AECB the sustainable building association
2009 Annual Conference

Building for a Sustainable Future

Policy | Research | Practice

Oxford Brookes University | 11-12 June 2009

Optional tours of local renovations: 13 June 2009

Organised by: AECB the sustainable building association

Academic Partner: Oxford Brookes University

Principal Sponsor: Knauf Insulation it's time to save energy

Student Bursary Sponsor: Greenbuilt building with people for people

AECB CarbonLite

back AECB

Welcome to the CarbonLite Programme

- Home Page
- Energy Performance Standards
- Training
- Support and Guidance
- Software
- Buildings Performance Database
- Learning and Feedback Zone
- Building Assessment & Accreditation
- CLP Forum
- FAQs
- Downloads
- Contact

Supported by

CARBON TRUST

AECB the sustainable building association

Esmée Fairbairn FOUNDATION

Welcome to the CarbonLite Programme - an AECB initiative providing the tools and knowledge to create low-energy buildings in line with existing and future legislation covering both domestic and non-domestic buildings.

Available to all AECB members, the CarbonLite Programme is a practical step-by-step guide aimed all those practitioners involved in the design, construction and use of low-energy, low-CO_2 emissions buildings. The Programme is designed to be clear, informative and impartial, and outlines the reasons behind the need for more sustainable building practices, as well as providing wide-ranging yet detailed guidance on the ways in which this change is best achieved.

Through its unique combination of research materials, technical data, training programmes, discussion forums and useful links and contacts, the CarbonLite Programme represents an essential resource in the building sector's drive towards low-carbon living and the legislation that will regulate it.

The CarbonLite programme was endorsed at its launch by the president of RIBA and directors of the UKGBC and CABE.

The Introduction to the CLP and The Energy Standards are free to anyone wishing to download them. All other CLP documents are available to AECB members only. Join the AECB here

Pines Calyx centre
Gold Standard

Elizabeth Fry Building
Carbonlite Standard

Stawell
Silver Standard

Herefordshire
Gold Standard

CarbonLite Buildings Performance database

- Can we really create low energy buildings?
- How much energy do they use?
- How much CO_2 are they responsible for emitting?

The CarbonLite on-line database aims to capture low energy UK buildings with measured energy results - to share what people have tried to do, and what they have achieved.

Adding a building to the database enters into the spirit of the AECB's culture of sharing. We can all learn what works and what doesn't - and thereby improve building energy performance - the energy design standards in use, the construction methods, materials and equipment, energy strategy.

Who enters this information?

- Any AECB Member or registered AECB / CarbonLite Forum user.
- A technical background would be useful but could be done with input from others.
- The AECB member or forum user who logs in to enter data will be listed as the project owner – be sure this is agreed amongst the project team.

Section 1 – Project Description

When can I enter my project?

At any time and as early as possible – not just after it is complete.

Does it matter if it isn't designed to an AECB / CarbonLite Standard?

No – There are a wide range of options to choose from and space to enter your own.

Section 2 – Design Stage Data

What do I enter here?

A summary of your strategies to achieve your selected energy standard. The list is a good set of prompts for issues that are important to address from the outset.

Where do I obtain the Energy & Fuel Use Forecast Data?

If you are at a pre-planning stage and working to one of the CarbonLite standard – use the information in CarbonLite Programme Vol. 3 Guidance on the Energy Standards as a guide as a starting point.

From PHPP (or SAP or other calcs) if you have a more developed design.

Section 3 – As Built Design Data

What do I enter here?

The details of how you have implemented your design: description of actual construction / U-values; boiler / MVHR system specs;

Section 4 – Measured Performance

Does it do what it says on the tin?

Provide evidence of performance in two key areas: airtightness and fuel use.

All you need to do is enter fuel use data and the Primary Energy and CO_2 emissions are automatically calculated (according to coefficients in Vol. 2 of AECB/CL Programme Guidance).

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CarbonLite Volume 5, Passivhaus/Gold Standard Detail Design Guidance

The guidance is intended to be:

•Educational … helping you work thoughtfully through the issues when designing and constructing robust and practical construction details

•Practical….many details have been built in the UK or overseas – the guidance considers this experience in a UK context

•Time saving….'hit the ground running' in your next low energy project

Contents

Glossary of main terms

Heat Loss Parameter (HLP)
The building's specific heat loss (in units of W/K) divided by the building's floor area (measured internally – i.e. within the thermal envelope), units W/Km²

ψ – (psi) value
Linear thermal bridge heat loss coefficient, units W/mK

Note that the ψ-values in this document have all been calculated with respect to the inside to outside temperature difference not the inside to ground temperature difference as recommended in the PHPP2007 manual. Consequently, these all need to be entered in PHPP 2007 in the areas worksheet as 'Category 15 Thermal bridges ambient', not 'thermal bridges to ground/perimeter'.

λ – (lambda) value
Thermal conductivity of a material, units W/mK

K – (kay) value
Alternative symbol for thermal conductivity of a material, units W/mK

χ – (chi) value
Point thermal bridge heat loss coefficient, units W/K

R-value
Thermal resistance, units m²K/W

U-value
Thermal transmittance, units W/m²K

EPS
Expanded polystyrene

XPS
Extruded polystyrene

PU/PI foam
Polyurethane or polyisocyanurate foam

Contents (cont)

Glossary of main terms (Cont)

CarbonLite
The AECB's Carbon Lifestyle Design and Construction Programme

Silver Standard
A low energy building standard used in CarbonLite Step 1

Passivhaus Standard
A low energy building standard used in CarbonLite Step 2

Gold Standard
A low energy building standard used in CarbonLite Step 3

Passivhaus Institut (PHI)
A German research and consultancy establishment, the originator of the Passivhaus movement and of the Passivhaus Standard

Passivhaus Planning Package (PHPP)
A modeling and accreditation software tool developed and updated by the Passivhaus Institut.

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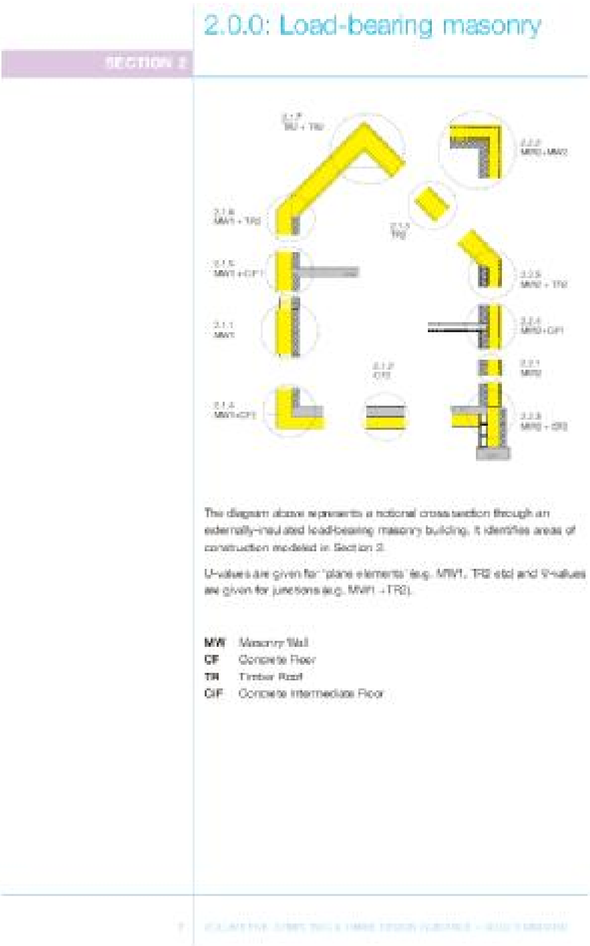
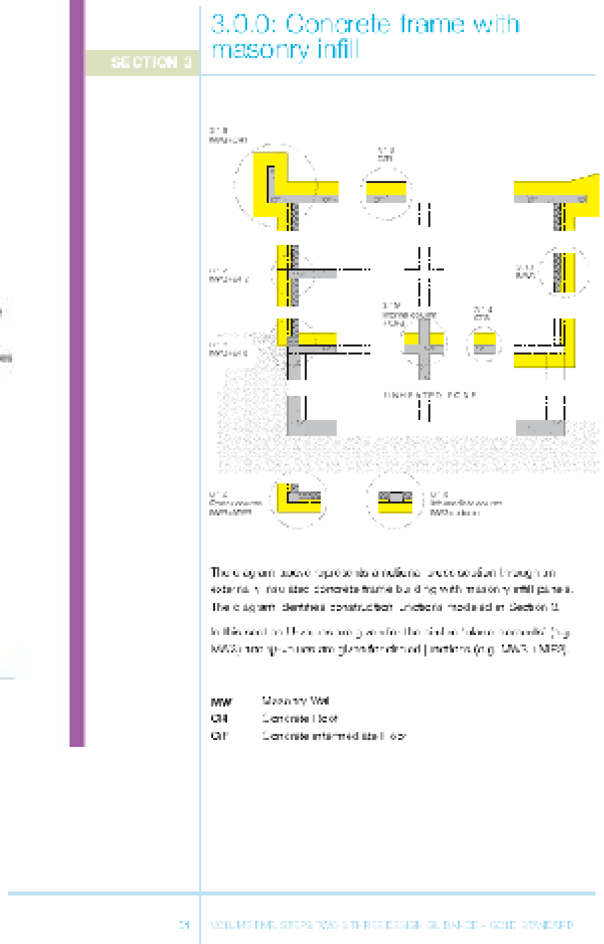
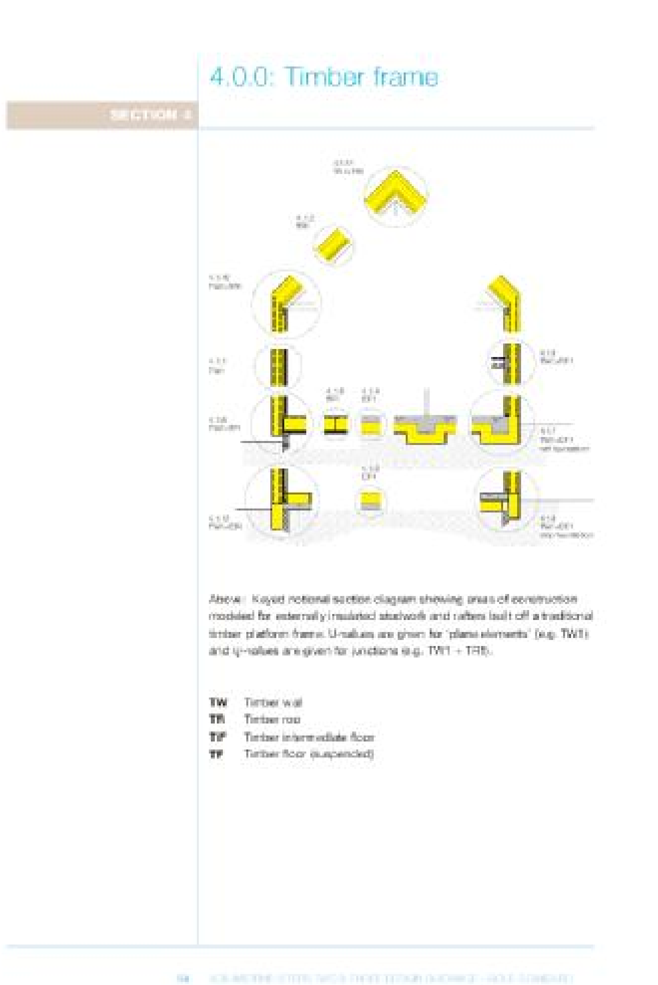
www.aecb.net

The CarbonLite Programme is funded by:

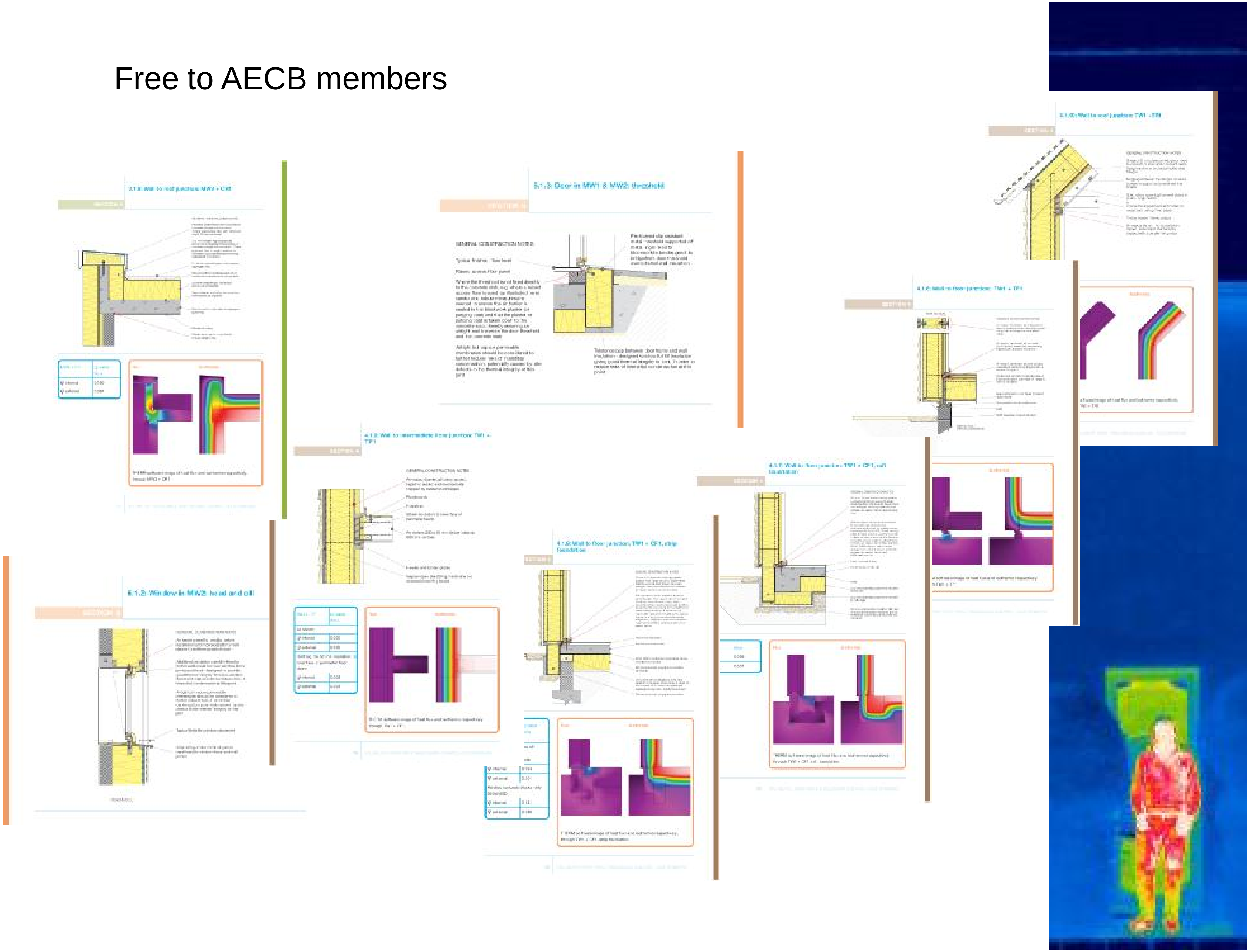






...and Section 5 looks at windows and doors

Free to AECB members



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This presentation will cover:

1. Description of refurbishment features
2. Discussion of PHPP modelling
3. Regional context defining refurbishment standards

Design team

- Architects: Simmonds.Mills
- Energy and services advice: David Olivier (Energy Advisory Associates) and Alan Clarke
- Structural engineer: Bob Johnson
- Builder: Mike Neate (ECO-DC)
- Guidance: AECB CarbonLite, Passivhaus Institut
- Commercial sponsors: Permarock Ltd, Knauf Insulation, Vencil Resil, Second Nature, Internorm Windows UK, Green Building Store, East Midlands Insulation, City Roofs, Keim Paints, ECO-DC
- Mortgage: Ecology Building Society

Strategic design approach and targets

- Follows guidance of the AECB Carbon Literate Design and Construction Programme (CarbonLite or CLP)

- We have adopted for this project CLP Step 2 – the Passivhaus standard = investing in a pension

The CLP is based around a set of rigorous energy and CO_2 performance standards - and uniquely is designed to emphasise delivering low carbon buildings that perform - in reality.

The CLP is endorsed by:
- RIBA
- CABE
- UK Green Building Council

CLP is funded by:
- The Carbon Trust
- Esmee Fairbairn Foundation
- Intelligent Energy Europe

Strategic design approach and targets

- Energy and CO_2

We have designed the extended and refurbished house to reduce its total CO_2 emissions by c. 80-85% compared to the typical measured performance of a similar house of the same size.

Step	Standard	Useful space heating energy kWh/m^2.yr	Primary energy consumption [1] kWh/m^2.yr	CO2 Kg/m^2.yr	Reduction in CO_2 compared to average stock
One	Silver	≤40	≤120	≤22	70%
Two	Passivhaus Passivhaus in a UK context	≤15 ≤15	≤120 ≤78	No explicit limit ≤15	85%
Three	Gold	≤15	≤58	≤4	95%

1. Table applies CLP standards to domestic sector - based on a typical 80m2 semi-detached house

The AECB standards apply to domestic and non-domestic buildings

Specific Demands with Reference to the Treated Floor Area

Treated Floor Area: 136.3 m²

18 -22 expected

	Applied:	Monthly Method	PH Certificate:	Fulfilled?
Specific Space Heat Demand:	**18**	**kWh/(m²a)**	**15kWh/(m²a)**	**No**
Pressurization Test Result:	**1.0**	**h^{-1}**	$0.6h^{-1}$	**No**
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):		**kWh/(m²a)**	120kWh/(m²a)	
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):		**kWh/(m²a)**		
Specific Primary Energy Demand Energy Conservation by Solar Electricity:		**kWh/(m²a)**		
Heating Load:	**9**	**W/m²**		
Frequency of Overheating:	**1**	**%**	over 25 °C	
Specific Useful Cooling Energy Demand:		**kWh/(m²a)**	15kWh/(m²a)	
Cooling Load:	**7**	**W/m²**		

Does so much insulation overheat the building?! No, it keeps heat out too!

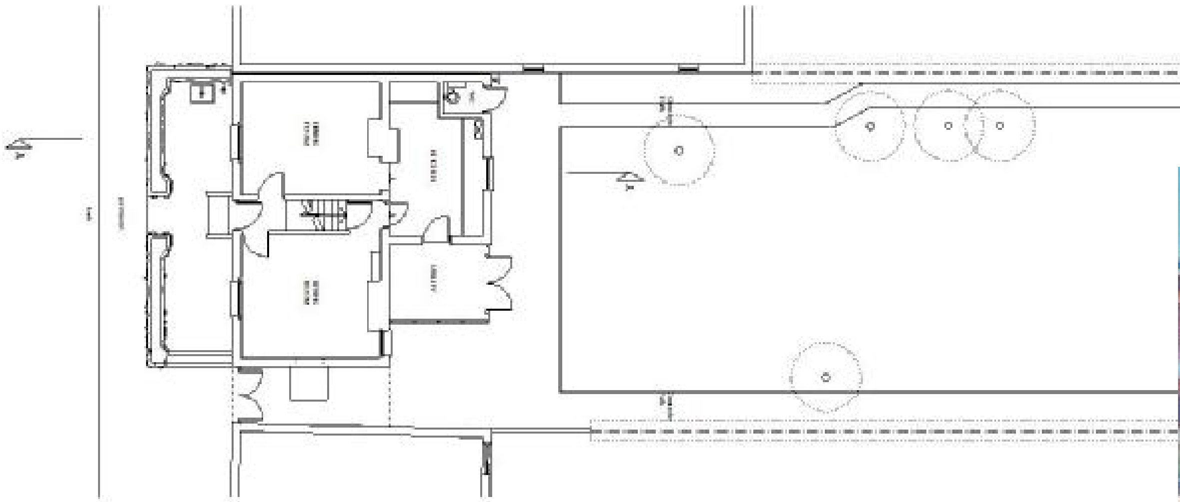
We confirm that the values given herein have been determined following the PHPP methodology and based on the characteristic values of the building. The calculations with PHPP are attached to this application.

Issued on:

signed:

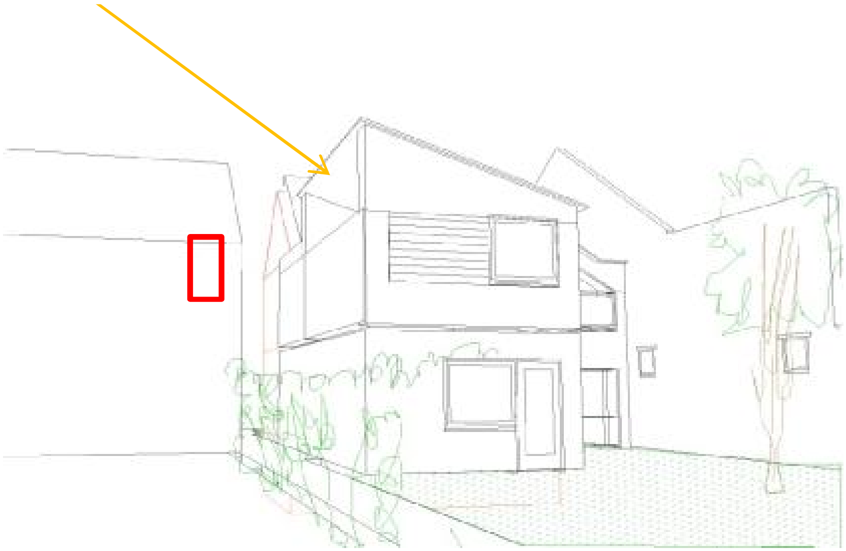
Description of the building in its site

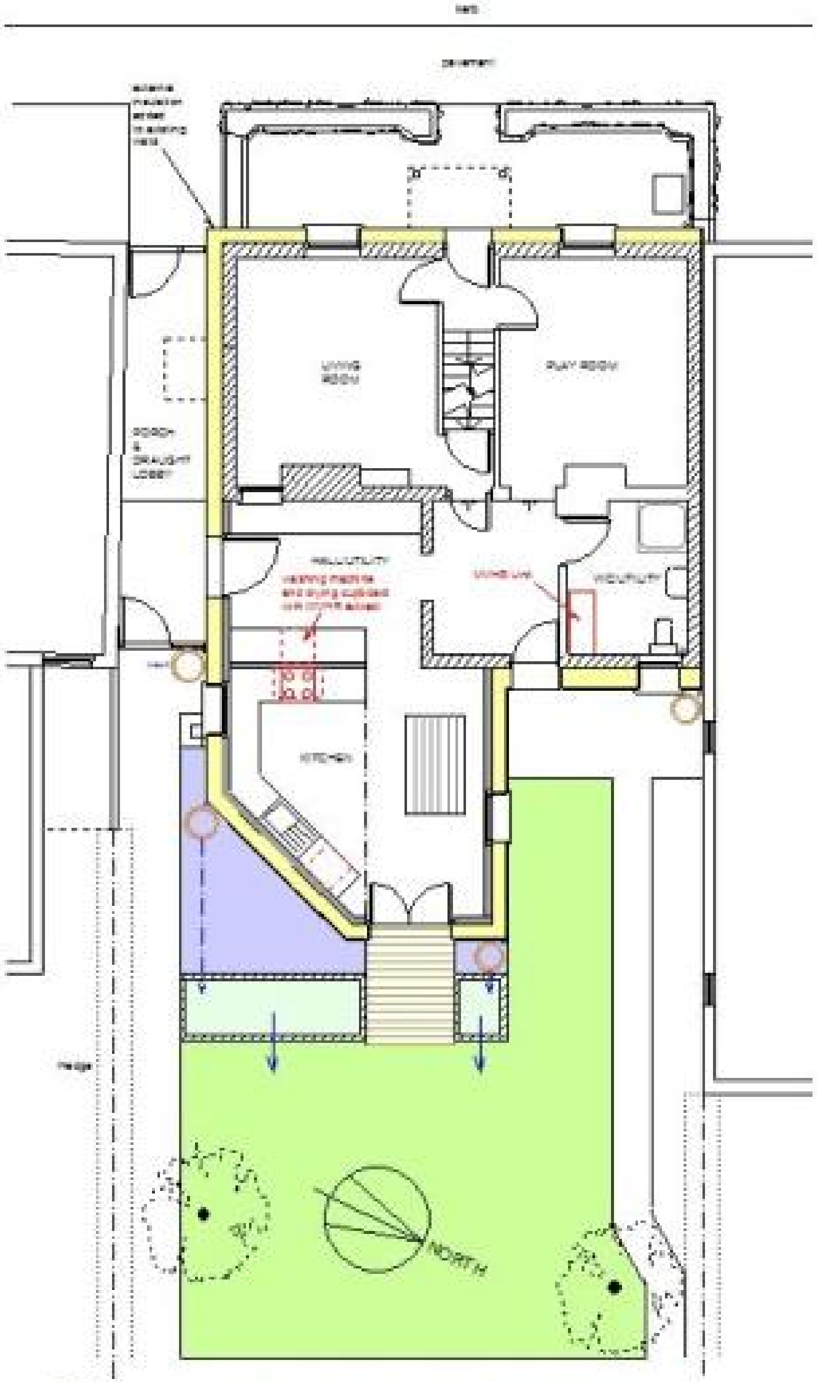
Description of the building in its site



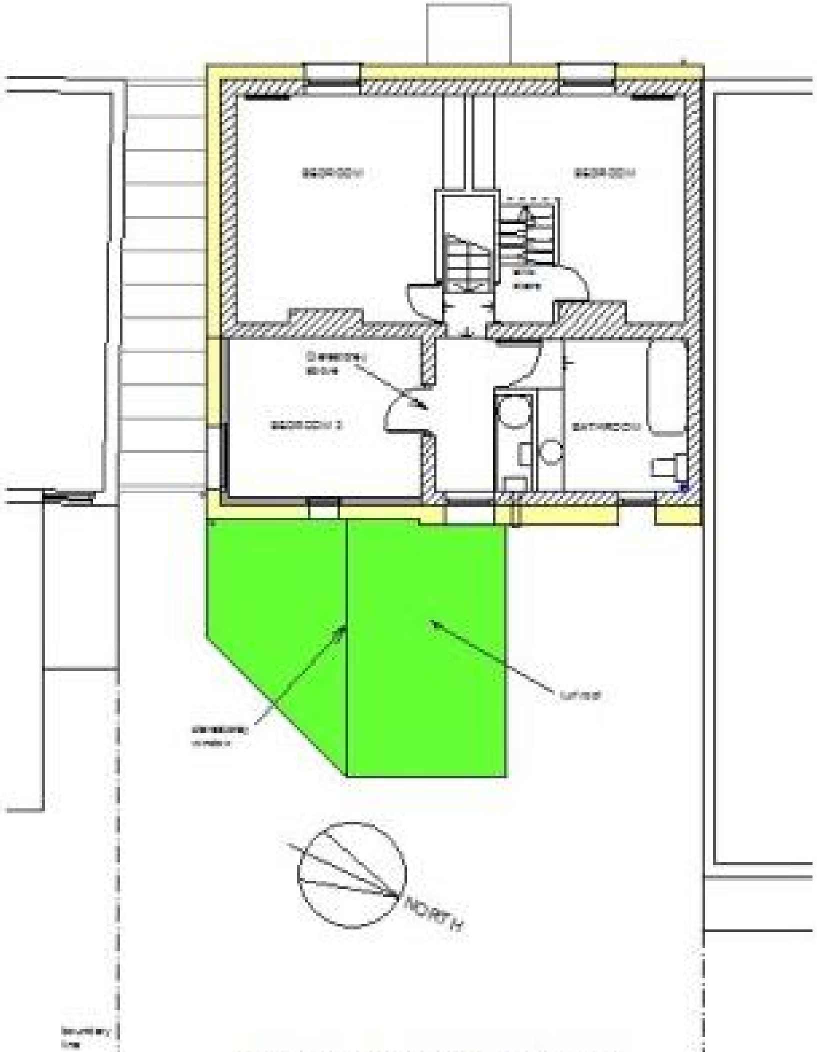
The original house in 2007

Design proposals

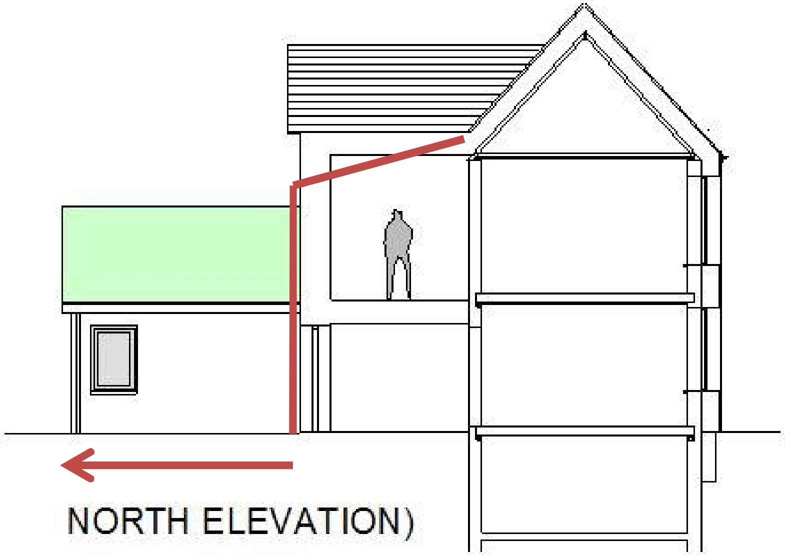




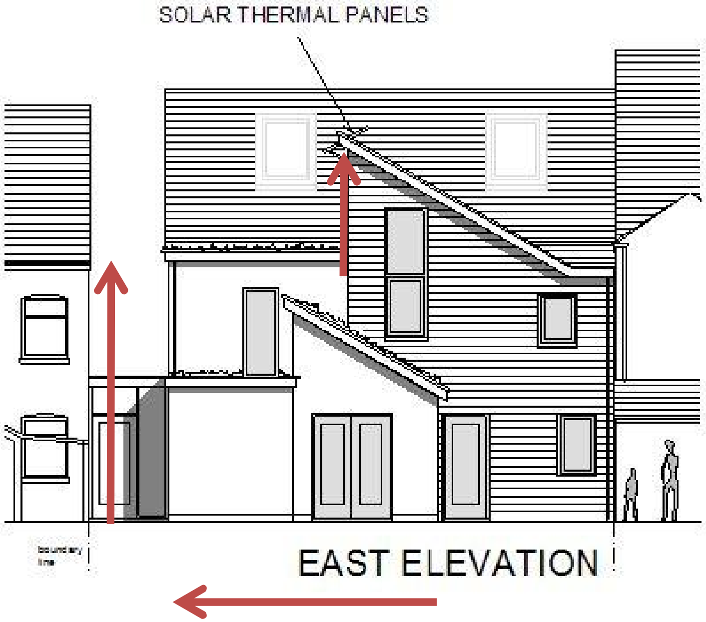
GROUND FLOOR PLAN



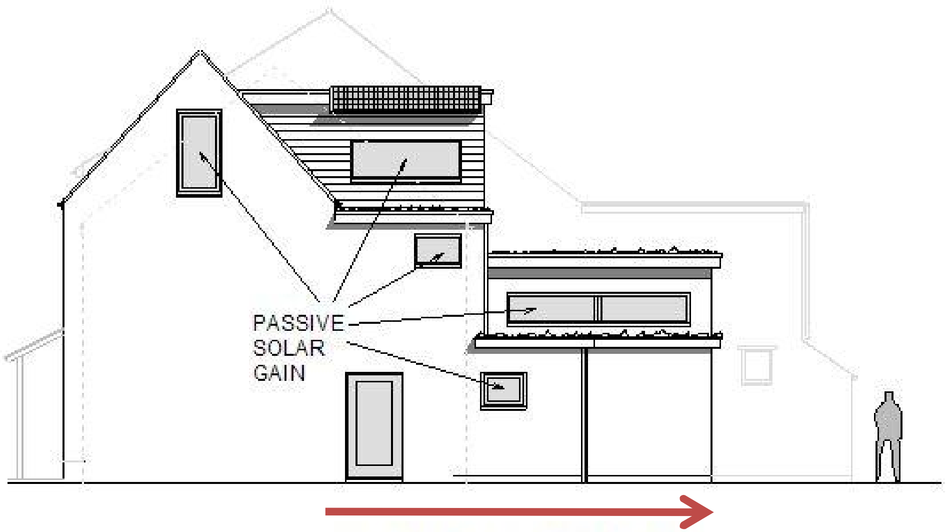
FIRST FLOOR PLAN



NORTH ELEVATION)

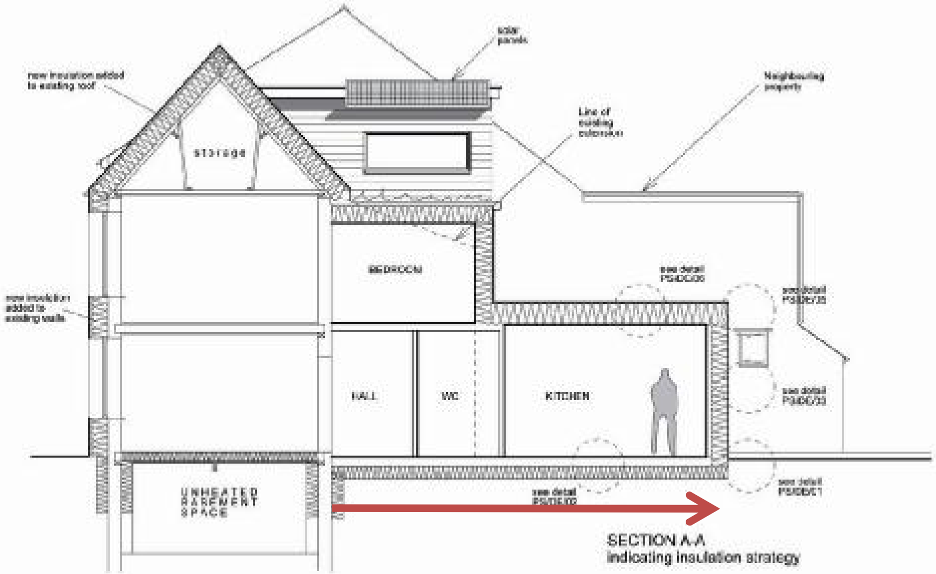


EAST ELEVATION

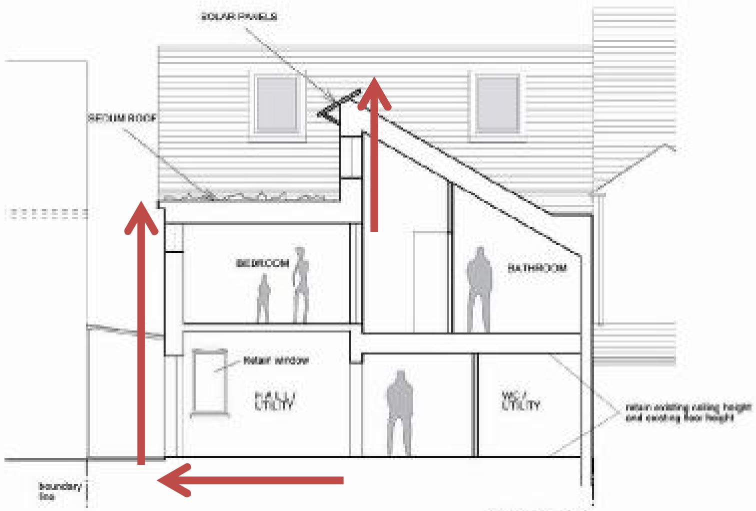


SOUTH ELEVATION
(section thro' passage way)

WEST ELEVATION



SECTION A-A
indicating insulation strategy



SECTION B-B

Proposed Materials:
Walls - horizontal timber cladding &
painted render
Roofs - reuse existing artificial slates to higher pitch,
sedum to flat and lower pitched roof.
Doors and windows - timber

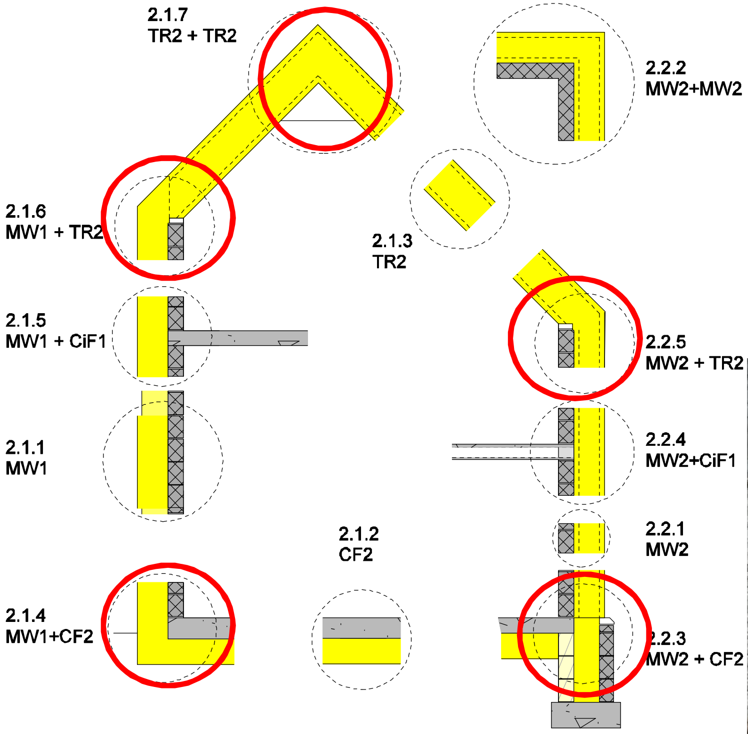
PROPOSED SECTIONS
57 PORTFIELD STREET
DWG NO. PS/BR/09
SCALE: 1:100
JUNE 08

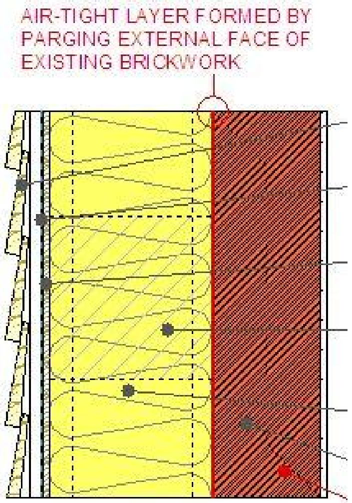
Brief overview of work undertaken (refurbishment element)

Before (1869 - 2008)

After its 100 year service (2008-2009)

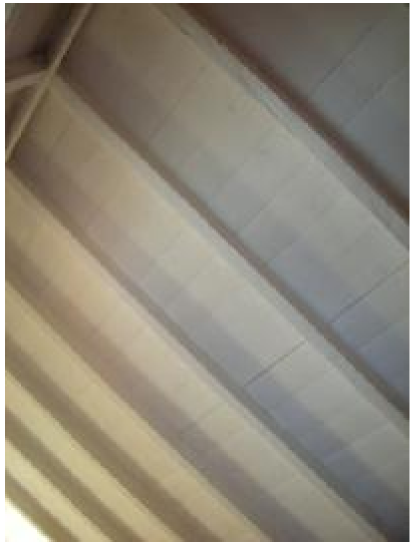
Construction methods – helped trial CLP Volume 5 details





Roof slates off – insulation on






Walls made airtight, windows replaced & ready for...

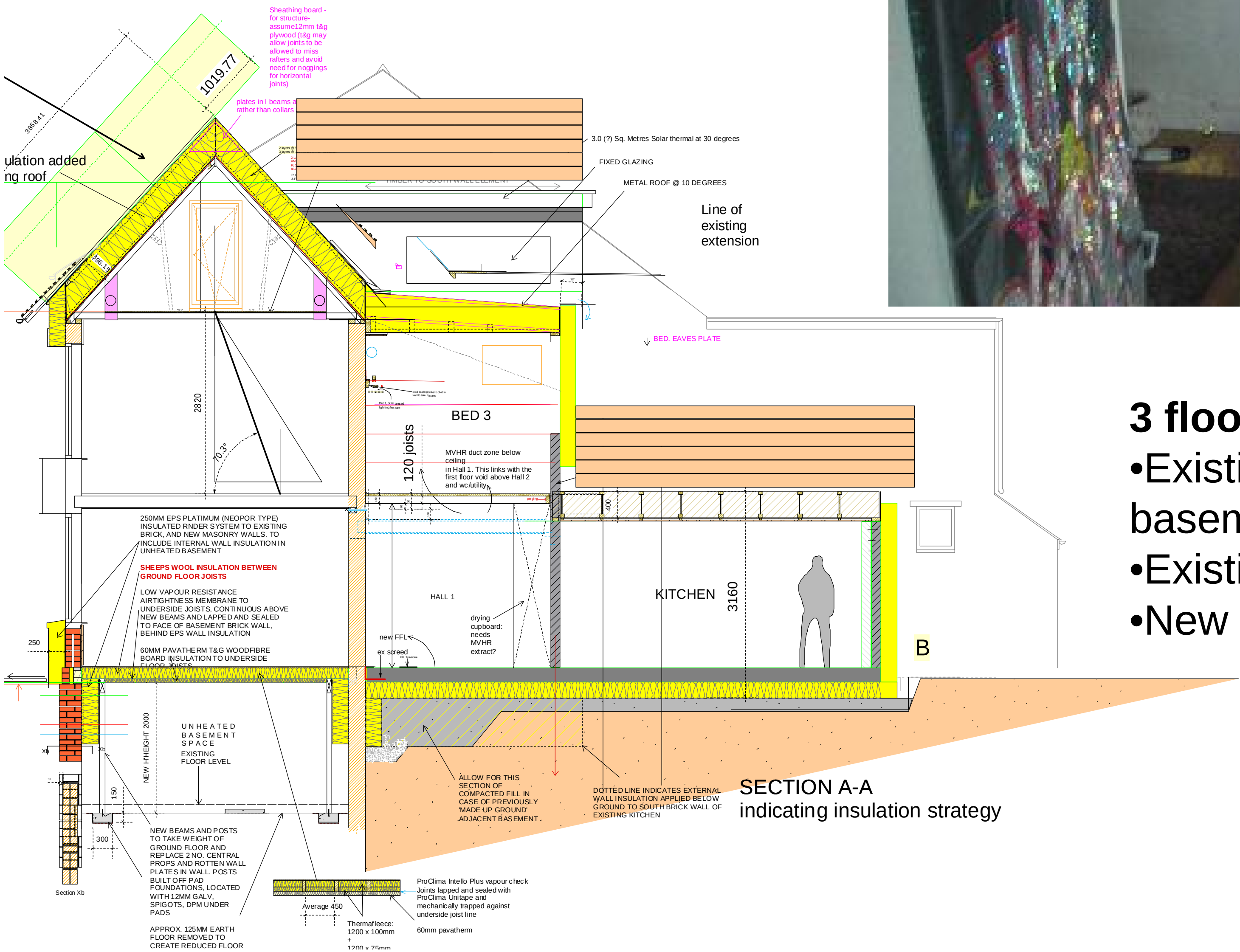
250 mm of insulation

Rendered

(Timber clad) walls insulated

EAST ELEVATION

Floors

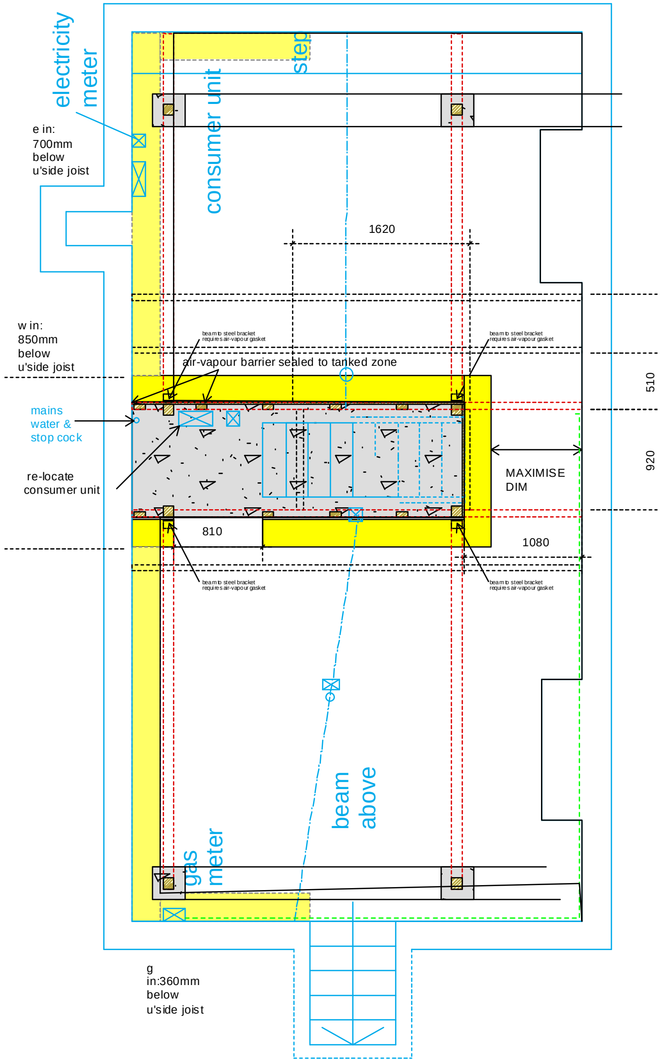


SECTION A-A
indicating insulation strategy

3 floor types:

- Existing suspended over basement
- Existing solid floor
- New floor to extension

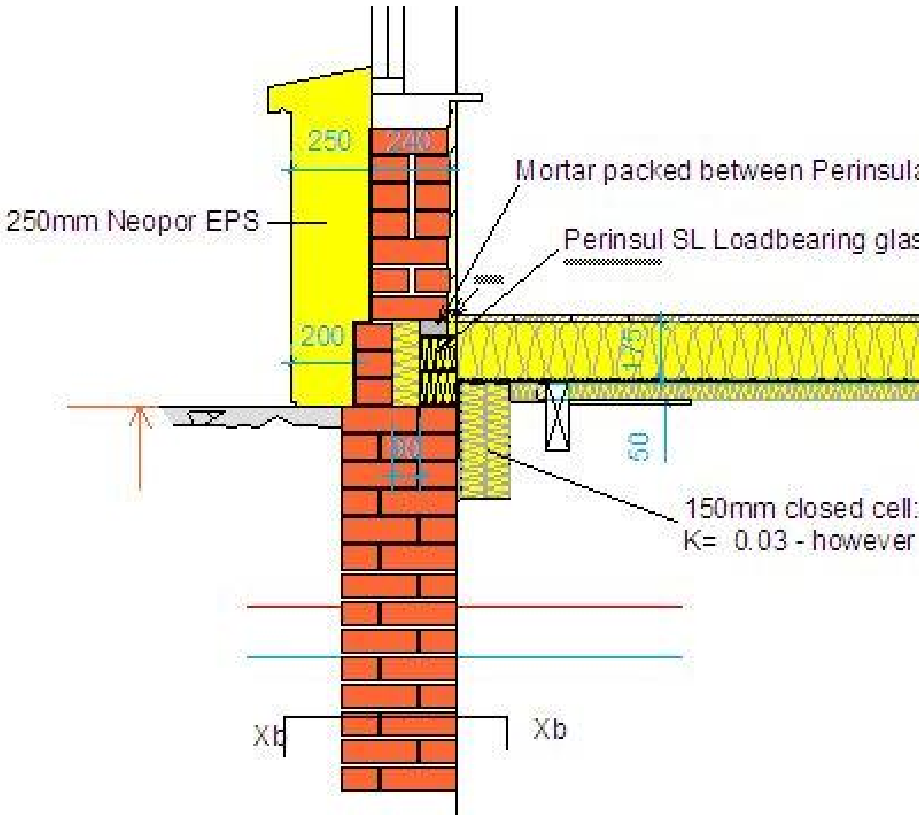
Floors insulated



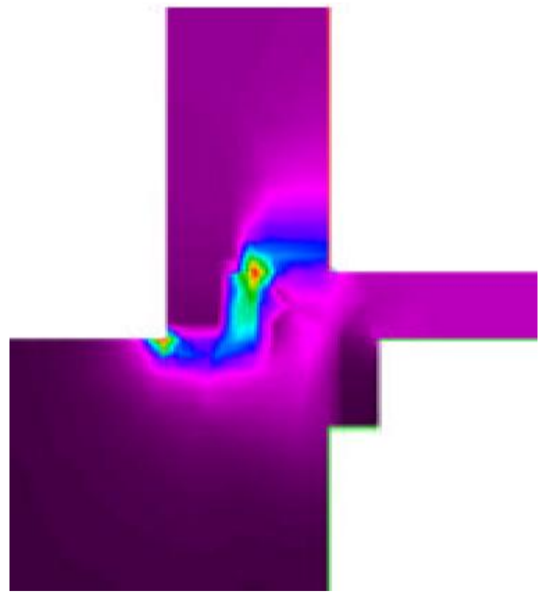
Floors – basement ceiling

Thermal bridge example

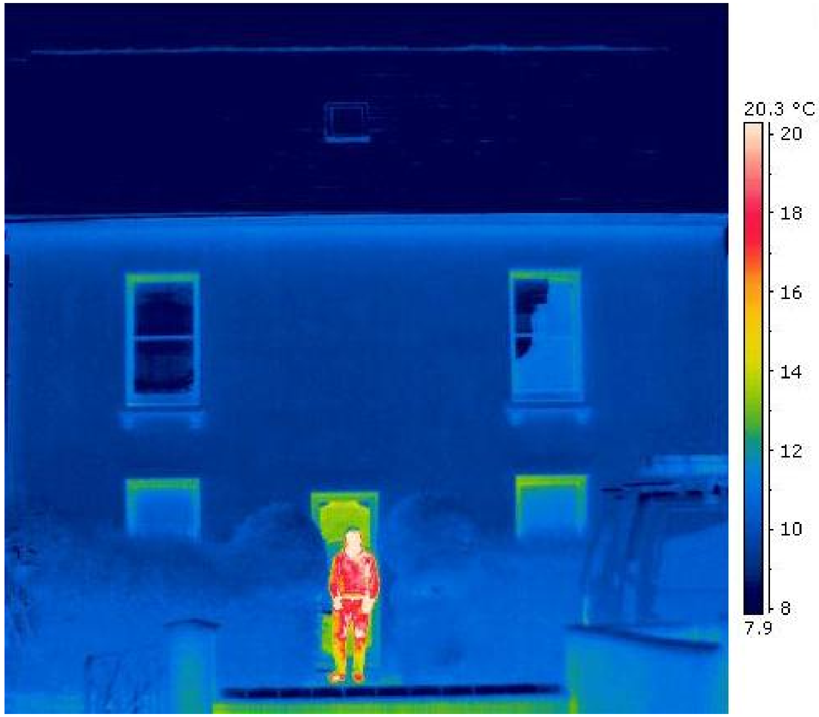
Example of thermal analysis saving money



£150 spent on ‘Therm’ modelling to develop a method of repairing area of house wall whilst dramatically improving its thermal performance oin line with requirements of PH standard – saved several hundreds of pounds.



Air leakage (Final test): 1.0 ac/hr and 0.97 m3/m2hr



Detail

1. Passive solar / daylighting / solar thermal / hot water storage

•Basic passive solar design – subject to site limitations
•Daylight to displace substantial amounts of electric light
•Future proof for retrofit of solar thermal or PV’s & solar ready hot water cylinder

Video clip – building form

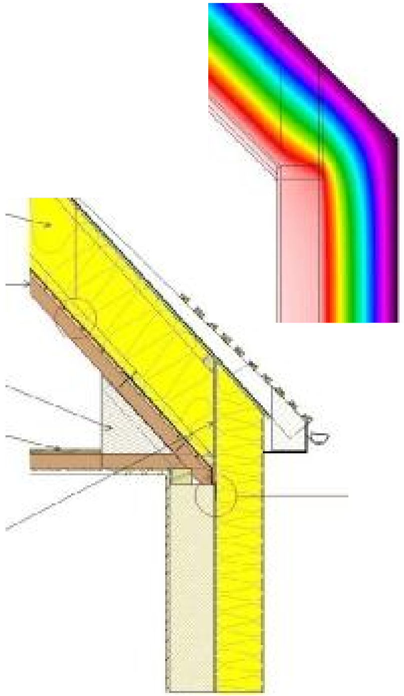
Video clip – solar gain/daylight

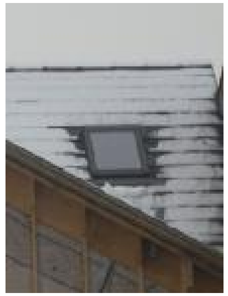
Video clip – hot water & secondary heating system

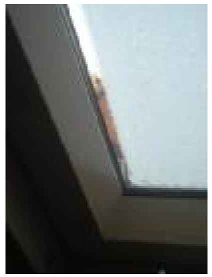
Localised ‘hot spots’ – MVHR distribution, overheating, solar control, good daylighting

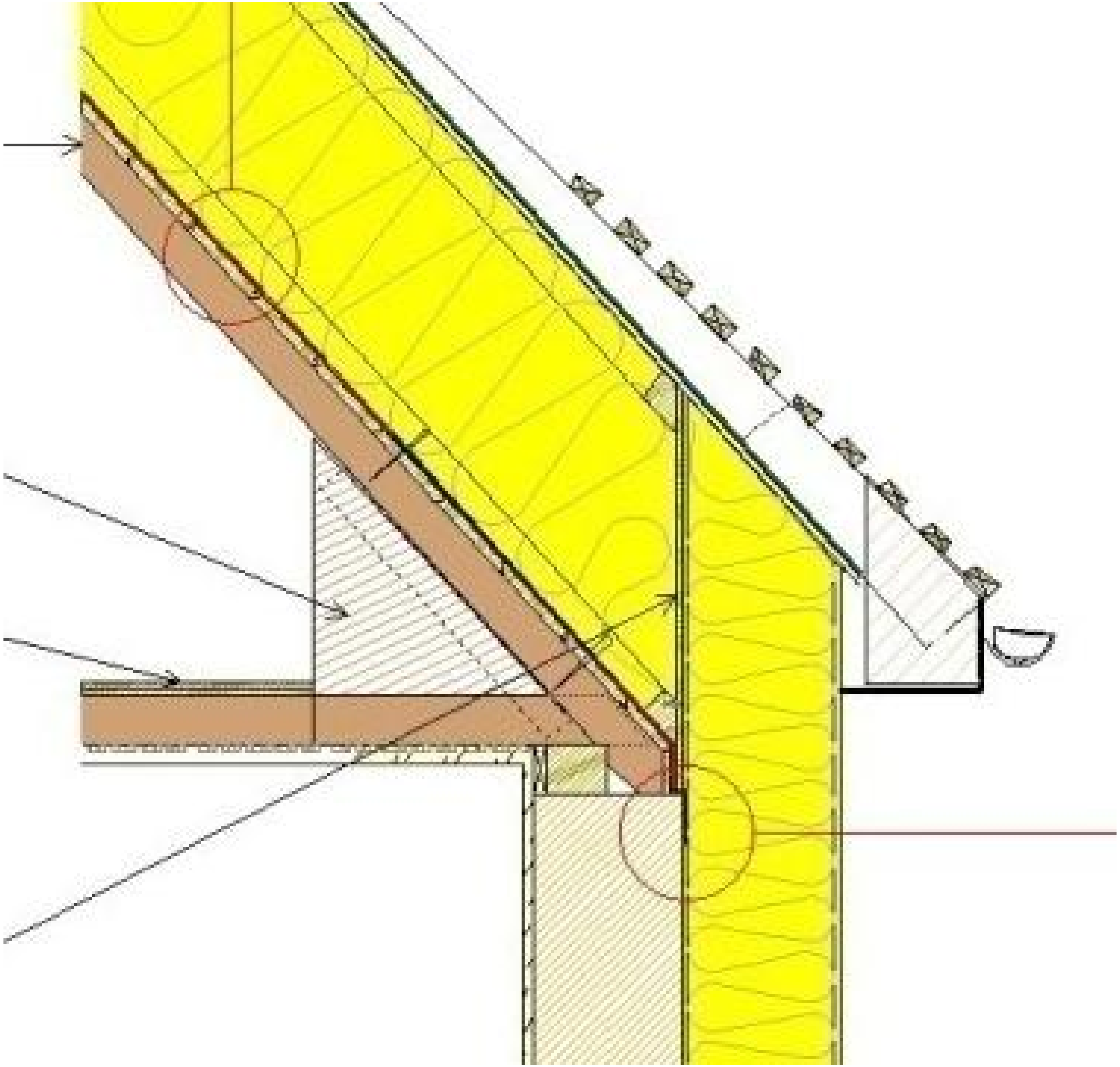
2. Roofs

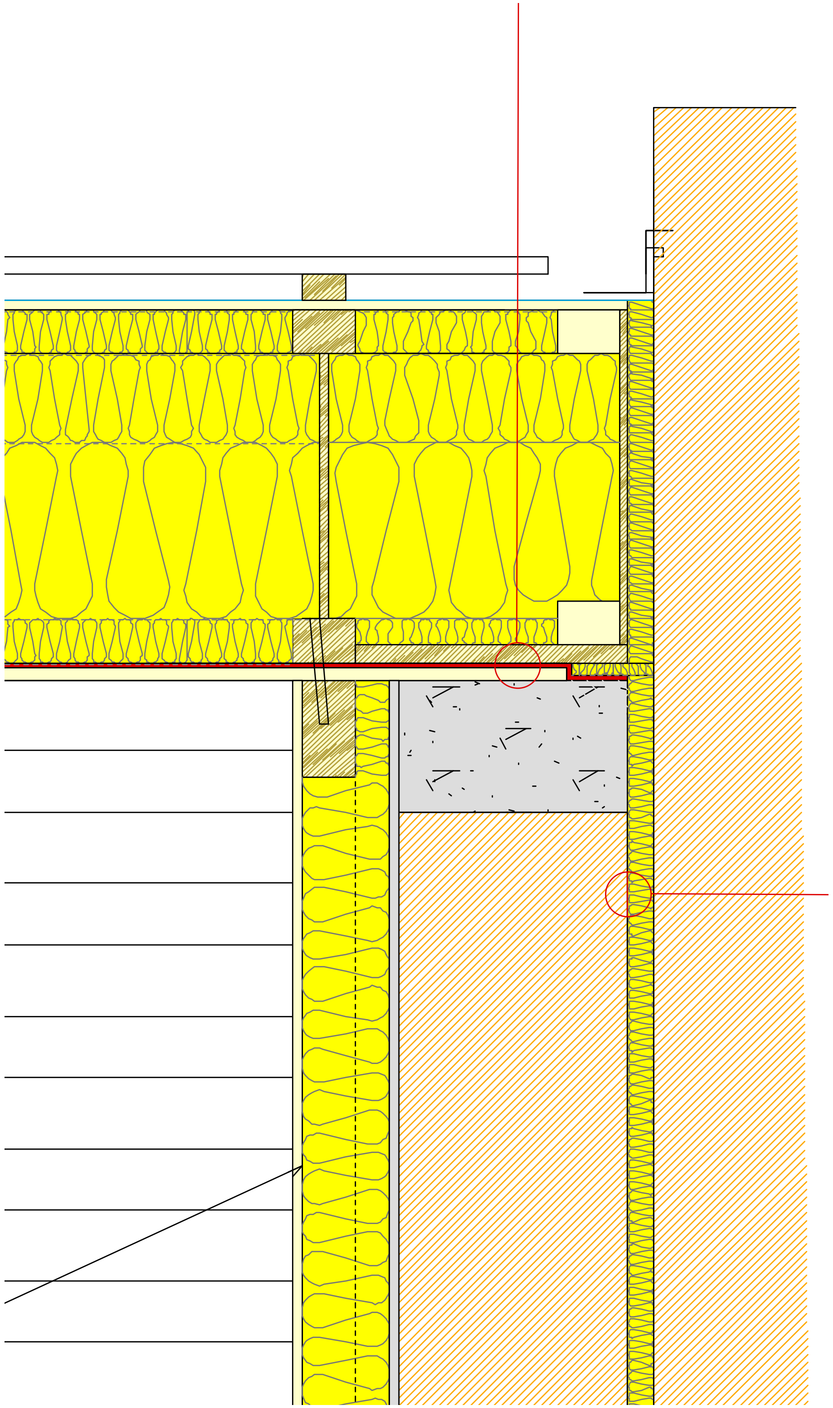
•Roof insulation

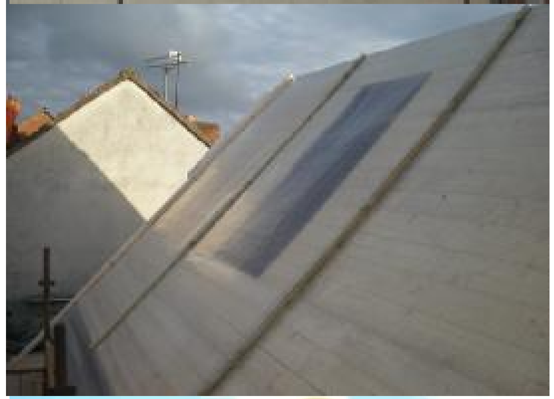






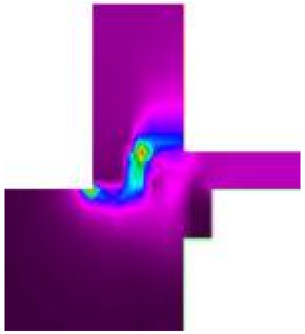


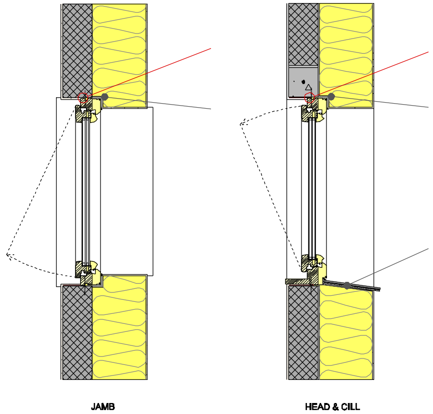


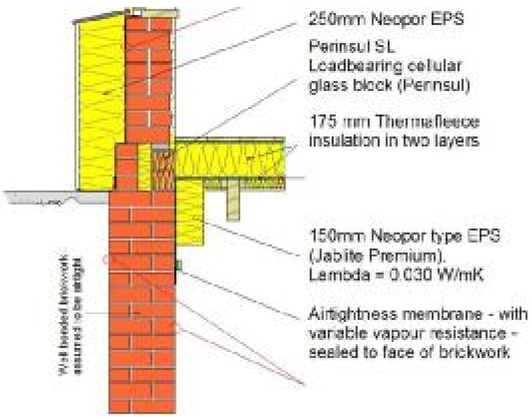


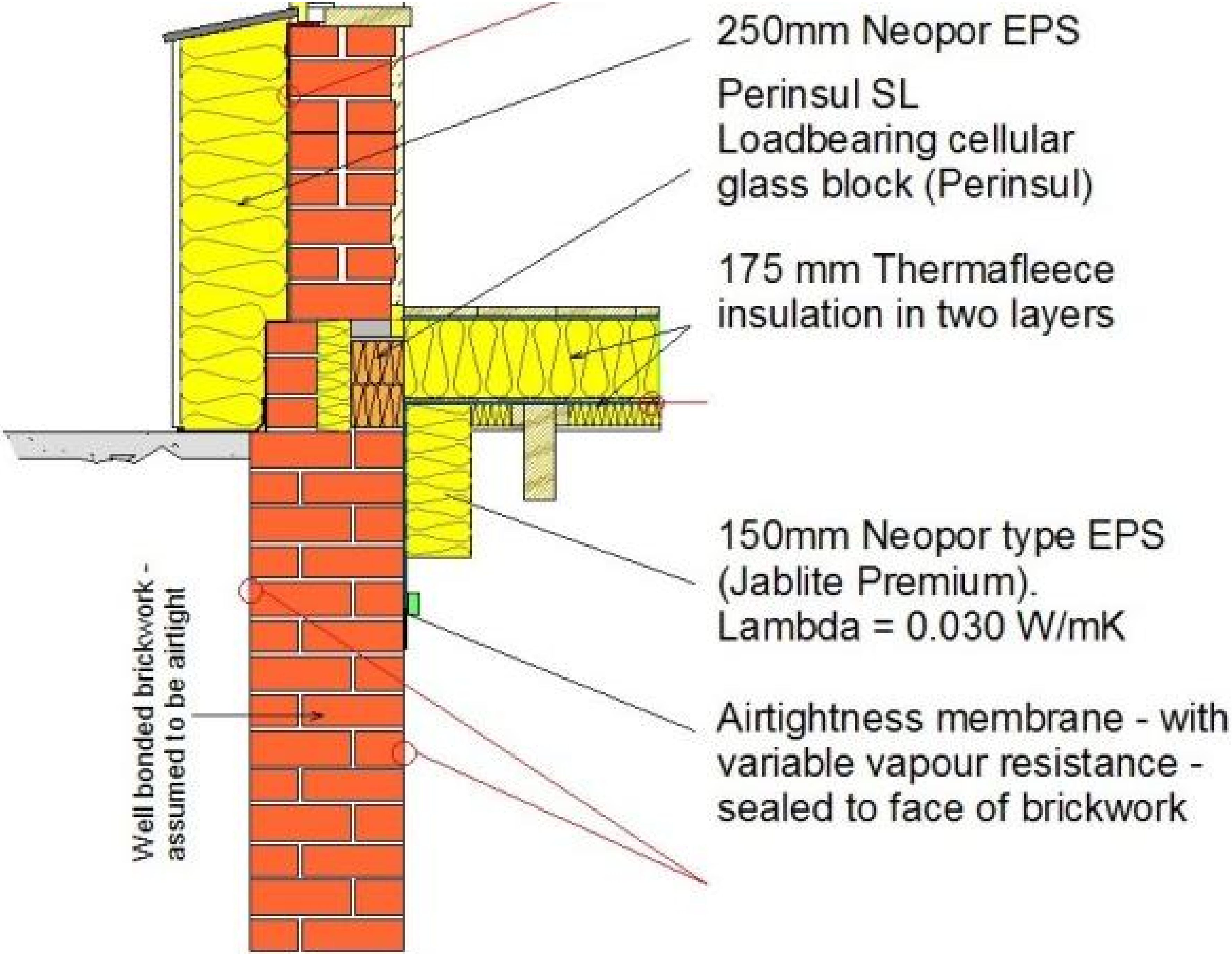
3. Walls

•Wall insulation MW1



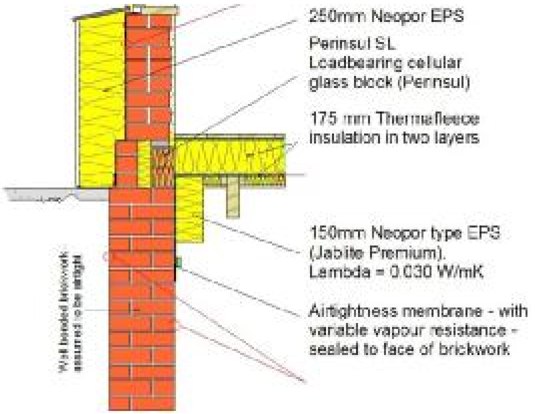


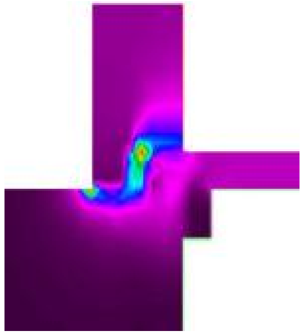


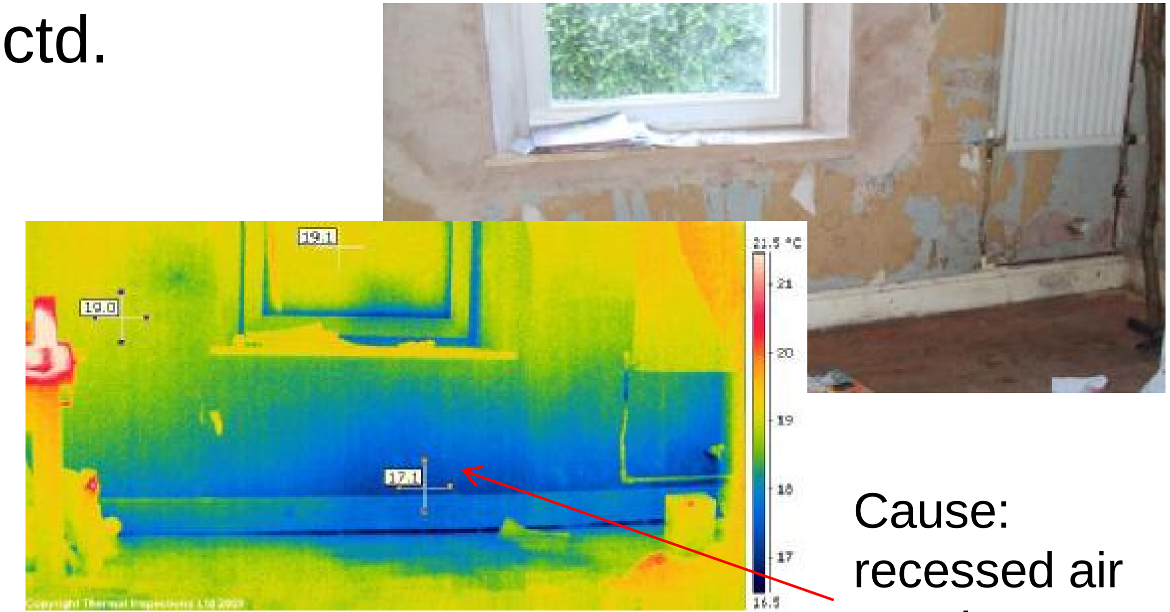


250mm Neopor EPS
Perinsul SL
Loadbearing cellular
glass block (Perinsul)
175 mm Thermafleece
insulation in two layers
150mm Neopor type EPS
(Jablite Premium).
Lambda = 0.030 W/mK
Airtightness membrane - with
variable vapour resistance -
sealed to face of brickwork
Well bonded brickwork -
assumed to be airtight

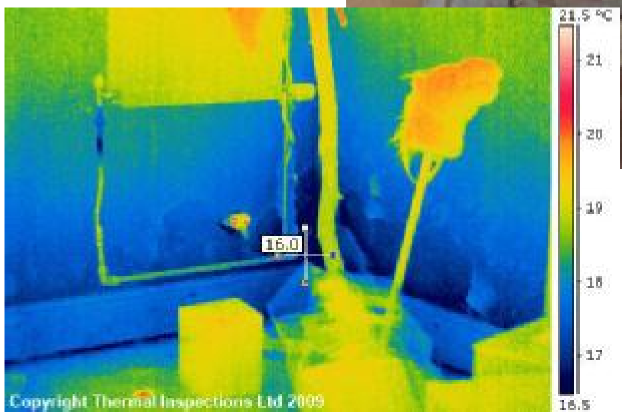
•Wall insulation MW1 ctd.

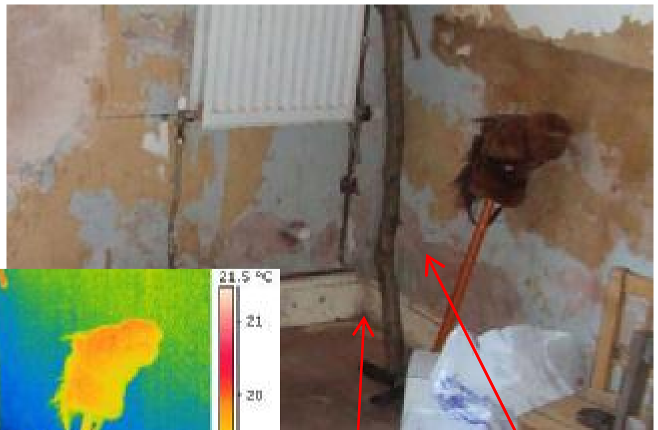




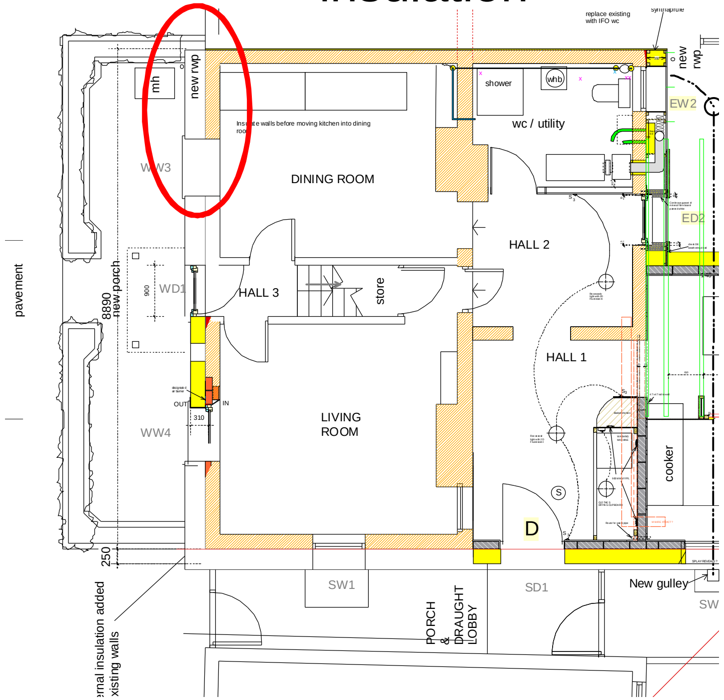


Cause: recessed air vent in external insulation

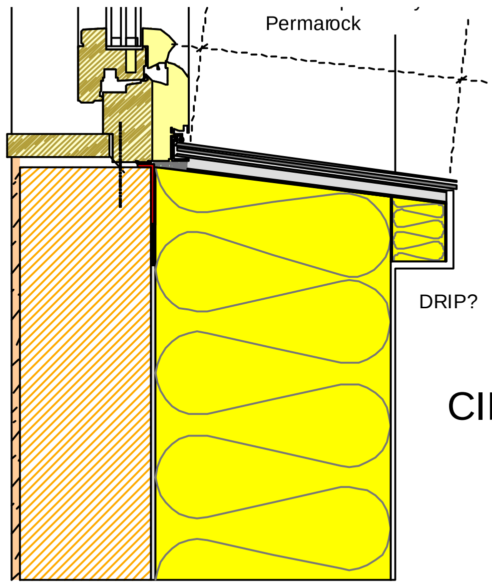




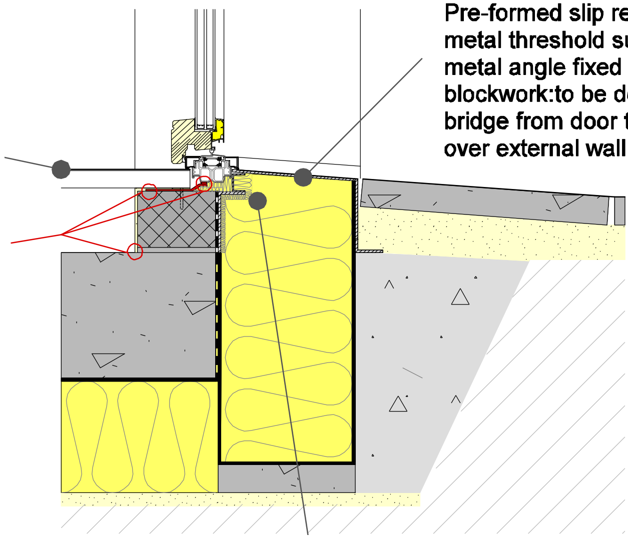
Cause: cavity foam not yet in place in this area. Also site of minor air leakage.

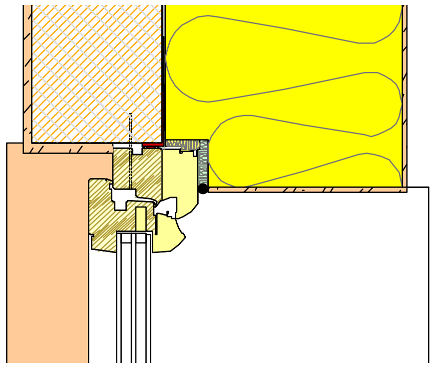


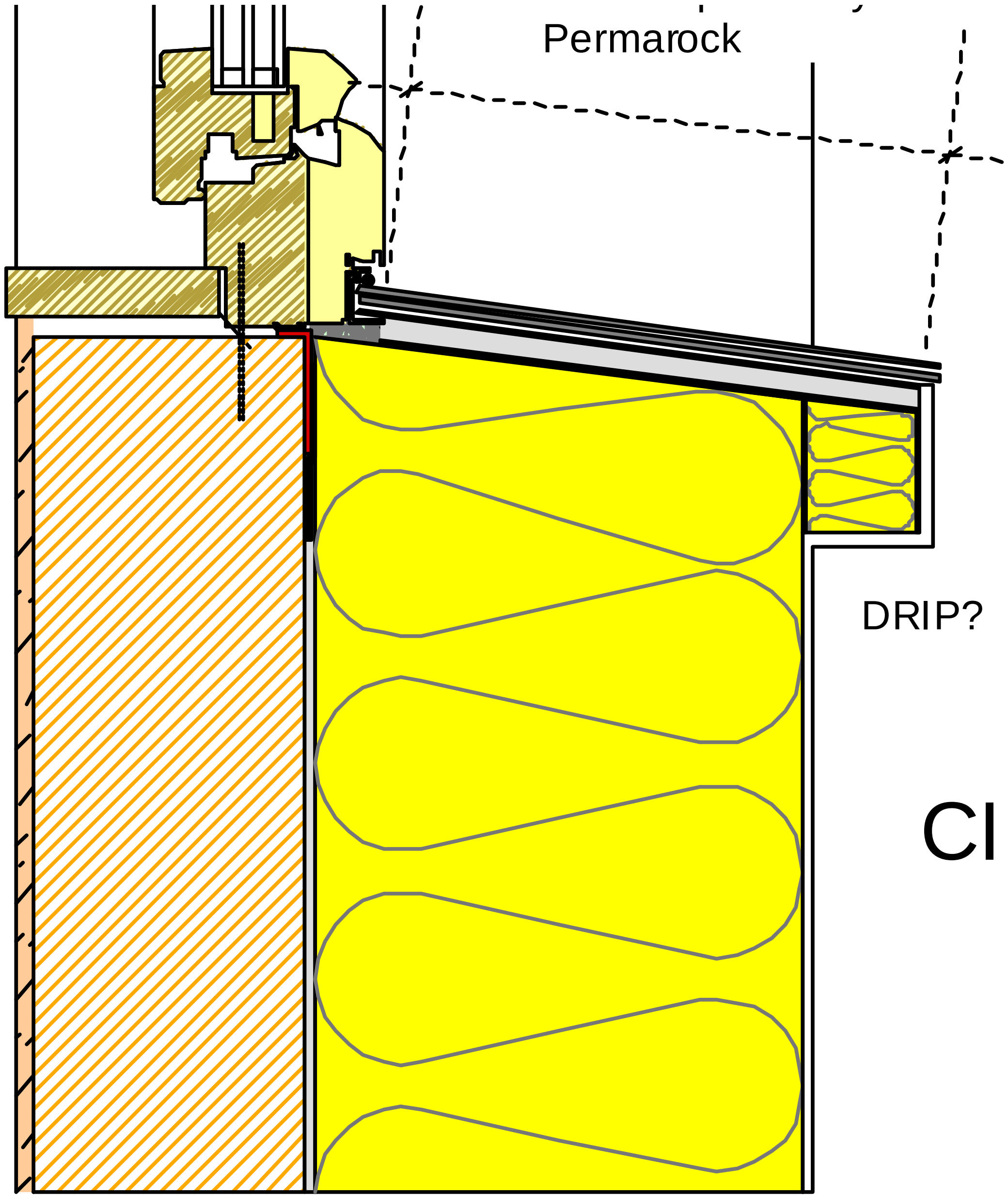
•Window in MW1 & Wall insulation type MW2

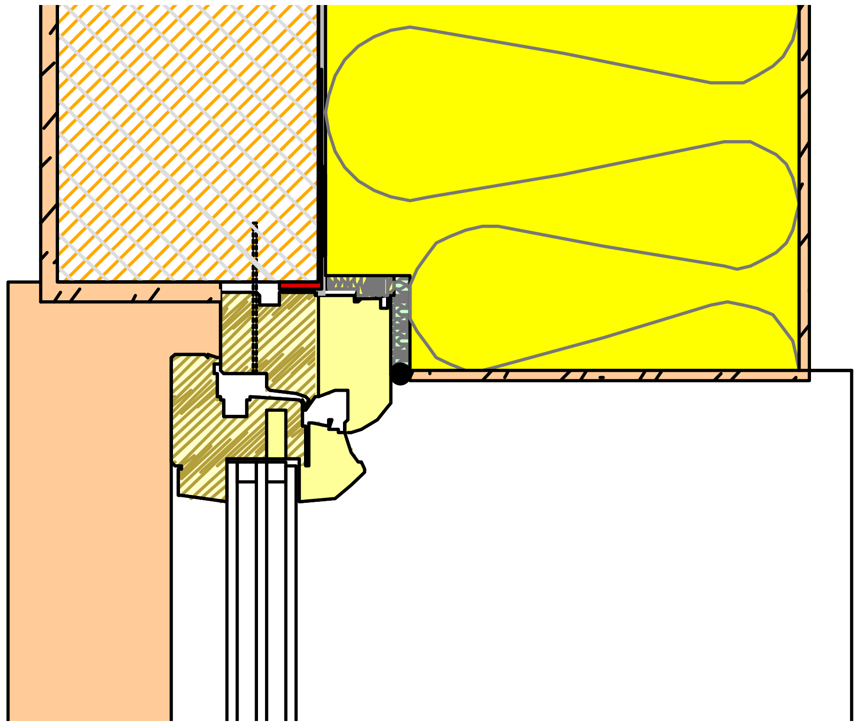


CILL

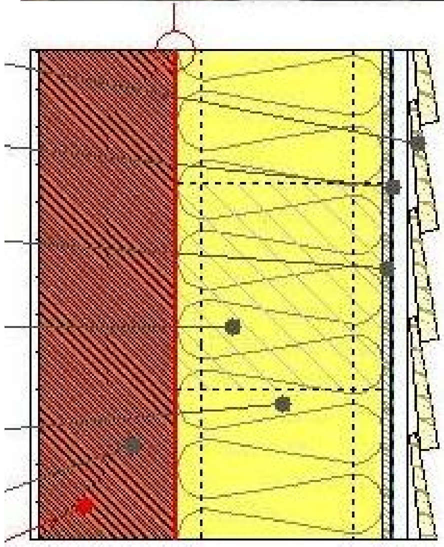


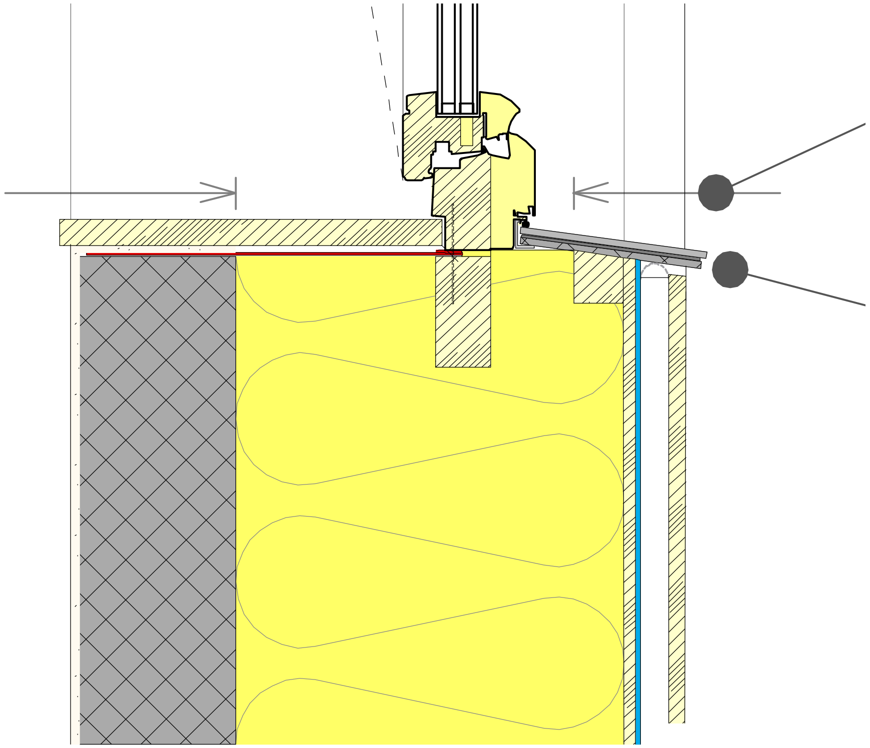


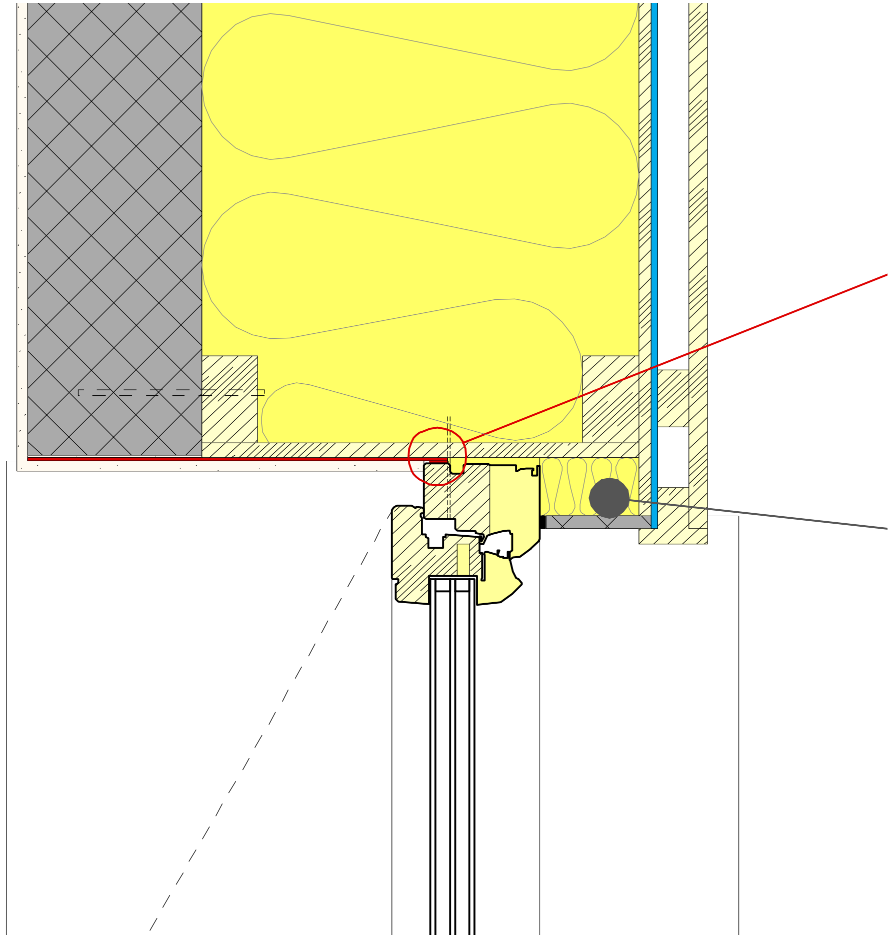




CILL

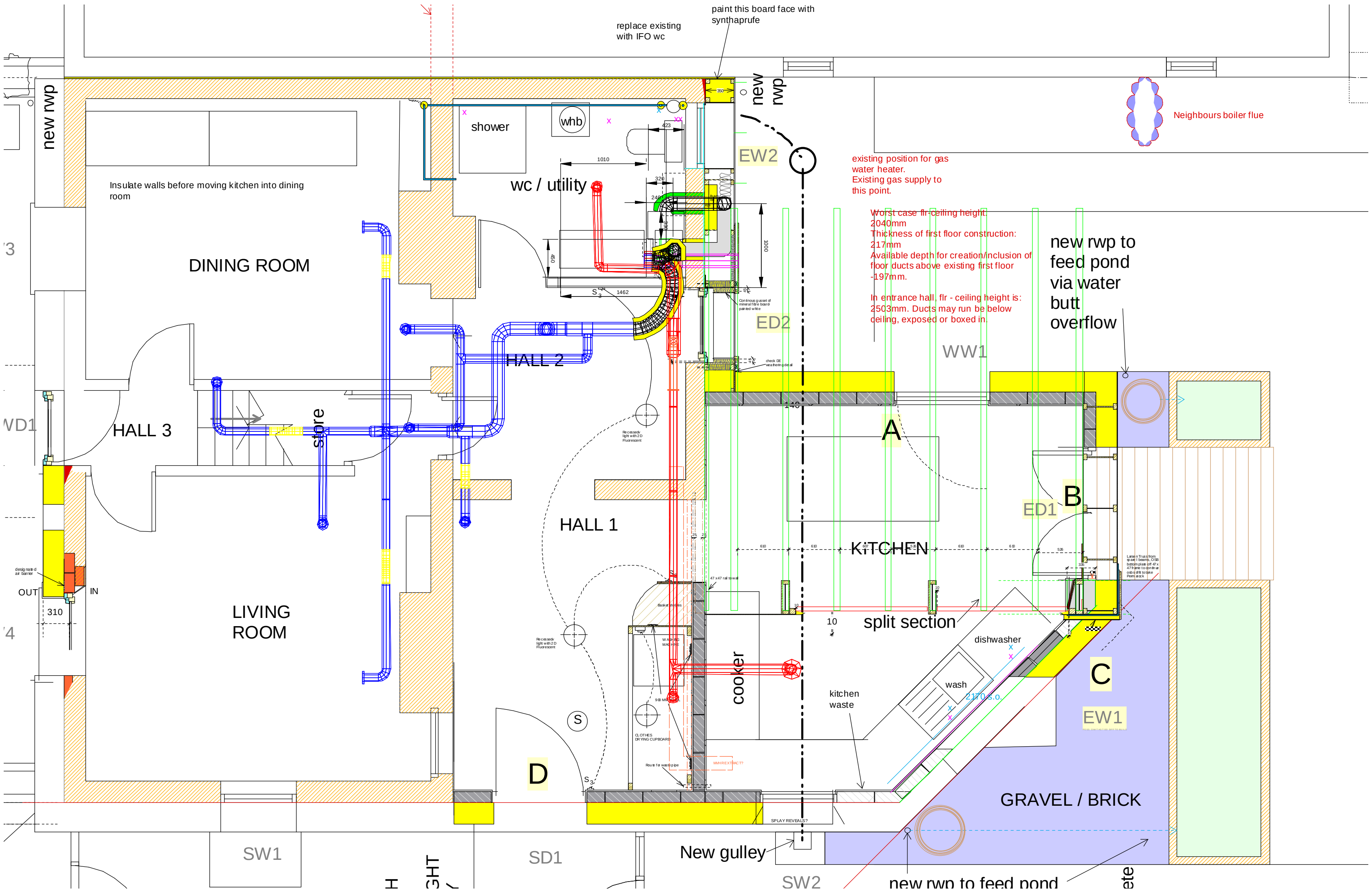






HEAD & CILL

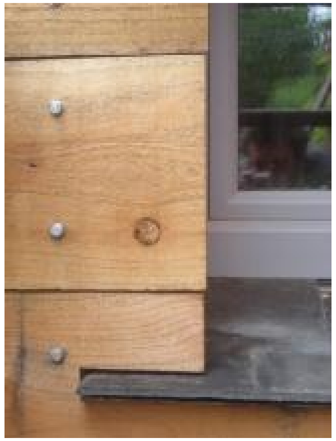
4. Mechanical Ventilation & Heat Recovery



MVHR





Costs

- The Sustainable Development Commission estimate: advanced low carbon refurbishment costs - in the region of £25,000 - £30,000 per dwelling.
- Environmental Change Institute (ECI) estimate: £20,000 - £60,000 per dwelling.
- WWF estimated costs of £2.6 - £3.5bn per year to reduce CO_2 by 80% by 2050
- CERT, the Carbon Emissions Reduction Target, is government's main policy for reducing household emissions and runs from 2008 until 2011. Funding of this scheme is estimated at circa £2.76 billion over three years, paid for through a levy on household energy bills. *40% of the energy savings through CERT are to be derived from homes occupied by low-income and elderly customers*
- In total, some £23bn is currently spent by home owners each year on repair, maintenance and improvement in the UK housing stock, a figure well in excess of what is being discussed for low-carbon works.

- Pending a careful cost analysis this project suggests that for similar properties with the same sort of challenges faced at Grove Cottage , costs for refurbishment to near Passivhaus levels of performance could be more in line with ECI predictions.

AECB the sustainable building association

2009 Annual Conference

Building for a Sustainable Future

Policy | Research | Practice

Oxford Brookes University | 11-12 June 2009

Optional tours of local renovations: 13 June 2009

Organised by: AECB the sustainable building association

Academic Partner: Oxford Brookes University

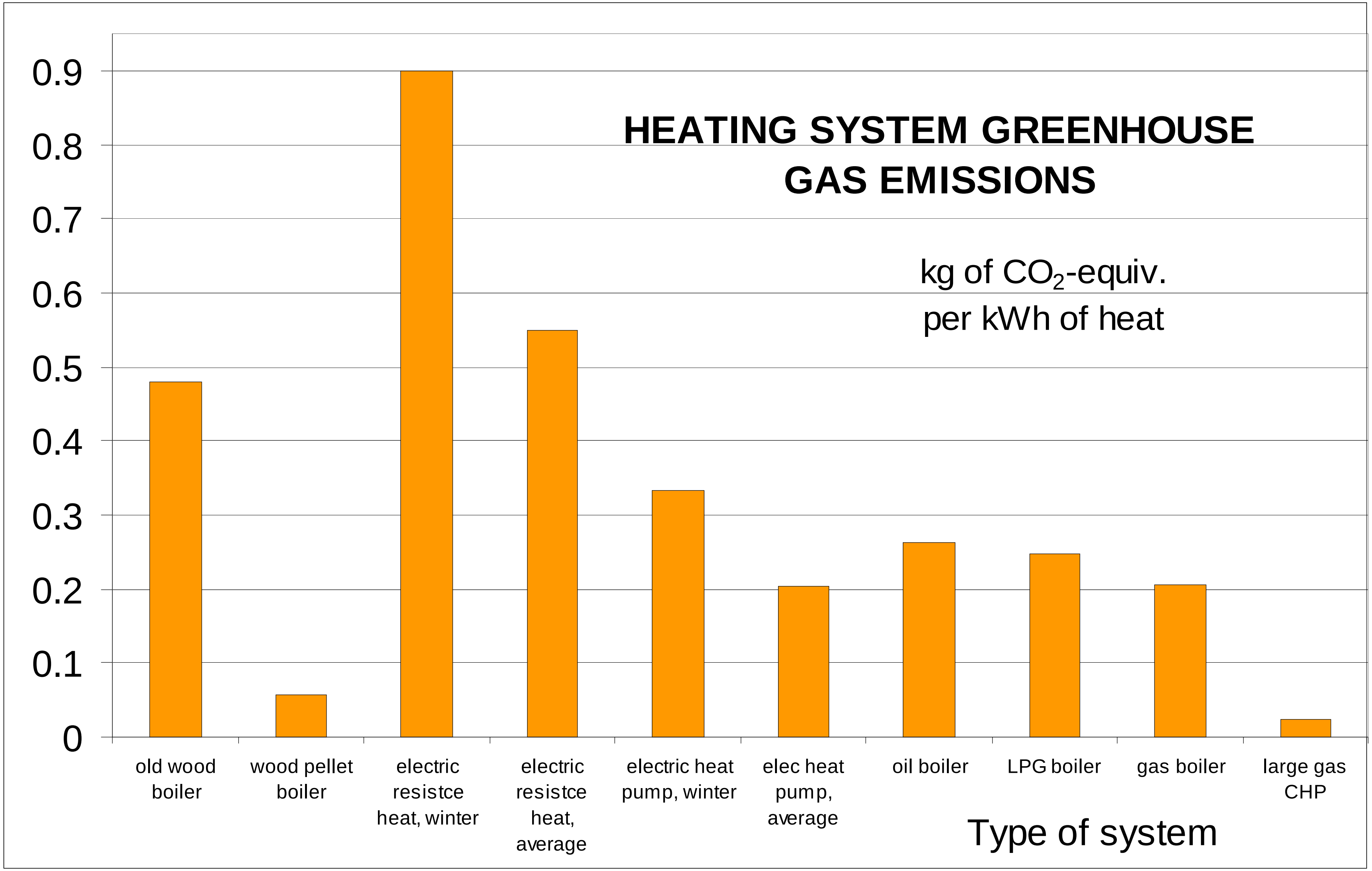
Principal Sponsor: Knauf Insulation — it's time to save energy

Student Bursary Sponsor: Greenbuilt — building with people for people

ENERGY INFRASTRUCTURE OPTIONS WORKSHOP

David Olivier, BSc MASHRAE
ENERGY ADVISORY ASSOCIATES

CO_2 emissions from "renewable" heating systems can be higher than realised.



Heat Planning in Denmark

The country is divided into three zones:

(1) Built up areas and some villages on the outskirts of towns and cities:

(a) A heat supply area. The preferred energy carrier for space and water heating is piped hot water (roughly 65% of country).

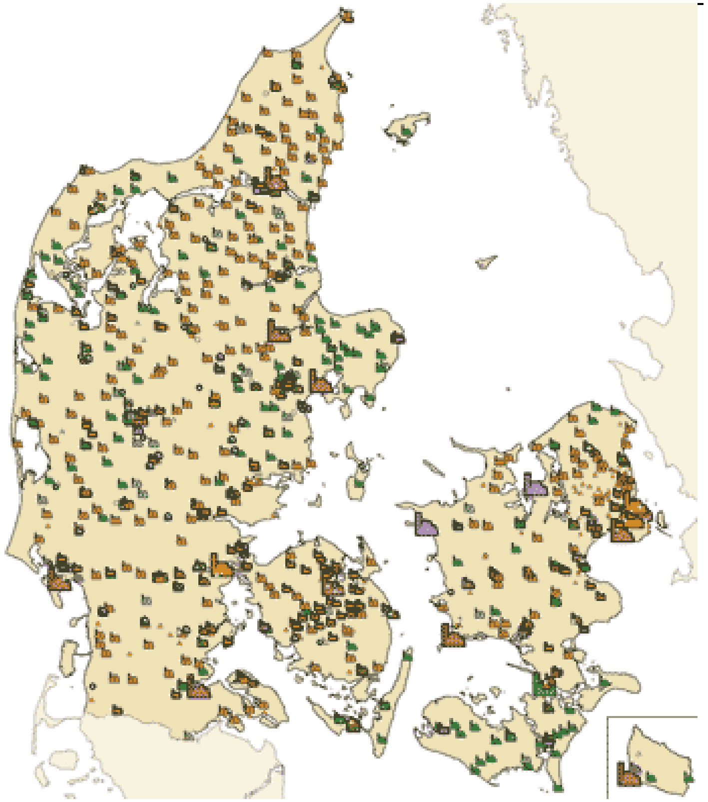
(b) A gas supply area. While Danish North Sea gas lasts the preferred energy carrier for space and water heating is piped gas (roughly 20%). Longer term much of this area looks suited to heat mains.

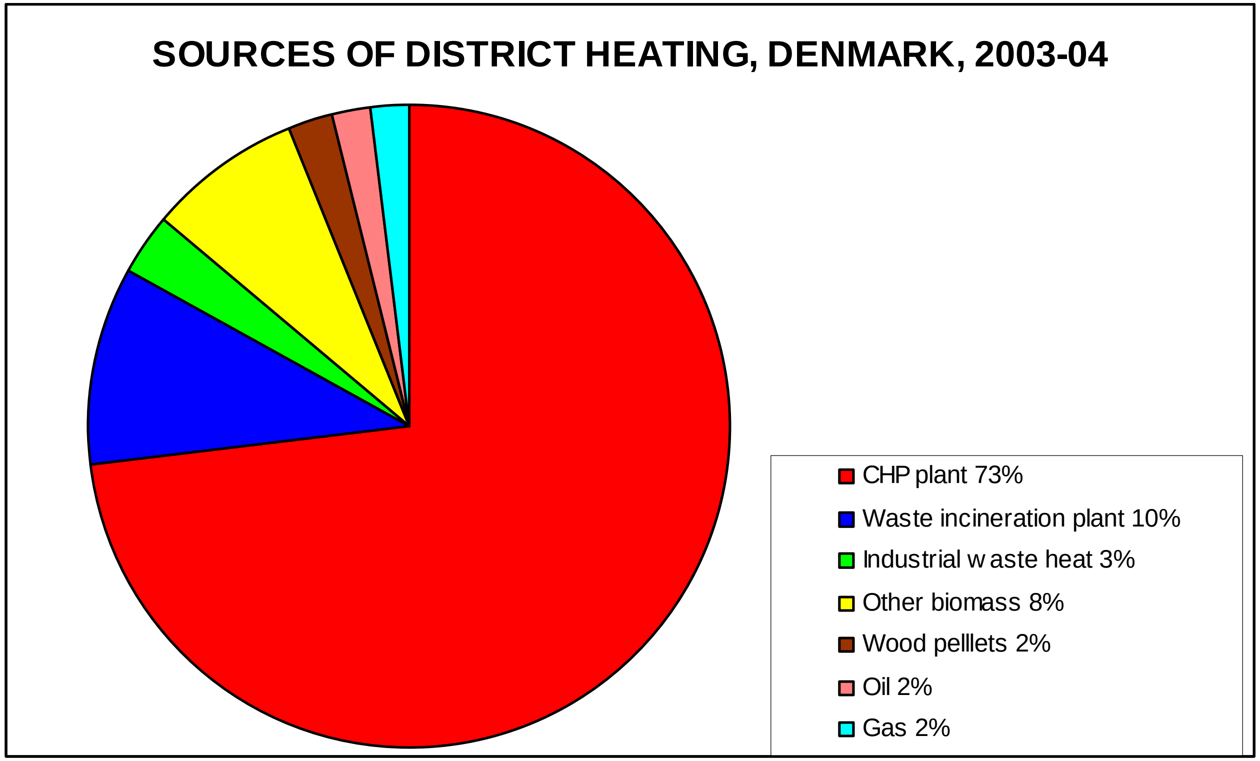
(2) Low density areas

It is uneconomic to lay either gas or heat mains and various other technologies are in use including oil, LPG, electric heat pumps and biomass boilers (roughly 15%).

In accordance with the Danish National Heat Plan 1979, Heat Supply Act 2000 et al.

Where the Heat Comes From





Source: DBDH.

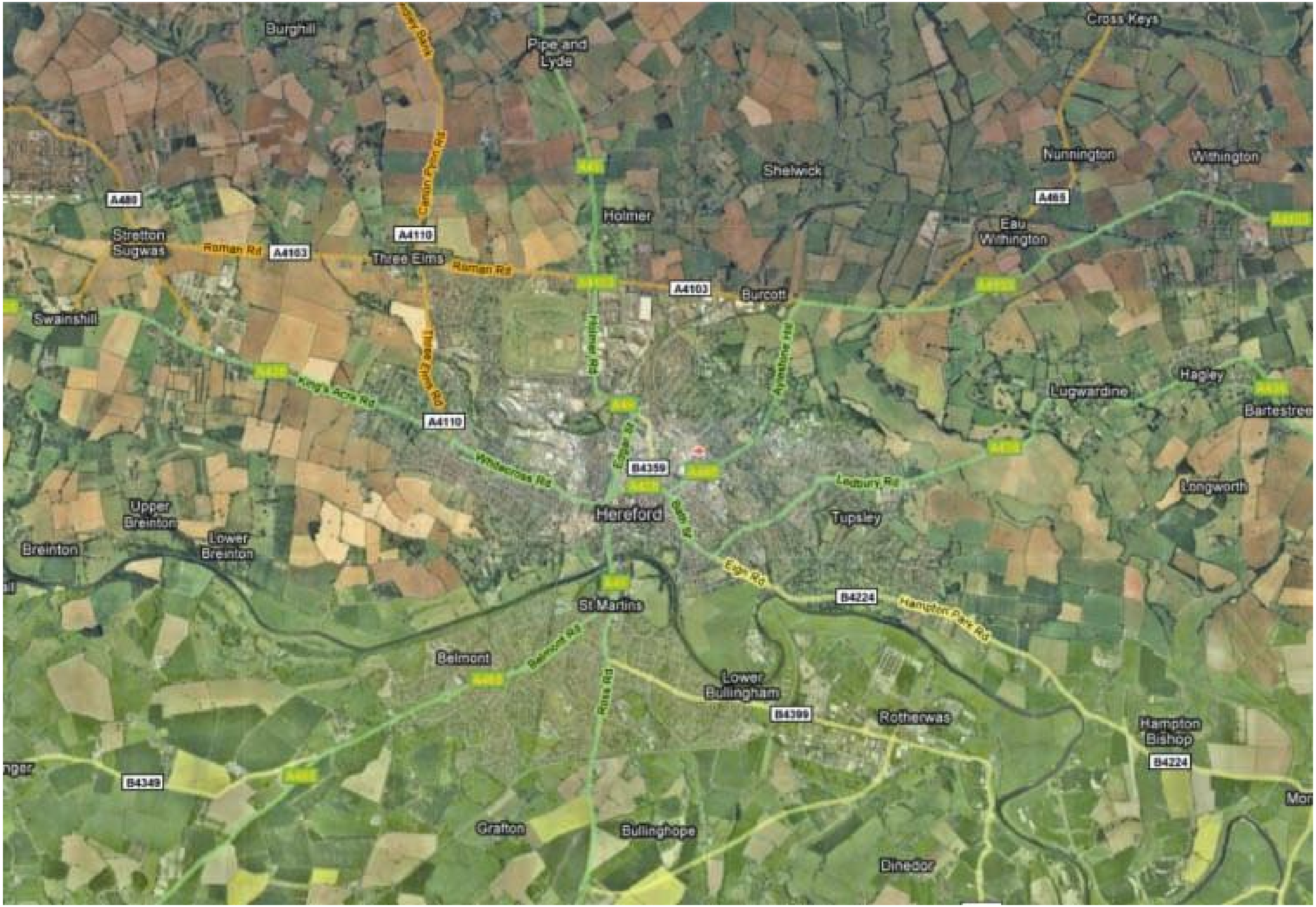
Solar Collectors, Denmark and Sweden

18,000 m^2 collectors help to heat the small town of Marstal (popn. 3,000), left.

10,000 m^2 collectors were added to the district heating system of Kungalv, 20 km N of Gothenburg in 2001, below.

Large solar collector fields produce heat at one-fifth the cost of heat from collectors on house roofs.

Courtesy: Leon Miller and Kungalv Energi AB.

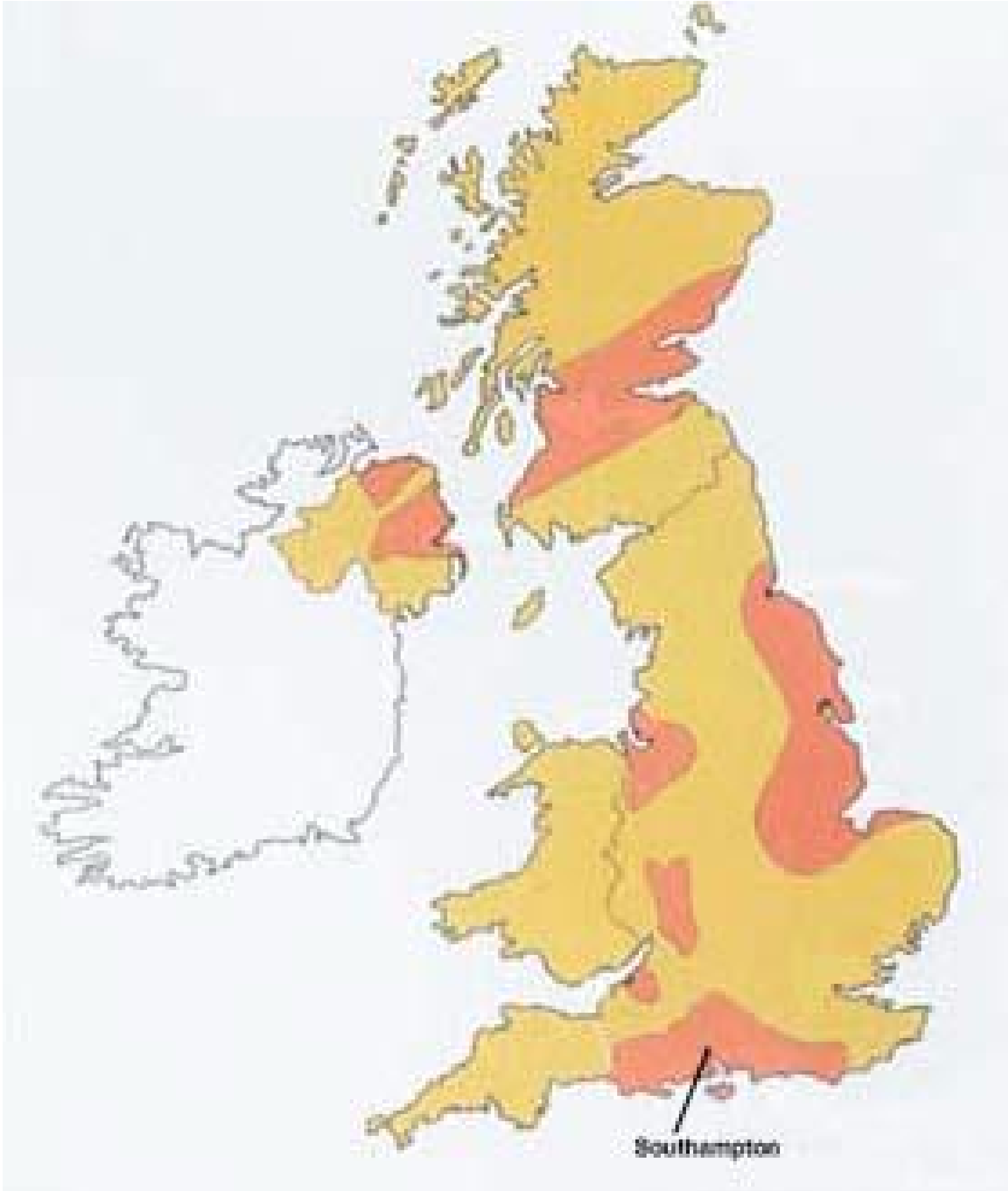


Burghill
Pipe and Lyde
Cross Keys
Shelwick
Nunnington
Withington
A480
Holmer
A465
Stretton Sugwas
Roman Rd
A4103
A4110
Three Elms
Roman Rd
Eau Withington
A4103
Burcott
Swainshill
Holmer Rd
Three Elms Rd
King's Acre Rd
A4110
Hagley
Lugwardine
Bartestree
Whitecross Rd
B4359
Ledbury Rd
Longworth
Upper Breinton
Hereford
Tupsley
Breinton
Lower Breinton
Eign Rd
B4224
Hampton Park Rd
St Martins
Belmont
Belmont Rd
Lower Bullingham
Ross Rd
B4399
Rotherwas
Hampton Bishop
B4224
B4349
Grafton
Bullinghope
Dinedor

UK Geothermal Aquifers

Water at 76ºC has helped to heat central Southampton since 1981. Since 2004 it has heated 5000 houses near Copenhagen.

Geothermal district heating was first used in France in the 1300s. Today it heats parts of Paris.



District Heating for Low Energy Buildings?

The marginal cost of reject heat is lower than heat supplied by; e.g., a gas fired heat only boiler or an electric heat pump.

Accordingly, optimum levels of insulation and draughtproofing may differ between heating systems.

DH has continued to expand throughout Denmark, whose new buildings have had 125 to 200 mm wall insulation since 1980. Danish DH technology is relatively suited to low heat densities, as typified by small detached houses on large plots.

Other examples:

Kronsberg, nr Hanover, Germany, comprises homes to the Low Energy & Passivhaus Standards & is heated by a gas CHP plant.

New Passivhaus flats in Vienna are being connected to the city's DH system, not given individual heating systems.

UK Space and Water Heating 2050?

- *Towns, cities, large villages (c.80% of load, mostly within "gas supply area")* - piped heat. Sources: biofuel- / gas fired CHP with CCS, geothermal, solar, industrial waste heat including biorefineries, biomass heat-only standby & peaking plant and others.

- *Small villages, countryside and dispersed suburbs (c.20% of load, mostly outside "gas supply area")* - electric heat pumps in situations where these do not generate new, expensive peaks in demand, active solar backed up by liquid and gaseous biofuels.

With acknowledgment to the Danish National Heat Plan of 1979, The Danish Heat Supply Act of 2000 and amendments.

Conclusions

- ?25,000 dw. x 8000 kWh/yr = 2M kWh/yr. delivered heat.
  Add non. res, say 250 M kWh/yr.
  Insulation but PH on homes not in need of a makeover and on all Cavity Wall homes wd. bankrupt us. Assume most solid walls insulated but not Hfd. cathedral, etc.

  Cd. be
  (1) 400 000 m2 collectors (25x Marstal)
  (2) (a) bio CH4
  (b) wood & plastic waste
  all in CHP plant with CCS making it C negtve
  (NB Denmark, Switz. etc burn plastics as recyclg. may emit more CO2 than it saves)
  Plus small other measures.

  Don't quote exact no.s yet.

  Measures such as PH retrofits are needed in areas where heat networks are
  unviable & where heat inevitably costs more. In wilds of Hfds. may need PH (EWI) as all heat is so expensive, whether active solar, GSHP, oil, LPG (+ bio eqs.) & CH4 made from garden waste.
-
- Old thick solid walled bldgs. (eg cottage I rent) use less heat than 20th C. Worst problem may prove to be homes built 1930s to 2000 as have CWs.
-
- Need Danish Natl. Heat Plan 1979 and Heat Supply Act 2000. (All LAs must prepare a plan for heat supply in their area. Danish Bldg. Regs. [c Silver] set the min std. in the heat supply area.)

Conclusions

- A strategic and detailed Heat Plan is required for each county ASAP;
  - Plan to be started now, costed and legally committed to within 3 years,
  - Supply and distribution infrastructure (e.g. solar thermal fields and other low carbon heat supply plants & associated distribution by DH networks) actioned within 10 – 20 (?) years
  - An immediate [funded] rolling programme of exemplar refurbishment within range of AECB Silver to Passivhaus levels -starting now...leading to large scale ongoing refurbishment programme as soon as Government 'catches up'

Meanwhile..........

- Lowering domestic space demand is always good - sensitive to architectural and historical cultural legacy - (but we may have to be clearer about what is exempt in this 'new age'). But ideally in future each project will be developed in the context of the local Heat Plan.
- Start developing equitable, financially incentivised range of solutions required for integrated whole building, heat conservation measures .
- Commission research into production of liquid and gaseous biofuels and plant and others issues highlighted by early development of Local Heat Plan

Can Herefordshire lead the way?

- There is an opportunity for Herefordshire to demonstrate a national exemplar strategy for sustainable low carbon refurbishment through the development of a local Heat and Power Plan combined with a number of low carbon refurbishment exemplars.