

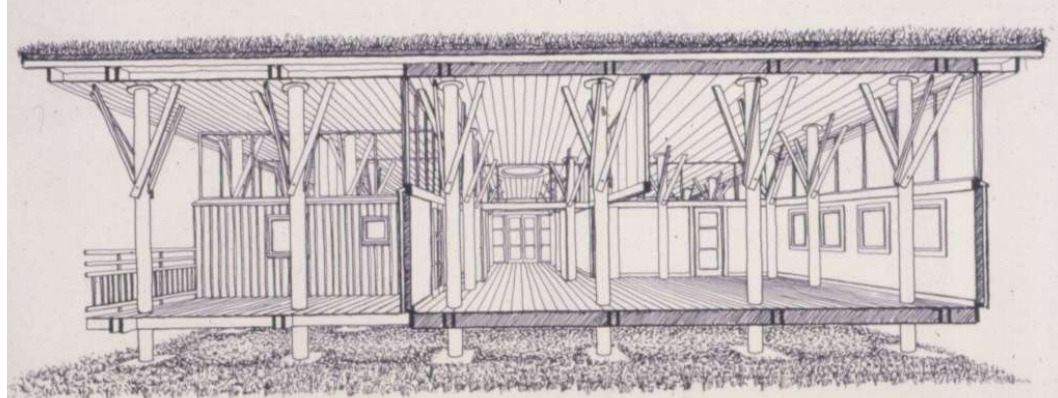
Architype

Mark Lumley

Healthy Buildings



Early days Diggers self build



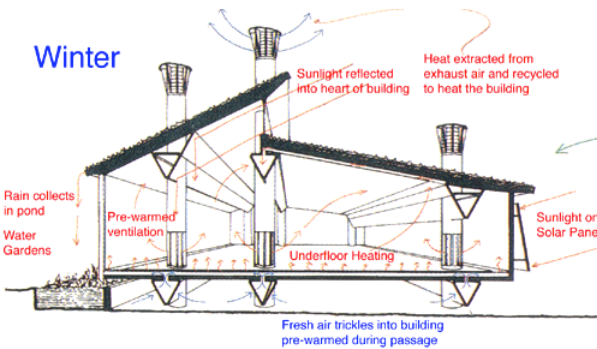
National Federation of City Farms, Bristol



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Winter

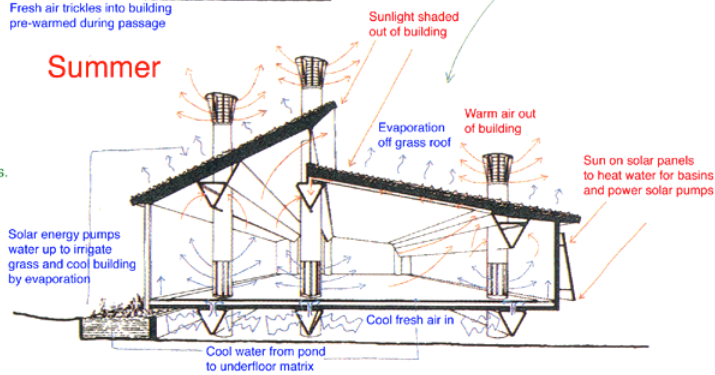


The whole building will cost less than £250 to heat using solar power - less than a typical house (1/4 the size)

Heavy insulation using recycled newspaper and breathing construction

Ventilation is entirely natural - integral to the building's design

Summer



At the heart of the building, a computer monitors all the building's energy usage and water movement. Displays will constantly show the consumption and collecting of resources.

All the floor finishes, paints and timber stains are organic.

The centre will be surrounded by ponds and an organic garden. Water will be cleaned with the help of reed beds and recycled using solar pumps.

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Springhill Co Housing

2004

Springhill Co-housing is the first new build co-housing scheme in the UK. Based on the Danish mode

- Key
1. Parking area
 2. Common house
 3. Pedestrian street
 4. Shared gardens
 5. Houses
 6. Flats
 7. Studios



Genesis Centre 2006

Somerset College of Arts & Technology; a demonstration building for sustainable construction

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Hereford Office 2006
Twyford Barn



robust and timeless





Cwm Ifor School
2011
A Welsh 21st Century School



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Staunton School
2010
POE carried out through a
TSB funded study



Pre-Passivhaus schools

St Luke's 2009
POE carried out through a
KTP with Oxford Brookes



Pre-Passivhaus schools

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Willows 2010

POE carried out through a
KTP with Oxford Brookes



progression and feedback loop relating to the delivery of 5 primary schools in Wolverhampton

St Luke's 2009

POE carried out through a KTP with Oxford Brookes



Bushbury Hill 2011

POE carried out through a KTP with Coventry University & Architype



Wilkinson 2013

POE carried out through a KTP with Coventry University & Architype

Wilkinson 2010

Old school burns down following an arson attack



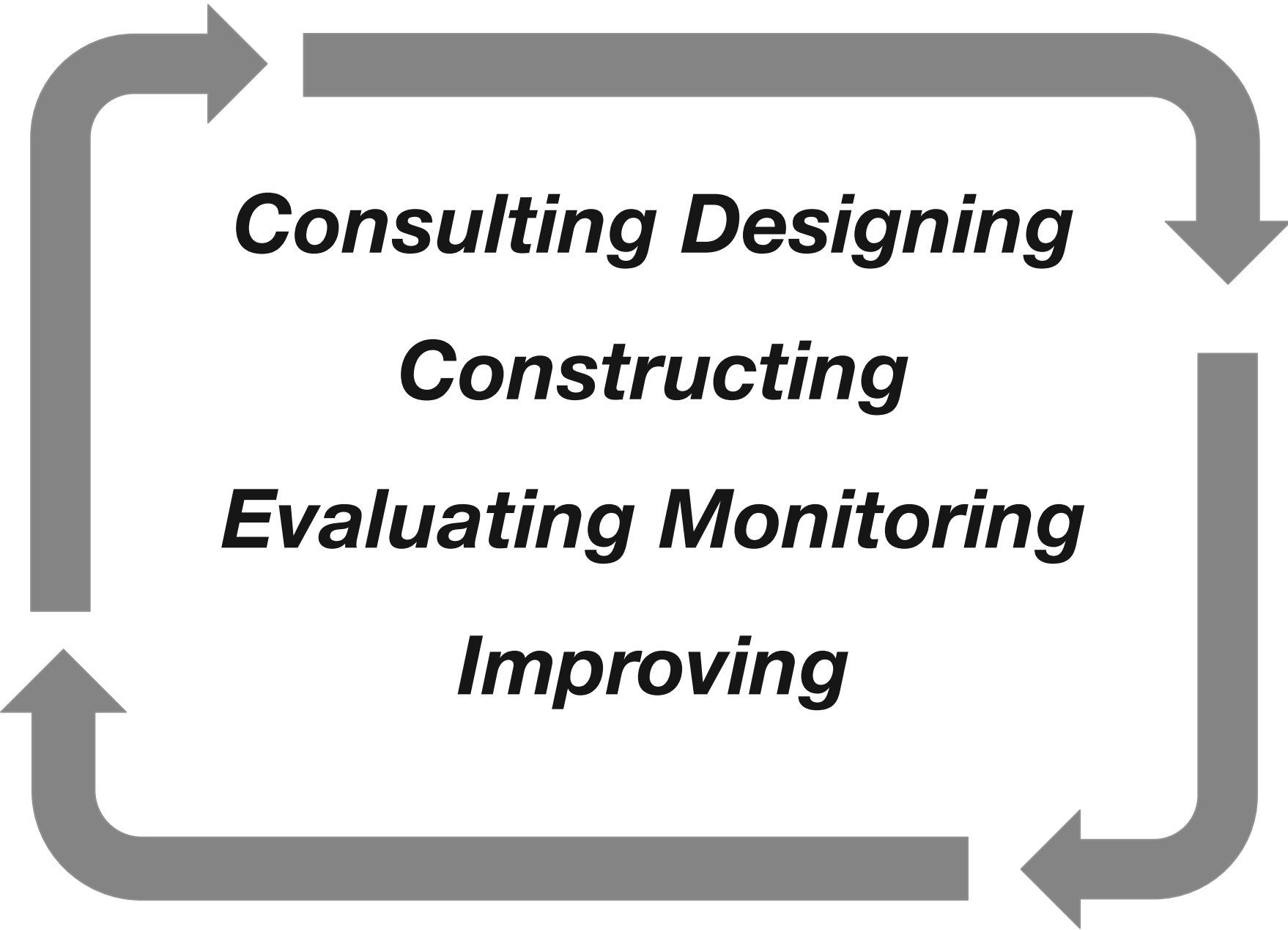
The Willows 2010

POE carried out through a KTP with Oxford Brookes



Oak Meadow 2011

POE carried out through a KTP with Coventry University & Architype



Consulting Designing

Constructing

Evaluating Monitoring

Improving

First Passivhaus Schools

Why the move to Passivhaus

- to achieve a joined up ventilation strategy that ensured better air quality all the year round using MVHR and retaining heat
- to reduce energy and save on running costs by using high levels of insulation combined with very high air tightness
- to achieve a healthier and more comfortable environment, triple glassed windows etc
- to use a more reliable predictive design tool to ensure better performance of the building fabric the PHPP modelling package, helping to ensure elimination of cold bridges and component performance
- plus in addition to PH to use as many natural materials as possible to reduce Voc's off gassing

Collaboration and the added discipline of delivering a Passivhaus school

- integrated total design team commitment including client buy in
- passivhaus integrated into design from day one
- constant focus on simplicity of design and detailing
- relentless focus on value engineering to achieve cost
- a committed contractor dedicated to delivering passivhaus
- ongoing team work throughout construction stage
- focussed workshops with all key sub-contractors
- rigorous and regular site inspection

Envirograf Foiled Cavity Barrier -
Pattern D

Tescon Vana 150 tape K11/465B

Continuous tilted fillet

Protektor Insect mesh No. 9071

Seal Tape by Permarock

Render Stop bead by Permarock

CT-114 applied as continuous DPM by
Permarock

All falls away 1:80

Paver

CT-114 applied as water proofing coating to face
of insulation and lapped over render

Mortar

Granular
Sub-base

CT-114 applied as continuous DPM by
Permarock

CT-114 applied as continuous DPM by
Permarock

PermaRock render system: high density EPS200

insulation waterproofing and rendered plinth
above ground M21/210A (Installed to
manufacturers recommendations)

DPM (Visqueen) J40/120A lapped up wall
(temporarily protected prior to installation of
Permarock) sealed above and below as it
protrudes from concrete slab and then
sealed between two Permarock CT114 layers

Eggcrate free drainage layer J40/295 Angled away from
the building at base

Air tight layer

Skirting P20/240

Siga Sicral 1 tape P10/315C

Denotes airtight seal

0.00 SSL

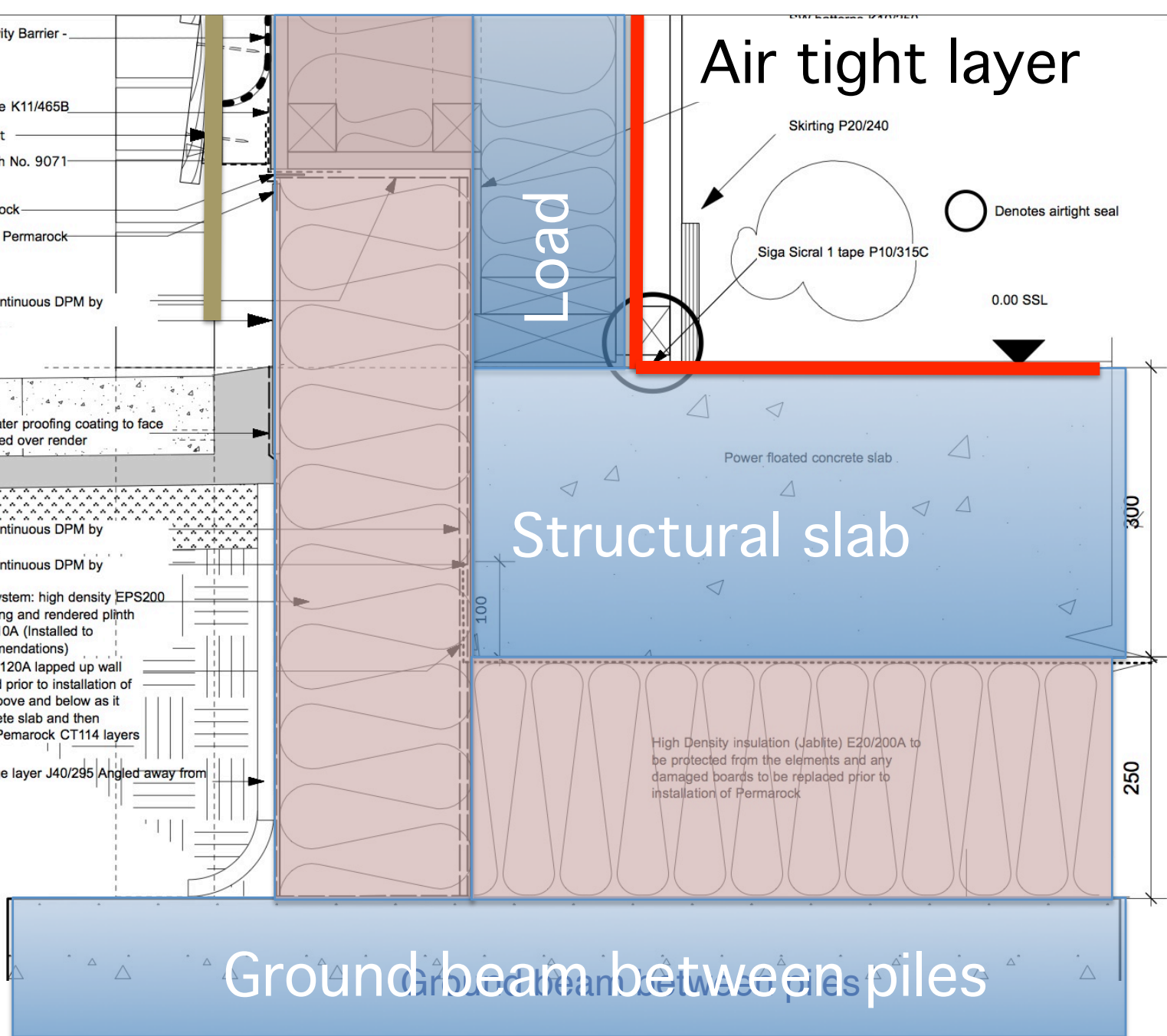
Load

Structural slab

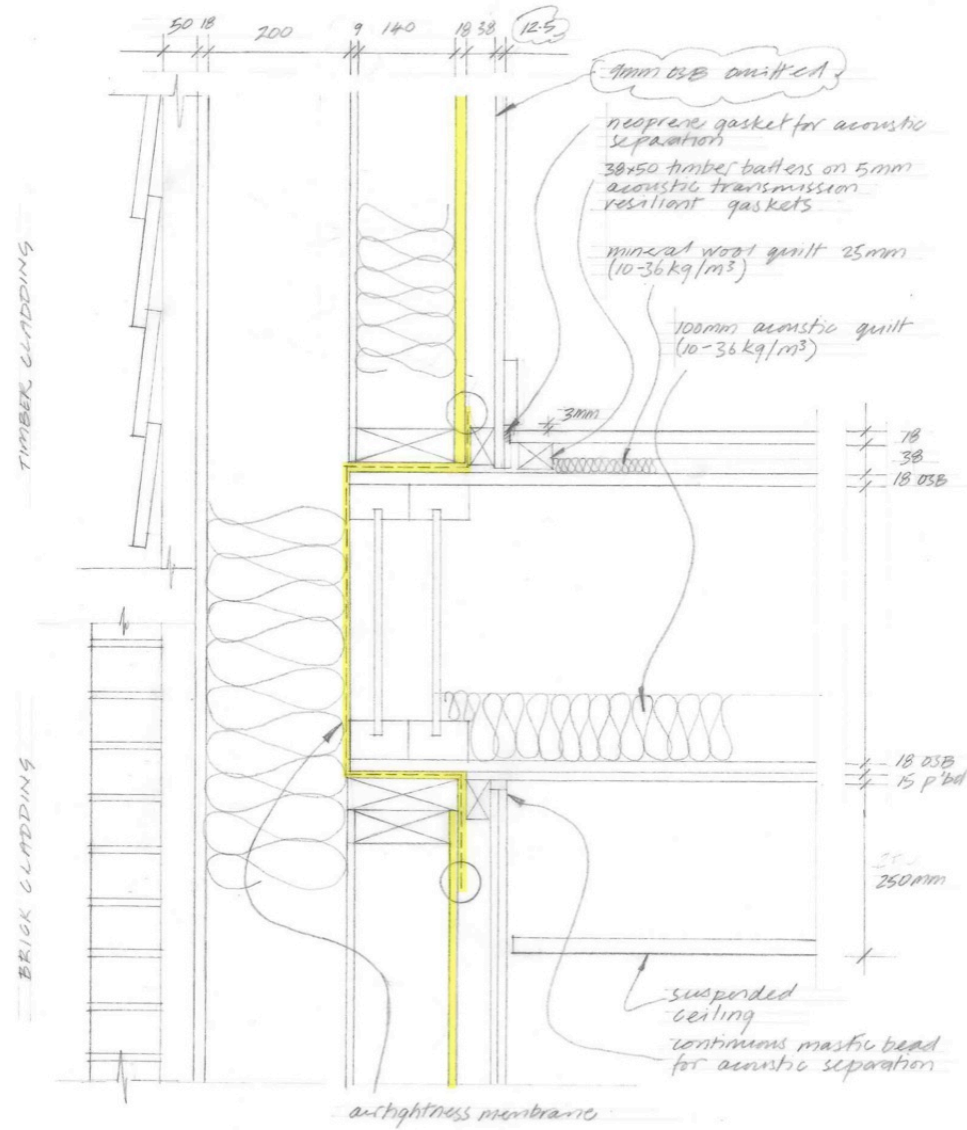
Power floated concrete slab

High Density insulation (Jablite) E20/200A to
be protected from the elements and any
damaged boards to be replaced prior to
installation of Permarock

Ground beam between piles

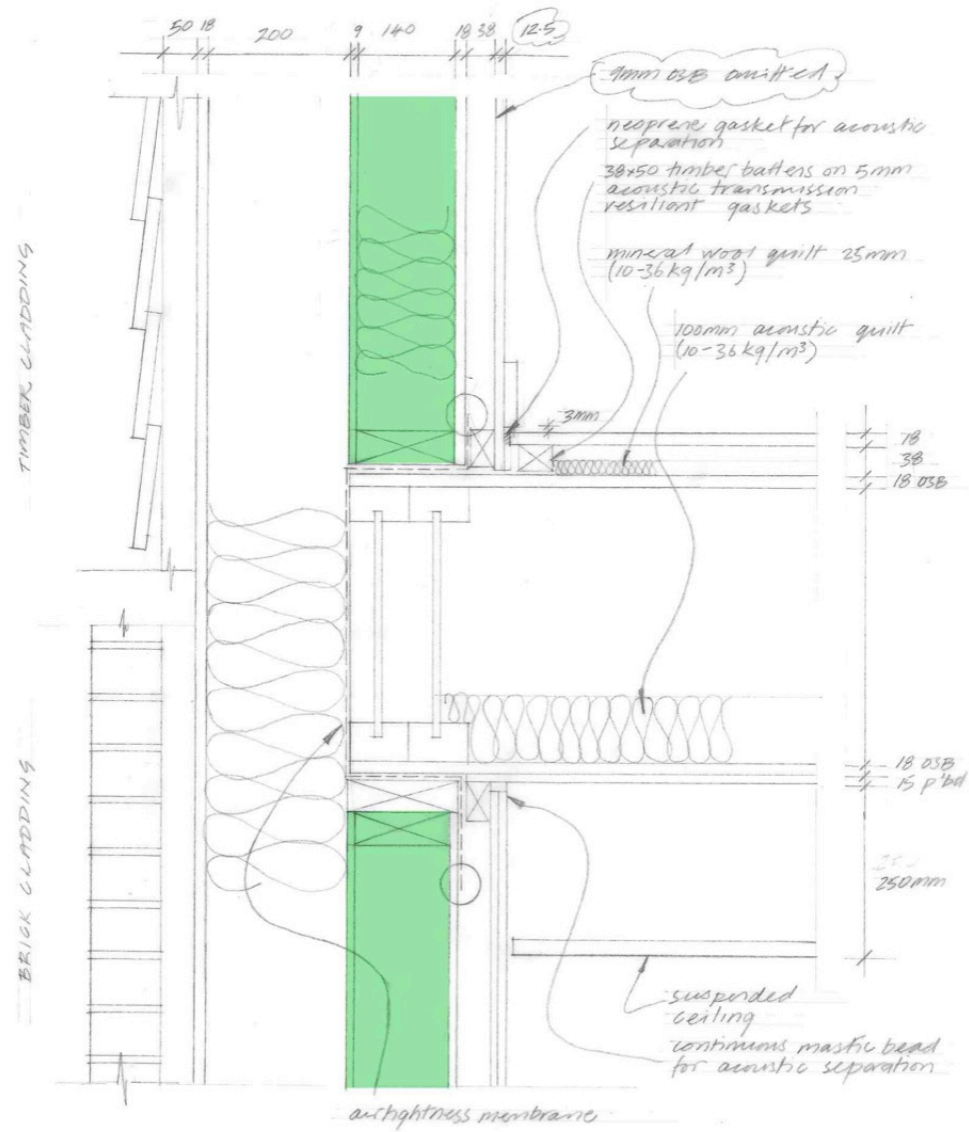


Air Tightness Layer



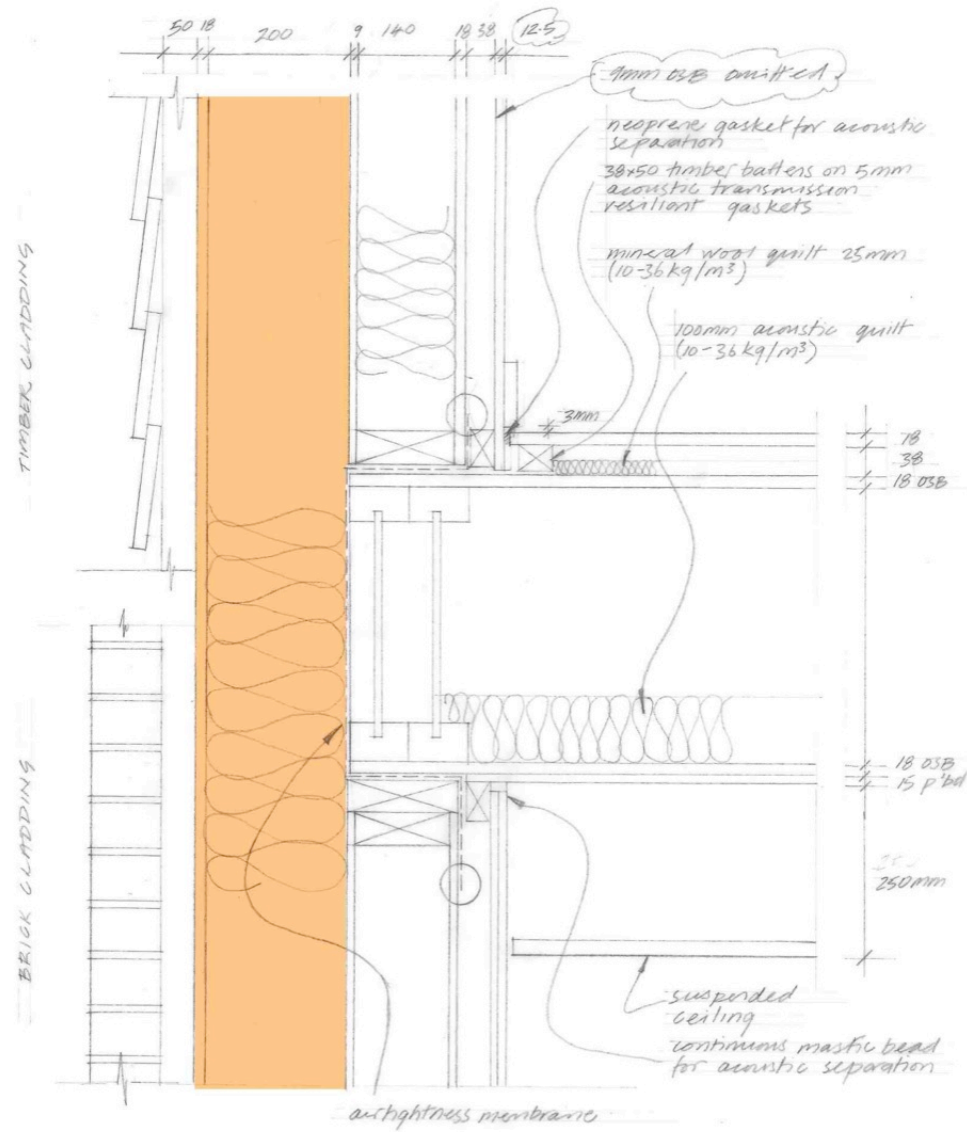
NOTE:
 shown with part timber cladding part brick cladding
 TYPICAL JUNCTION FIRST FLOOR / EXTERNAL WALL FOR CONSTRUCTION

Structural Layer



NOTE:
 shown with part timber cladding part brick cladding
 TYPICAL JUNCTION FIRST FLOOR / EXTERNAL WALL FOR CONSTRUCTION

Thermal Layer



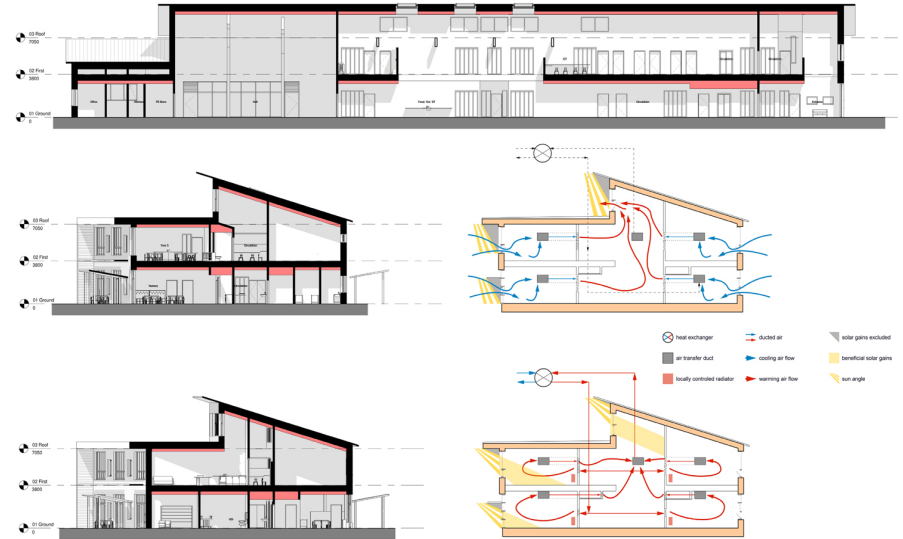
NOTE:
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 TYPICAL JUNCTION FIRST FLOOR / EXTERNAL WALL FOR CONSTRUCTION

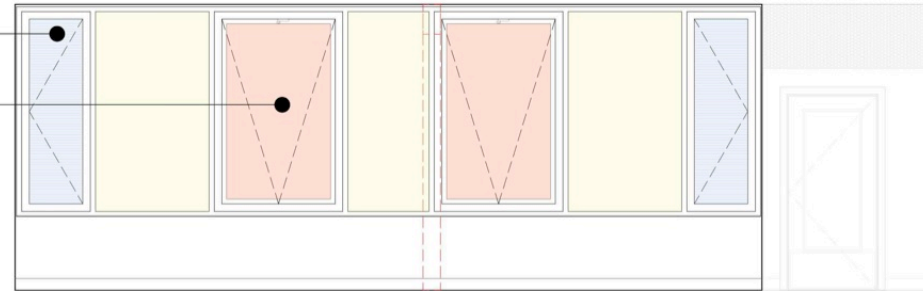


First Generation Passivhaus Schools

Bushbury Hill Primary School: Wolverhampton: 2011

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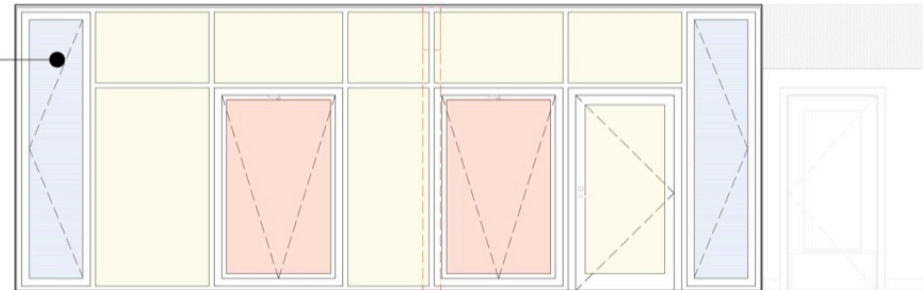


First floor classroom

Daylight =  +  = 10.97 sqm

Day vent =  +  = 2.88 sqm

Night vent =  = 0.84 sqm



Ground floor classroom

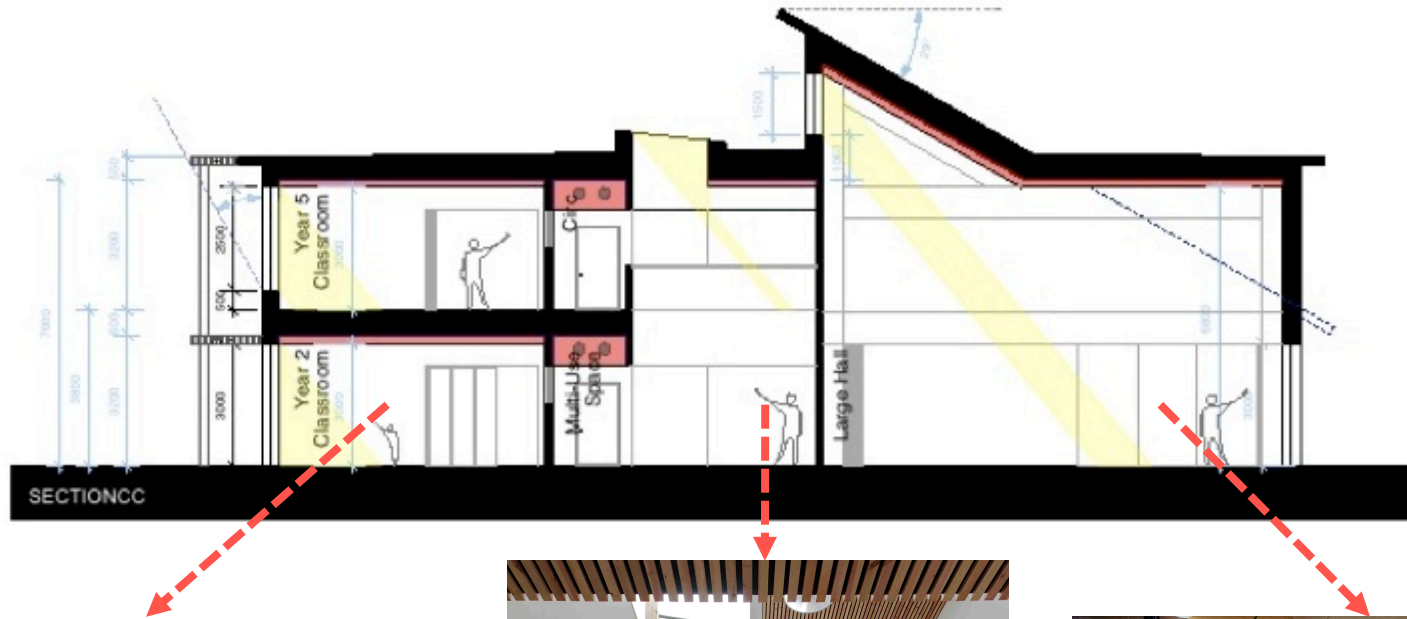
Daylight =  +  = 14.39 sqm

Day vent =  +  = 3.16 sqm

Night vent =  = 1.12 sqm

Oakmeadow Primary School - Classroom Facade analysis

First Generation Passivhaus Schools



Second Generation Passivhaus School Wilkinson Primary, Wolverhampton

Completed in 2013



Second Generation Passivhaus School

Wilkinson Primary School:
Wolverhampton: 2013

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Second Generation Passivhaus School

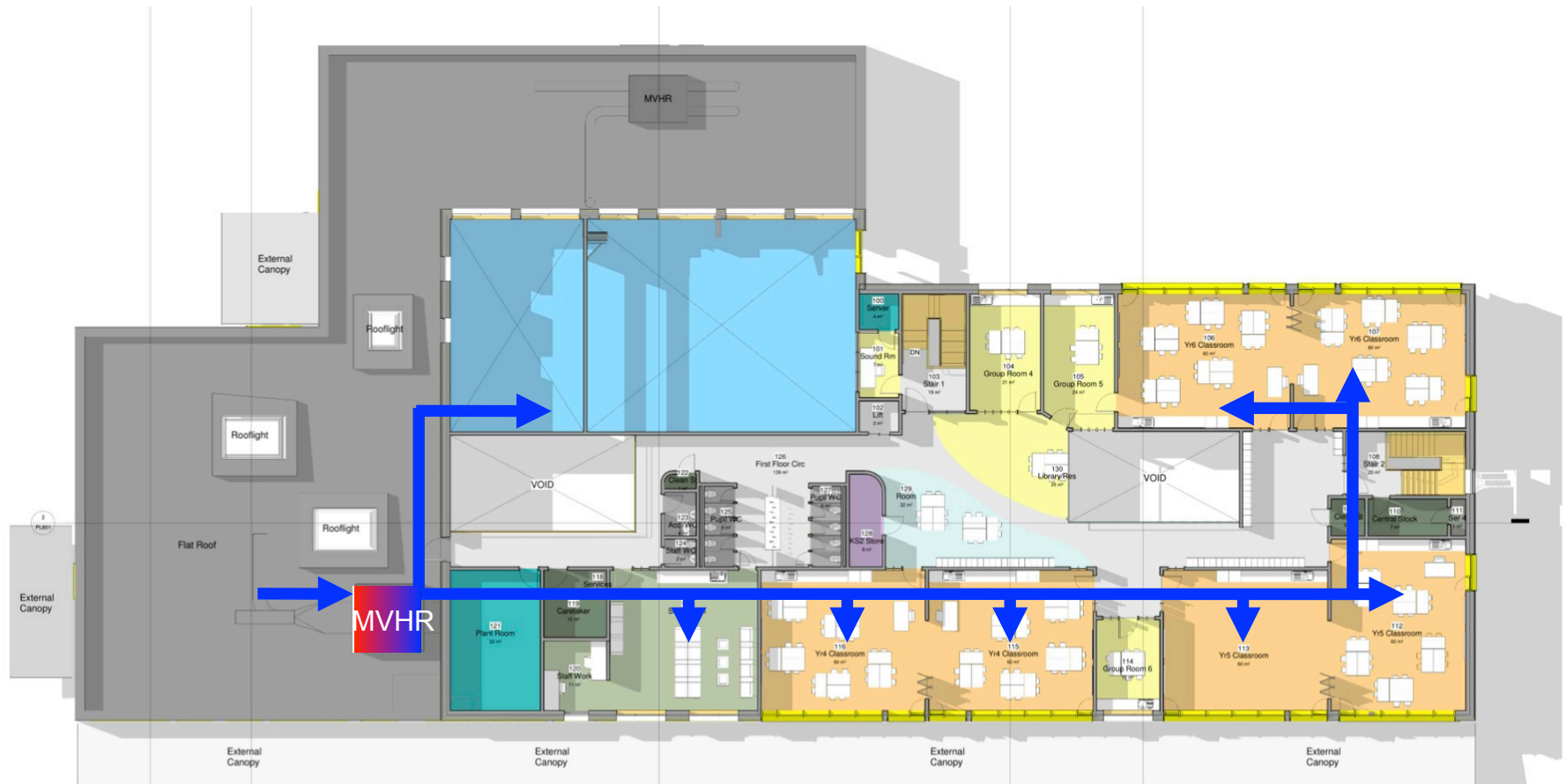
Wilkinson Primary School:
Wolverhampton: 2013

ARCHITYPE



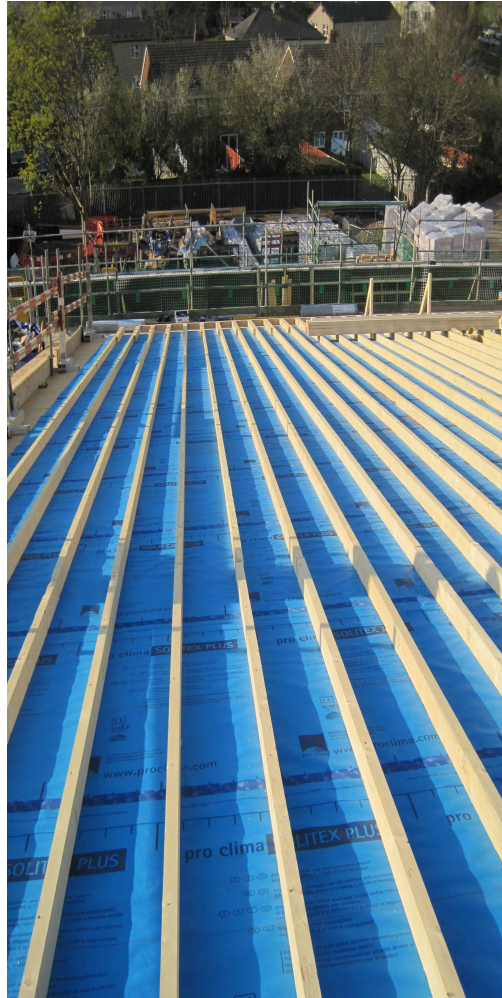
ARCHITYPE





Construction Approach

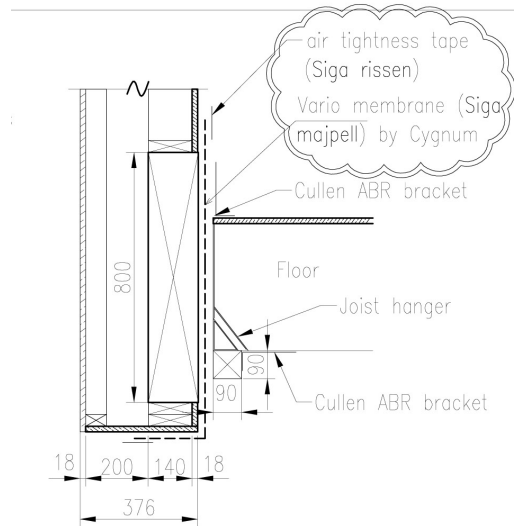
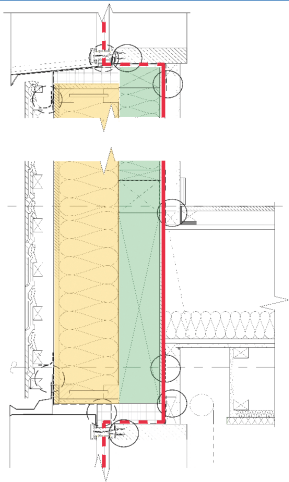
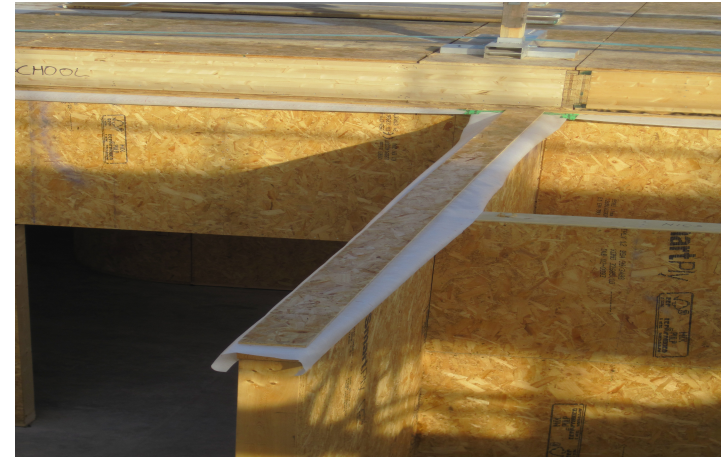
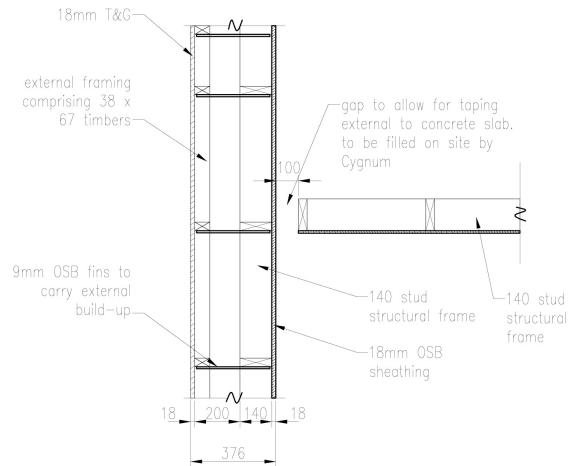
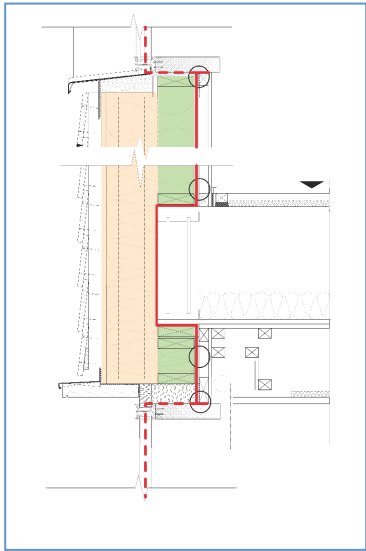
ARCHITYPE



Lessons Learnt

relating to construction

Timber Frame Improvements



Window Improvements

ARCHITYPE



A photograph of a modern commercial kitchen. The room features stainless steel countertops, a large stainless steel range hood with multiple lights, and several large windows on the left wall. In the foreground, there are stainless steel sinks and a large industrial oven with a glass door and a control panel. The floor is dark and polished. The text "design approach" is overlaid in white, sans-serif font, and "primary energy" is overlaid in white, italicized font.

design approach

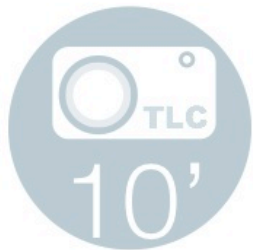
primary energy

Some hand over and operational issues and lessons

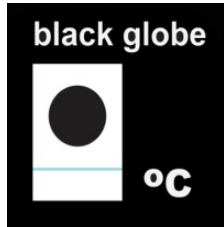
- commissioning not properly carried out, the M&E sub contractor went out of business just prior to handover, more complex to complete post handover
- BMS controls protocols not fully implemented, a work in progress
- maintenance contracts critical for future effective operation more challenging with MVHR plant as new to UK
- extra training and support needed beyond the first year for building operation; user guides and training videos are being tested
- communicating how a Passivhaus building operates key to user comfort, longevity and for the school to get energy saving benefits
- monitoring helps with feedback on operational issues
- keeping other design team members involved with POE extends the feedback loop and achieves more expert help
- continuity of staff from all involved helps with problem solving

Monitoring method & studied parameters

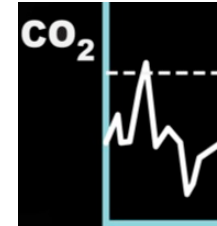
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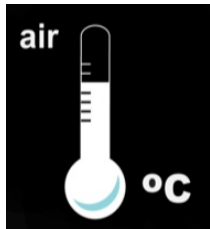
Monitored factors



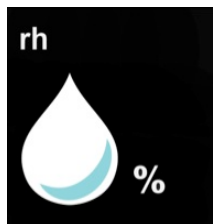
Black globe temperature (°C) in 24 classrooms



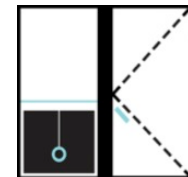
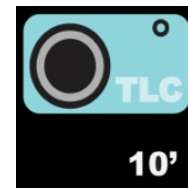
CO₂ concentration in 10 classrooms



Air temperature (°C) in 22 classrooms



Relative humidity (%) in 22 classrooms



Window and blind operation in 6 classrooms

Monitoring

Why monitor CO₂ levels?

- A good proxy of indoor air quality
- Provides information on the ventilation rates
- Affects learning and performance
- Affects health and exposure to high concentration
- is associated with symptoms such as headaches

Current UK regulations for classrooms

- Absolute maximum 5000 ppm
- Average should not exceed 1500 ppm
- Occupants should be able to reduce to below 1000 ppm at any point.

Monitored Primary Schools

Non-Passivhaus schools

- 1 Much Birch 1970
- 2 St Luke's 2009
- 3 Willows 2010

Passivhaus schools

- 4 Oak Meadow 2011
- 5 Bushbury Hill 2011
- 6 Wilkinson 2013



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ARCHITYPE



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Monitored Primary Schools



Non-Passivhaus schools

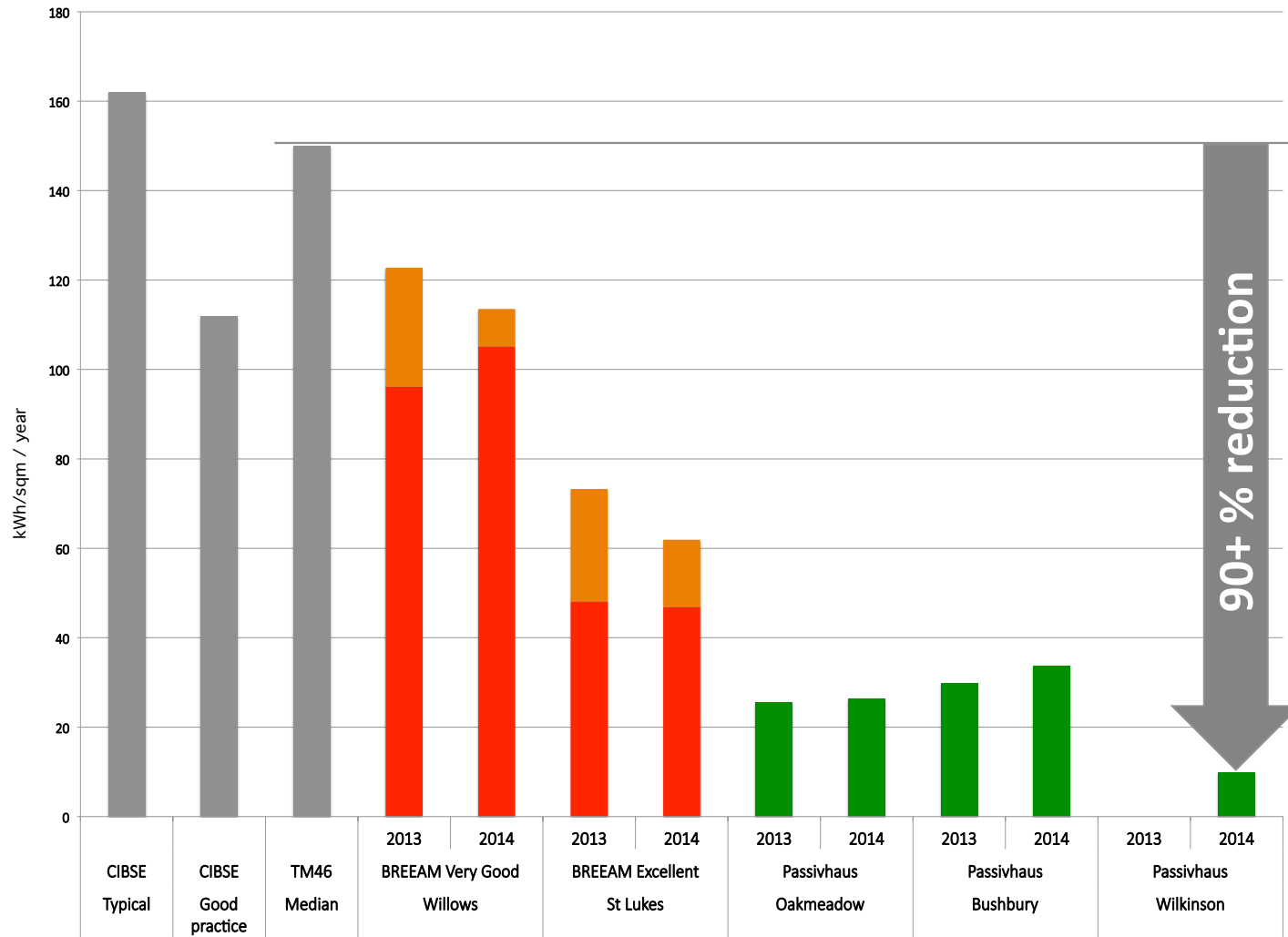
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Passivhaus schools

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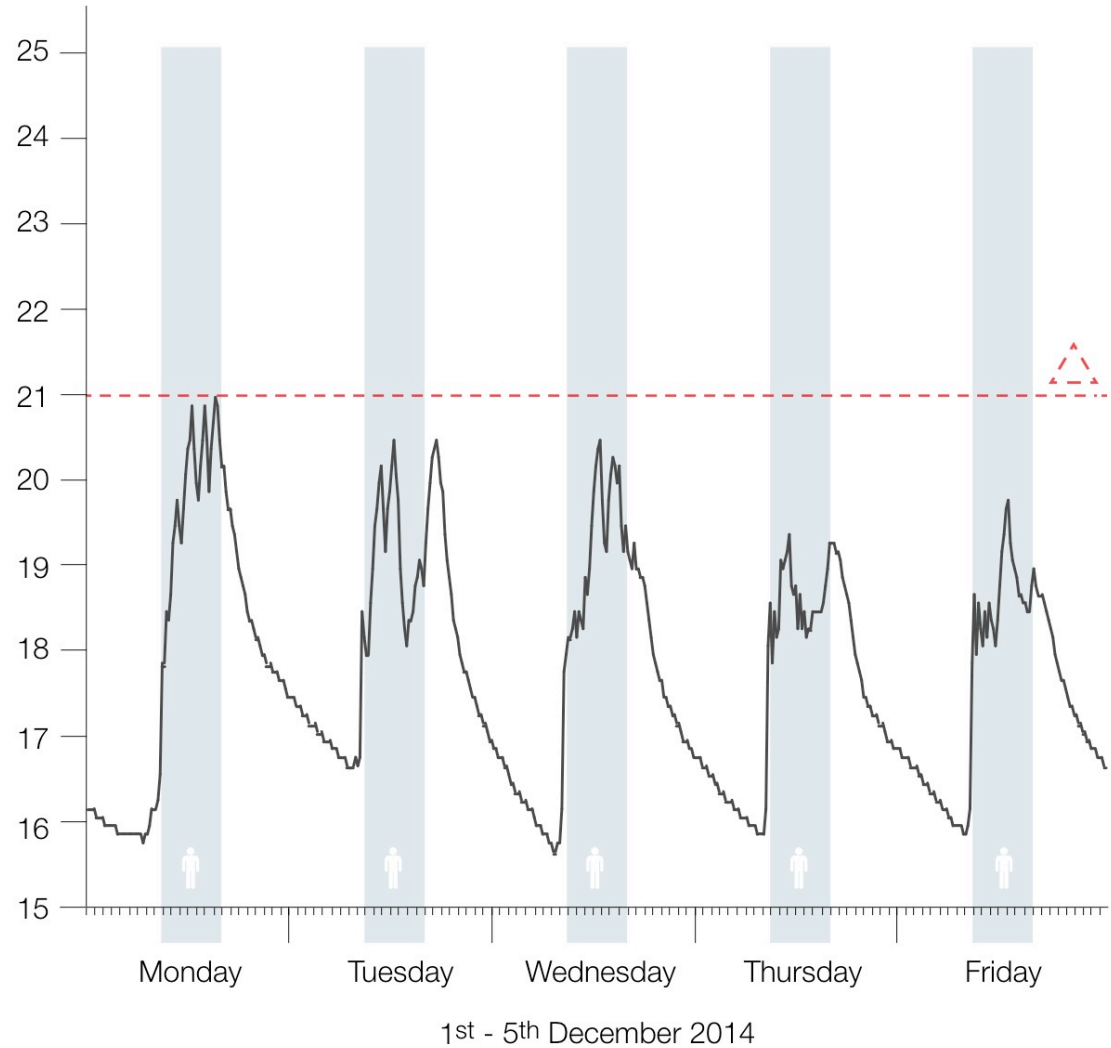
Recorded thermal energy consumption in UK schools





Air
Temperature
(°C)

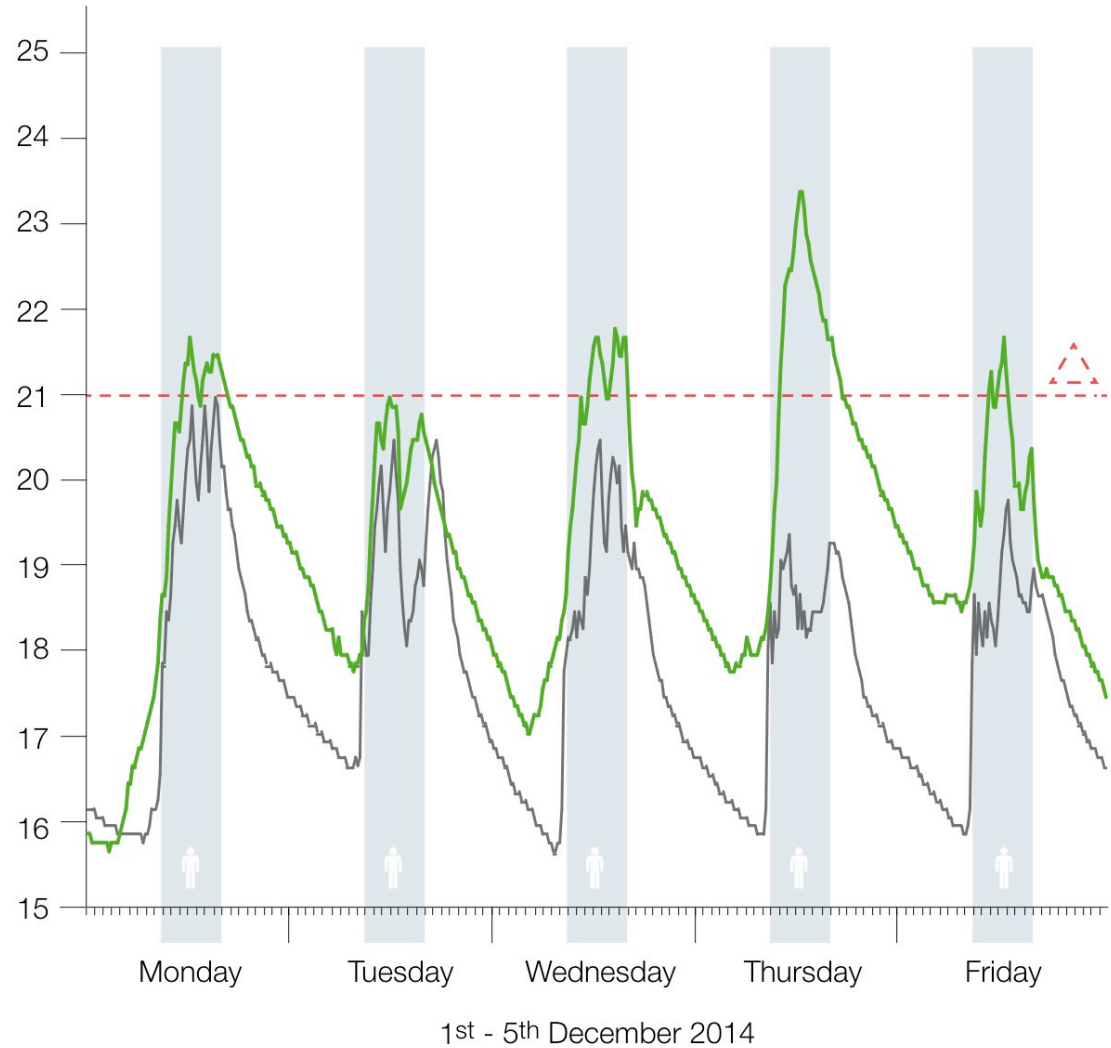
- Conventional 1970s
-  Occupied hours 9:00 - 16:00
- - - Lower limit





Air
Temperature
(°C)

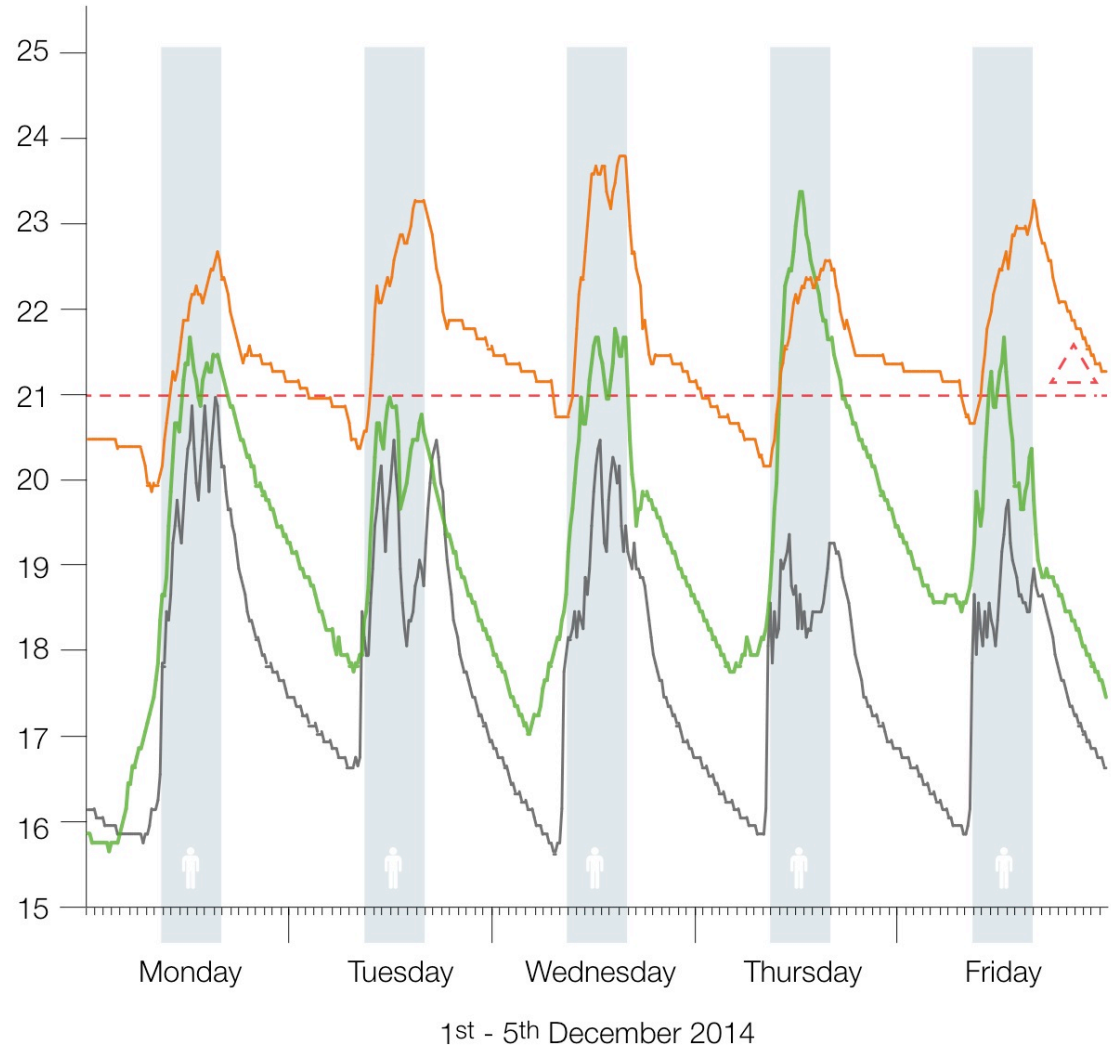
- St Luke's pre-PH / 2009
- Conventional 1970s
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- - - Lower limit





Air
Temperature
(°C)

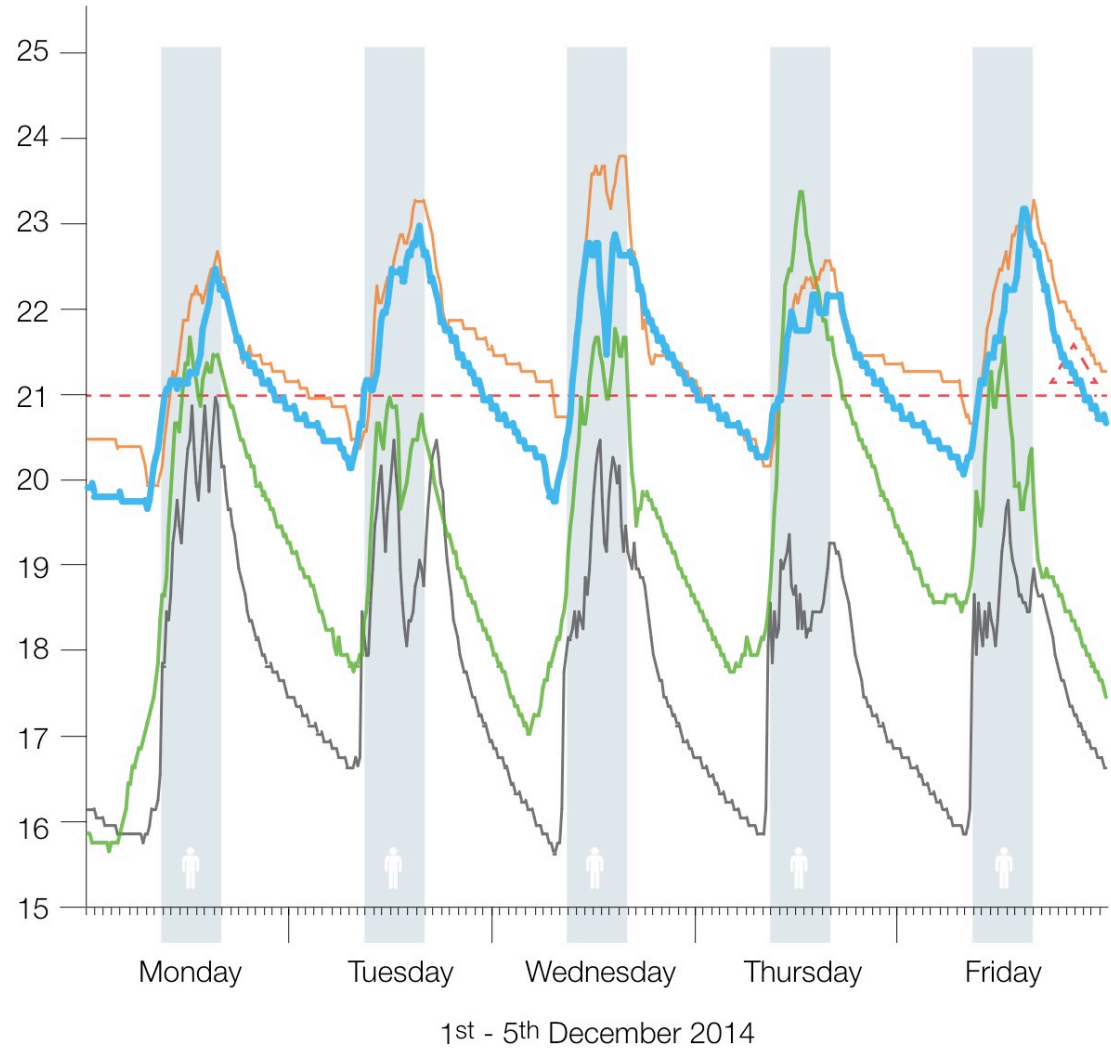
- Bushbury Hill
1st generation
PH / 2011
- St Luke's
pre-PH / 2009
- Conventional
1970s
- Occupied hours
9:00 - 16:00
- Lower limit





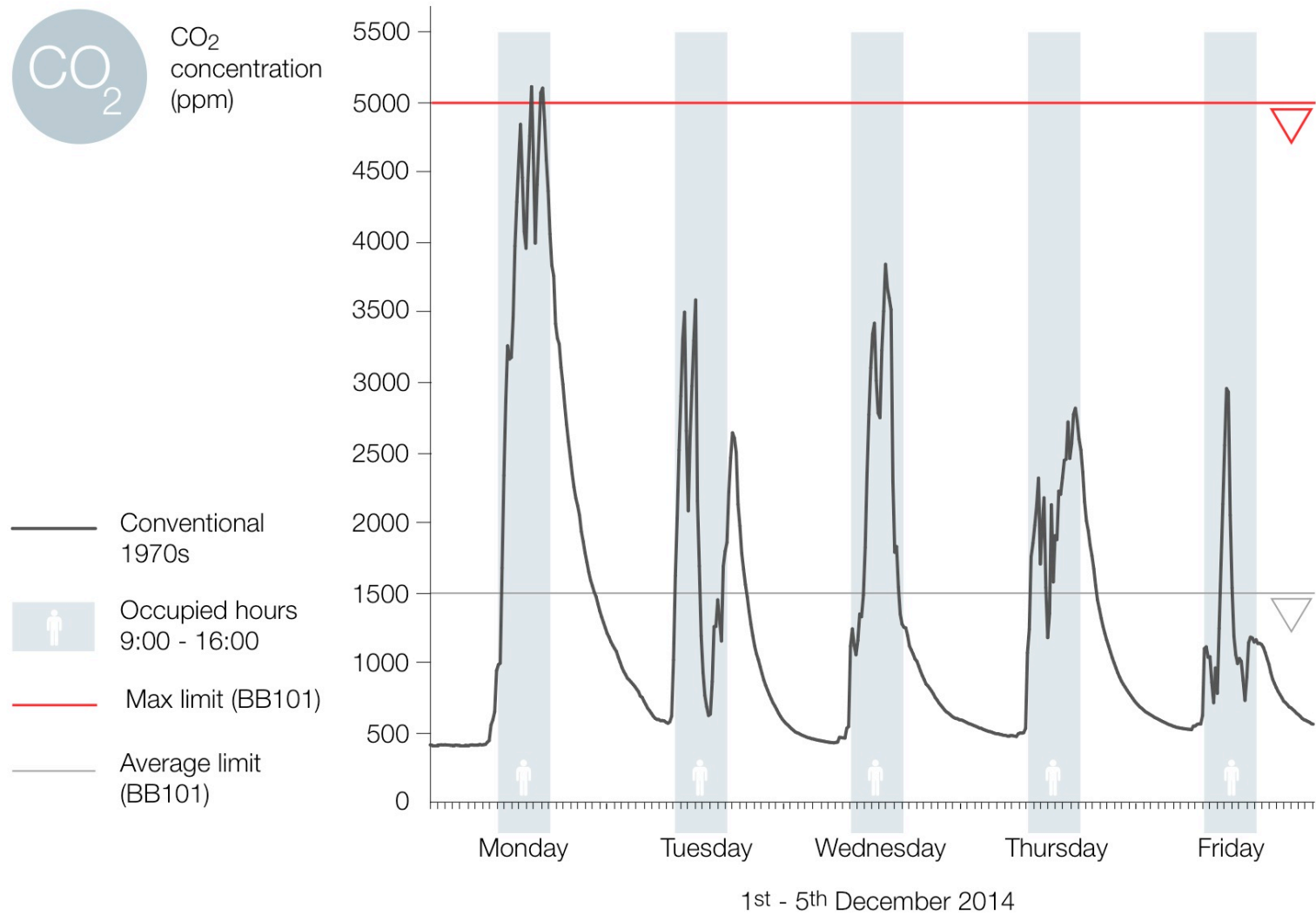
Air
Temperature
(°C)

- Wilkinson
2nd generation
PH / 2013
- Bushbury Hill
1st generation
PH / 2011
- St Luke's
pre-PH / 2009
- Conventional
1970s
- Occupied hours
9:00 - 16:00
- Lower limit





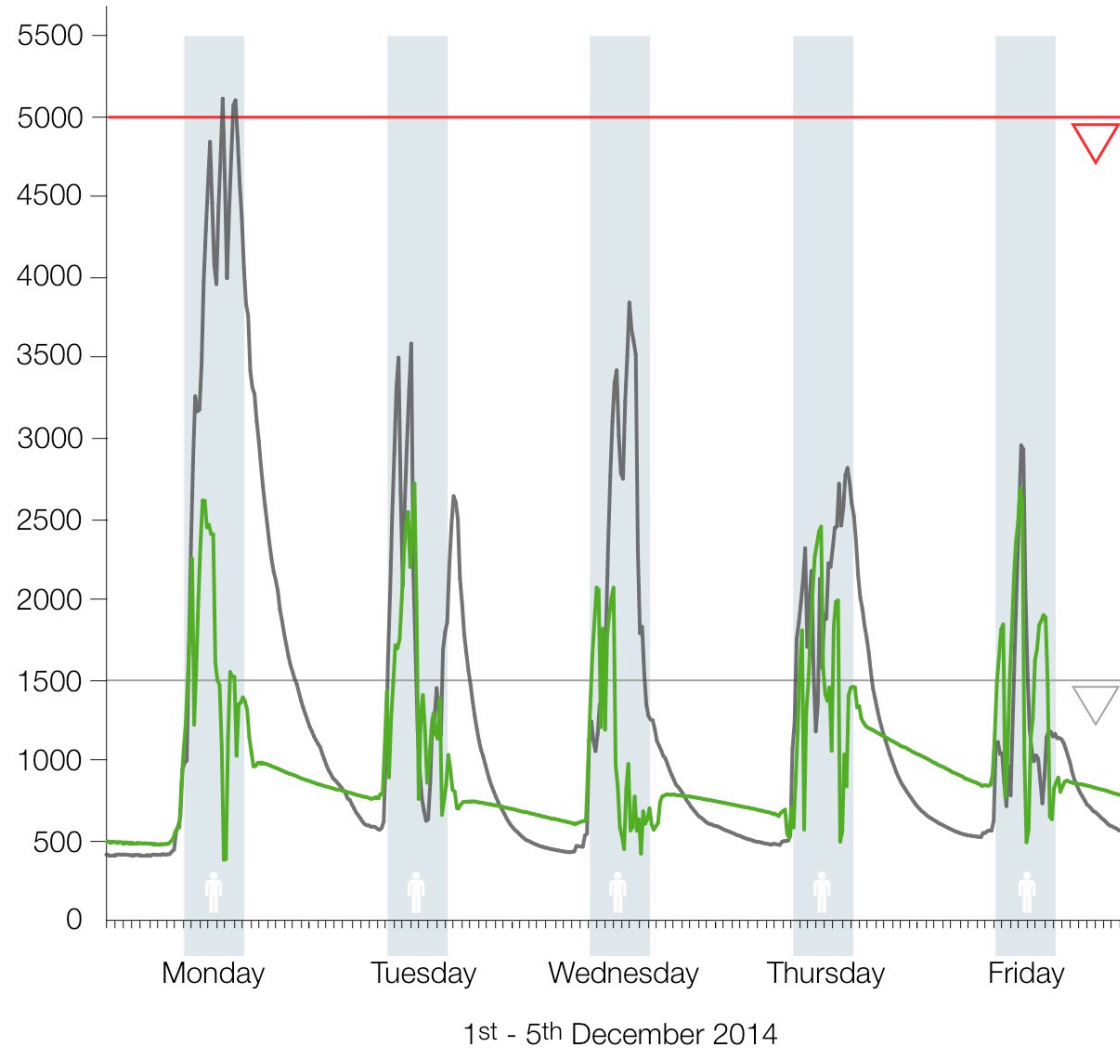
CO₂
concentration
(ppm)





CO₂
concentration
(ppm)

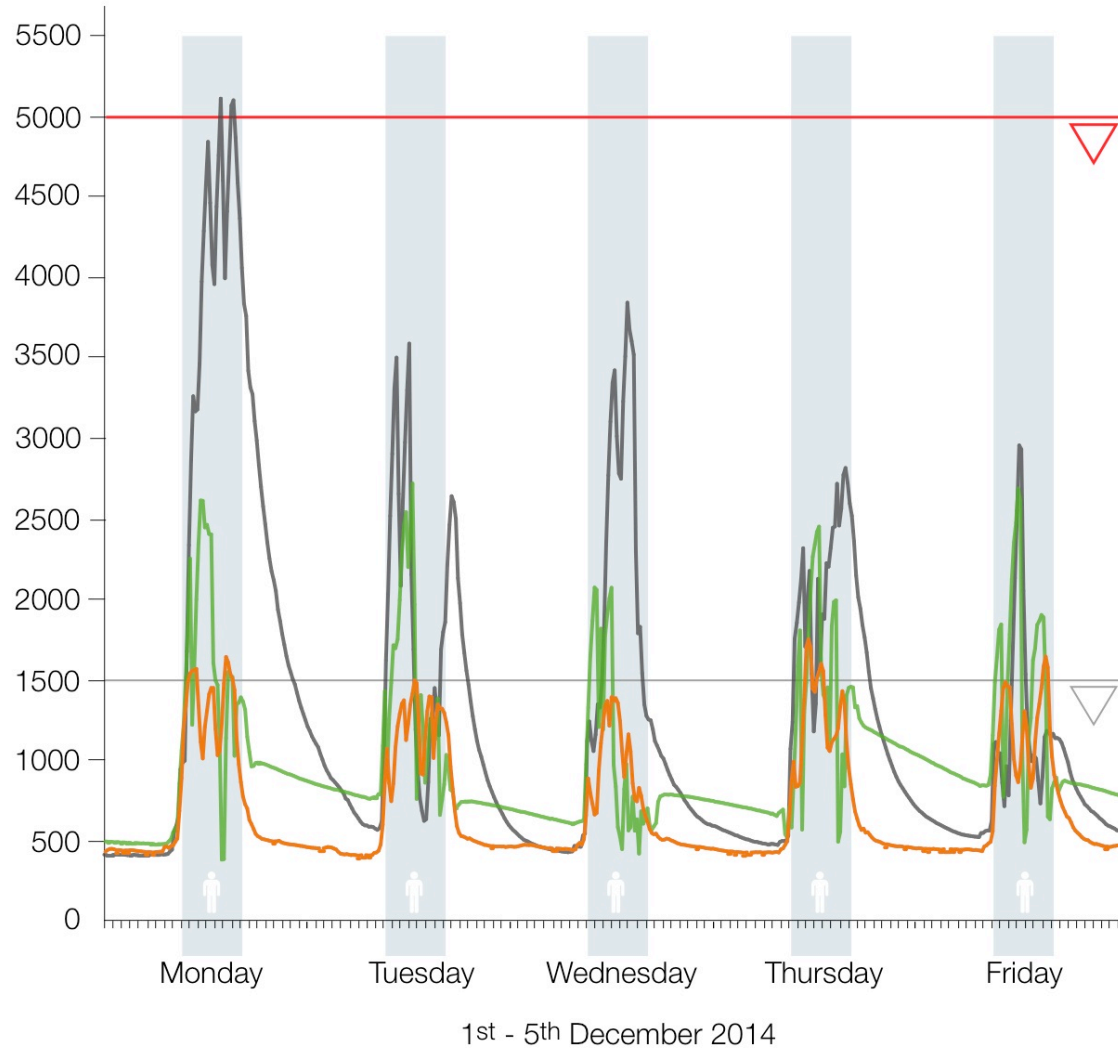
- Willows pre-PH / 2011
- Conventional 1970s
- Occupied hours 9:00 - 16:00
- Max limit (BB101)
- Average limit (BB101)





CO₂
concentration
(ppm)

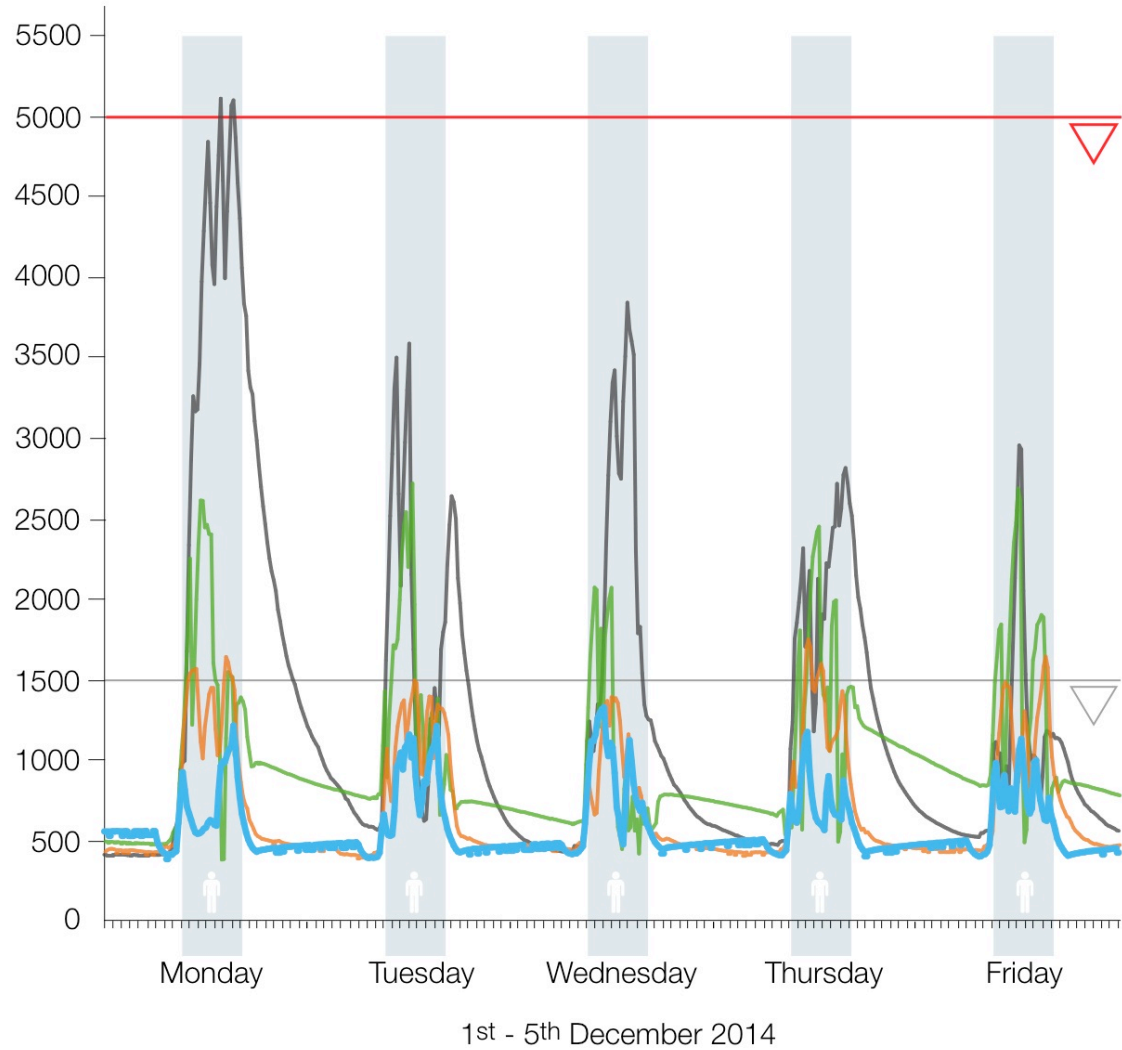
- Oak Meadow
1st generation
PH / 2011
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pre-PH / 2011
- Conventional
1970s
-  Occupied hours
9:00 - 16:00
- Max limit (BB101)
- Average limit (BB101)





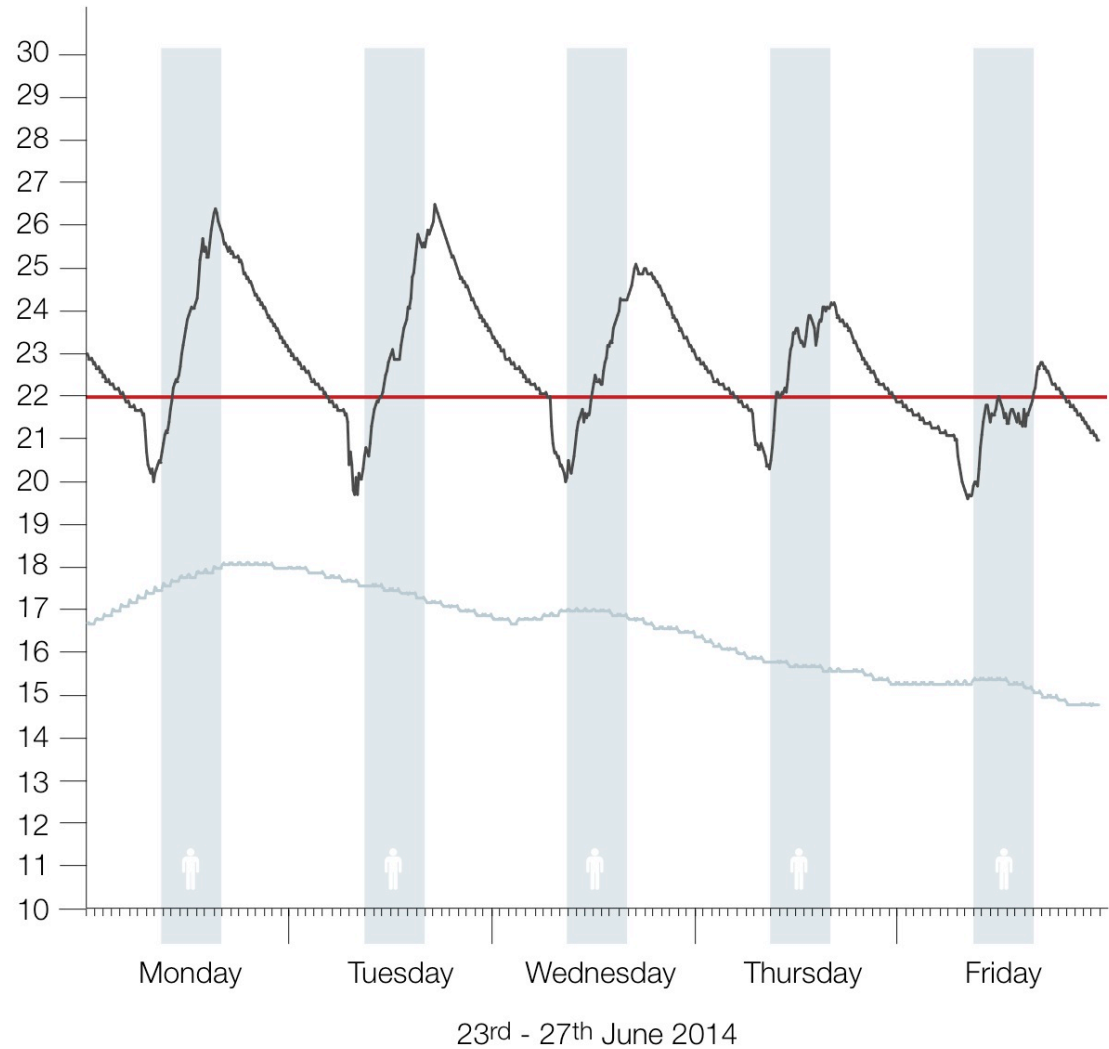
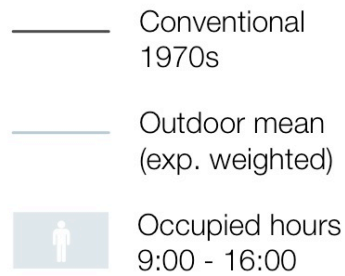
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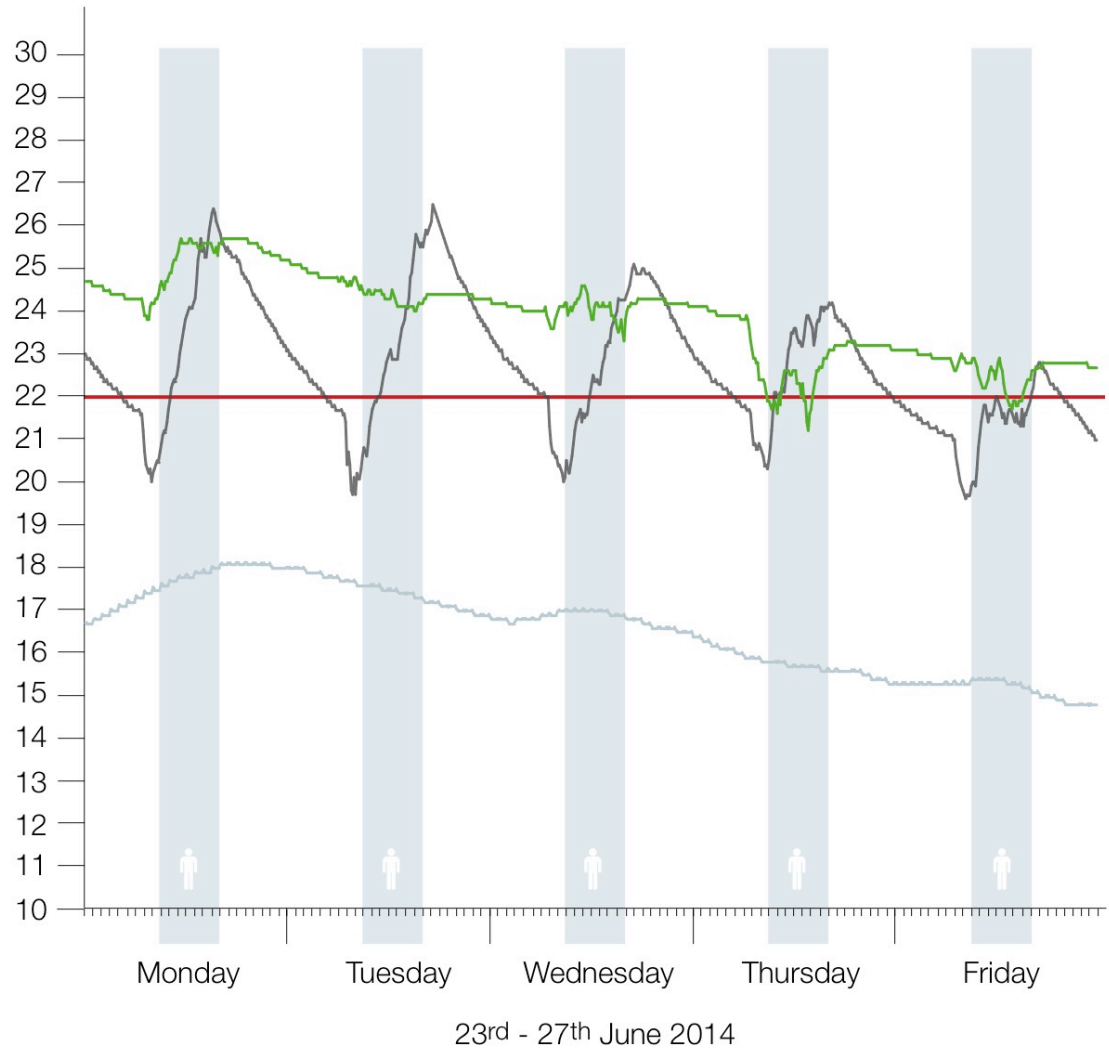
Air
Temperature
(°C)





Air
Temperature
(°C)

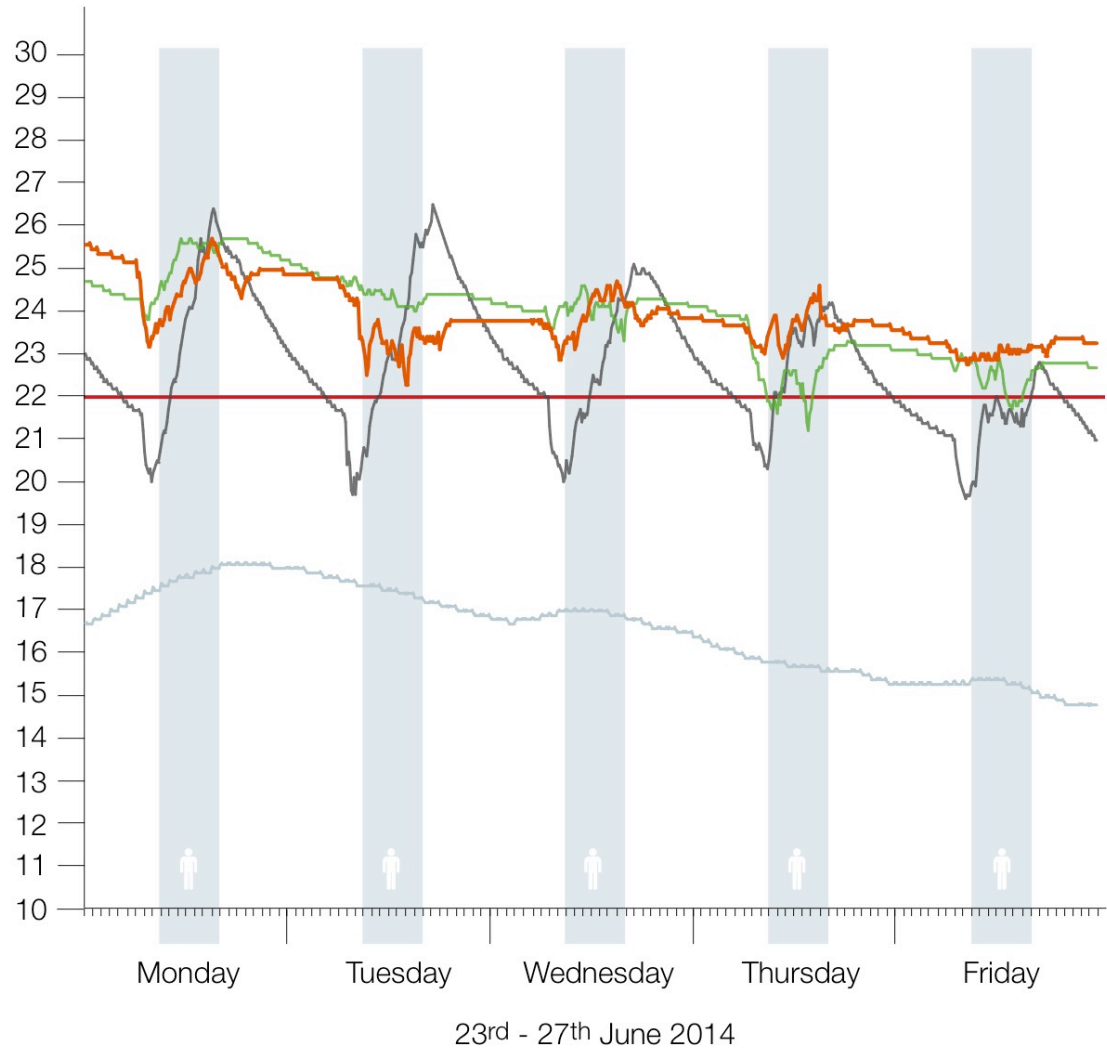
- Willows pre-PH / 2011
- Conventional 1970s
- Outdoor mean (exp. weighted)
- Occupied hours 9:00 - 16:00





Air
Temperature
(°C)

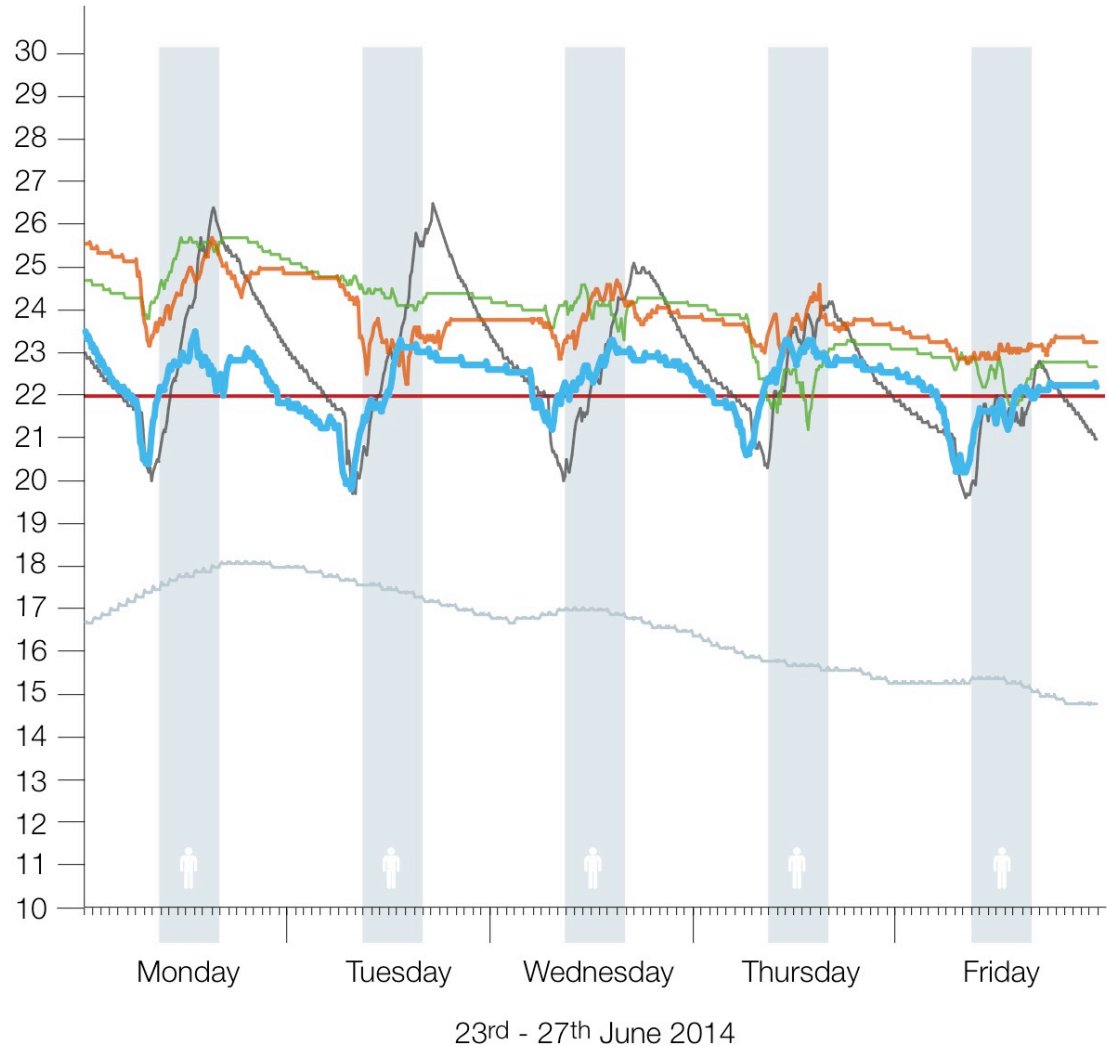
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PH / 2011
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pre-PH / 2011
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1970s
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- Occupied hours
9:00 - 16:00





Air
Temperature
(°C)

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2nd generation
PH / 2013
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pre-PH / 2011
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1970s
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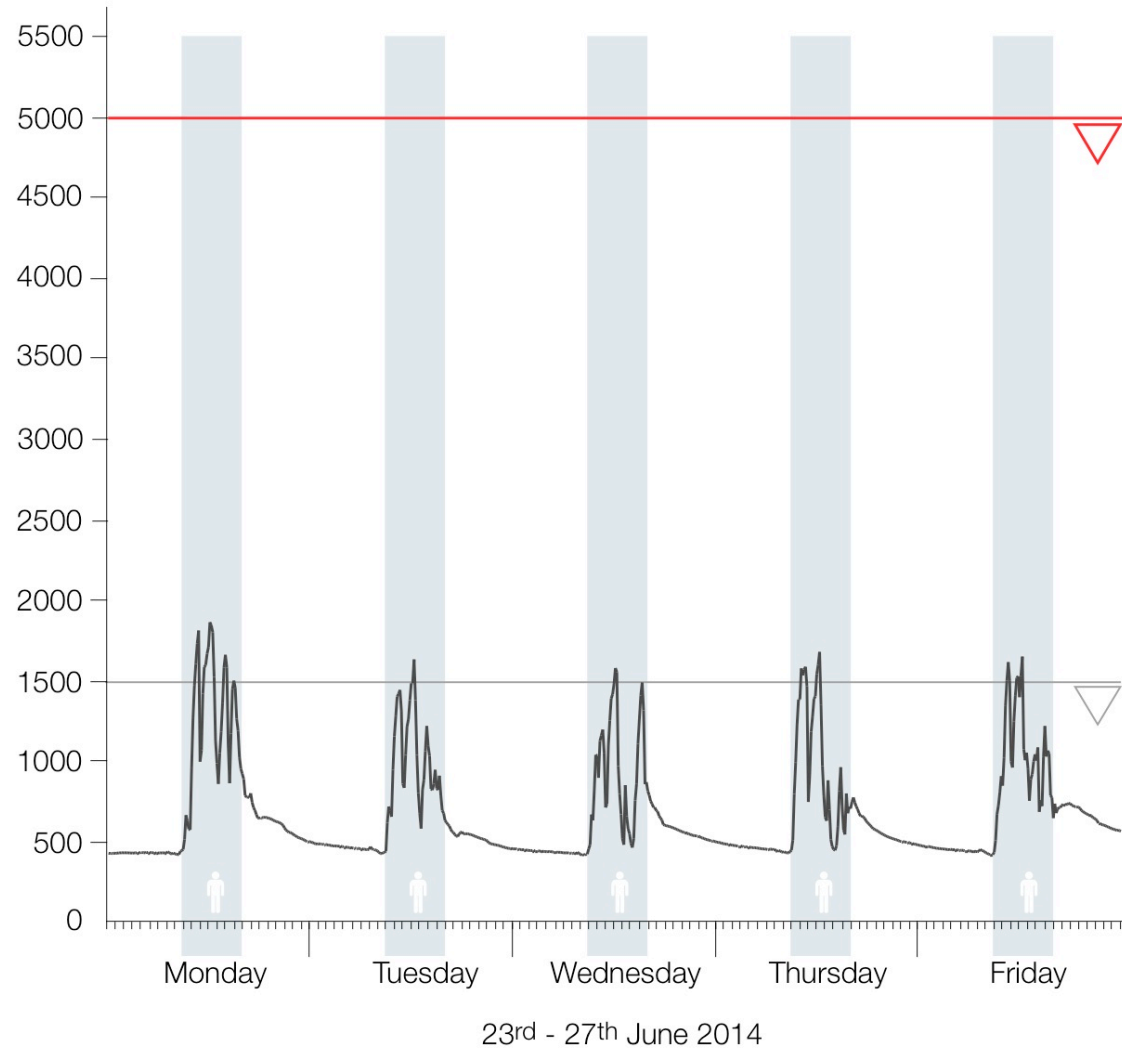


Indoor Environment / Indoor Air Quality / Summer



CO₂
concentration
(ppm)

- Conventional 1970s
- Occupied hours 9:00 - 16:00
- Max limit (BB101)
- Upper limit of average (BB101)

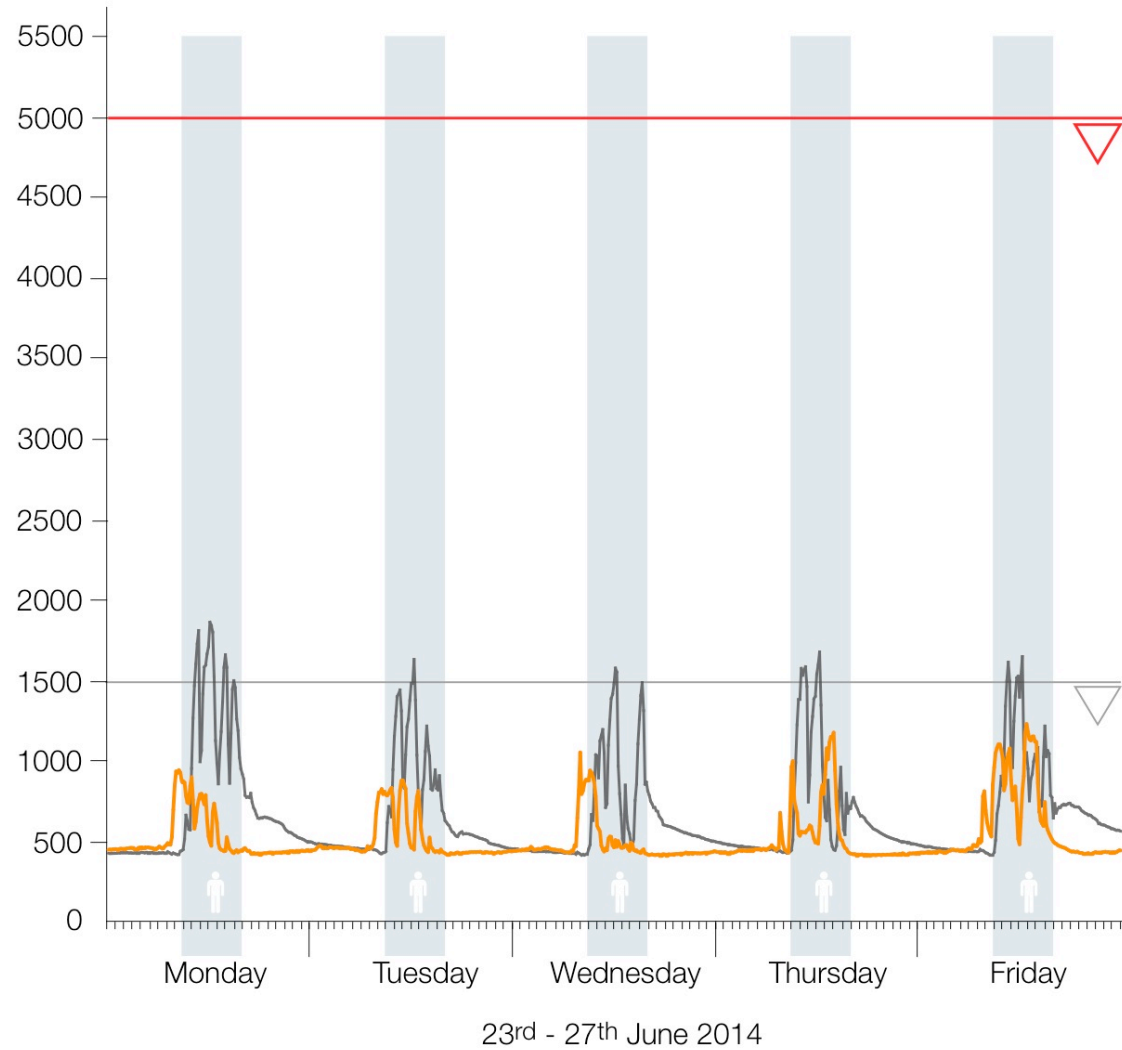


Indoor Environment / Indoor Air Quality / Summer



CO₂
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1st generation
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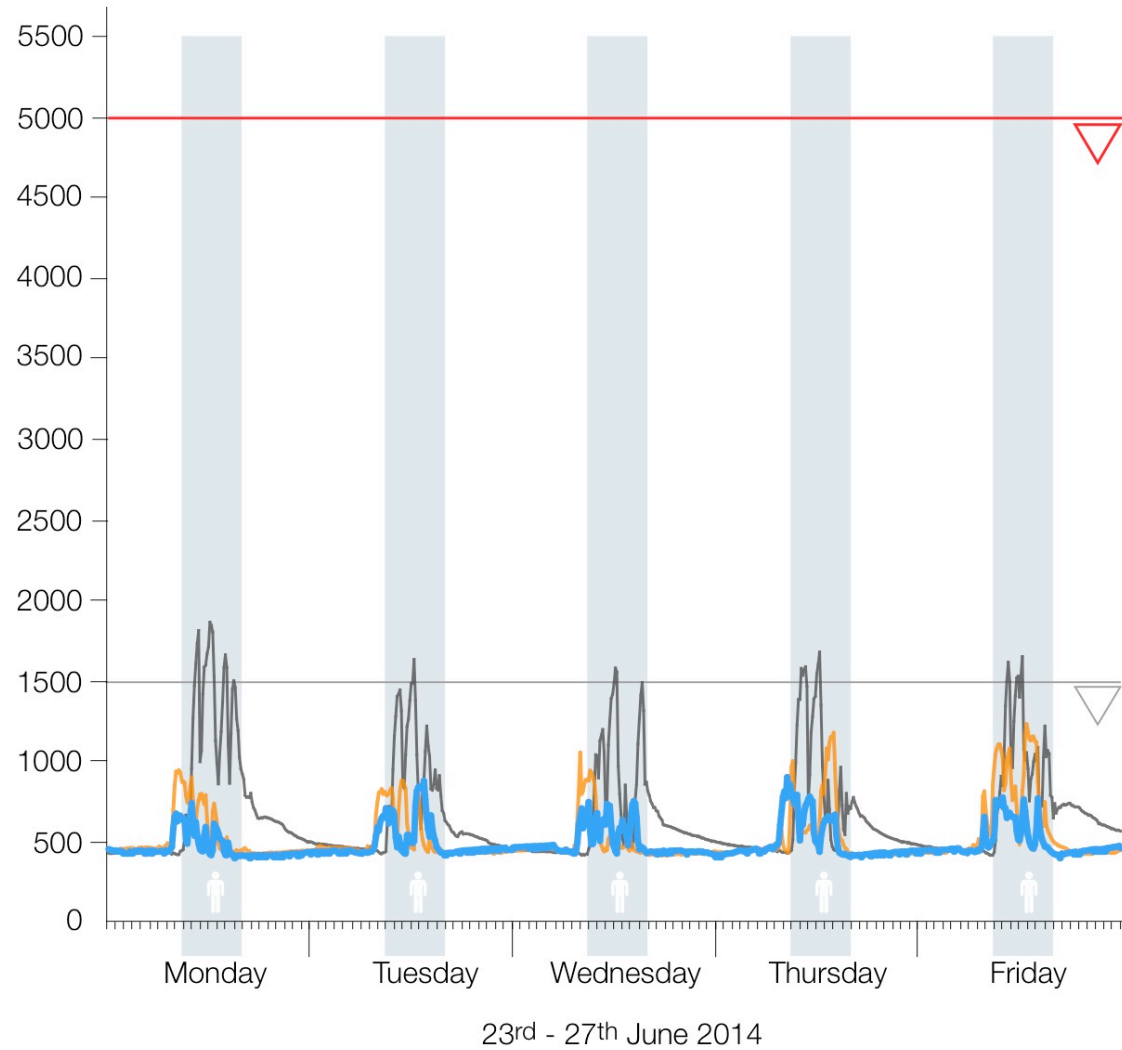


Indoor Environment / Indoor Air Quality / Summer



CO₂
concentration
(ppm)

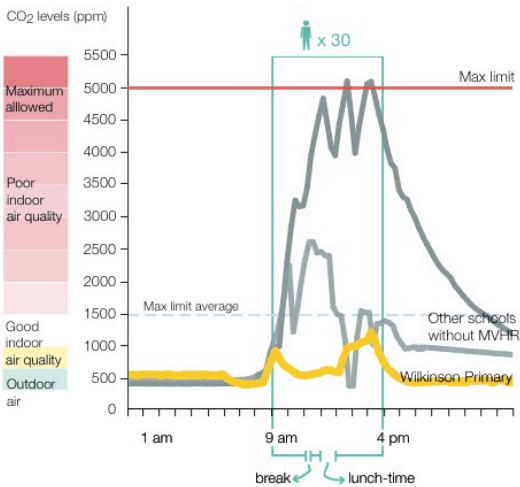
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average (BB101)



Classroom Guide

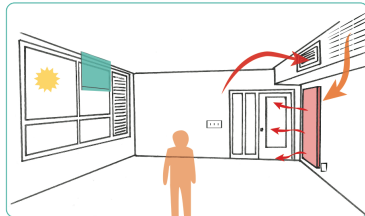


Classroom Indoor Air Quality



Classroom Guide

Classroom guide for winter ; during daytime.



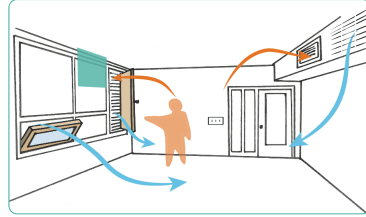
- Windows and ventilation panels can generally remain closed in the winter, as enough fresh air is mechanically supplied. By keeping the windows closed we save energy for heating!
- Even in winter, you may wish to open the windows to allow more fresh air in. However, if this happens too often, tell the facilities manager.

Daylight and blinds

- A daylight learning environment is good for health and performance. Keep the blinds up when there is no glare from the sun.
- Remember to turn off the lights; when there is enough daylight, and when you leave the classroom.

Classroom guide for summer; during day-time.

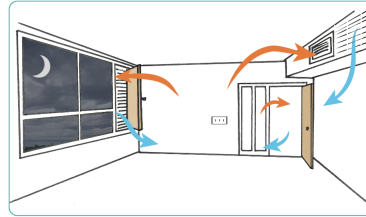
- Warm air escapes through the open ventilation panels.
- Warm air escapes through the grilles to the hub space.



- Open windows and ventilation panels in summer help cool down the classroom. In the unlikely event that outdoor air is warmer than indoor air, it may be better to close windows.
- Cooler fresh air enters through the open windows & ventilation panels.
- Fresh air is supplied mechanically into the classroom through the grilles.

Classroom guide for summer; during night-time.

- Warm air escapes through the open ventilation panels.
- Warm air escapes to the hub, through the vents and the classroom door to the hub space. If overnight cooling with natural ventilation is activated, then air movement is enhanced by the open windows in the hub space.



- Fresh air is supplied mechanically into the classroom at a reduced rate, unless overnight cooling with mechanical ventilation is activated.
- Cooler fresh air enters through the open ventilation panels.

Why is air in the classroom is heated by the heat emitted by laptops, screens, electric lights, the occupants and sunlight. In order to cool down the classroom, ventilation is required.



University of East Anglia
Enterprise Centre



- Passivhaus certified
- BREEAM Outstanding
- Low embodied carbon
- Local materials
- Modelled for 80 year climate data



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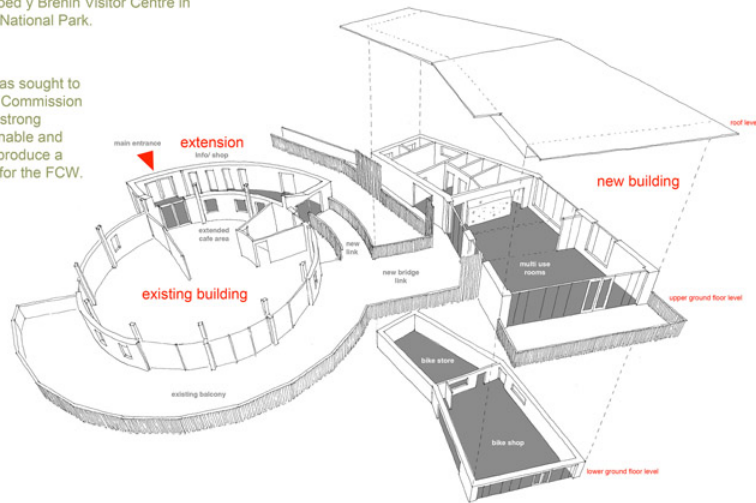
Coed y Brenin Visitor Centre, Snowdonia National Park [proposed extension]



In September 2010 Archtype were appointed by the Forestry Commission Wales (FCW) to design an extension to the Coed y Brenin Visitor Centre in the south Snowdonia National Park.

The design process has sought to combine the Forestry Commission Wales' values, with a strong commitment to sustainable and innovative design, to produce a new flagship building for the FCW.

The FCW outlined certain aspirations for the project which placed emphasis on sustainability, achieving BREEAM Excellent rating, integrating the new building well with the existing building and site conditions, and the use and showcase of Welsh timber.



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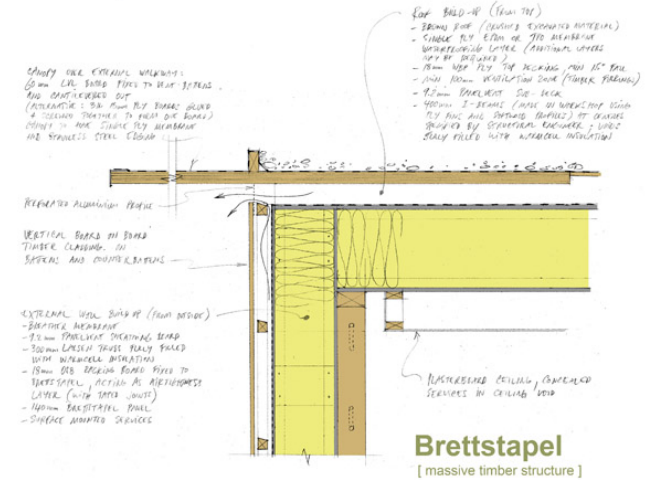
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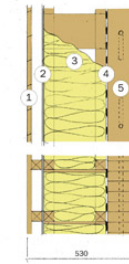
Coed y Brenin Visitor Centre, Snowdonia National Park [proposed extension]



Brettstapel

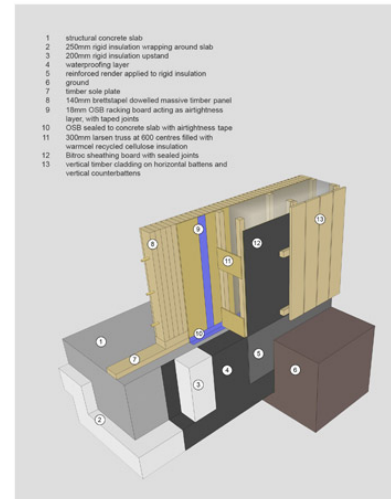
[massive timber structure]

Brettstapel is a solid timber construction system, it has no glues or nails. Fabricated from softwood timber posts connected with hardwood timber dowels, this relatively simple method of construction uses low grade timber that would otherwise be unsuitable for use in construction, to form load-bearing solid timber wall, floor and roof panels.



The system works by using dowels with a moisture content lower than that of the posts; over time the dowels expand to achieve moisture equilibrium thus 'locking' the posts together and creating a structural load-bearing system.

With Brettstapel normally manufactured entirely out of untreated timber, it is important to stress that glue is not necessary. The exclusion of glue and nails (which are seen in other solid timber systems) means a healthier indoor air quality can be achieved, while the timber itself locks in vast amounts of carbon dioxide without emitting harmful toxins found in other materials.



- 1 horizontal timber cladding on 50x50 battens
- 2 6.4mm Panelvent sheathing board (with optional breather membrane)
- 3 300mm larsen truss timber cassette filled with Warmocell insulation
- 4 vapour check layer
- 5 140mm Brettstapel massive timber load bearing wall, dowelled with hardwood stakes

Target U -value 0.12 W/m²K

Target u-value 0.12 W/m²/K

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“The children are more alert in the afternoon,
and are more attentive because the air is so
fresh and comfortable.” Sara Morris, head



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Thank you for listening