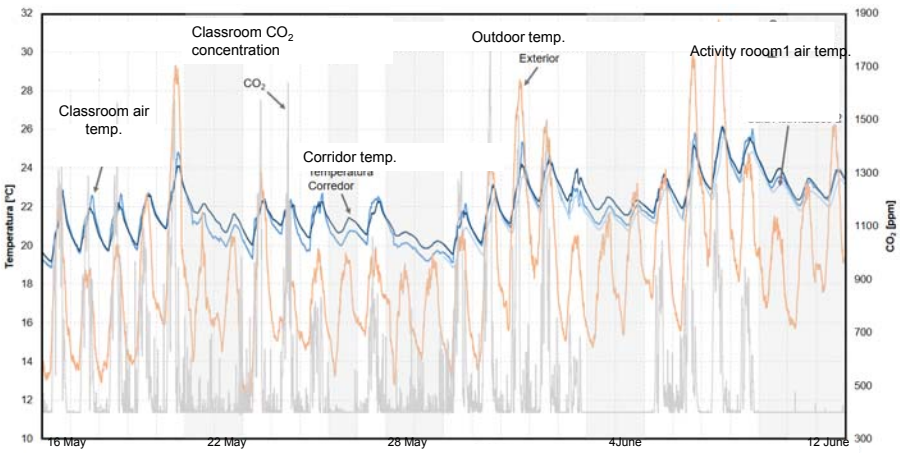

9 Performance Evaluation

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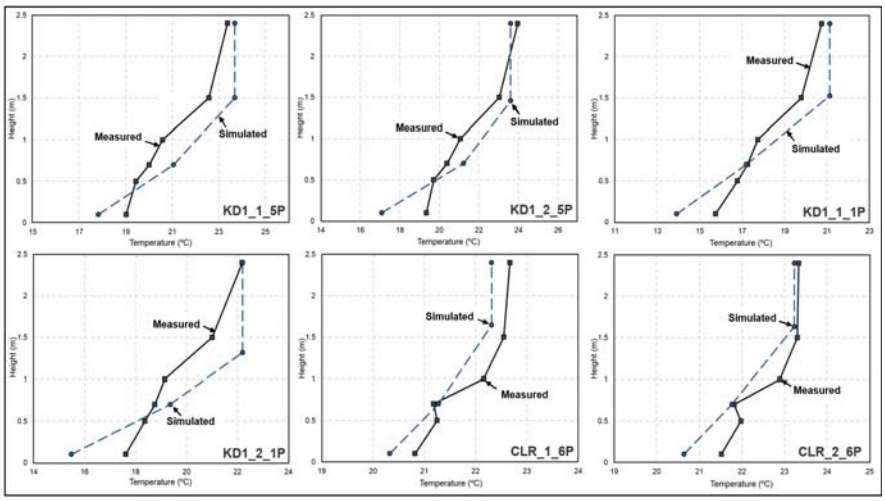


10 References

IEA EBC Annex 62 The IEA project on ventilative cooling

Persily, Evaluating building IAQ and ventilation with indoor carbon dioxide, ASHRAE Transactions 103 (1997) 1–12.

EnergyPlus (2013). Energy Plus Documentation: Getting Started with EnergyPlus, EnergyPlus Engineering Reference, Input and Output Reference.

R. Wallider, D. Norback, G. Wieslander, G. Smedje, C. Erwall, Nasal mucosal swelling in relation to low air exchange rate in schools, Indoor Air 7 (1997) 198–205.

RECS, Regulamento de Desempenho Energético dos Edificios de Comércio e Serviços, Decreto-Lei nº 118/2013 de 20 de Agosto. Diário da República nº159 - Ministério da Economia e do Emprego, Lisboa, 2013.

Nuno M. Mateus, Guilherme Carrilho da Graça, A validated three-node model for displacement ventilation, Building and Environment, Volume 84, January 2015, Pages 50-59, ISSN 0360-1323, http://dx.doi.org/10.1016/j.buildenv.2014.10.029.

Nuno M. Mateus, Gonçalo Nunes Simões, Cristiano Lúcio, Guilherme Carrilho da Graça, Comparison of measured and simulated performance of natural displacement ventilation systems for classrooms, Energy and Buildings, Volume 133, 1 December 2016, Pages 185-196, ISSN 0378-7788, http://dx.doi.org/10.1016/j.enbuild.2016.09.057.

Thank you for your time!

Brunel University London

International Workshop
Ventilative cooling in buildings: now & in the future

Implementing technologies in a lecture room

Maria Kolokotroni, Thiago Santos

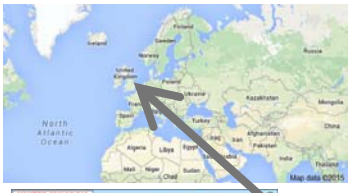
Institute of Energy Futures

Department of Mechanical, Aerospace and Civil Engineering

Brunel University London

Where is Brunel University?

30 October 2017



Brunel University London

Some background facts

A University since 1966

15,000 students

2,000 international students from over 100 countries

Strong research activities in engineering

Who was Brunel ?

Isambard Kingdom Brunel

Famous Engineer

Born 1806, died 1859

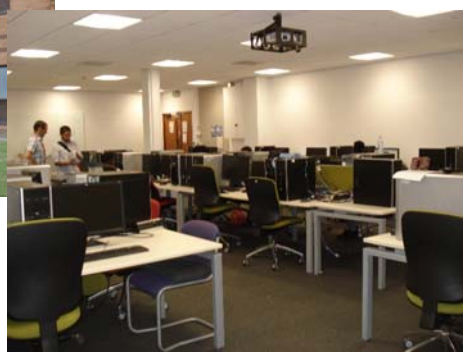
EBC Annex 62 Expert meeting – Sep 2014
In front of Brunel's statue at Brunel University

Clifton Suspension Bridge, spanning the River Avon at Bristol

930 ft bridge for
Great Western Railway

Annex 62 – Subtask C – Case-study

30 October 2017

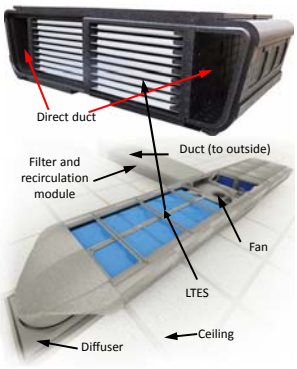


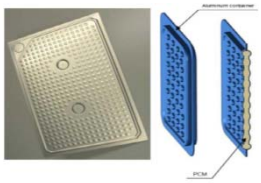
Educational
Building
Computer
Seminar
Room

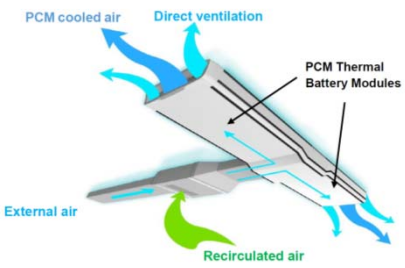
Ventilation system: CoolPhase by Monodraught

30 October 2017

The Cool-Phase® system uses the concept of **Latent Thermal Energy Storage** consisting of Phase Change Material (PCM) plates within the ventilation path to capture and store heat







Ventilation system

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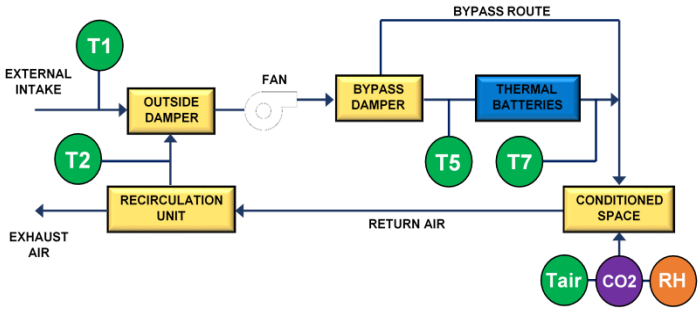

Case-study: University Seminar Room

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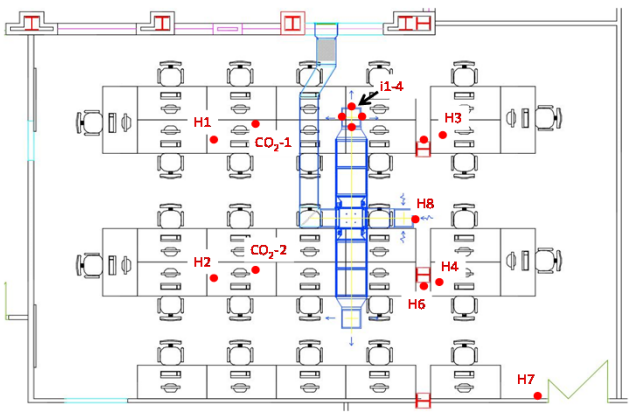

Operation during a summer day

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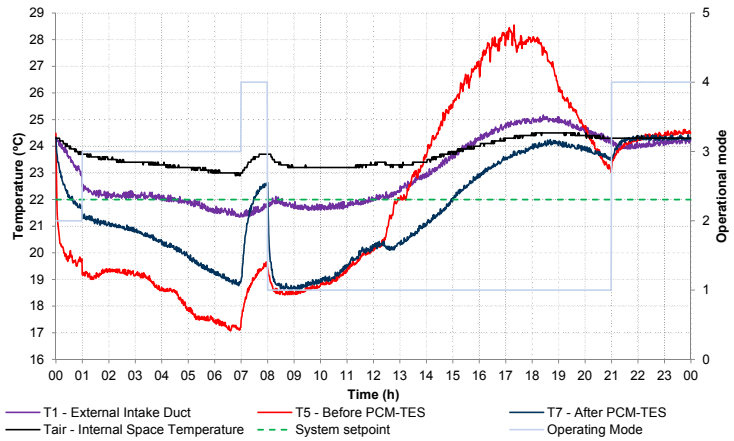

Monitoring inside the room

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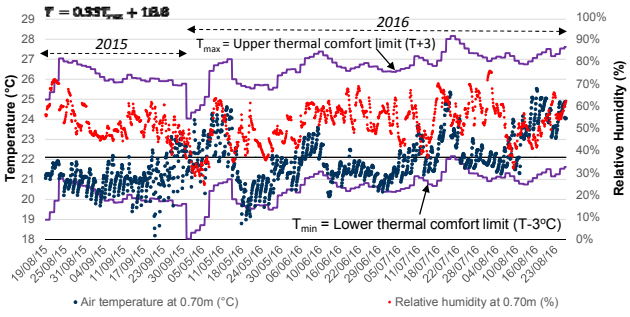

IAQ using metabolic CO_2 indicator

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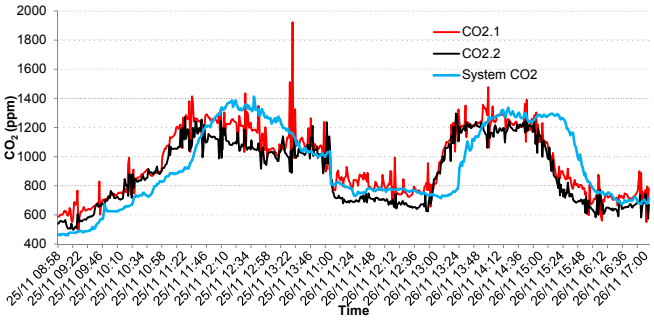

Occupants' questionnaire

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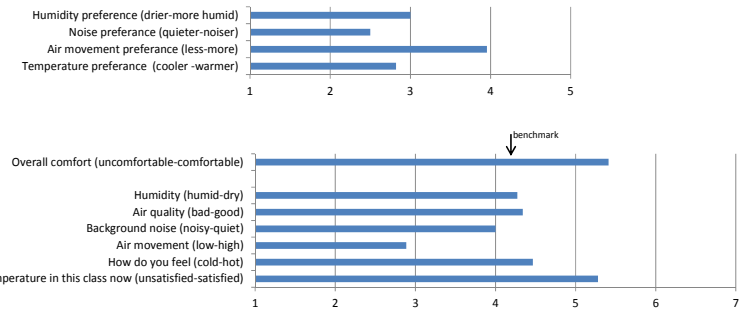
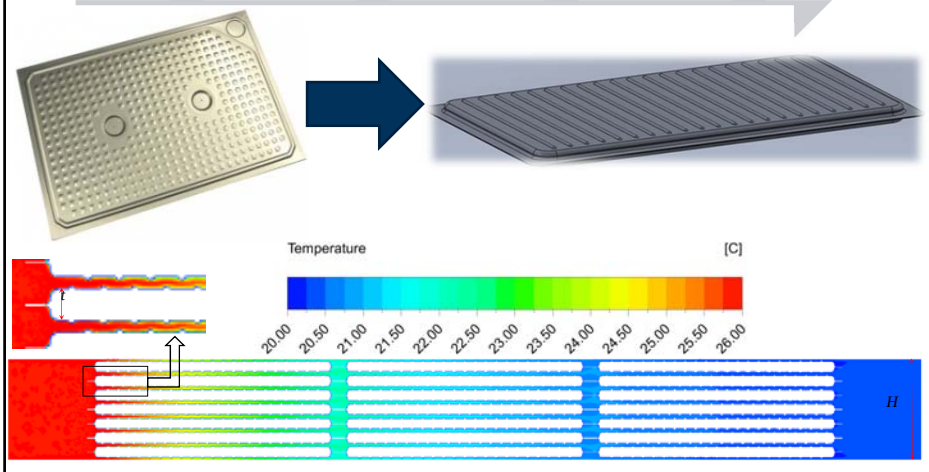


Improving heat transfer through the encapsulation

3D Design | Validation | 2D Design | Refinement | Final Design



References

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Santos T, Kolokotroni M, Hopper N and Yearley K. (2017*). A study of panel ridges effect on heat transfer and pressure drop in a ventilation duct*. 38th AIVC International Conference, 13-14 Sep 2017, Nottingham, UK

Santos T, Hopper N, Kolokotroni M, (2016). *Performance in practice of a ventilation system with thermal storage in a computer seminar room*, CLIMA2016, 12th REHVA World Congress, 22-25 May 2016, Aalborg, Denmark.

Kolokotroni M, Santos T and Hopper N (2016), Ventilative cooling of a seminar room using active PCM thermal storage, REHVA Journal, January 2016, pp36-40

Forthcoming: Annex 62 case-study brochures

Thank you!