#UKPHC20

PASSIVHAUS AS A ROUTE TO NET ZERO:

NEW BUILD PASSIVHAUS HACKBRIDGE PRIMARY & HARRIS ACADEMY

Christian Dimbleby

ARCHITYPE

New Build Passivhaus Route To Net Zero

Hackbridge Primary School

Client: London Borough of Sutton

Designer: Architype Ltd

Contractor: LakeHouse / Willmott Dixon

Gross Internal Area: 1,685m2

120 pupils: One FE (expansion to 2FE)

Completed: November 2019

Harris Academy Sutton

Client: London Borough of Sutton

Designer: Architype Ltd

Contractor: Willmott Dixon

Gross Internal Area: 10,625m²

1,275 pupils: Six FE plus 6th form

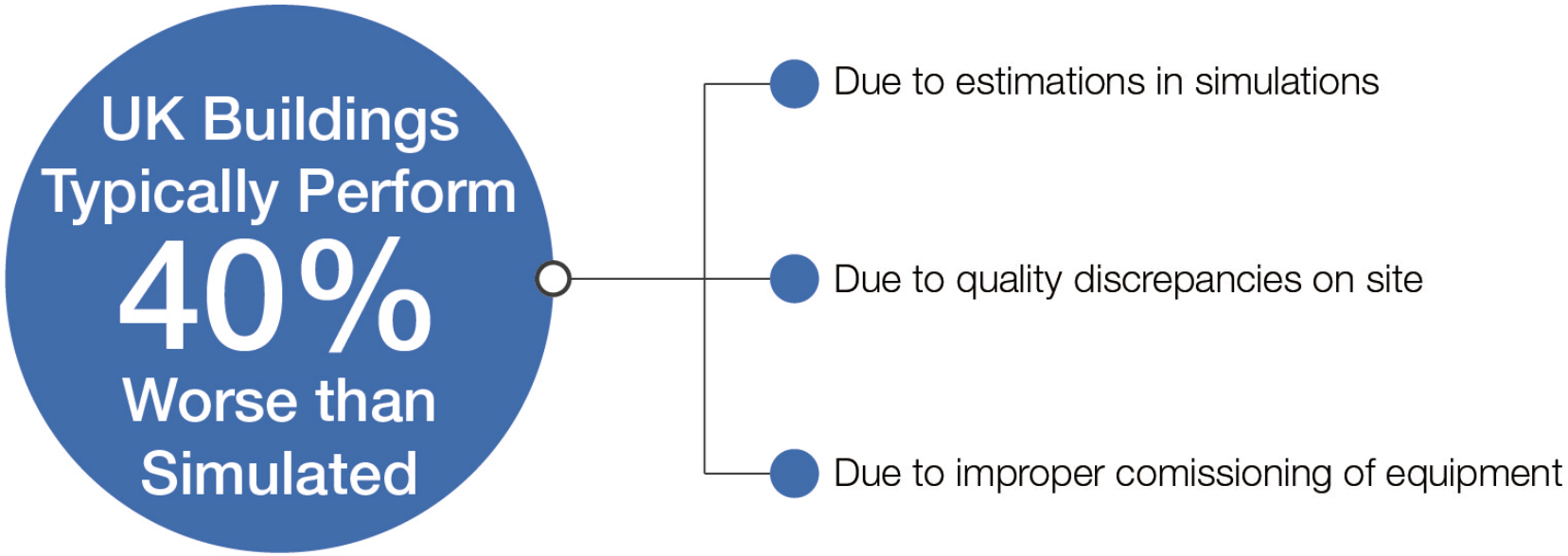
Completed: September 2019

Sutton's Reasons for Choosing Passivhaus Standard

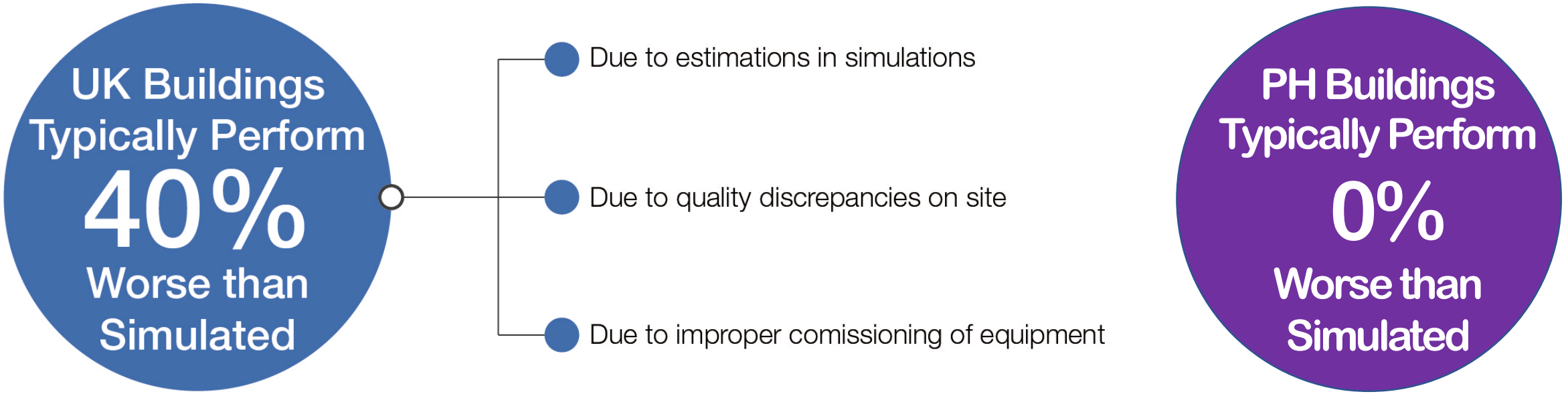
ONE PLANET SUTTON

- a rigorous **energy** standard
- a rigorous **comfort** standard
- a rigorous **evidence** based standard
- a rigorous **quality assurance** standard

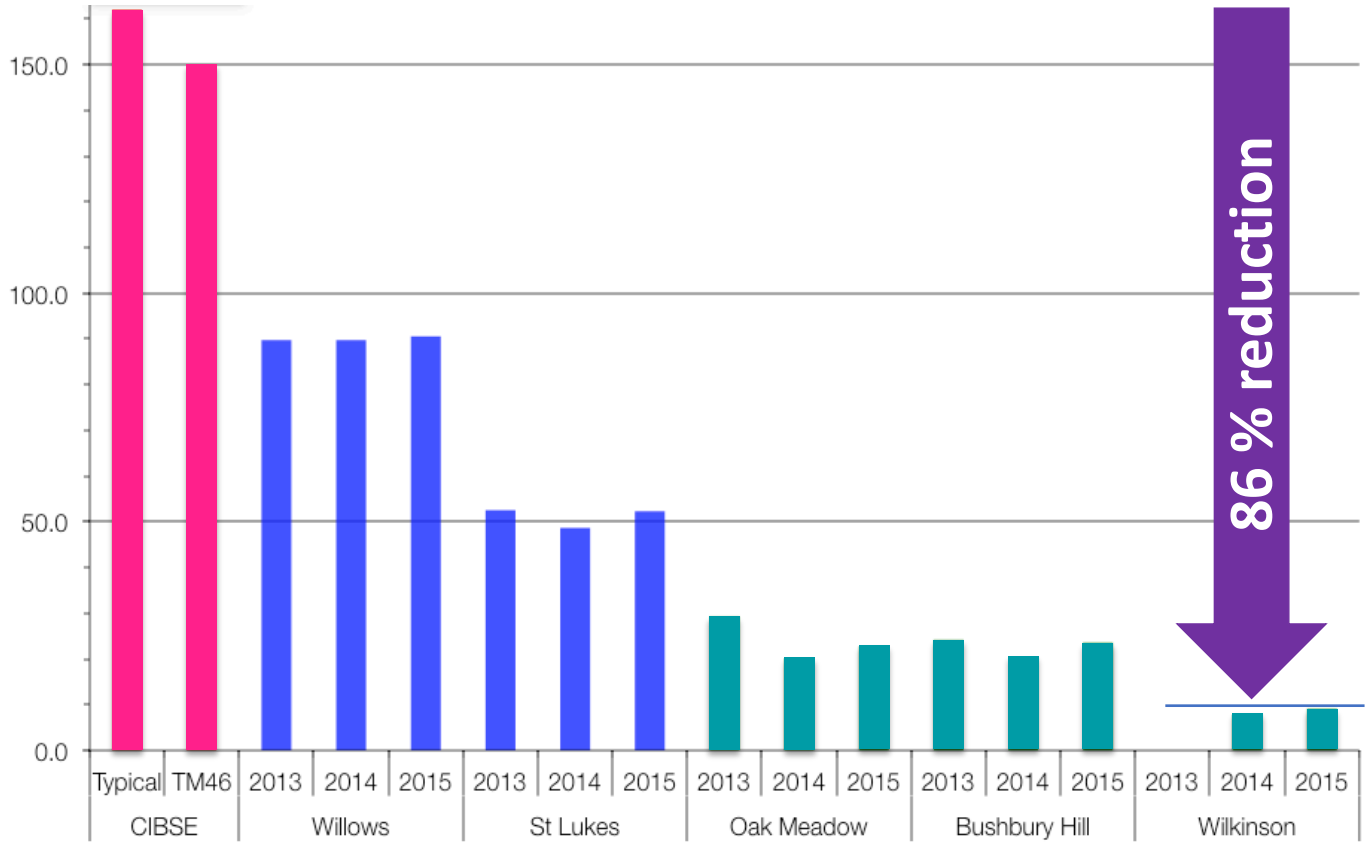
Closing The Performance Gap



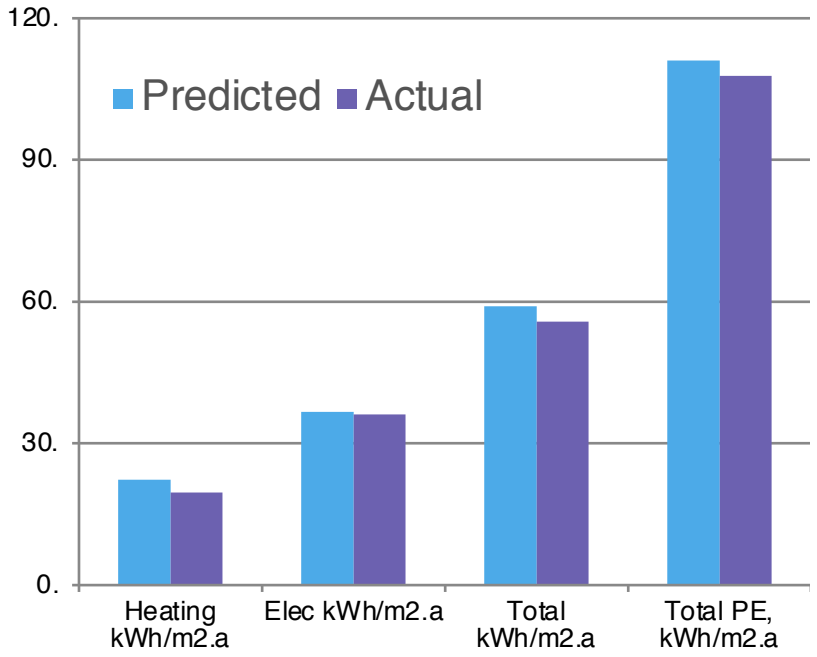
Closing The Performance Gap



Passivhaus Standard Reduces Energy Demand



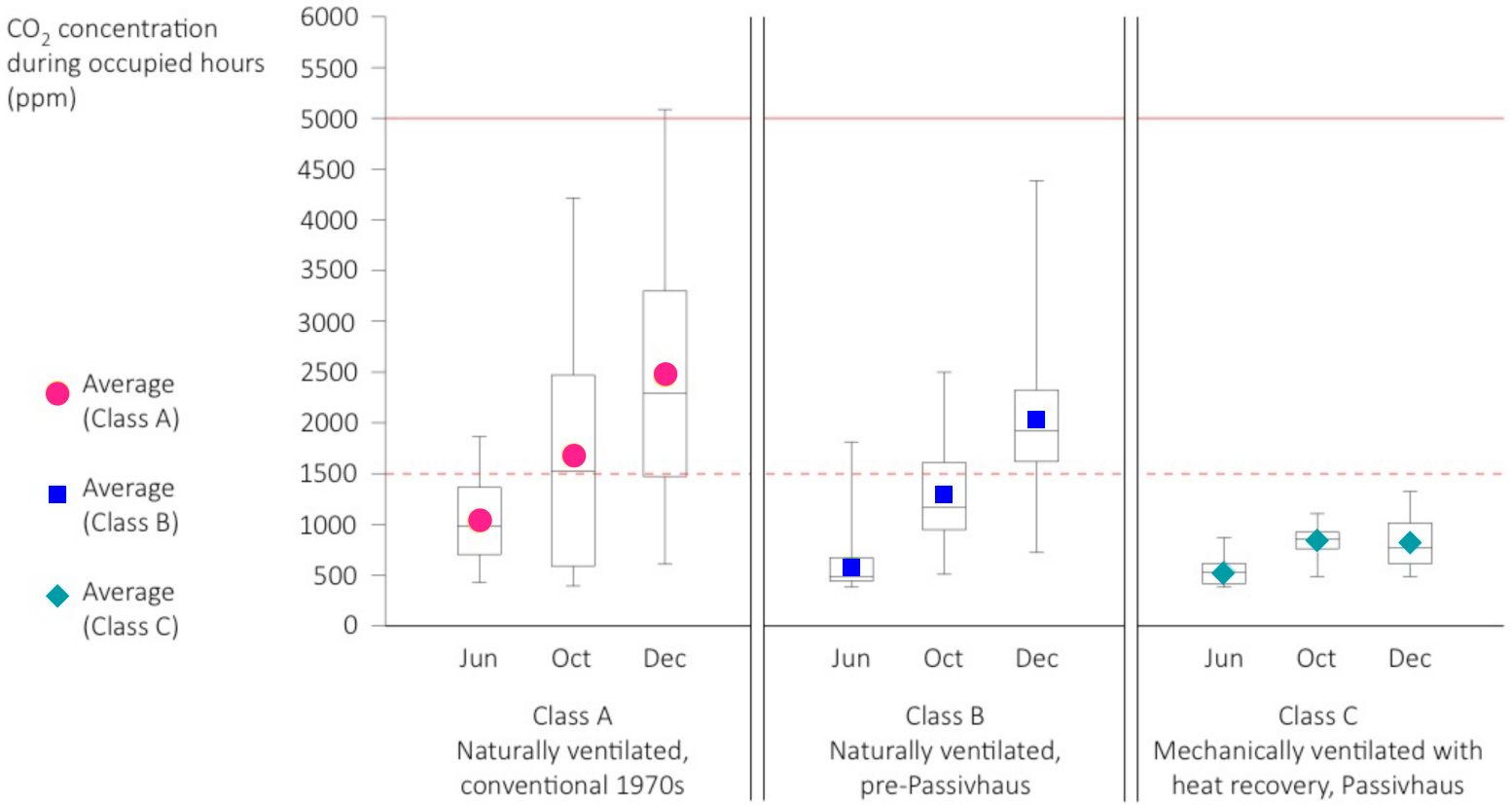
Architype POE monitoring of schools energy



Enterprise Centre UEA

Comfort and wellbeing

KEEN research project - Comparing Air Quality:



"our children are more alert and attentive in lessons due to the amount of daylight in classrooms and the fresh air throughout the school. The fact that the new school is built to Passivhaus standards means that learning has been enhanced; our pupils love coming to school"

Sara Morris, Head Teacher, Oak Meadow Primary School

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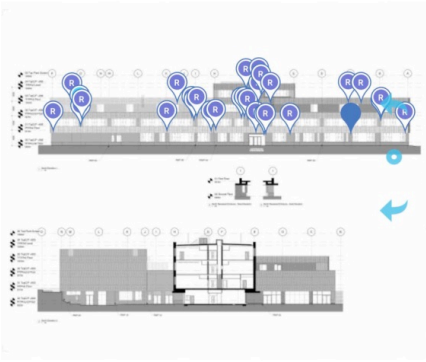
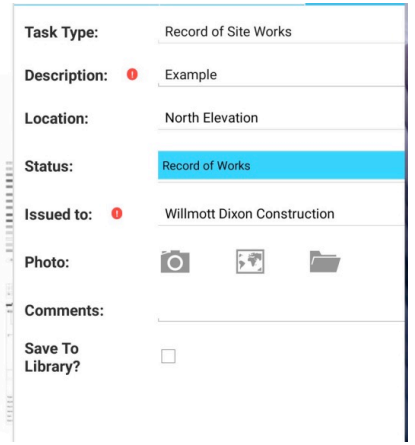
Passivhaus Quality Requires Collaboration

CERTIFIED PASSIVE HOUSE TRADESPERSON

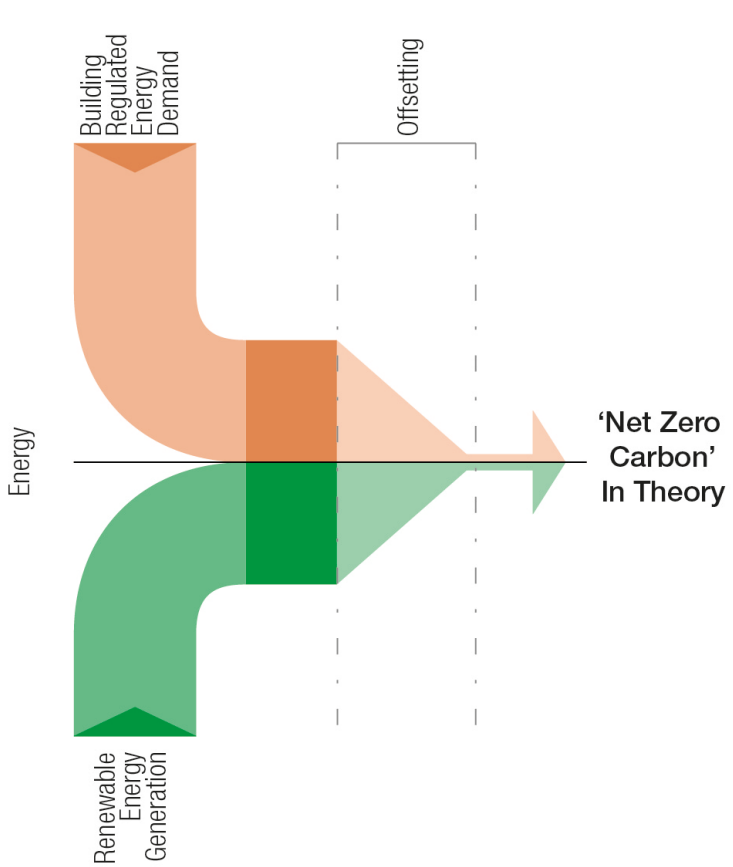
TRADESPERSON

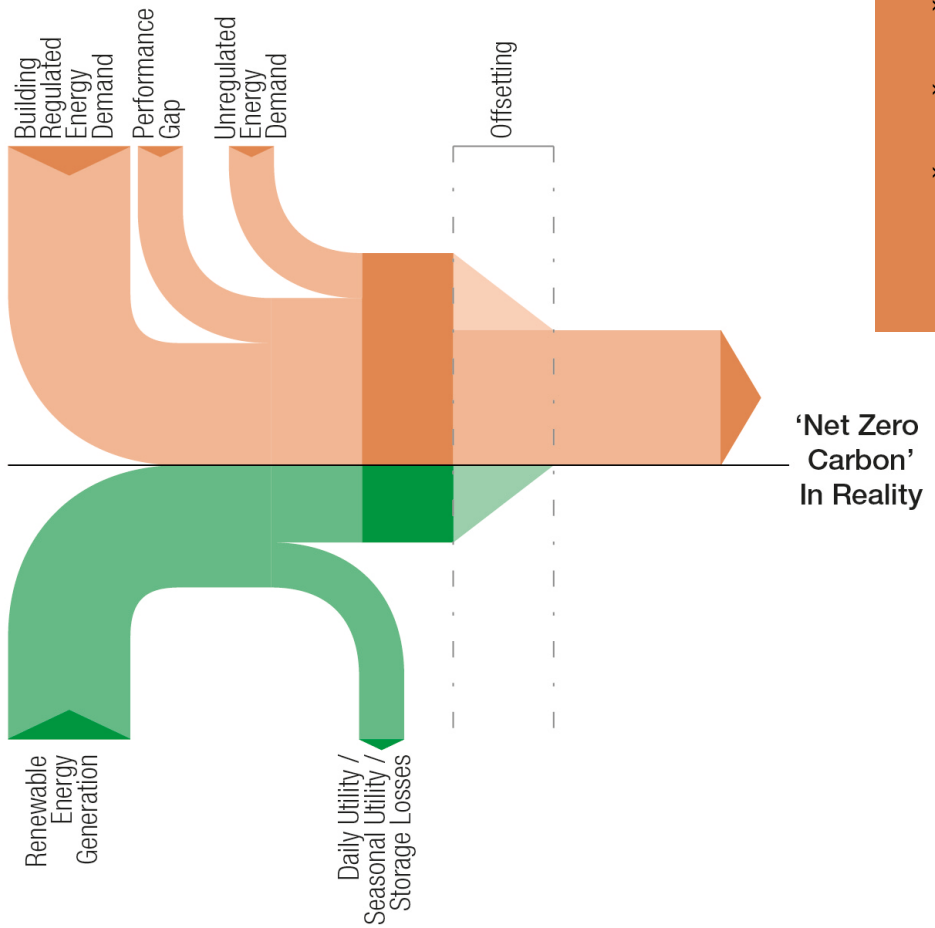
- Lessons learnt workshops
- Trades person training
- Passivhaus induction for operatives
- Setting the expectations on quality





Net Zero Theory and Reality





'Net Zero Carbon' in Theory and Reality

- Performance gap increases energy demand
- Unregulated energy is often omitted from calculations
- Seasonal difference in renewable energy generation is often omitted.

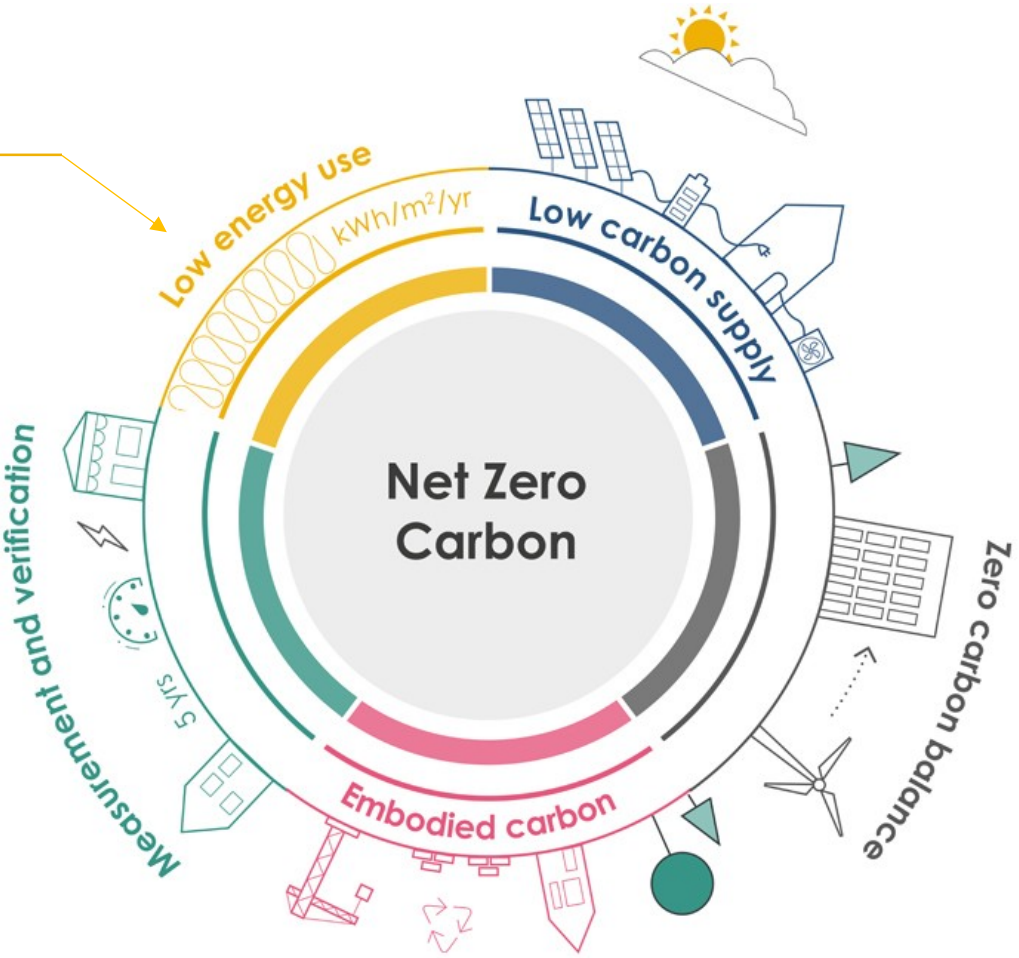
LETI - Net Zero Operational Carbon Targets

Low energy use

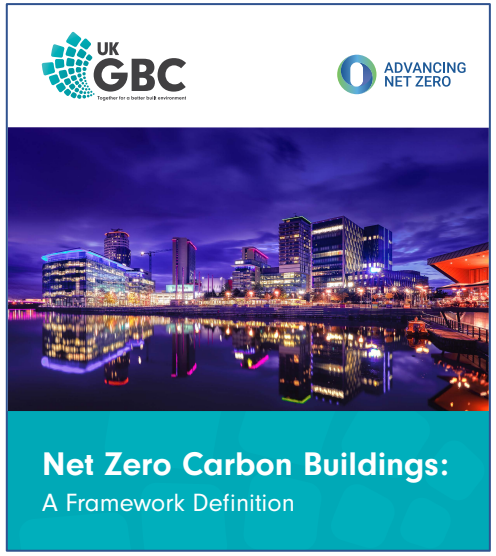
1. Total Energy Use Intensity (EUI) - Energy use measured at the meter should be equal to or less than:
   - **35 kWh/m²/yr** (GIA) for residential[1]

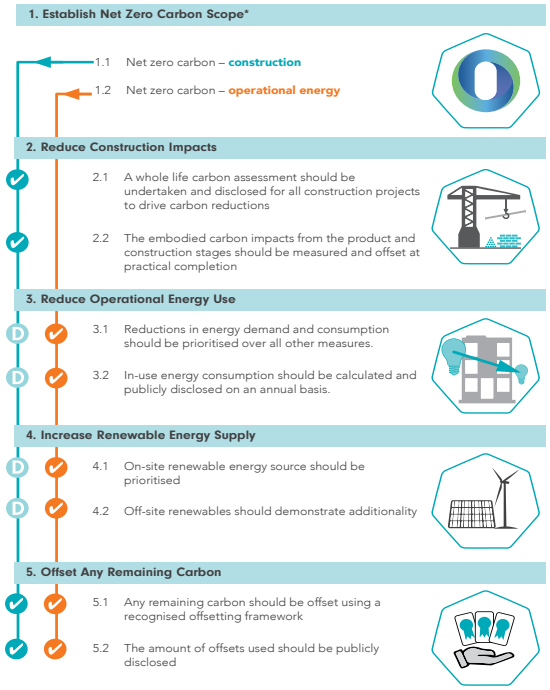
   For non-domestic buildings a minimum DEC B (40) rating should be achieved and/or an EUI equal or less than:
   - **65 kWh/m²/yr** (GIA) for schools[1]
   - **70 kWh/m²/yr** (NLA) or **55 kWh/m²/yr** (GIA) for commercial offices[1,2]

2. Building fabric is very important therefore space heating demand should be less than **15 kWh/m²/yr** for all building types.



Net Zero Carbon - Construction



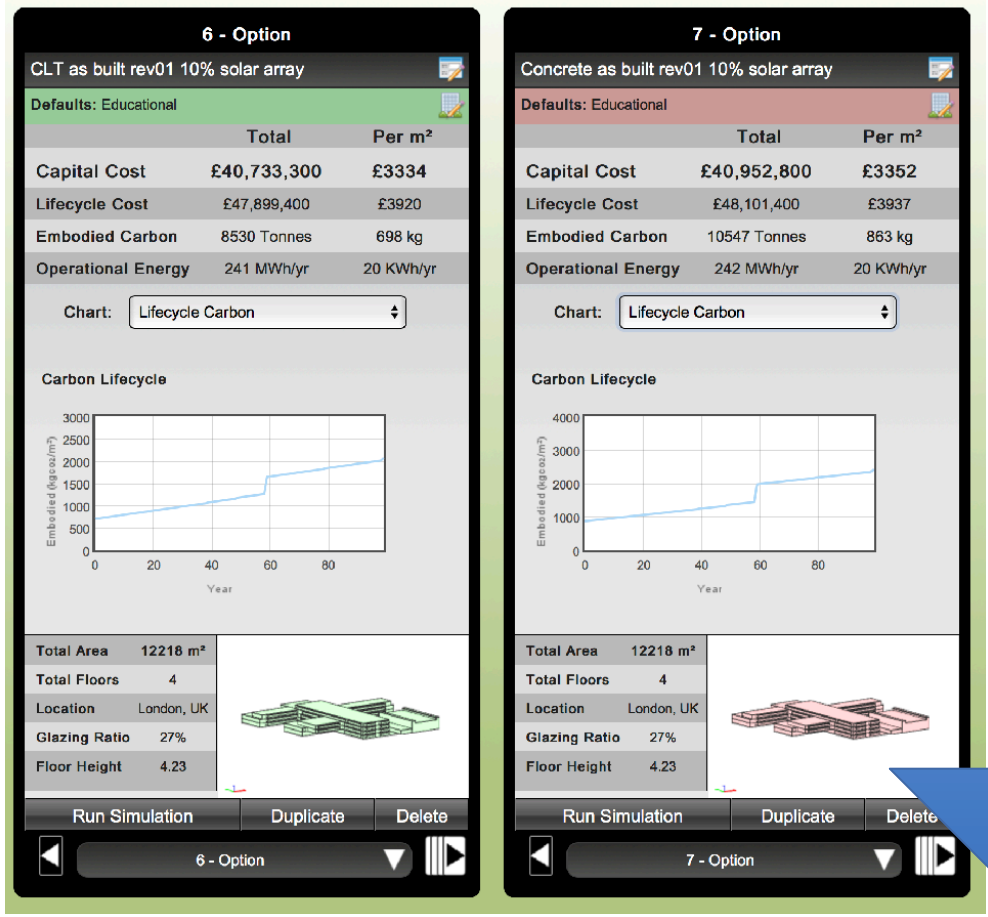


Net zero carbon – construction (1.1):

"When the amount of carbon emissions associated with a building's product and construction stages up to practical completion is zero or negative, through the use of offsets or the net export of on-site renewable energy."

Net zero carbon – operational energy (1.2):

"When the amount of carbon emissions associated with the building's operational energy on an annual basis is zero or negative. A net zero carbon building is highly energy efficient and powered from on-site and/or off-site renewable energy sources, with any remaining carbon balance offset."



20+ % reduction embodied carbon

Architype's Sustainable Performance Evolution

Reducing energy → Reducing carbon → Reducing cost → Improving wellbeing → Positive performance

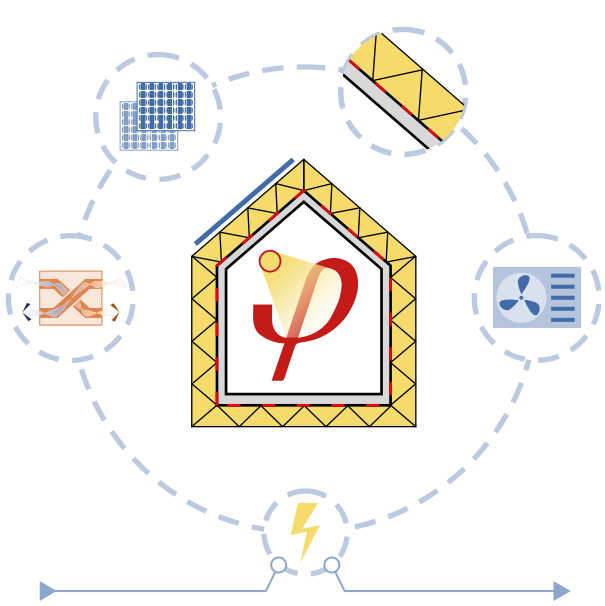
Passivhaus Design Requirements To Get To Net Zero Operational Carbon

Heating Demand	Or	Heating Load
15 kWh/m²a		10 W/m²

Cooling Demand	Or	Cooling Load
15 kWh/m²a		10 W/m²

Airtightness	Frequency of Overheating
0.6 ACH	10% ideally <2%

Primary Energy	Or	Primary Energy Renewable
135 kWh/m²a		60 kWh/m²a



- Form and Orientation
- Continuous Super Insulation
- Draft Free Construction
- Efficient Services
- Onsite Renewables

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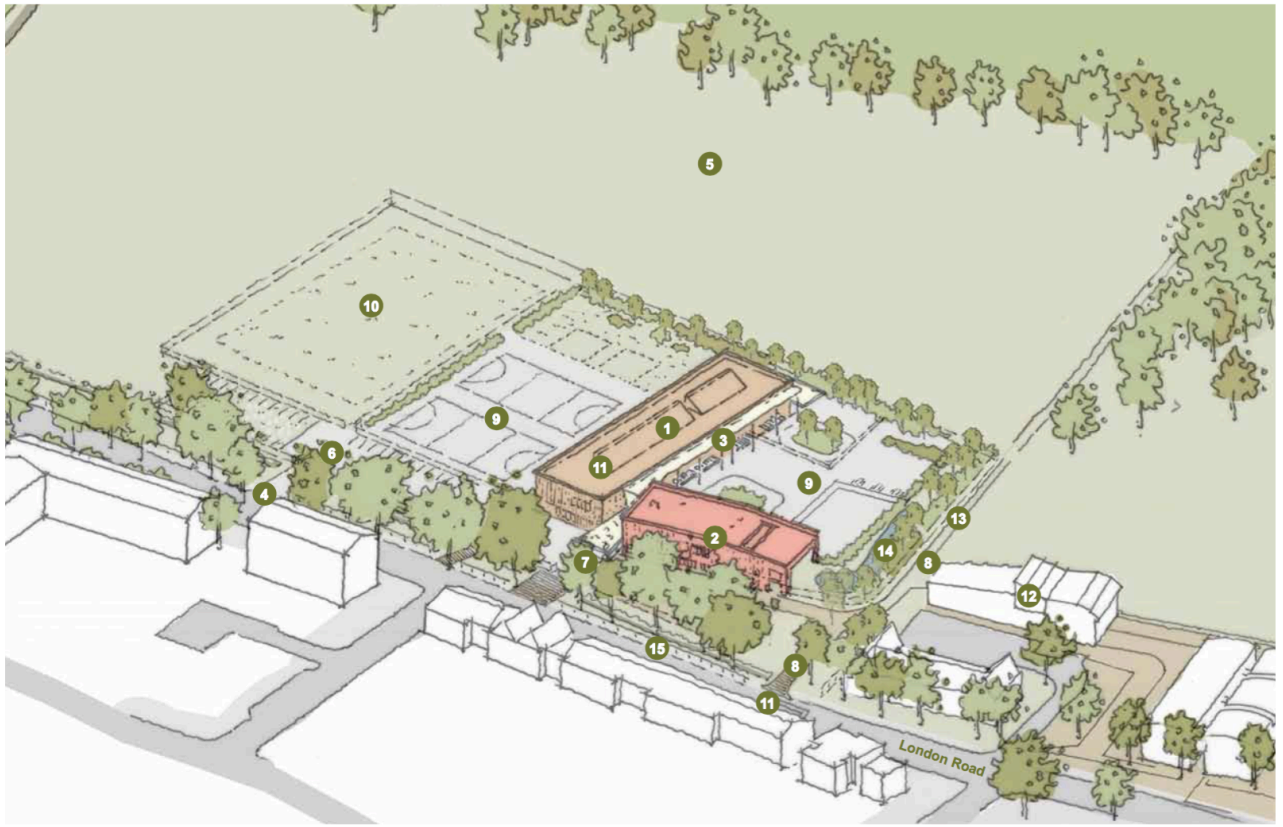
Hackbridge Needed Passivhaus to Achieve Planning



Proposed site strategy

KEY:

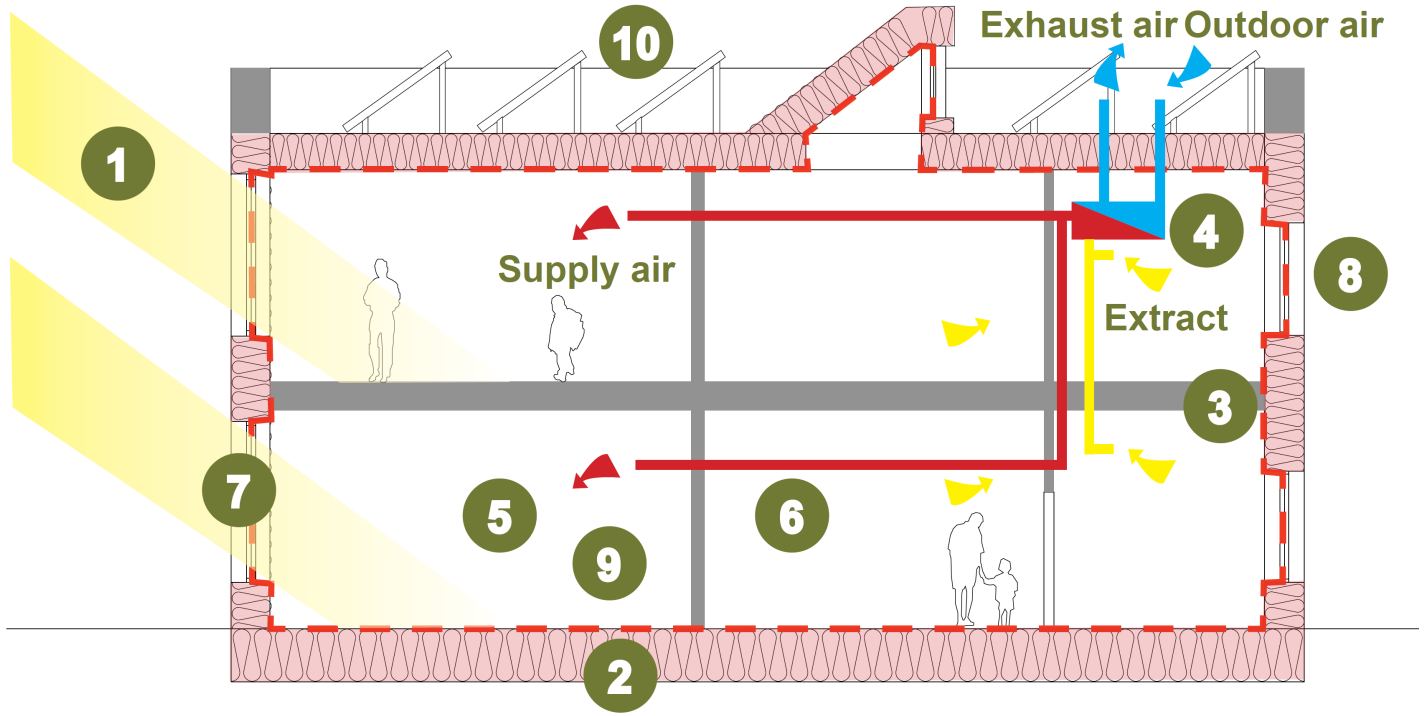
1. Classroom wing
2. Community wing
3. Canopy
4. Vehicle entrance/exit
5. Potential future ecology park
6. Staff car park
7. Main building entrance
8. Access to MOL
9. Playground
10. Grass pitch
11. New raised table in road
12. BedZed pavilion
13. Foot path
14. Habitat area
15. Footpath widening

Hackbridge: Regenerative Design

Site Before

Site Proposed

Hackbridge: Passivhaus Design Strategy

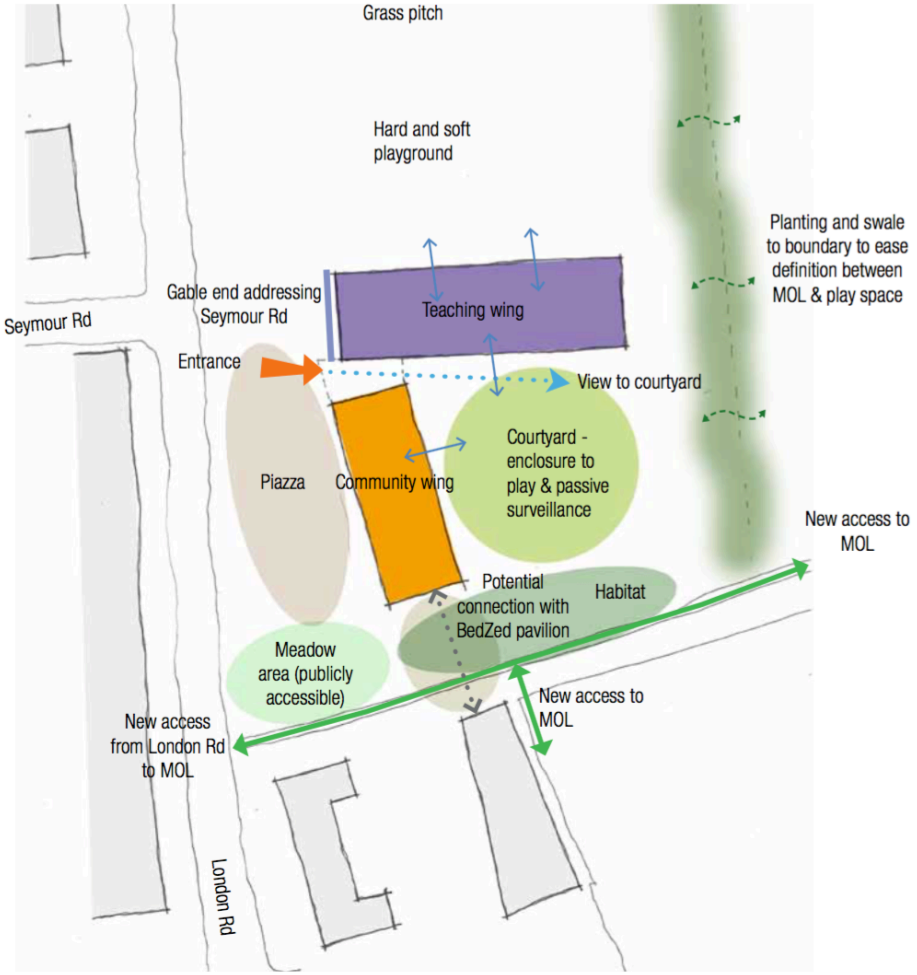


KEY:

1. Good solar orientation & compact form
2. Super insulation and no thermal bridges
3. Air tight envelope
4. Ventilation with heat recovery
5. High comfort levels
6. Low primary energy
7. Triple glazing
8. Natural ventilation in the summer
9. Reduction in small power
10. Photovoltaic panels to help achieve Zero Carbon

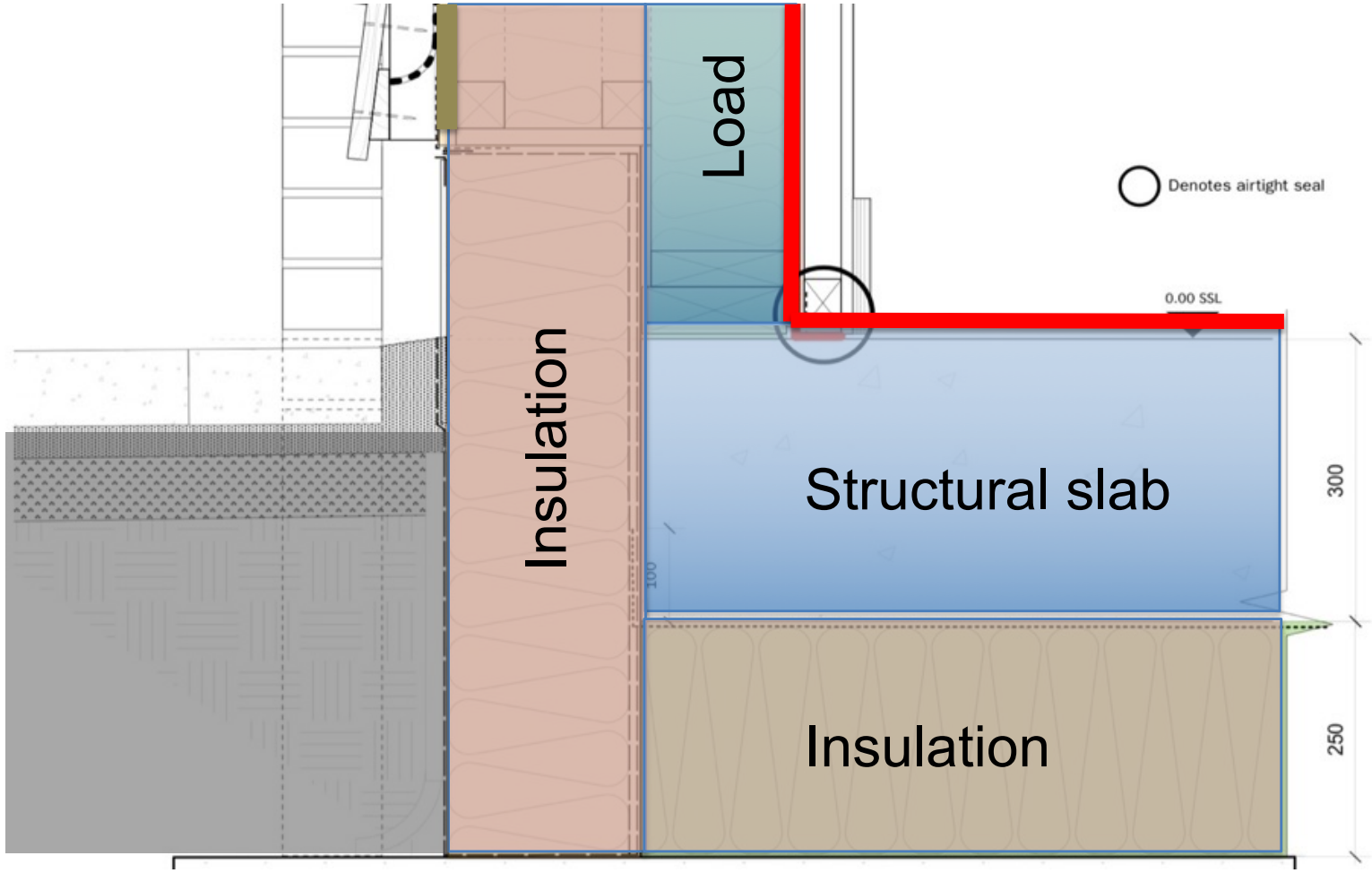
Form and Orientation	Facade	Fabric	MEP
Form Factor Solar Gains	Glazing Ratio Glazing Layout Shading	Fabric Specification Fabric Construction	Positioning Efficiency

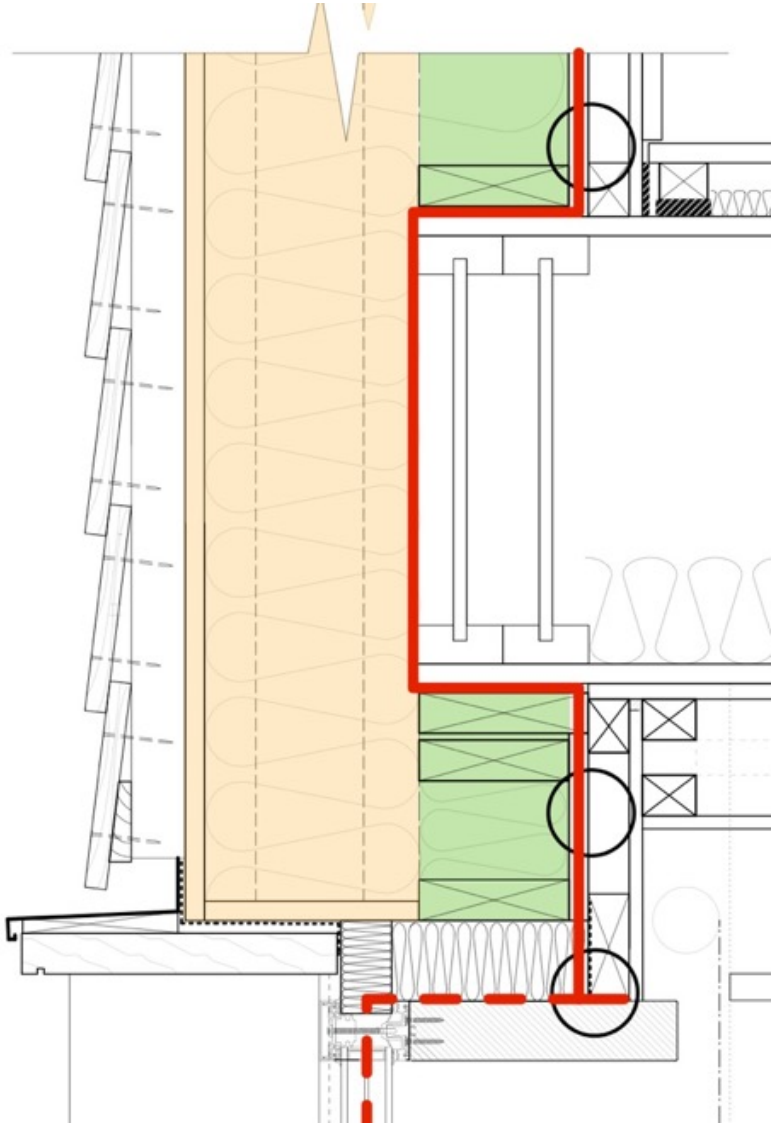
Hackbridge: Form, Orientation & Facade



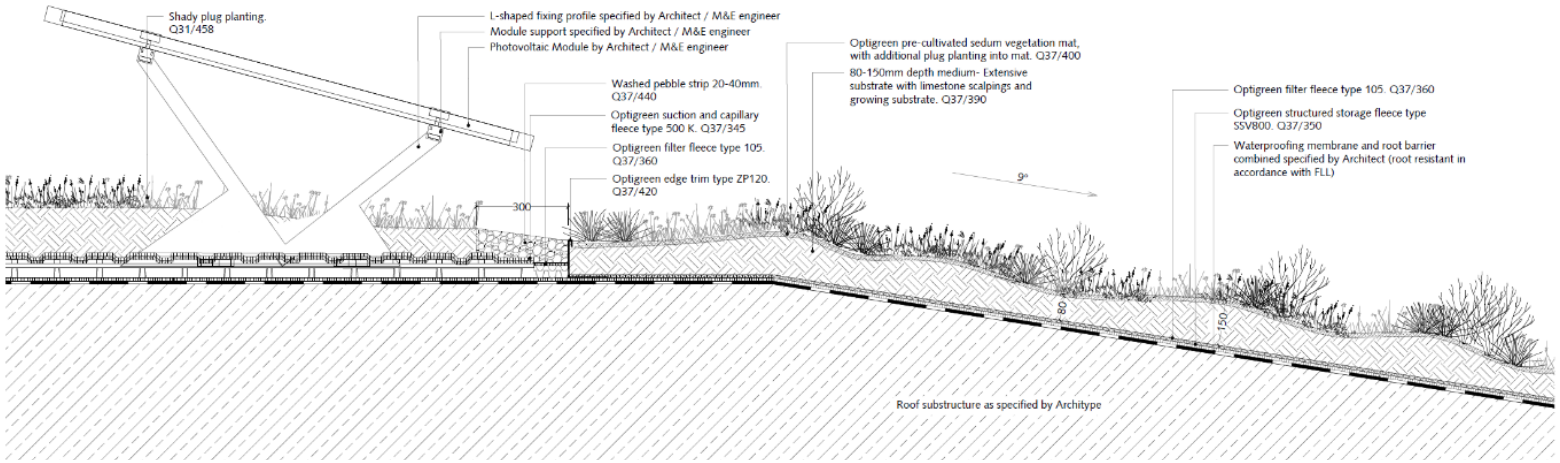
Building concept diagram

Hackbridge: Passivhaus Fabric



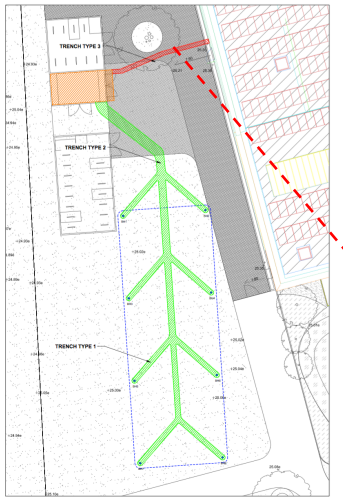


Hackbridge: MEP to Net Zero

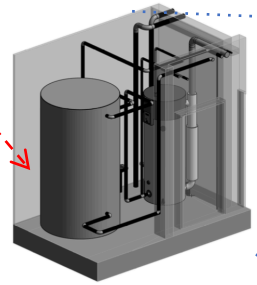


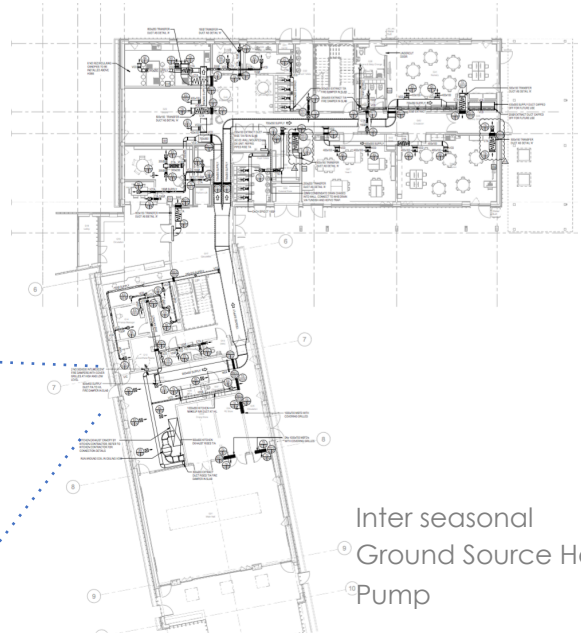
100% Heating Demand
– Designed to be achieved through inter-seasonal ground source heat pump

100% Electrical Design
– Designed to be achieved through Bio-Solar Roofs (PVs)



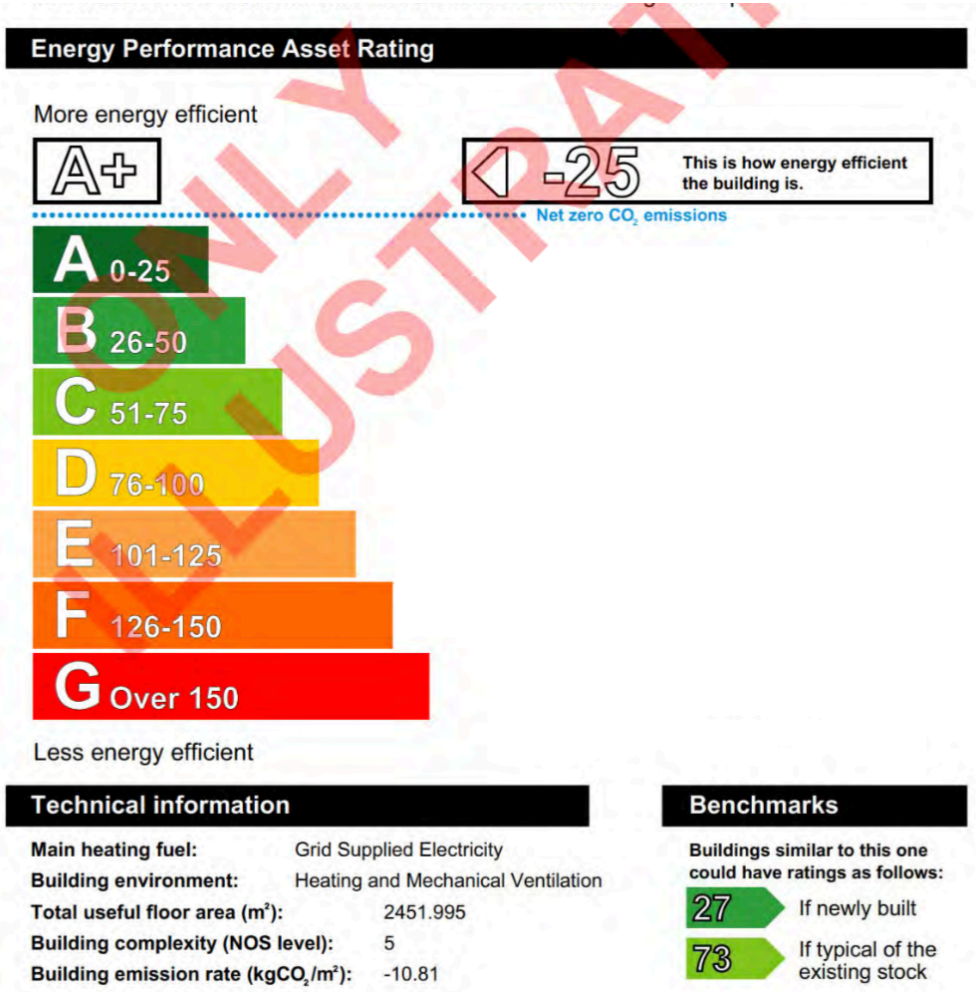
Thermal Store with Gas top up

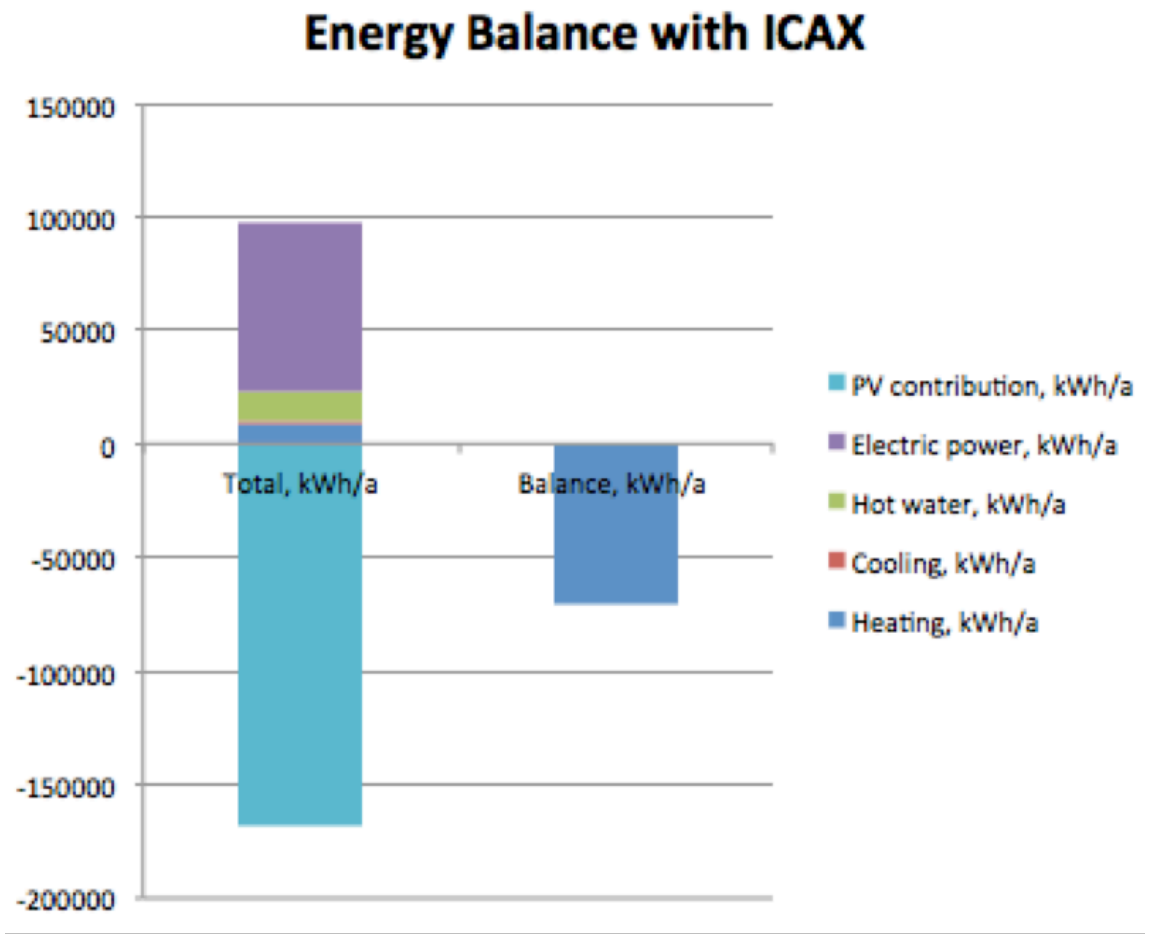




Inter seasonal Ground Source Heat Pump

Hackbridge: MEP to Net Zero





Hackbridge Primary School

Hackbridge Primary School

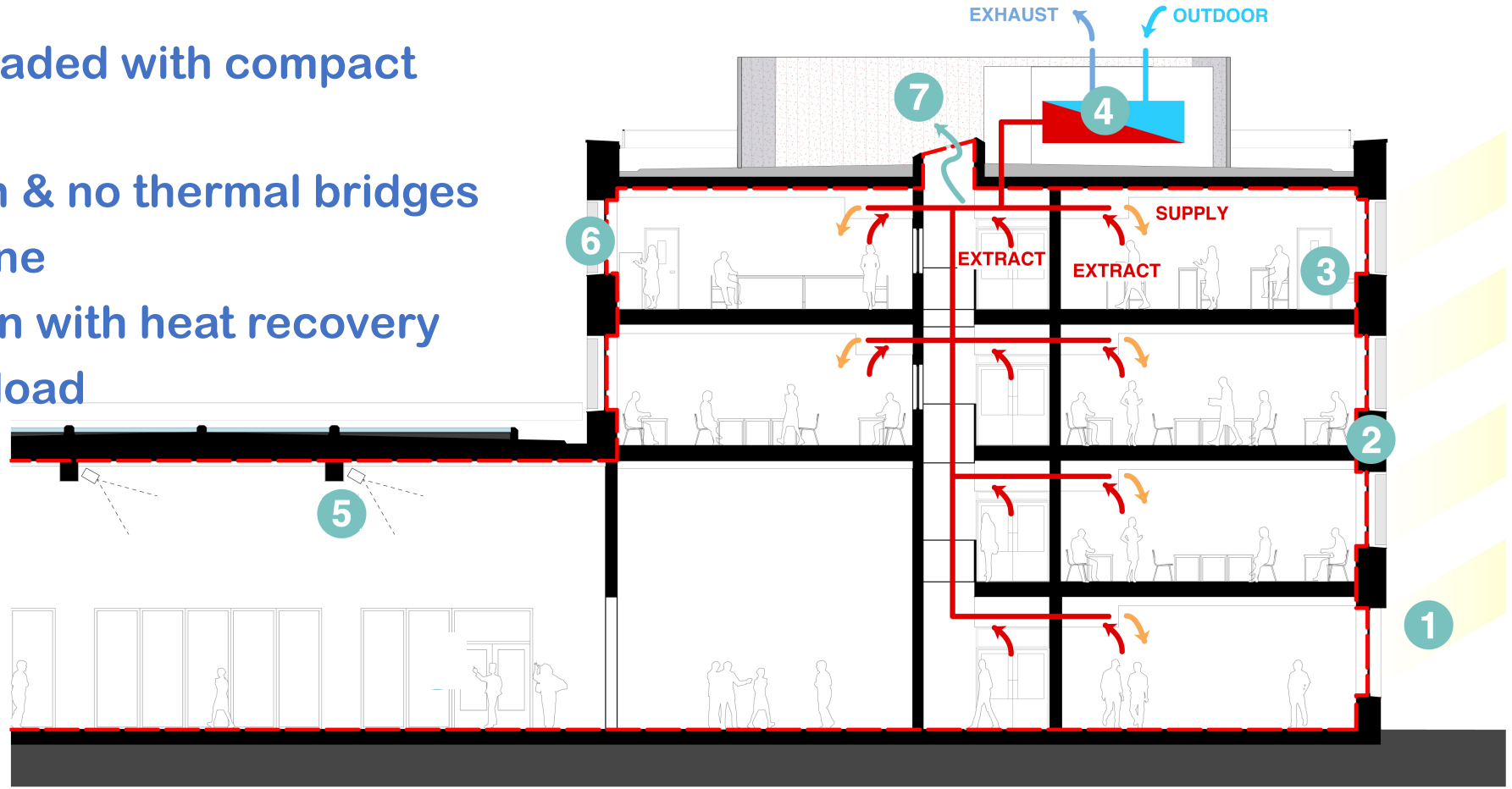
Harris Academy Sutton

Large Scale Project

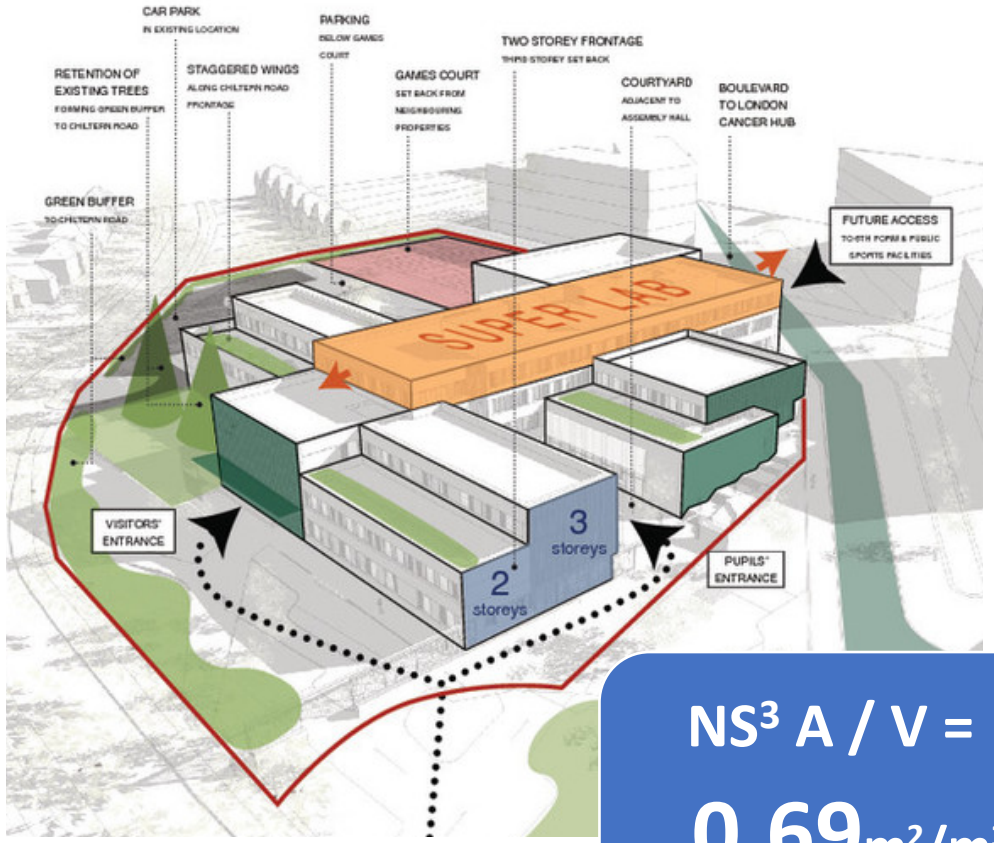
How low can we go?

Harris Academy: Passivhaus Design Strategy

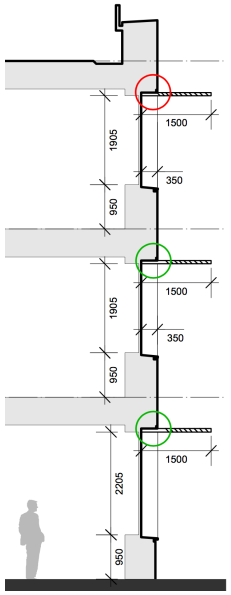
1. Solar orientated & shaded with compact form
2. Continuous insulation & no thermal bridges
3. Continuous airtight line
4. Mechanical ventilation with heat recovery
5. Reduce small power load
6. Triple glazing
7. Natural ventilation in temperate months



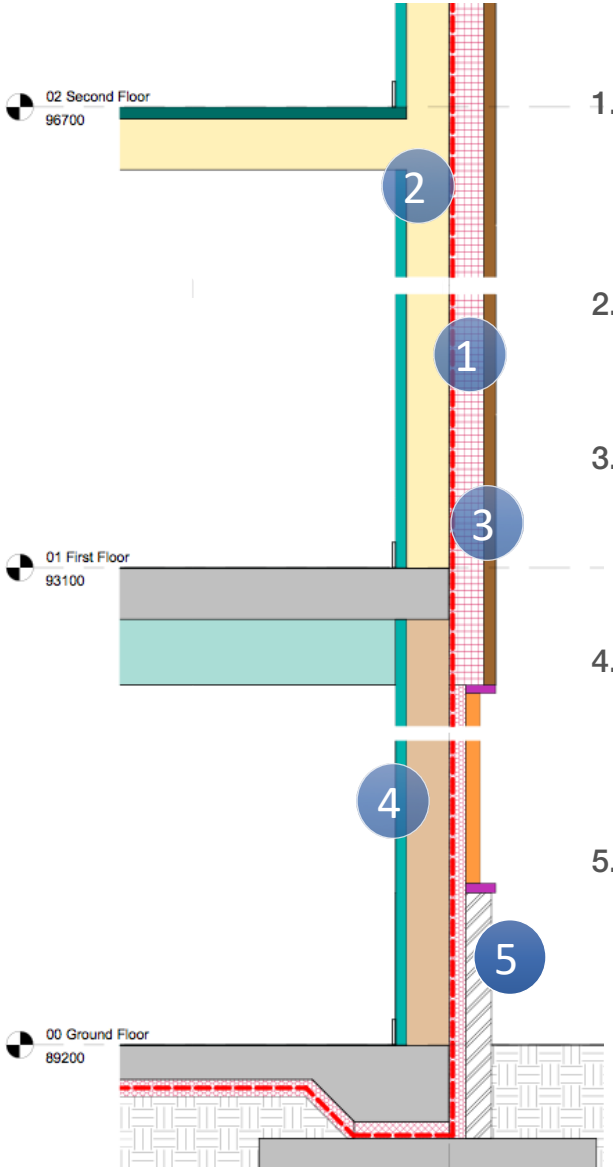
Harris Academy: Form, Orientation & Facade



NS³ A / V = 0.69 m²/m³



Harris Academy: Fabric



1. Continuous insulation
   without thermal bridges or cavities/gaps <0.15W/m2.K
2. Continuous airtight layer
   impermeable to air movement
3. Continuous windproof layer
   to prevent wind purge of the insulation
4. Separate services layer
   to prevent future impact on the airtight layer
5. Weather-proof cladding

CLT / Glulam	Aluminium cladding
Concrete	Timber cladding
Roof system	Timber frame infill
Larsen truss	Copper cladding
Foamglas	Aluminium capping / flashing
XPS insulation	Floor system
Brickwork	Wall lining / partition system
Window / door	Ceiling system
Brise soleil	Airtightness line

Harris Academy: MEP Minimized Energy Demand

Heating Demand
– Designed with domestic size Gas boiler, with provision to connect to planned district heat main

10% Electrical Design
– Significantly reduced demand and a further 10% of this achieved through Bio-Solar Roofs PV

Harris Academy Sutton

Harris Academy Sutton

Summary

- Passivhaus is the essential first step to Net Zero Operational Carbon buildings.

- You need to consider the form, facade, fabric and then MEP.

- Harris Academy demonstrates that using Passivhaus on large scale projects can significantly reduce energy demand. It has also been designed to achieve Net Zero Operational Carbon by 2050 as the electrical grid decarbonizes, and when it is connected to the DHM.

- Hackbridge Primary School shows that small projects with efficient design, can become Net Zero Operational Carbon NOW.

ARCHITYPE

"It really is a spectacular learning environment where our students will thrive academically and develop long-life interests and talents... I've been involved with the development of the school and have enjoyed working with Architype and the team to see it take shape. Architype listened to our needs throughout the design process and have given us a building which delivers, not only on quality and looks, but also on environmental targets, which are increasingly important in today's world. Our new school provides an inspiring new space for students and teachers a like"

James Fisher (Principal at Sutton Secondary School)

CIVIC TRUST AWARDS 2021 REGIONAL FINALIST

ARCHITYPE

UKpassivhaus conference 2020

A HEALTHY & GREEN FUTURE

THANK YOU

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