AECB
the sustainable building association

2011 Annual Conference

Retrofit: Moving in and Moving on

16-17 September 2011
Jubilee Campus, University of Nottingham

Organised by:

AECB
the sustainable building association

In association with:

The University of Nottingham
Department of Architecture and Built Environment

Evolved design;
Is there a low energy building style?

AECB Conference 2011
Nottingham University
Nick Grant

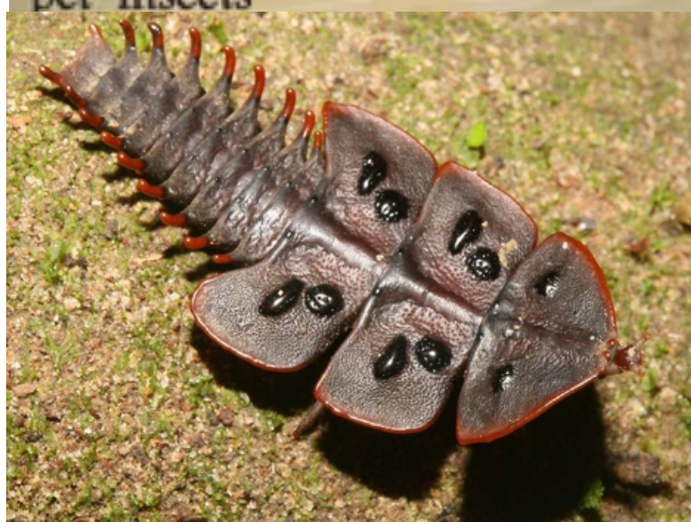
Passivhaus Trust
The UK Passive House Organisation

AECB

Is there a style in the natural world?

(Will we ever find a mouse with wheels??)

J. B. S. Haldane



Windows®. Life without Walls™. Dell recommends Windows 7.

DELL

If you can imagine it, you can create it.

Set your imagination free – and bring your most amazing ideas to life – with Dell Precision™ certified workstations.

Constraints

Physics:

- Size
- Heat loss area
- Linear thermal bridge length
- Thickness and continuity of insulation
- Glazing area
- Material properties
- Useful functional area and volume
- Climate
- Resources
- Sinks
- etc

Practicalities:

- Budget
- Available materials
- Planning
- Structural penetrations
- Given site
- Views to North?
- Noisy road to South?
- etc

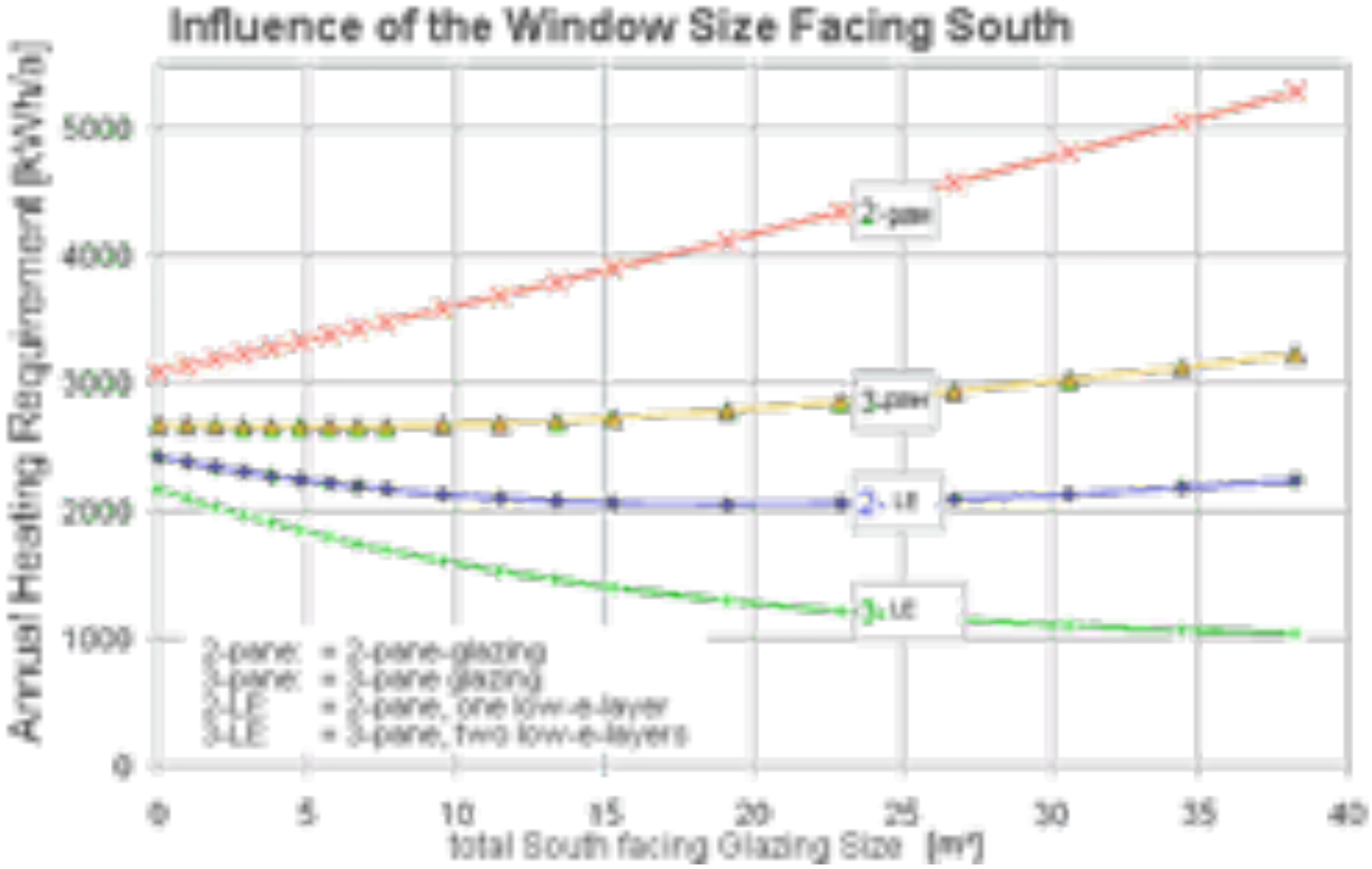
Ski slope in the desert

‘I don’t remember being forced to accept compromises, but I’ve willingly accepted constraints.’

Charles Eames

Solar vs Insulation

Passive solar style

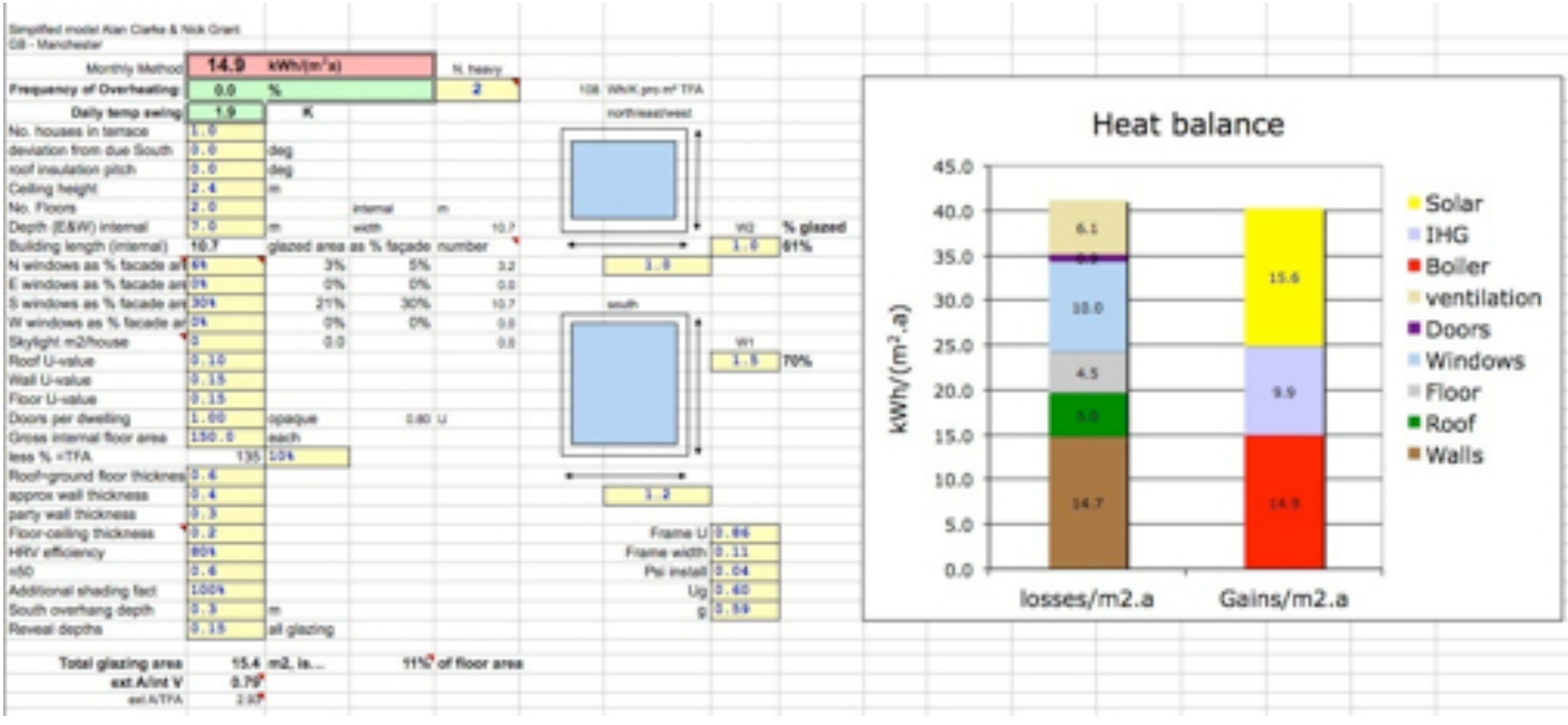

Influence of the Window Size Facing South
Annual Heating Requirement [kWh/m²]
5000
4000
3000
2000
1000
0
2-pane
3-pane
2-LE
3-LE
2-pane: = 2-pane-glazing
3-pane: = 3-pane glazing
2-LE = 2-pane, one low-e-layer
3-LE = 3-pane, two low-e-layers
0
5
10
15
20
25
30
35
40
total South facing Glazing Size [m²]

The First Passivhaus

1991

Massing

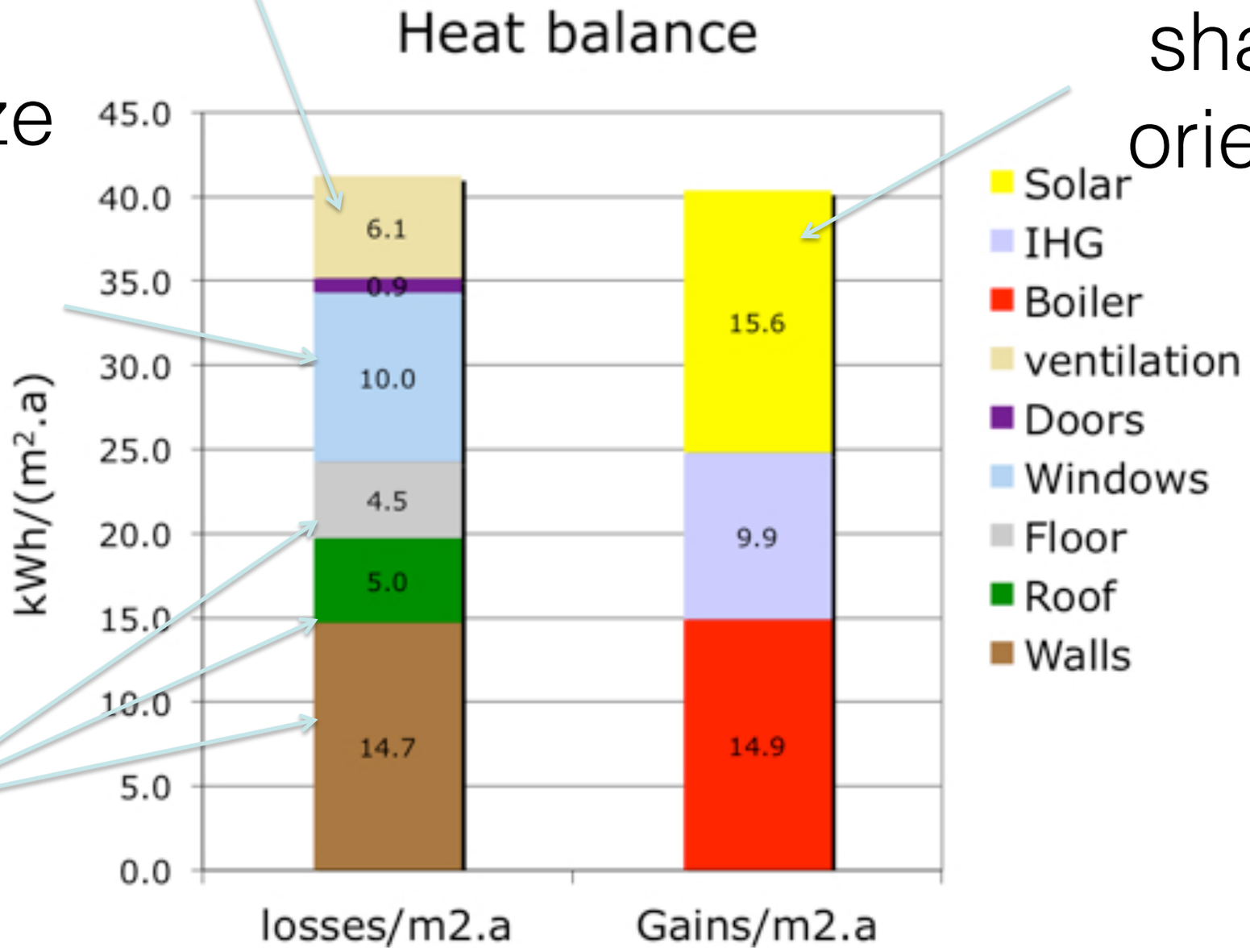
Parametric PHPP model



PHPP Energy balance

volume, occupancy

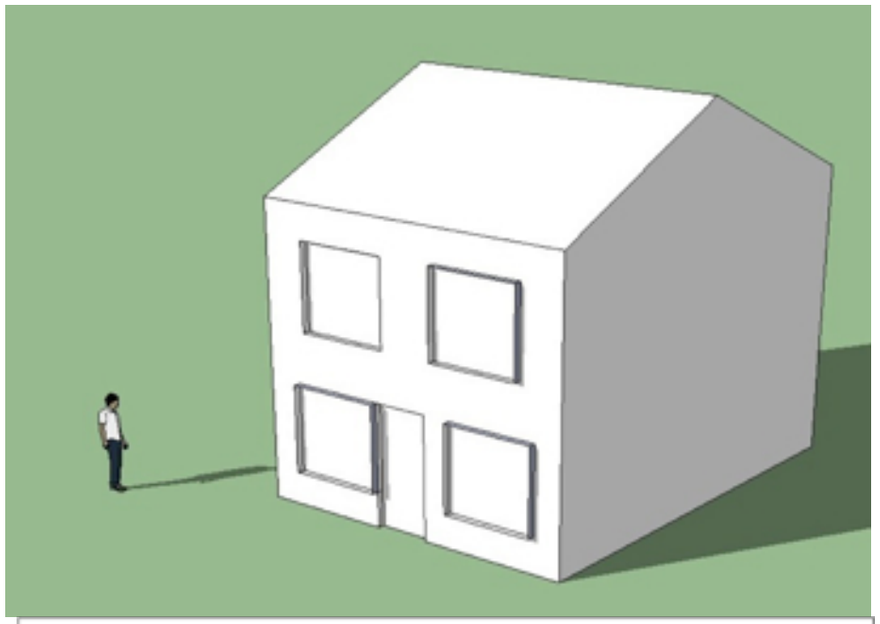
window size & shape

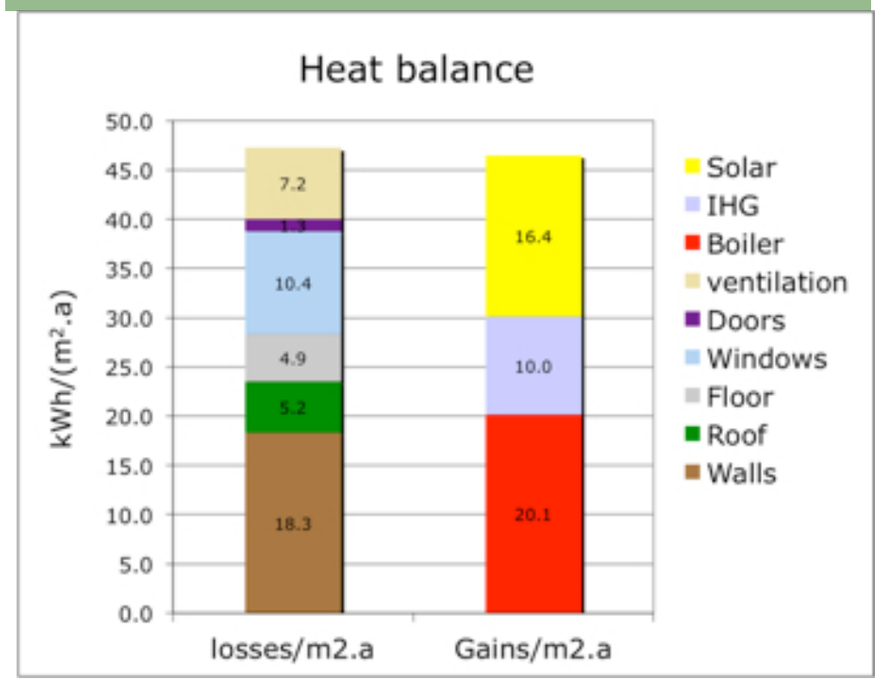


shading, orientation

form

100m^2 Detached

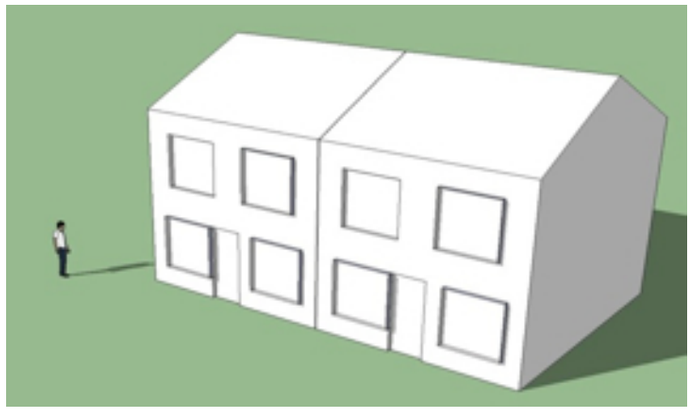




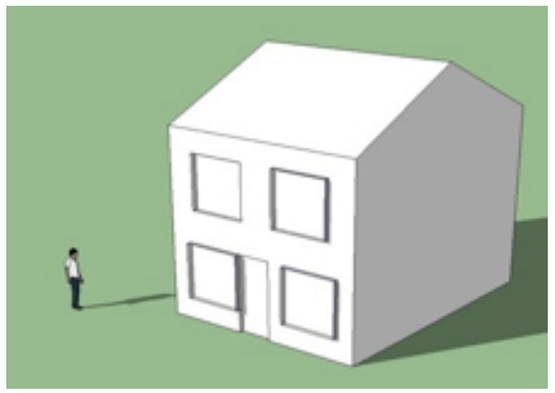
20kWh/(m^2.a) – not PH
= 2,000 kWh/a = £200 @10p/kWh

Size matters:
150m^2 with same spec' = 15kWh/(m^2.a)
= 2,250 kWh/a= £225 @10p/kWh

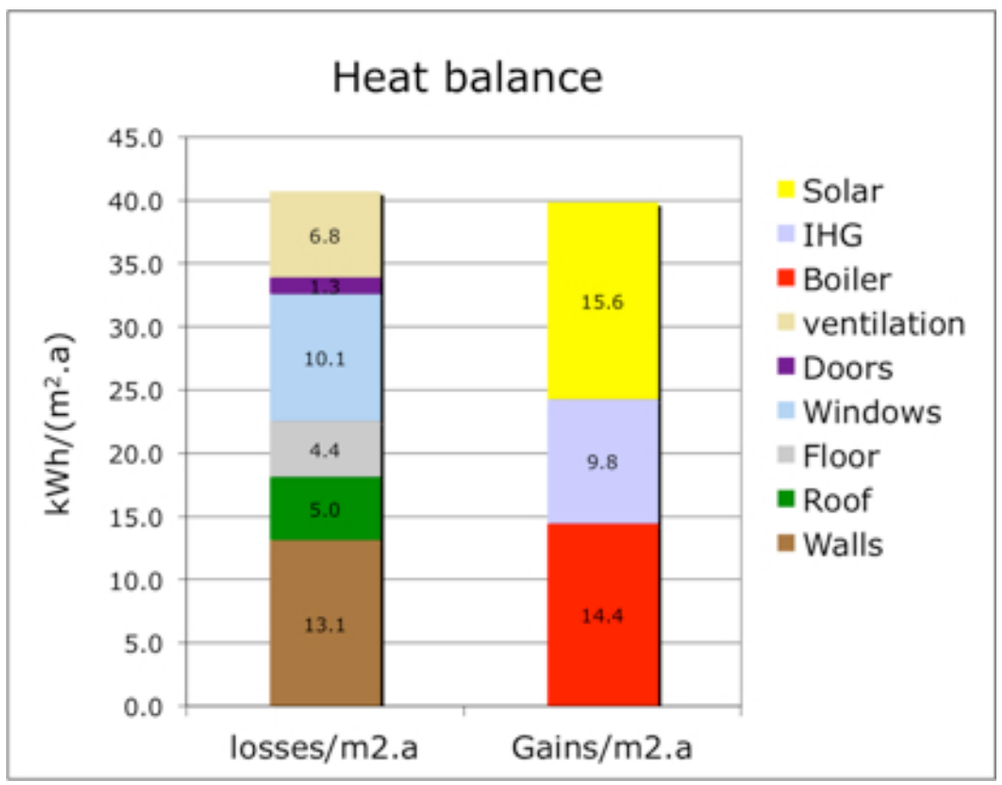
2 x 100m² Semi Detached

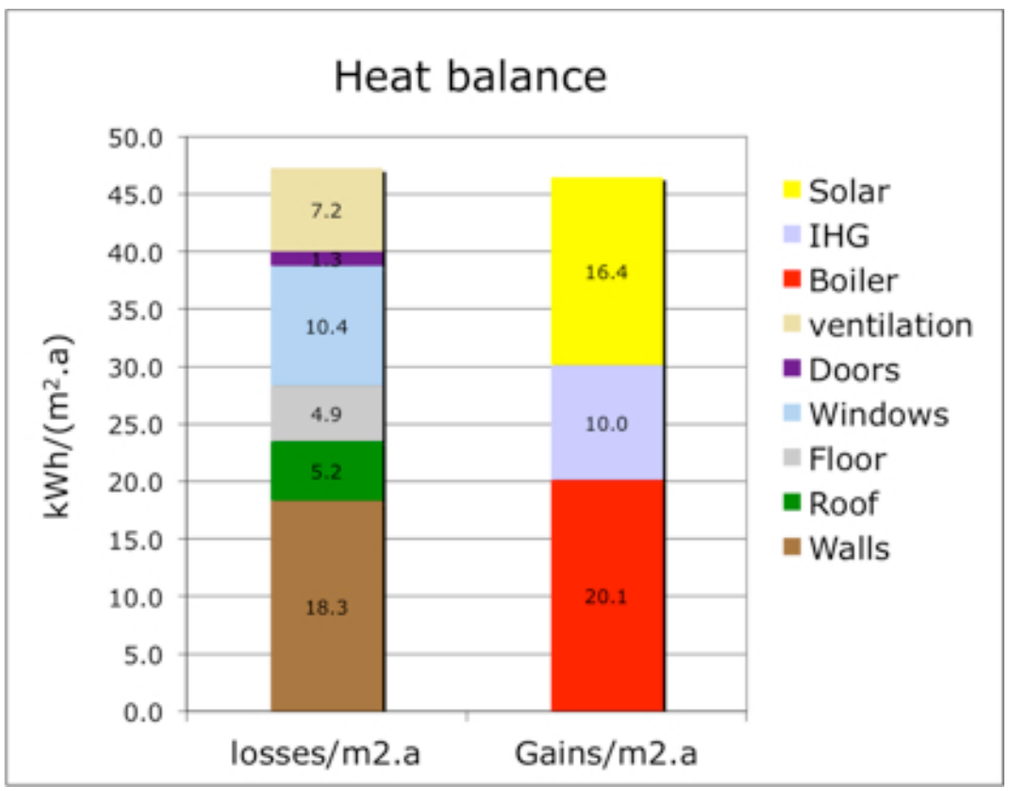


A/V = 0.74
A/TFA = 2.8
14.4 kWh/(m².a)
£140/year heat

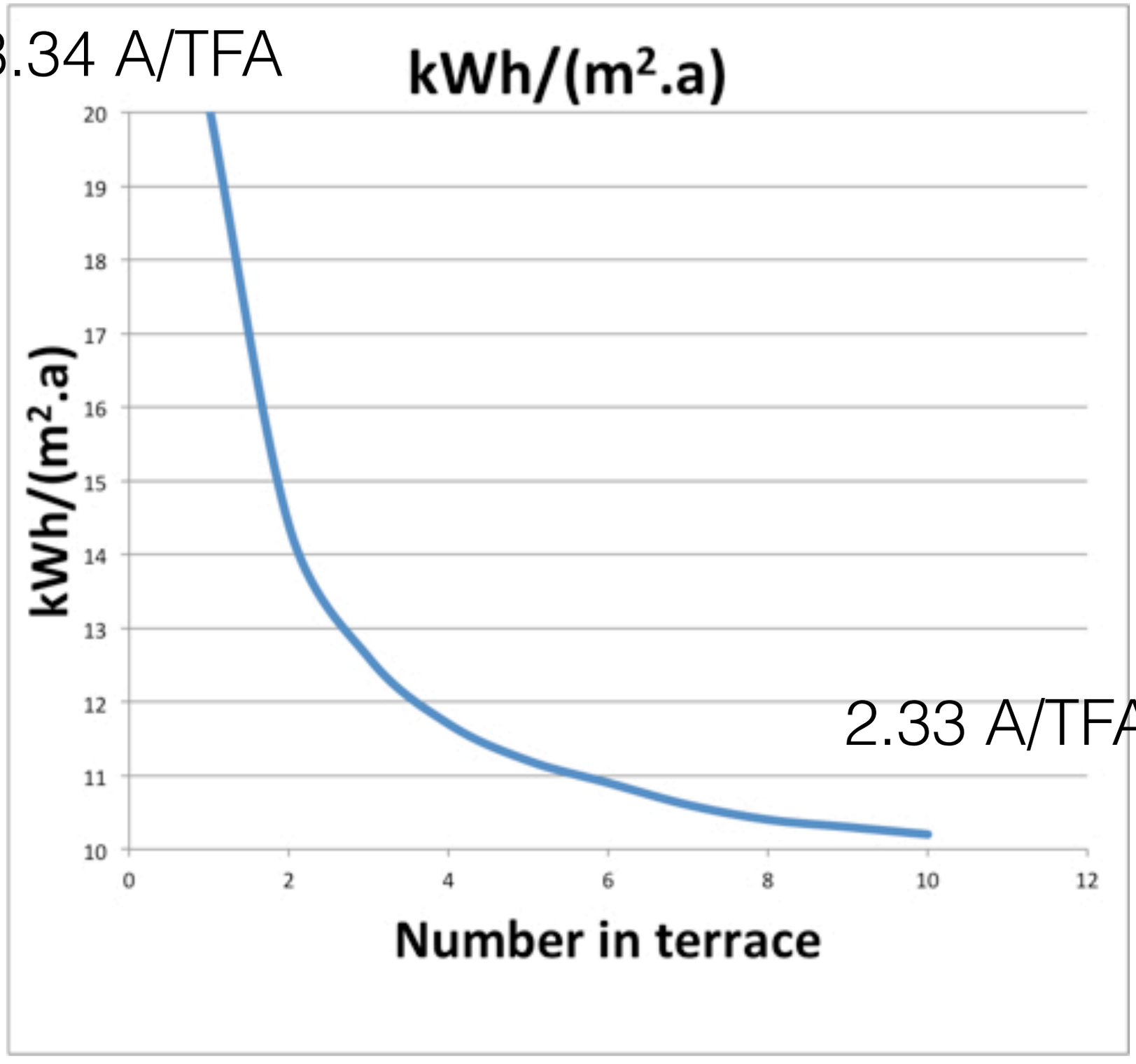


A/V = 0.87
A/TFA = 3.3
20.1 kWh/(m².a)
£200/year heat





3.34 A/TFA



2.33 A/TFA

Less energy or same energy for much less capital cost
Compound benefit – less heat loss area is less area to build

Lancaster Co-Housing

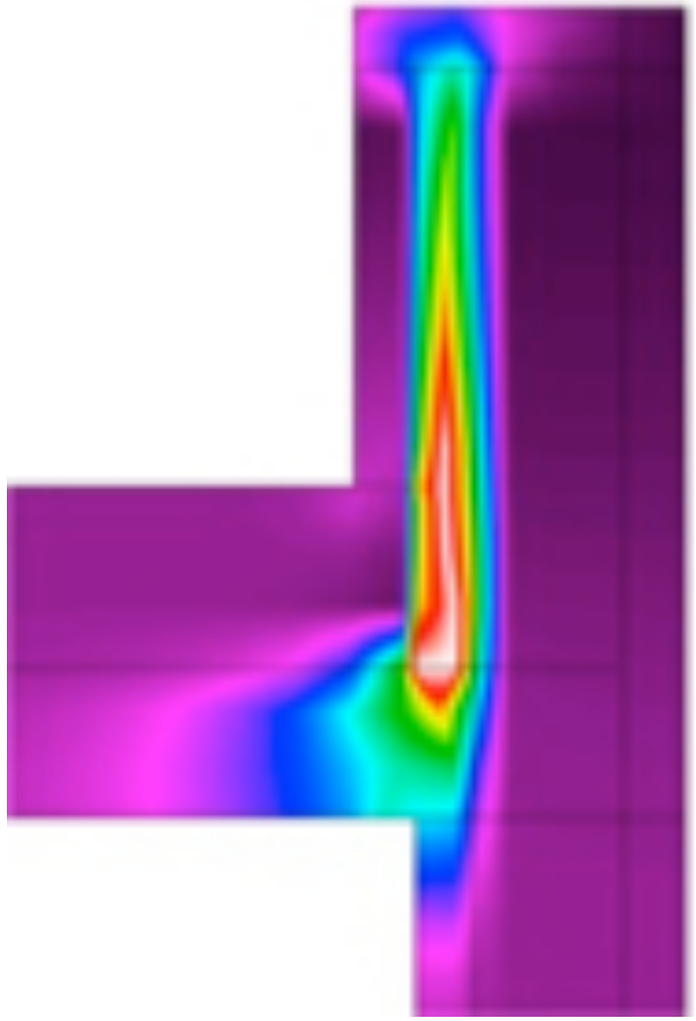
Passivhaus, simple compact form

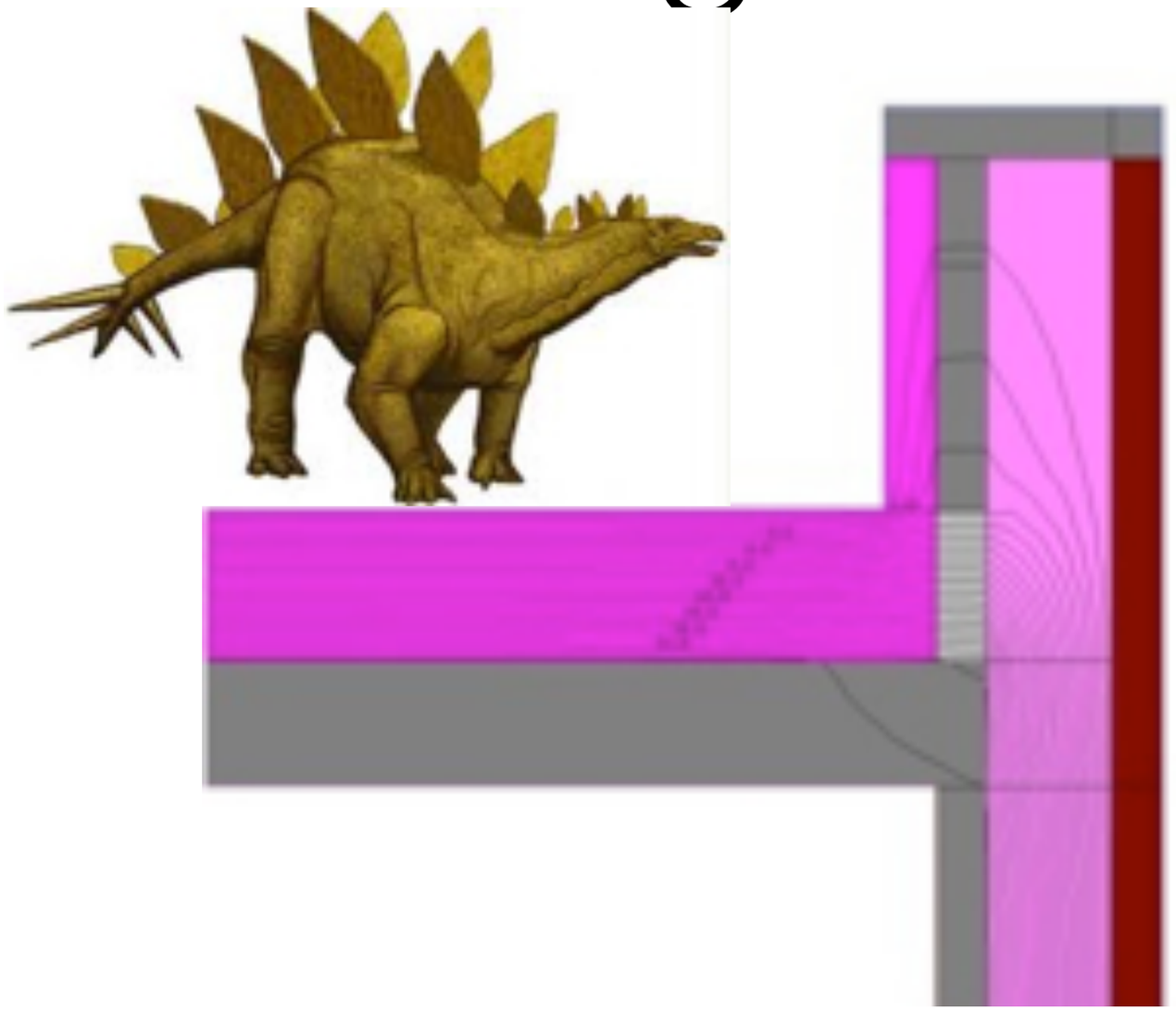
Shape & complexity

Increased complexity means:

- Increased heat loss area for less useful floor area
- Shading of windows by building
- Thermal bridges – physical and geometric
- Tricky airtightness
- Increased cost
- Slower build
- More effort needed on finishes.

Parapets – cooling fins!





Heat flux Ψ_{ext} 0.12 W/mK

Fixed but is it safe?
use expensive connectors?

Spandrel panels.

(worked example from AECB Carbonlite Course)

The heat loss of glazing - without the light or solar gains.

Say 10m^2 of spandrel on 150m^2 building in Manchester

U wall 0.1, U spandrel 0.8 so $\Delta U = 0.7 W/m^2.K$

10m^2 x 0.7$W/m^2.K$ x say 70 kKh = 490 kWh/y extra heat

= another 3.3$kWh/m^2.a$

Energy costly features

- Bricks hung from structure
- Long vent ducts
- Long hot water circuits
- Cantilevered balconies
- Bin stores indented into envelope
- Shaded glass etc etc

As in nature:

- Layers:
  - structure
  - air barrier
  - insulation
  - wind and weather
  - external structure

no penetrations

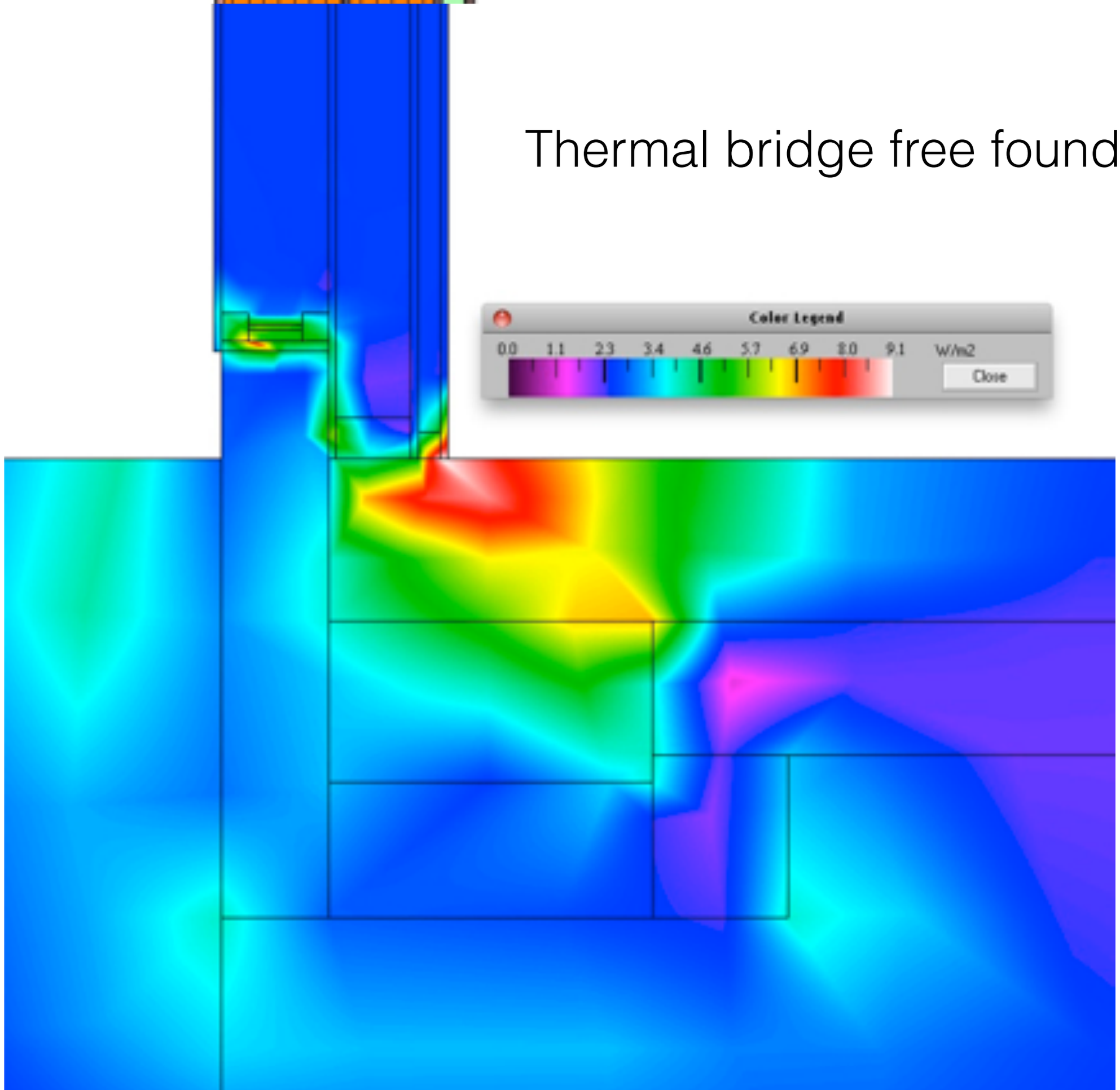
they leak!

Old barn but good airtightness strategy and good result


KLÖBER PERMO
KLÖBER PERMO forte


sigacoat
www.siga.ch

Thermal bridge free foundation



The First (of 3) UK Passivhaus Schools

Oakmeadow Primary Wolverhampton, Architype

Outmoded constraints

Windows - performance

For UK Building Regulations, the performance of these two windows can be considered the same:

But with Passivhaus, you have to calculate them individually

Poor Installation;

Traditional mullions

U_{window}=1.8 W/m^{2}K

Installation free of thermal bridges;

Simplified design

U_{window}=0.8 W/m^{2}K

How could you optimise the window performance through design?


New thinking

Embrace constraints!

- Less options means less design time!
- Integrity of form and function
- Cost saving
- Often leads to great design
- Boring? Zen?

Conclusions

- Can’t cheat physics
- Keep the envelope simple
- Keep the windows simple
- Embrace constraints such as simple form and no structural penetrations
- Help define a genuine green building pattern
- Keep irony outside the thermal envelope.

AECB CarbonLite Passivhaus Design Course

V100

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