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COOLZONE
LIGHTWEIGHT THERMAL MASS FOR CLASSROOM COMFORT

Inspiring Great Spaces™

Armstrong®
CEILING SYSTEMS

THE PRIORITY SCHOOLS BUILDING PROGRAMME

COOLZONE, AT THE HEART OF YOUR ENERGY AMBITIONS

The first of more than 200 schools to have its condition needs addressed by the Priority School Building Programme (PSBP) will commence in 2014. All schools within the programme will be delivered by the end of 2017.

A more rigorous means of assessing thermal comfort has been detailed in the PSBP's Output Specification which considers operative comfort over currently used air temperature – an alternative methodology proposed by the CIBSE Overheating Task Force – and one which supersedes BB101. This highlights the benefit of thermal mass in reducing the risk of a building overheating.

This new approach follows the methodology and recommendations of European Standard EN 15251 to determine whether a building is overheated, or in the case of an existing building whether it can be classed as overheating.

Specifically the Output Specification states that:

- The contractor shall design the building so as to limit the maximum internal temperature. And...

- The contractor shall ensure that mechanical ventilation is not the sole method of summer-time ventilation in occupied spaces and that occupied space should wherever possible also have opening windows or vents.

THE NEW OUTPUT SPECIFICATION SETS THREE CRITERIA

Criteria 1

HOURS OF EXCEEDENCE

The predicted operative temperature shall not be more than the maximum temperature for more than 40 hours.

Criteria 2

DAILY WEIGHTED EXCEEDANCE

This criterion sets an acceptable level for the severity of overheating, which is arguably more important than its frequency.

Criteria 3

UPPER LIMIT TEMPERATURE

The predicted operative temperature shall not be more than 4ºC above the daily maximum temperature.

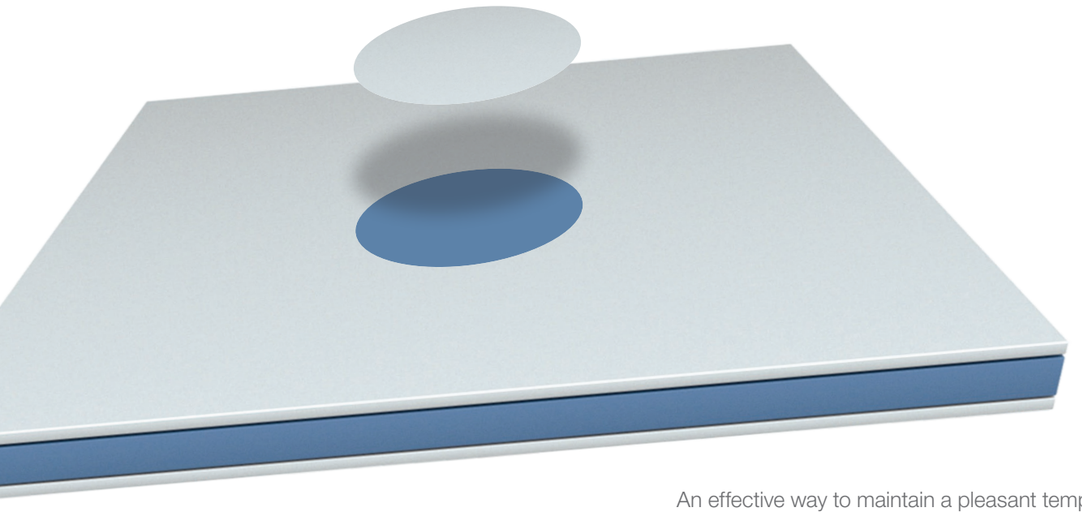
WHAT DOES ALL THIS MEAN?

- The new Output Specification replaces BB101
- The design must mitigate cold draughts by not using windows in winter
- Utilise exposed thermal mass to manage risks of summertime overheating
- Elimination of mechanical cooling and use of natural ventilation to manage occupant comfort
- Clients turning away from expensive, heavyweight buildings made from concrete
- Adoption of lightweight, sometimes timber constructions, which either require the addition of concrete rafts to give (heavyweight) thermal mass or PCMs to give (lightweight) thermal mass via wall to wall suspended ceilings which reduce the cost of dressing the soffit and hide services into the bargain.

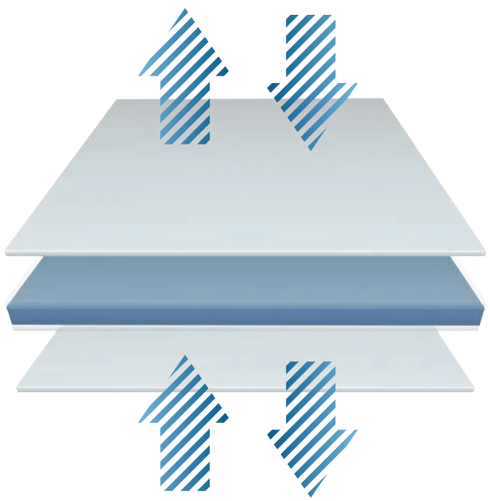
HOW DOES **COOLZONE** ACTUALLY FUNCTION?

THERMAL MASS

Thermal mass is a material's resistance to change in temperature. Objects with high thermal mass absorb and retain heat and are crucial to good passive design.



An effective way to maintain a pleasant temperature in summer is to increase the thermal capacity of a structure. By absorbing heat in the walls or ceilings and releasing it at the right moment, thermal mass acts as a buffer against temperature fluctuations. This is especially true for lightweight structures, which are more prone to overheating in the summer.



PCM?

PCM, or Phase-Change Material, is a substance with a high heat of fusion which, melting and solidifying at a certain temperature, is capable of storing and releasing large amounts of energy. Heat is absorbed or released when the matrerial changes from solid to liquid and vice versa; thus, PCMs are classified as latent heat storage (LHS) units.

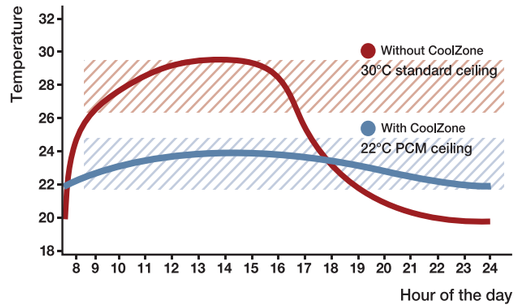
Source: Wikipedia

PCM IS THE GAME CHANGER

Unlike traditional thermal-mass materials like brick and concrete, Phase Change Material (PCM) melts and solidifies at specific temperatures, which enables it to store and release large amounts of energy. The key component is the interplay between solid and liquid states. As long as these two states exist simultaneously, the temperature won't increase. Instead, the inflowing energy is used up in the phase transition and thus remains latent.

Think of ice cubes in a drink: as the ice absorbs the warmer temperature from the drink, the ice slowly melts. But as long as there's still ice, the drink temperature stays constant.

PCM is similar but even better. Because, unlike the ice cubes, PCM returns back to its solid state with just a little cool night air.



CoolZone with natural ventilation reduces overheating and improves thermal comfort

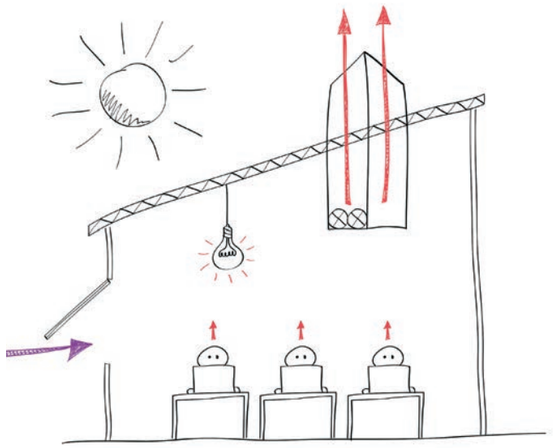
HOW **COOLZONE** LIGHTWEIGHT PHASE CHANGE MATERIAL (PCM) CAN HELP

- CoolZone stores heat energy, not only keeping the classroom air cool but absorbing radiant heat from occupants
- When used with natural ventilation CoolZone helps to manage occupant comfort
- CoolZone is part of a wall-to-wall ceiling solution which helps to hide services and provide acoustical comfort to optimise learning conditions
- Allows for lightweight construction designs over traditional heavyweight concrete structures

ARMSTRONG COOLZONE AND BREATHING BUILDINGS SYSTEMS

Working together Armstrong and Breathing Buildings have developed an integrated system to meet the Education Funding Agency “Guidance on ventilation, thermal comfort and indoor air quality in schools” and the Priority Schools Building Programme Facilities Output Specification.

The new regulations herald a new dawn for ventilation in schools. Not only have the benefits of exposed thermal mass been highlighted, but low energy, draught free ventilation is now mandatory for classrooms which are naturally ventilated. The Breathing Buildings systems offer an easy and proven way to meet the new requirements.



SUMMER STRATEGY
Upwards Displacement Ventilation

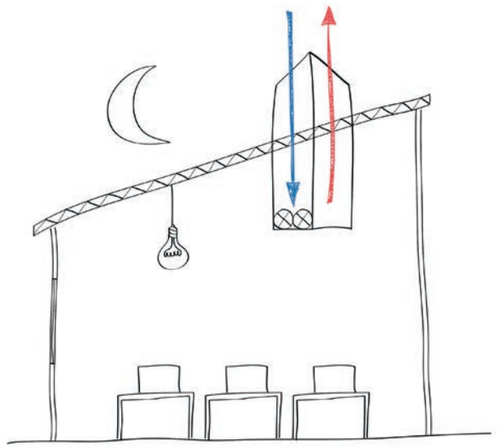
SUMMER

When the external temperature is above 16ºC, the Breathing Buildings system operates in conjunction with manually opening windows where these are available.

It can also work without additional openings but in this case air continues to be both supplied and exhausted at high level.

In the hotter months of the year it can be difficult to maintain comfortable interior conditions just using natural ventilation especially if the internal gains are high and the interior finishes of the building are thermally lightweight.

The addition of CoolZone can provide a means to prevent overheating.

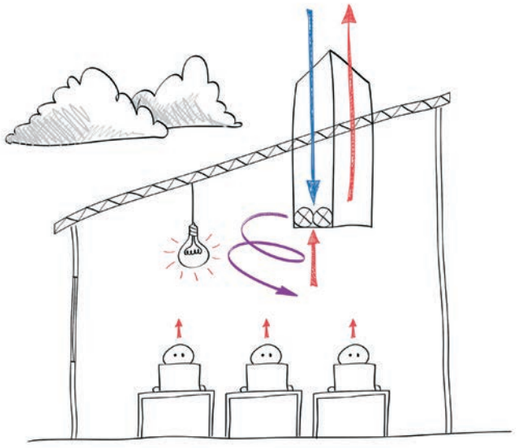


NIGHT COOLING
Cool outside air for free cooling

The Breathing Buildings systems exploit the benefits of CoolZone in two ways.

- The Breathing Buildings natural ventilation system operates to exploit free cooling during the first part of a summer day but once the external temperatures rise sufficiently above the internal temperature the system switches to minimum ventilation based on CO_2. This ensures that the CoolZone provides maximum benefit to the occupants.

- The Breathing Buildings natural ventilation systems provide night-cooling in summer. The logic in the control system ensures that when the summertime day temperatures are high, the ventilation system continues to operate at night and brings in cooler air to re-charge the CoolZone.



WINTER STRATEGY
Mixing Ventilation

WINTER

In cold weather, if a classroom is to be naturally ventilated, then the incoming cold fresh air must be pre-mixed with enough warm room air to avoid draughts. Pre-heating with radiators is no longer allowed since this causes excessive heating bills; by pre-mixing air, the internal heat gains are used instead.

Only in the coldest winter conditions when the internal gains are not sufficient to maintain the temperature at a comfortable level is the heating system used during the occupied day. The amount of pre-mixing needs to be controlled so that the temperature of the incoming air is elevated to within 5ºC of the room air before it reaches occupants.

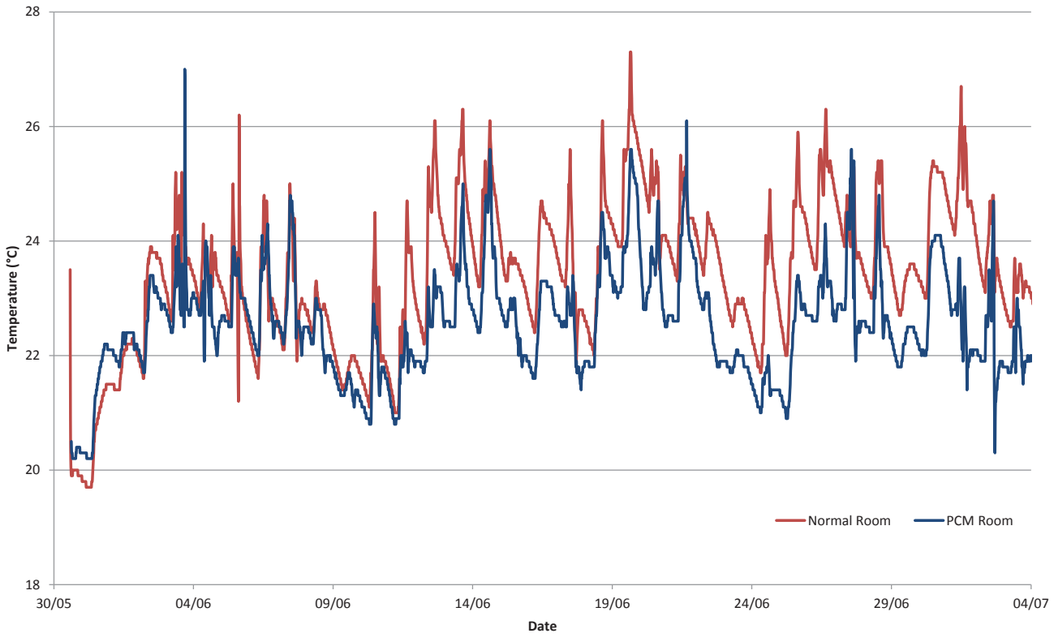
Furthermore, the speed of the air over the occupants in these conditions has to be less than 30cm/s. The Breathing Buildings systems are all designed to meet these requirements, and are the only tried and tested natural ventilation systems in operation. The pre-mixing system is derived from a Cambridge University owned patent to which Breathing Buildings have an exclusive license.

Breathing Buildings

CASE STUDY
BELVOIR HIGH SCHOOL

- Data collected summer 2013 at Belvoir High School (R Series in classrooms + opening windows)
- Two classrooms studied, one with Armstrong CoolZone ceiling tiles and the other without
- Temperature data below ceilings (hottest part of the room) shows consistently lower peak temperatures in room with CoolZone

ROOM TEMPERATURE COMPARISON



PRODUCT SPECIFICATION & TECHNICAL PERFORMANCE

	Item Number	Nominal Size (mm)	Thickness (mm)	Weight (kg)
COOLZONE TEGULAR 8/16	BPCZ4980M	600x600	25	9.0
COOLZONE MICROLOOK 8/16	BPCZ4981M	600x600	25	9.0

Other systems and modules are also available on request.

WEIGHT
25 kg/m²

THERMAL CAPACITY
The CoolZone infill contains **25% BASF Micronal** with a melt point temperature of **23°C** providing a total heat storage capacity as shown in the following table.

HEAT STORAGE Wh/m²	ΔT (°C)		
	4 °C	10 °C	20 °C
SENSIBLE	20	49	125
LATENT	125	125	125
TOTAL	145	174	250

FINISH
Factory applied polyester powder coat, minimum thickness **55 microns**

COLOUR	STANDARD		SEMI-STANDARD	
	RAL 9010	Global White	RAL 9006	RAL 9007
GLOSS (EN ISO 2813:2000)	20%	12%	30%	30%
LIGHT REFLECTANCE (EN ISO 7742-2 & 3)	85%	75%	–	–

Other colours available upon request.

ACOUSTIC PERFORMANCE (EN ISO 354 & EN ISO 11654)

α_w: 0.25 NRC: 0.20	Hz	125	250	500	1000	2000	4000
Sound Absorption Class : E	α_p	0.35	0.20	0.15	0.25	0.25	0.20

Dnfw: 40 dB (EN ISO 10848-2 & EN ISO 717-1)

FIRE PERFORMANCE (EN 13501-1)
EEA. Euroclass **B-s1, d0**

Up to **95% HR**
(for short-term exposure)

RECYCLED CONTENT (EN ISO 14021)
Metal ceiling tiles: up to **30%**

WANT TO LEARN MORE?

For more questions about **CoolZone** or to book our RIBA approved CPD 'Using Phase Change Materials in Construction for a more sustainable environment', contact us today!

www.armstrong-ceilings.co.uk
www.armstrong-ceilings.ie

United Kingdom • Republic of Ireland
Armstrong World Industries Ltd.
Buildings Products Division
Armstrong House
38 Market Square, Uxbridge UB8 1NG

0800 371 849 (UK) • 1800 409 002 (RoI)
Fax: +44 (0) 1895 274 287

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