Designing for Cost Optimisation

Chris Parsons – Parsons + Whittley
Tomas Gartner - Gale & Snowden

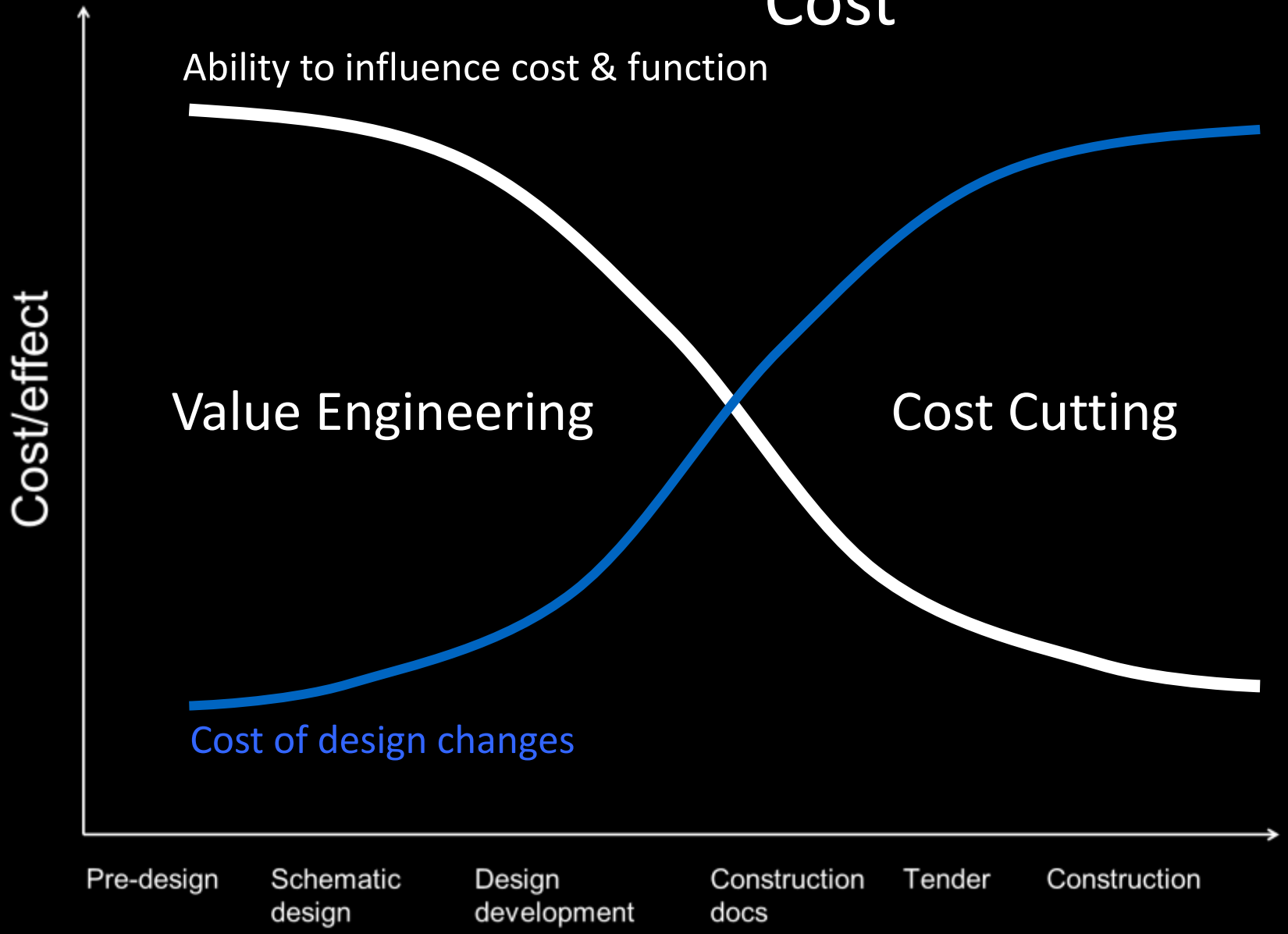
ukpassivhaus conference2015

bre

Designing for Cost Optimisation

- Welcome
- Design Approach
  - Form
  - Fenestration
  - Structure, Services and Controls
- Case Study
- Questions

$$\text{Value} = \frac{\text{Function}}{\text{Cost}}$$



Designing for Cost Optimisation

- Welcome
- Design Approach
  - Form
  - Fenestration
  - Structure, Services and Controls
- Case Study
- Questions

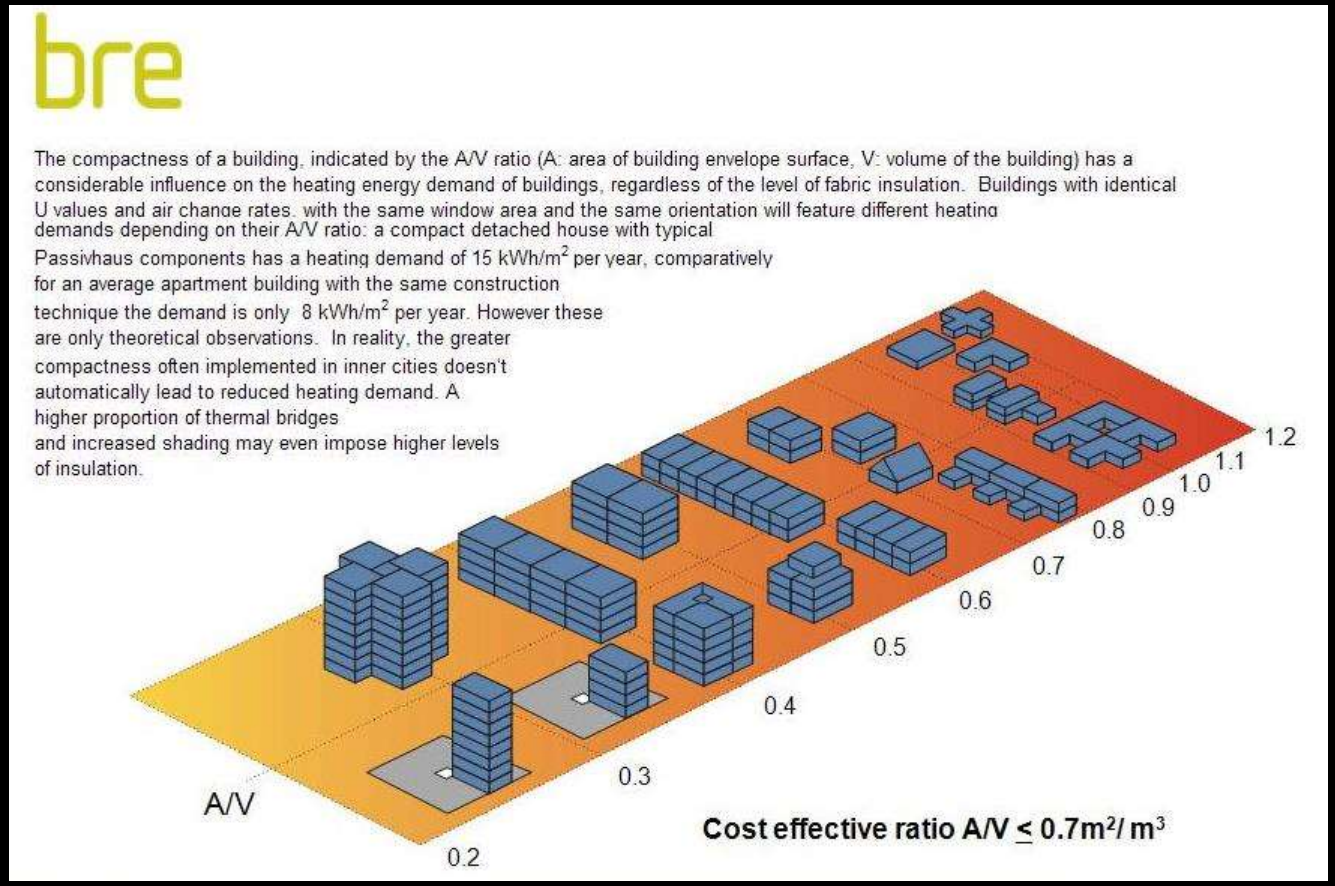
Form factors, AV Ratios and TFA

Always maximise Treated Floor Area

Gaining 2.0 m^2 in a small house can win around 1 $kWh/m^2/a$

And always double check it!

Form factors, AV Ratios and TFA



- Area/Volume ratio:

Form factors, AV Ratios and TFA

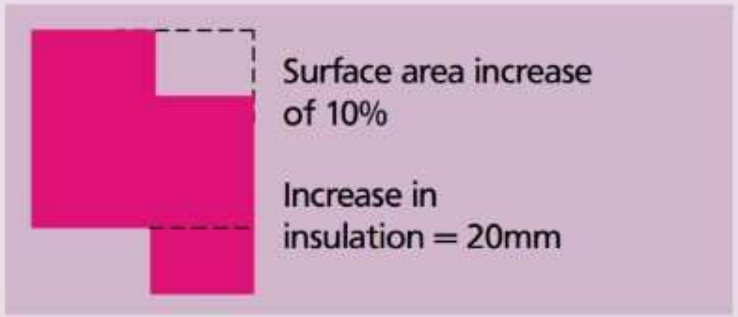


Figure 2 10% greater surface area

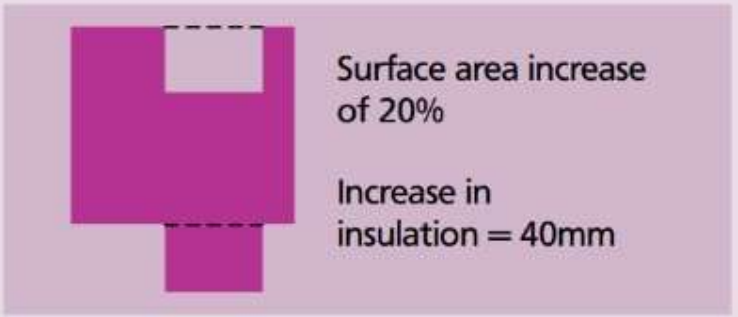
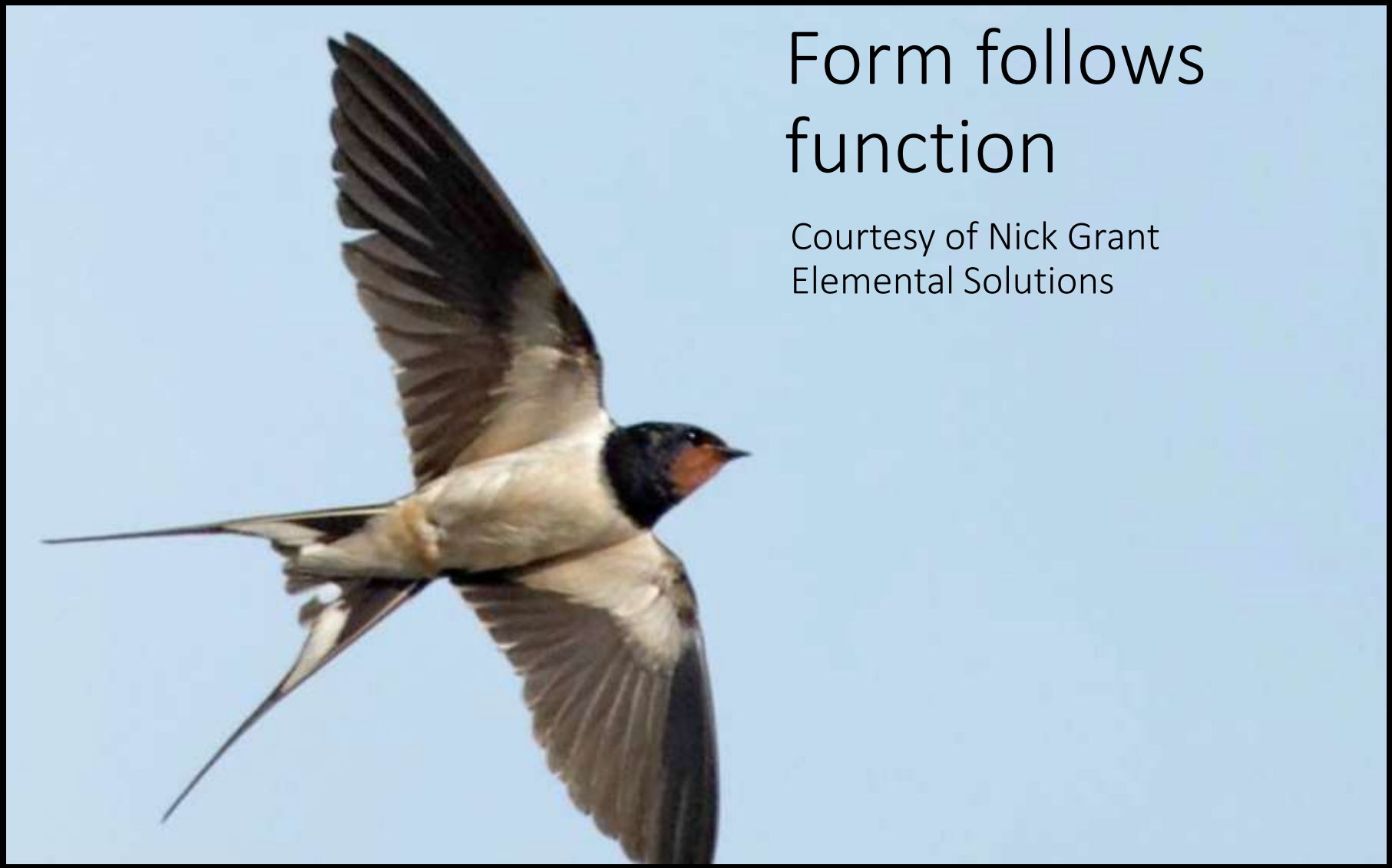


Figure 3 20% greater surface area

Image courtesy of BRE



Form follows function

Courtesy of Nick Grant
Elemental Solutions

But not all delight needs to go….

Sorry Nick….

Natural selection is slow and expensive

We can model

lding assembly description	Group Nr.	Assigned to group	Quan-tity	x (	a [m]	x	b [m]	+	User d mined
d floor area	1	Treated floor area	1	x (		x		+	116
vindows	2	North windows							
ndows	3	East windows							
windows	4	South windows							
indows	5	West windows							
ntal windows	6	Horizontal windows							
r door	7	Exterior door						+	
								+	
Wall	8	Exterior wall - Ambient	1	x (	10.80	x	5.35	+	
wall	8	Exterior wall - Ambient	1	x (	7.00	x	5.35	+	
gable triangle	8	Exterior wall - Ambient	1	x (	3.50	x	1.78	+	
wall	8	Exterior wall - Ambient	1	x (	10.80	x	5.35	+	
wall	8	Exterior wall - Ambient	1	x (	7.00	x	5.35	+	
gable triangle	8	Exterior wall - Ambient	1	x (	3.50	x	1.78	+	
pitch 27				x (		x		+	
				x (		x		+	
roof	10	Roof/Ceiling - Ambient	1	x (	10.80	x	3.93	+	
roof	10	Roof/Ceiling - Ambient	1	x (	10.80	x	3.93	+	
				x (		x		+	
				x (		x		+	
				x (		x		+	
slab	11	Floor slab / Basement ceiling	1	x (	10.80	x	7.00	+	

Please complete in Windows

Length
Depth

Height

Roof pitch

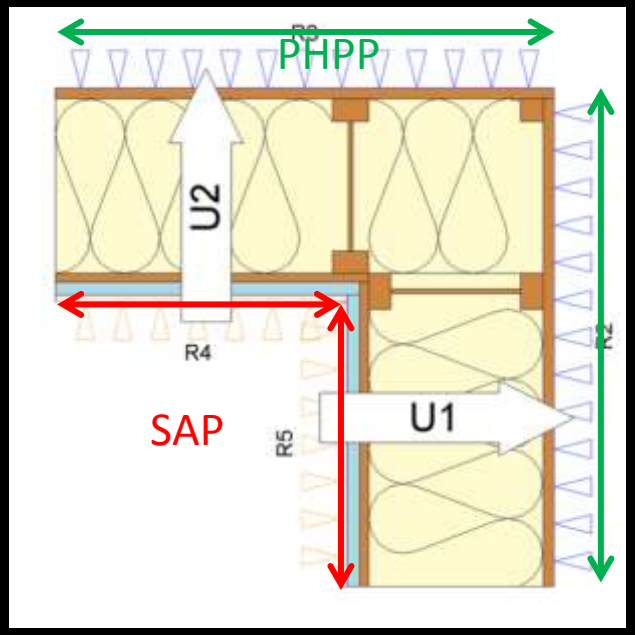
PHPP Optimisation

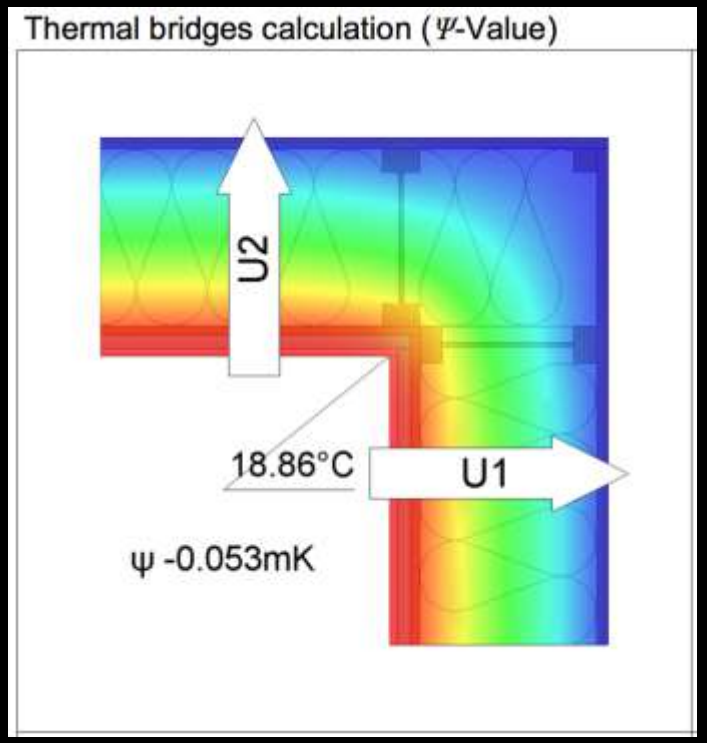
Approximate savings for minimal cost

Glazing:

- High G value glazing 2 kWh/m^2.a
- Thin frame windows 2 kWh/m^2.a

PHPP Optimisation





Thermal Bridge Modelling:

PHPP uses external dimensions (pessimistic) for heat loss area, SAP uses internal (optimistic).

Both are wrong! The ψ (psi) value is a correction.

PHPP Optimisation

Approximate savings for minimal cost

Thermal Bridge Modelling:

- Negative Thermal Bridges 1.5 - 3 kWh/m^2.a

- Need to model comprehensively though!

PHPP Optimisation

Approximate savings for minimal cost

Air tightness:

- n_{50} 0.3 ach 1.5 kWh/m^2.a
- Risky to rely on this and confidence in good results will depend on building size, complexity and door types.

PHPP Optimisation

Approximate savings for minimal cost

MVHR Duct Lengths:

- Keep to minimum 0.5 - 2.0 kWh/m^2.a
- But be realistic at design stage.

PHPP Optimisation

Approximate savings for minimal cost

Internal Heat Gains:

- PHPP 9 IHG allowance of 50W per dwelling
- Particular benefit for smaller properties
- Could save 1.5 – 3.0 kWh/m^2.a

Designing for Cost Optimisation

- Welcome
- Cost Overview
- Design Approach
  - Form
  - Fenestration
  - Structure, Services and Controls
- Contracts and Procurement
- Questions

Fenestration

- Size for daylight and views not as a solar heating system.
- Use the roof and reveals to provide summer shading for free.

Design out mechanical shading
(UK Climate)


Reveal as free shading

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

How could you optimise the window performance through design?

Poor Installation

Traditional mullions

U_{window} =

1.8W/m2K

Thermal bridge free installation

Simplified design

U_{window} =

0.8W/m2K

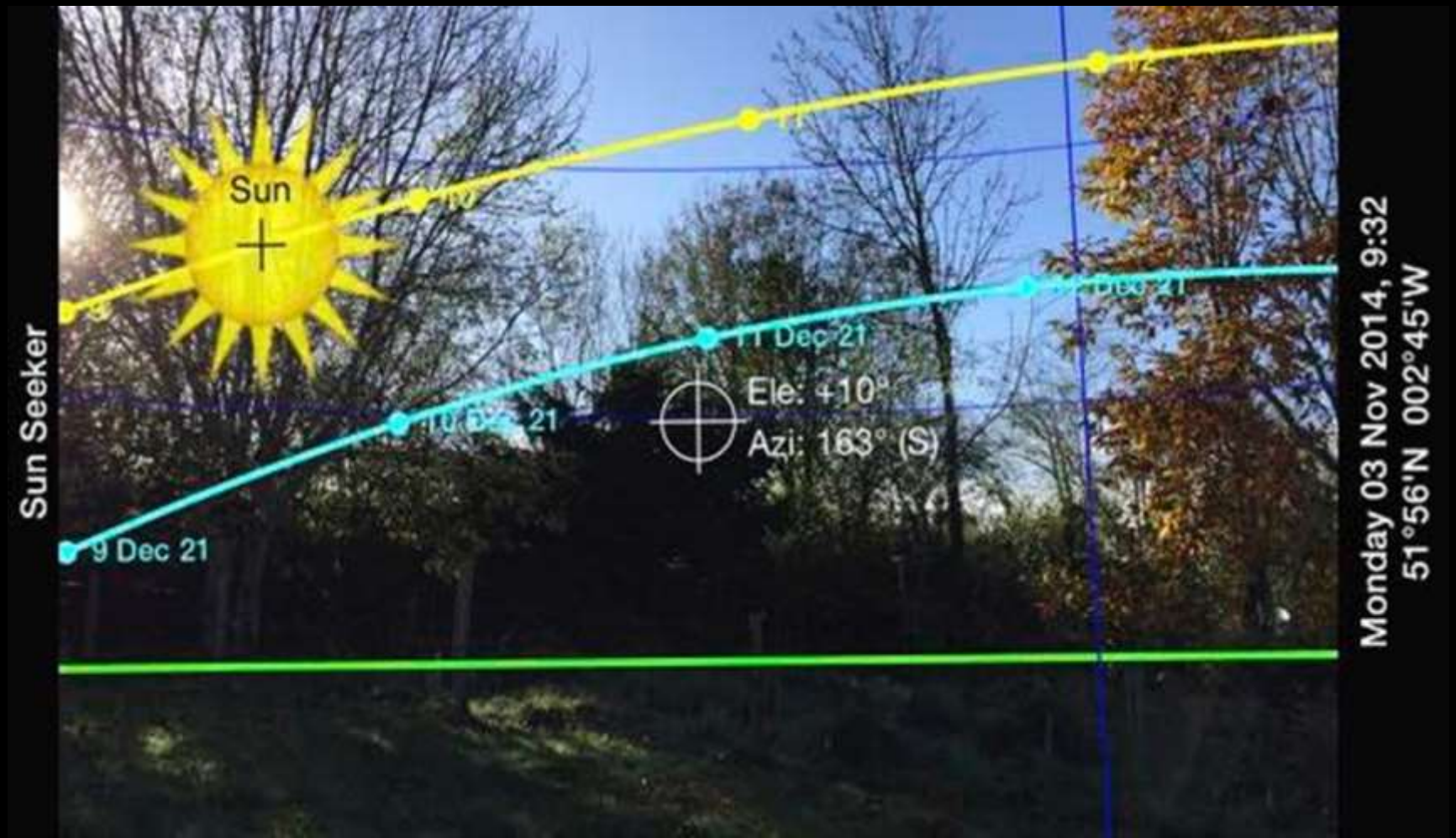
High drama, low cost

Fixed glazing c.a. 30% cheaper than opening windows, much cheaper than sliding doors.

Passivhaus by Bjørn Kierulf, Createra, Slovakia

Consider shading

Trees shade in winter as well as summer



Designing for Cost Optimisation

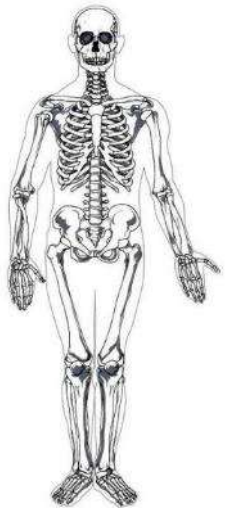
- Welcome
- Cost Overview
- Design Approach
  - Form
  - Fenestration
  - Structure, Services and Controls
- Contracts and Procurement
- Questions

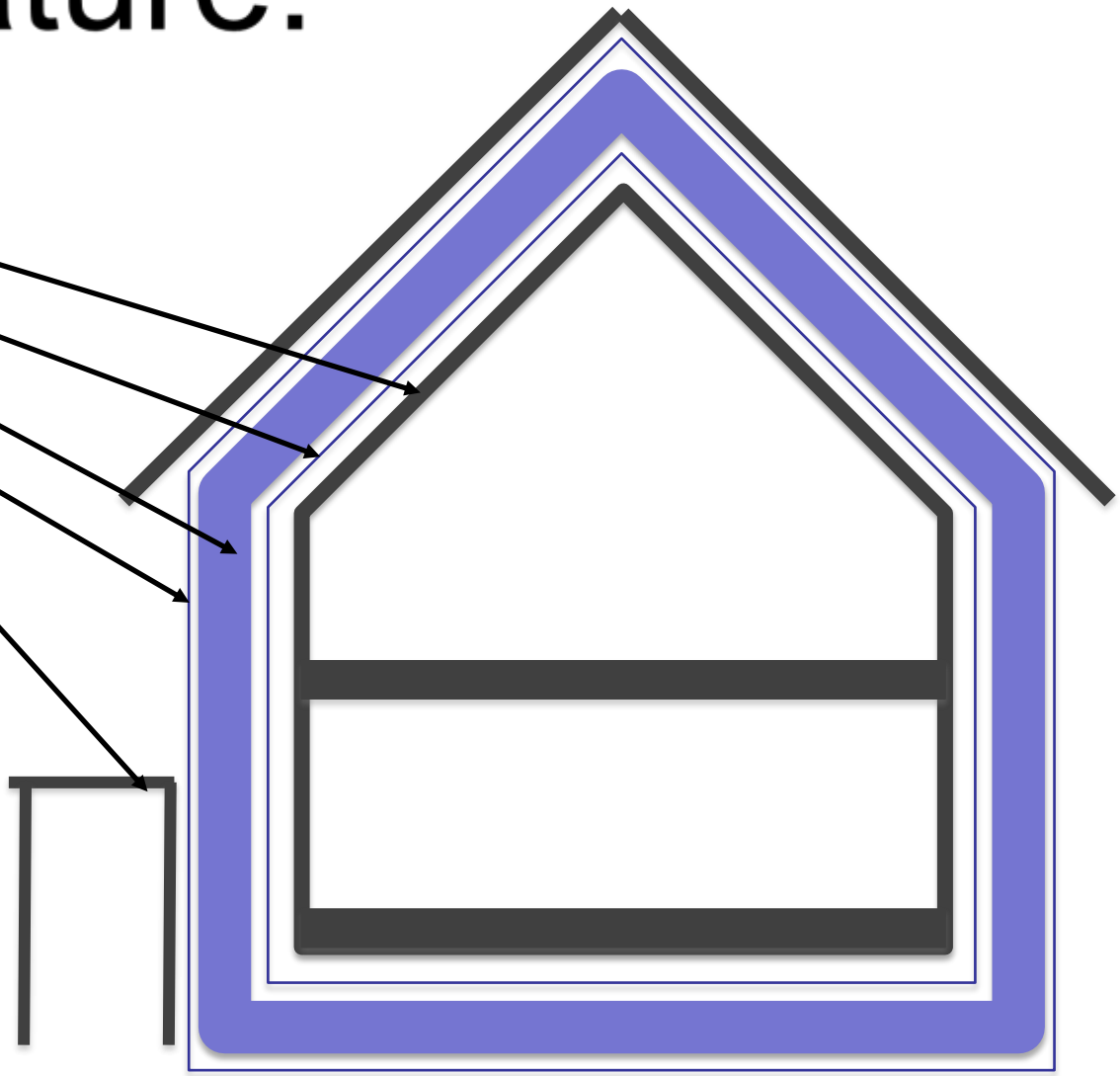
Structural strategy

- Easy to make airtight?
- Easy to avoid thermal bridges?
- Cost efficient?
- Perhaps part of the aesthetic?
- Using available materials?

As in nature:

structure
air barrier
insulation
wind and weather
external structure





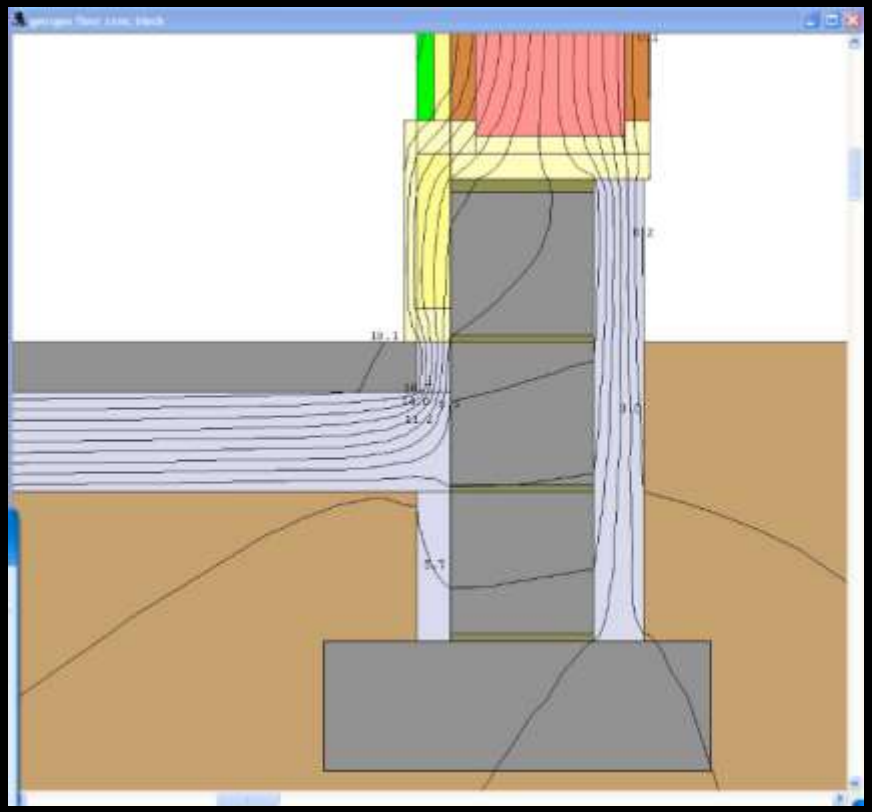
Also on the outside…

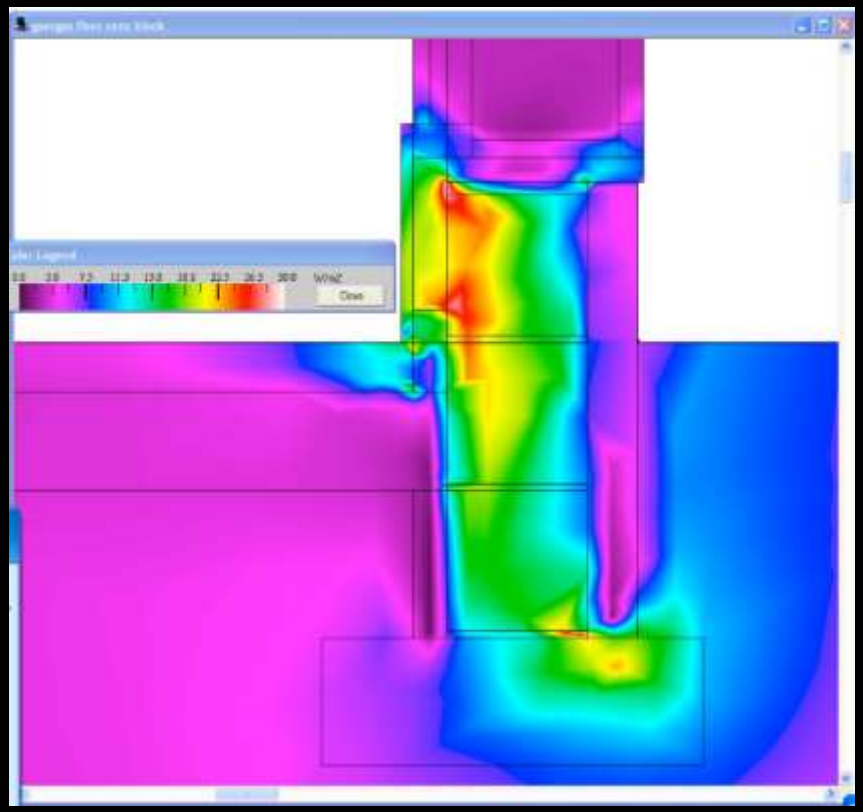
Very fiddly, lots of tape, not robust

Wind tight & cheaper to build

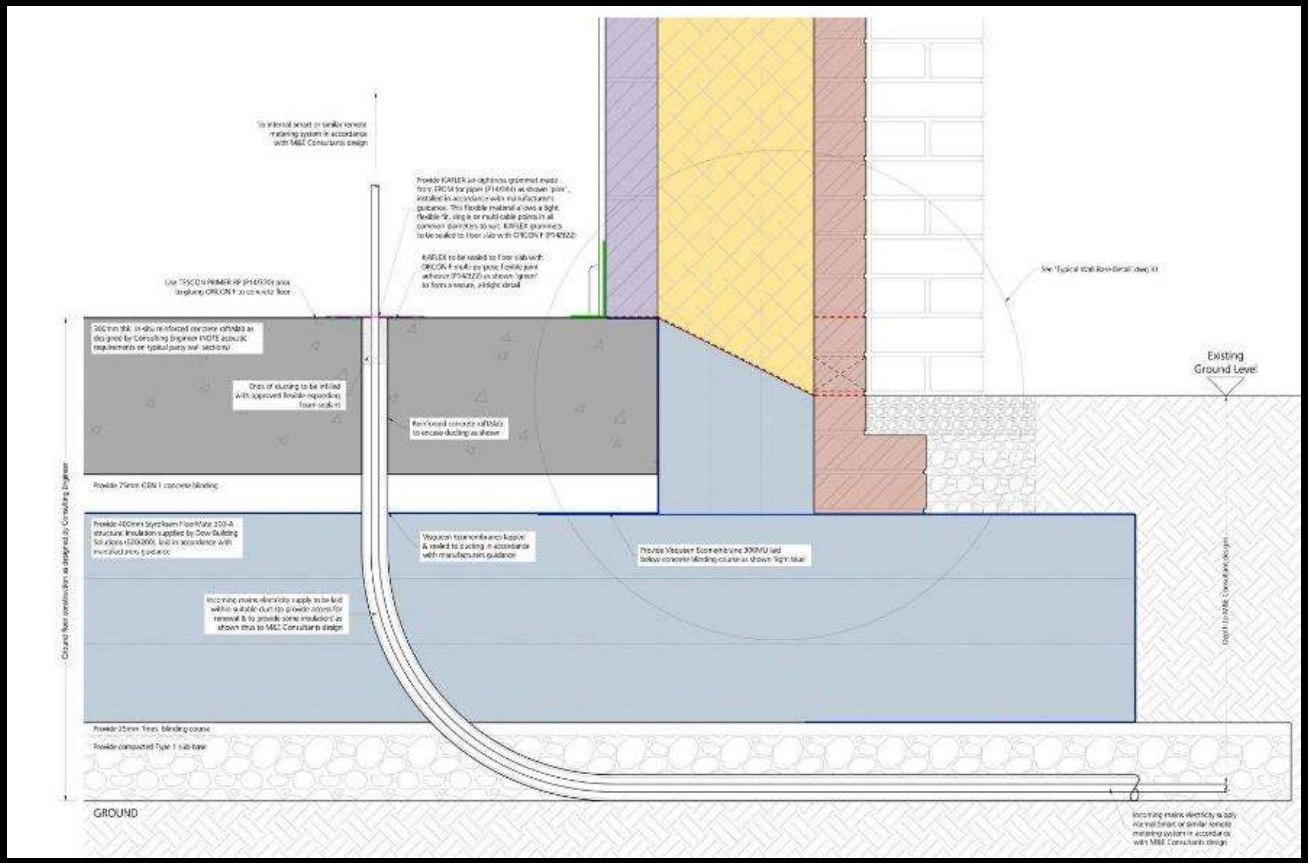
Wall/floor junction

Adding complexity to standard detail to reduce heat loss
Expensive, difficult to build



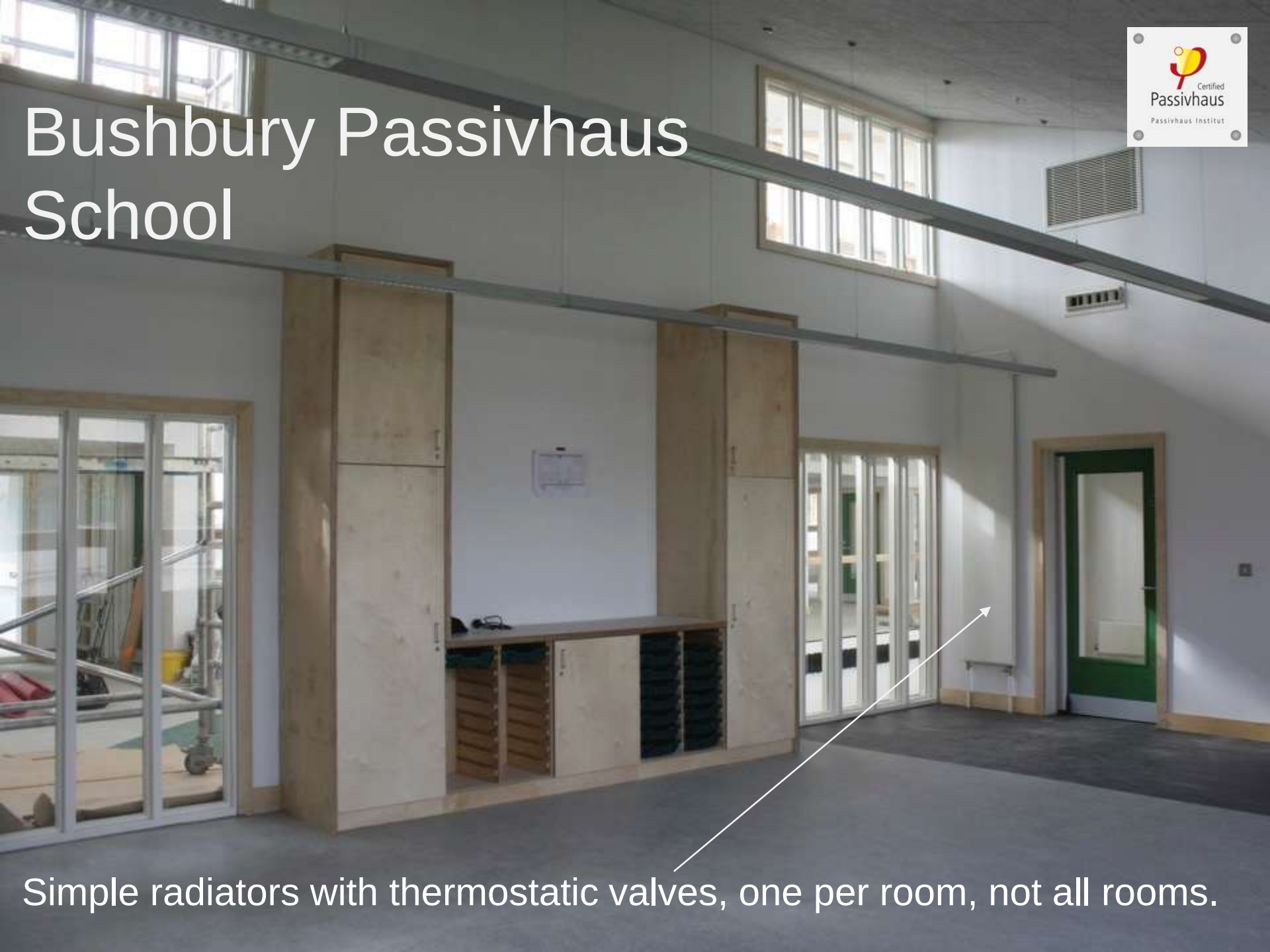


Simpler



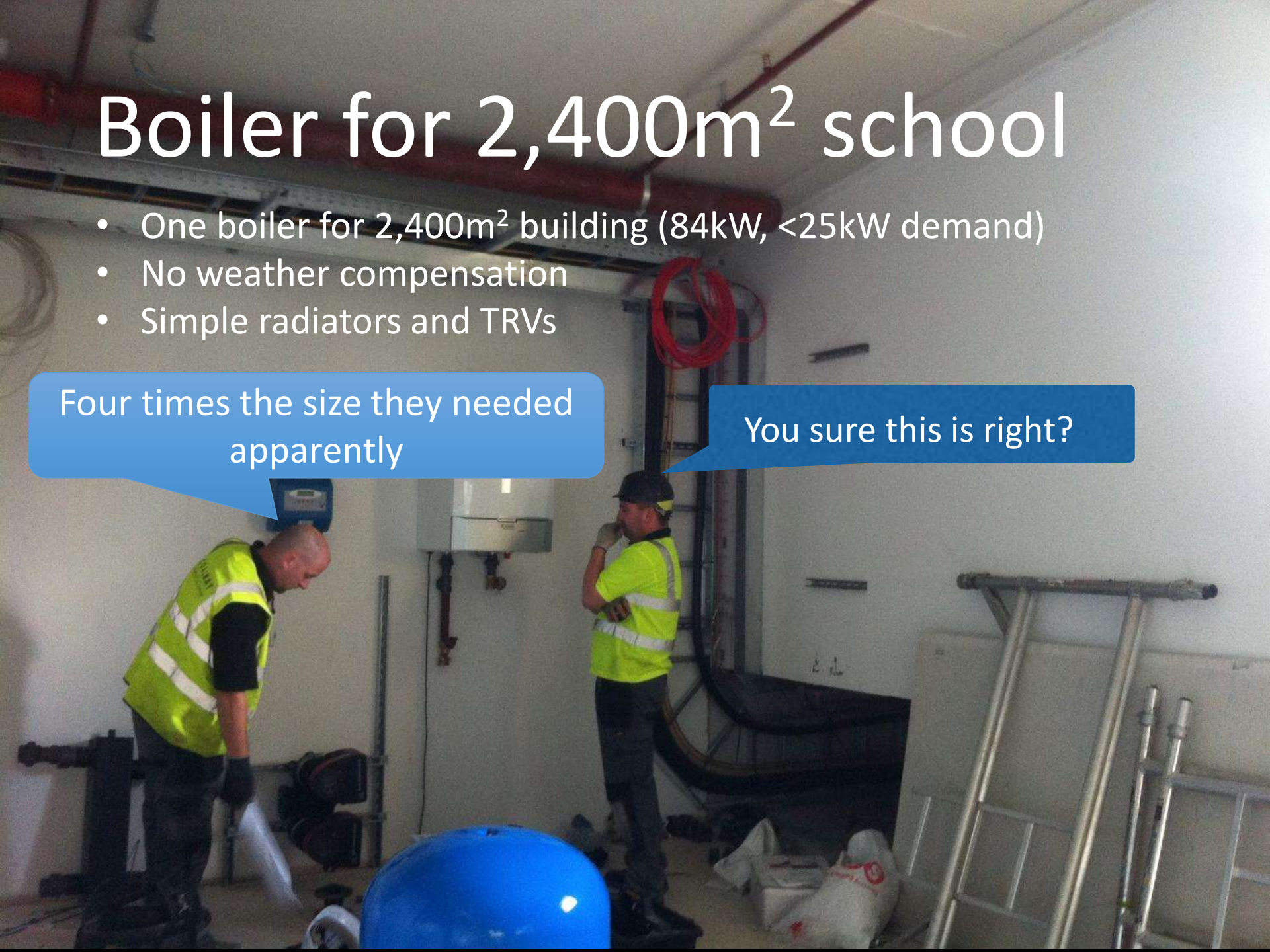
Typical Green Building Services

Bushbury Passivhaus School



Boiler for 2,400m^2 school

- One boiler for 2,400m^2 building (84kW, <25kW demand)
- No weather compensation
- Simple radiators and TRVs



Case Study

Learnings from Exeter's 'Infill Sites' Projects 2010-2015

CASE STUDY

ukpassivhaus conference2015

bre

GALE & SNOWDEN ecodesign.co.uk
exclusively low environmental impact design since 1992

Learnings from Exeter's 'Infill Sites' Projects 2010-2015

CASE STUDY

ukpassivhaus conference2015

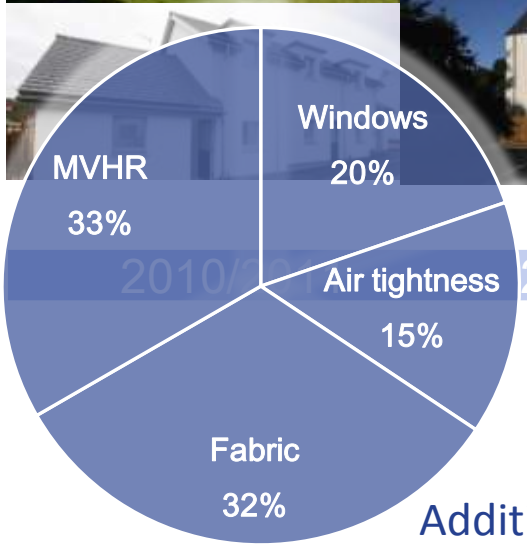
bre

Exeter ‘Infill Sites’ Project

- Exemplar affordable, sustainable council housing
- 12 sites in Exeter
- 120 affordable units (76 completed, 26 on site)
- individual designs
- Passivhaus
- Minimum CSH 4
- Lifetime Homes
- Healthy design (SBM2008)
- Climate Ready
- Building for Life

Exeter 'Infill Sites' Project

Timeline



2010/2011 2012/2013 2014/2015 2016

Additional cost for Passivhaus
(2010 scheme)

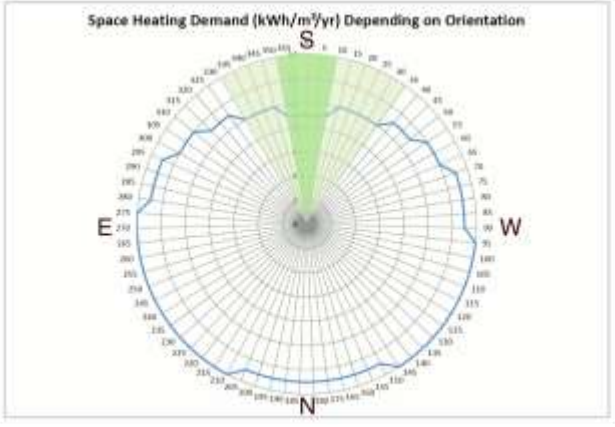
Learnings from Exeter's 'Infill Sites' Projects 2010-2015

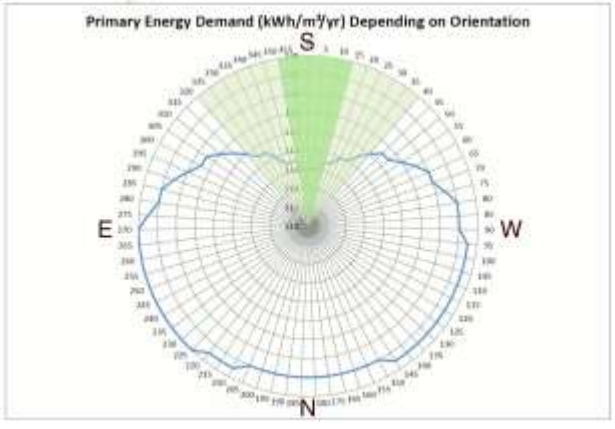
1 DESIGN

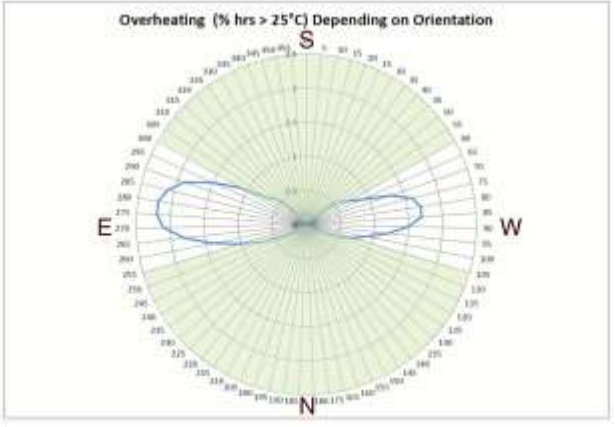
TAKE THE 'FREE' ENERGY SAVINGS

Maximise ‘free’ energy savings

Orientation





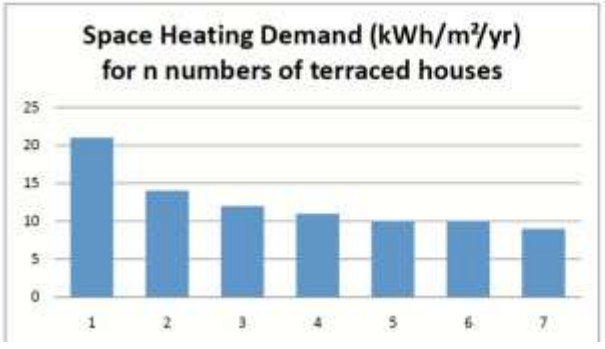


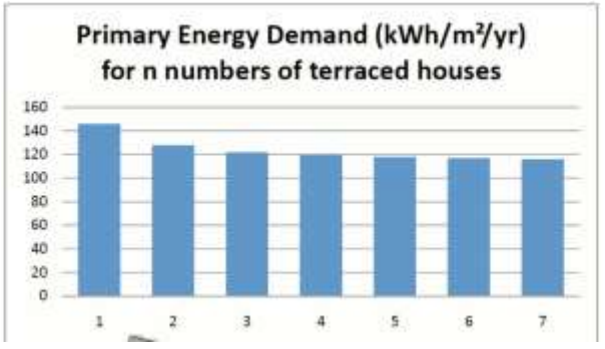
Site Layout

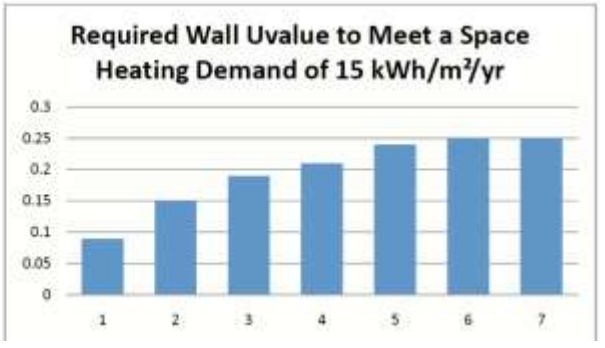
ecodesign.co.uk
GALE & SNOWDEN
exclusively low environmental impact design since 1992

Maximise ‘free’ energy savings

Form/Massing







Optimised form and orientation allowed for greater flexibility in fabric performance

GALE & SNOWDEN ecodesign.co.uk
exclusively low environmental impact design since 1992

Learnings from Exeter's 'Infill Sites' Projects 2010-2015

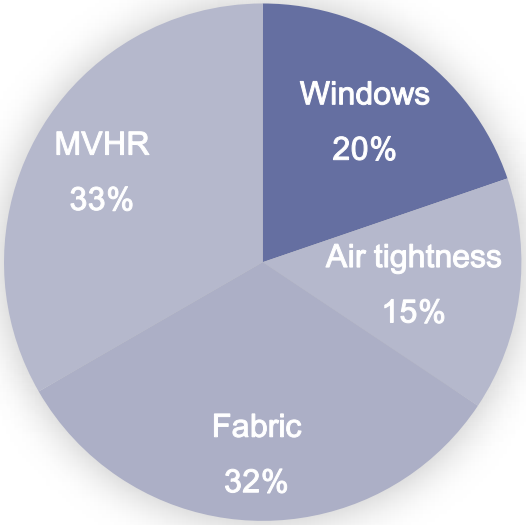
2 SPECIFICATION

DETAILING + CONSTRUCTION

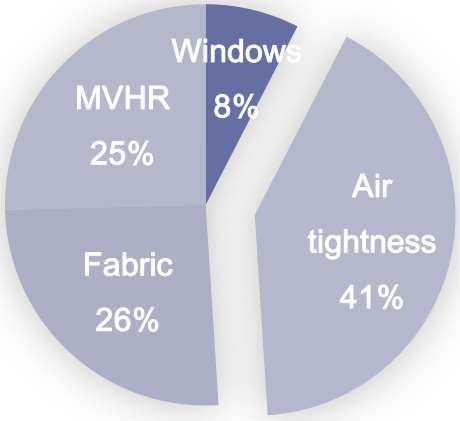
ukpassivhaus conference2015

bre

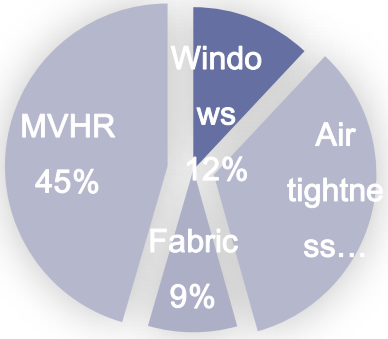
Cost effective Construction



-50%



-30%



5 Key Detailing Strategies

- **Minimise layers/trades** in key fabric elements
- **Rationalise fabric** performance by focusing on elements that are easy/cheaper to install
- **Efficient use of openings** to optimise solar gains eg max glazed area, reduce external reveals, avoid shading devices
- **Robust air tightness strategy**, appropriate for the size of project and expected supervision (avoid tapes etc.)
- **Dry or quick drying construction** to ensure adequate environment for high quality installation

Avoid the pitfalls

- Sustainability is more than just energy performance
- Life cycle costs: PH components are more expensive to replace – just because something is PH certified does not mean it will also necessarily last longer
- High performance insulants: costly, hazardous (?), environmental impact (?)
- Local climate: don't just copy what worked abroad
- Keep it simple and avoid 'belt and bracers'

Designing for Cost Optimisation

Summary

Value Engineer at design stage
Form
Orientation
Model, and model again
Optimise
Fenestrate for daylight
Simplicity of Structure
Simplicity of Services

Designing for Cost Optimisation

Thank you

Chris Parsons – Parsons + Whittley
Tomas Gartner - Gale & Snowden