

Value Engineering; What's not to love?

AECB Conference
Sheffield 2015

Nick Grant

Nick Grant, AECB Conference Sheffield 2015



Value Engineering

Value engineering (VE) is systematic method to improve the "value" of goods or products and services by using an examination of function. Value, as defined, is the ratio of function to cost. Developed at GE in WW2.

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

The originators of VE found that reducing cost often increased function.

Function of Buildings?

- Protection
- Comfort
- Physical health
- Mental health
- Impress other architects??
- Others?



‘The creative process is in formulating the problem. Once that is done in the right way, it’s all routine table work. The problem is solved’

Piet Hein

Art is solving problems that cannot be formulated before they have been solved. The shaping of the question is part of the answer.

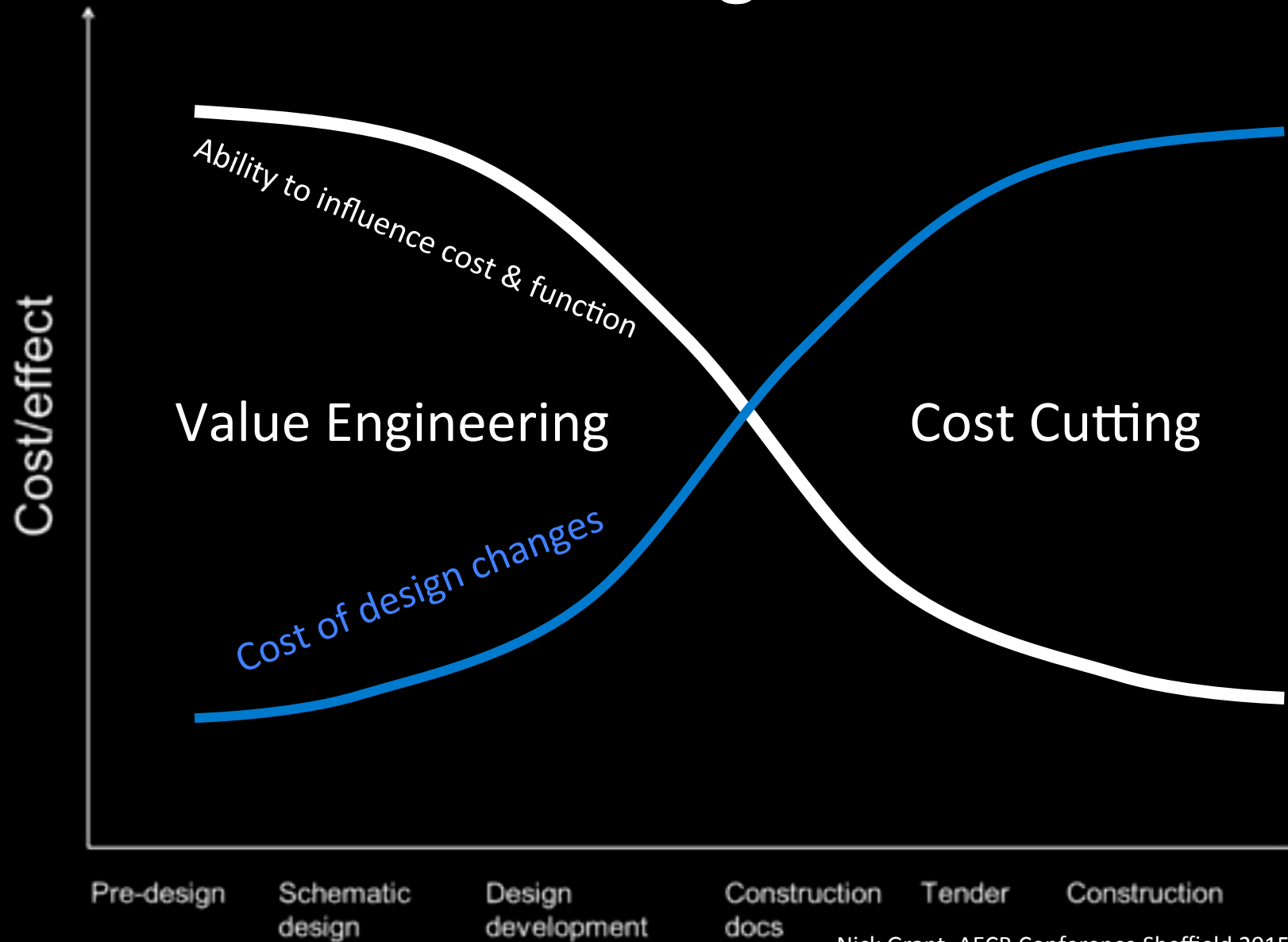


Value Engineering

Value, a branding problem?



VE vs. Cost cutting

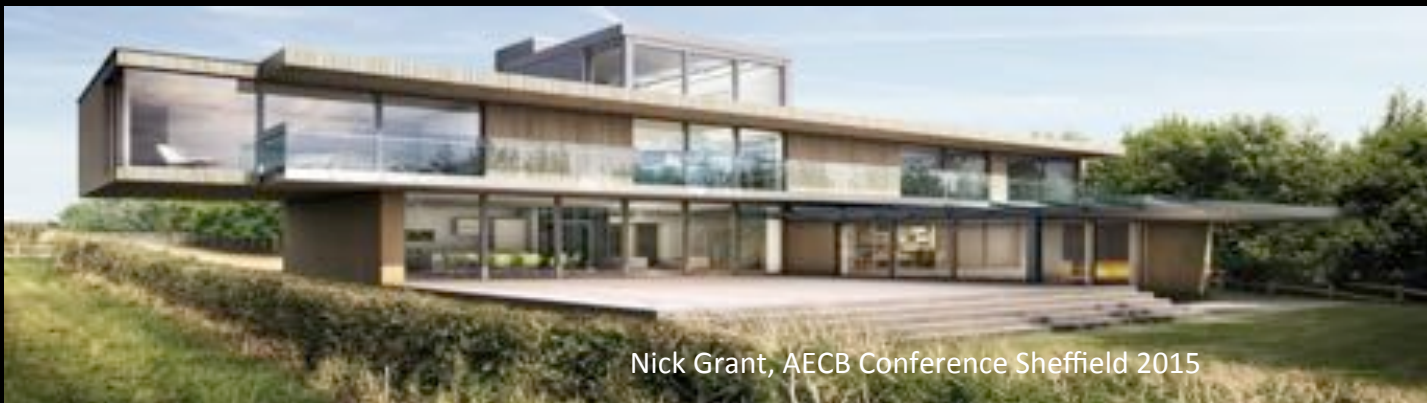


Options to reduce cost

- Do less – smaller building
- Pay less – play the market – be ruthless
- Improve efficiency – do more for less
 - Efficient use of space, materials, form, labour
- Sufficiency + efficiency = sustainable



Can we put a price on sustainability?



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High cost, what is the value? 'Aspirational green?'

08:00 95%

Passivehaus Serenity - CIBSE Journal October 2014

OPTIONS SKETCH

Labels in the sketch include:
- Efficient segment loop
- Day-to-night ventilation and roof
- Buried energy loop to stabilize ground temperature & provide space & serviceable structure
- Solar Blank Integrated PV's and solar for water
- ENTRANCE & ENTERTAINING
- LIVING
- Guest wing
- Buried segment loop
- Openings behind water fall to naturally ventilate and gully
- Openings behind water fall to naturally ventilate and gully
- Storage mass floor
- Thermal capacity to stabilize internal temperature & provide space & service during the winter
- Storage for cooling 2000 litres to each cluster

In the final design, a CHP plant replaced solar thermal technology. The buried energy loop network passes around the building's perimeter, connecting to each hub's heat pumps

Keeping it simple | - have been included in the design

2 6 10

Comment Share

What functions should we aspire to?

- Zero impact?
- Net zero energy?
- Plus energy?
- Autonomous?
- Living Building Challenge?
- Local?
- Urban/Rural?
- Innovation

Innovation as a goal



Chindōgu

BBC NEWS | **BBC NEWS CHANNEL**

Friday, 18 April, 2009, 04:20 GMT (11:22 UK)

R.I.P. Innovations Catalogue

THE INNOVATIONS CATALOGUE, the source of gadgets which really ought to be useful, has passed on to the colour supplement in the sky.

Starting life 20 years ago, the catalogue was a familiar friend to many, popping round unexpectedly most Sundays.

Always good company, it shared with new friends its passion for technology, and introduced many to the joys of clocks which are set to the right time **AUTOMATICALLY** by radio signal! Another love was genius devices which recharge **ORDINARY BATTERIES** **WITHOUT** their **EXPLOSION!**

It leaves behind an extensive window cleaning device, a handy portable paper shredder, three snow stoppers, some one-size-fits-all gadgets, and a fun fun-lined vibrating golf club cover.

For something which had the potential to enhance office life, it was fitting that one of its most passionate advocates was Ricky Davies. "I'm a gadget geek," he said. "I flick through the Innovations Catalogue and think: 'That'll give me the edge over other men!' None of it does, of course. Technology just hasn't kept pace with my needs. Where's the individual jet pack that allows you to just take off and land somewhere neat? Where's the Thought Downloader? The Moving Rejuvenator? The Complete Real in A Real? As a child, I was told such things were just a matter of time."

Its long-held mission was to "admire the amateur inventor toiling away in the garden shed". Who now knows what Moving Rejuvenators will be forever frozen, consigned to lonely years with only a lawn mower and rusty Springball for company.

No flowers.

Some of your tributes

I have admired Innovations from early childhood and am genuinely distressed by this turn of events. Luckily, I am wearing sponge-lined spectacles with integral FM tuner to absorb my tears (while I listen to the latest pop hits in style and comfort).

Ed Grace, London

Why my passion for VE?

Lucas Electrathon 1979, finished 39th out of 60 entrants
Cheap and cheerful - low cost and low value
(Youngest entrant, cheapest vehicle)



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THUMBS up from Nick in his electric car which cost just £8 to build.

Cedric Lynch – an inspiration

Radical VE, 2nd cheapest vehicle in the race?



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From soup tin motor to TTXGP winning machine



My formative years, 1980s

Parent's cottage industry chocolate factory – quality and economy

GEC Diesels – student apprentice design engineer

UCL – mech eng

Warwick Uni – EDAT

CAT – engineering vol', stand in site engineer

London Innovation Network – GLC – Cedric again!

Neater Eater – feeding aid

Reading – Walden, Small is Beautiful, Zen & The Art of Motorcycle

Maintenance etc

VE was a recurrent theme for me

A very formative year; GEC Diesels 1981-1982



GEC Diesels

- Inspired by VE, tried to introduce Japanese Quality Circles & mech' pencils!
- Unions v management, blue collar v white collar
- Culture of conflict, conservatism, class



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Neater Eater



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 Neater.co.uk

VE & Brainstorming; a powerful technique



Kaizen

“change for better”

改善

(Management bollockspeak alert)

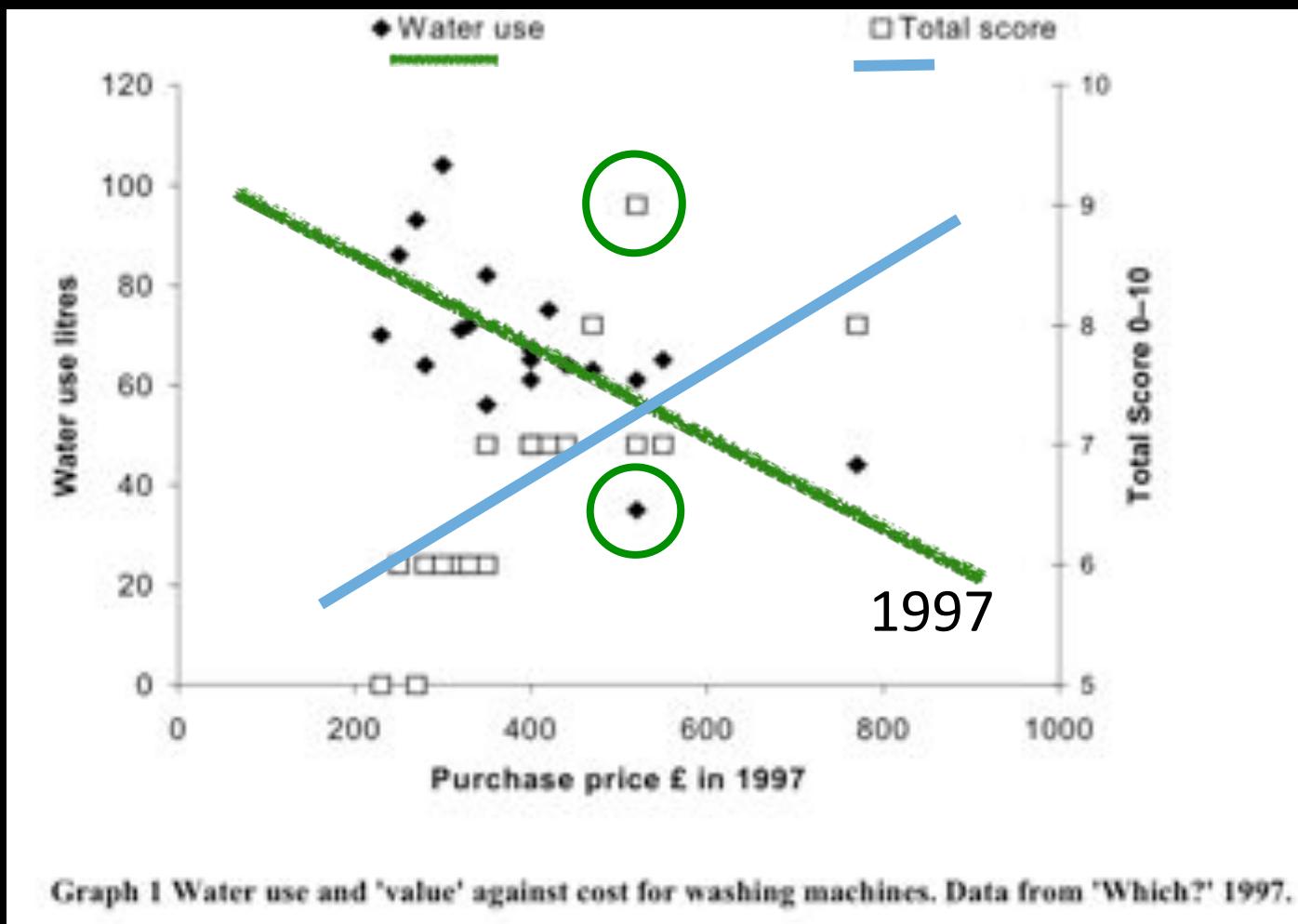


What happened to the British Motorcycle industry??

Unintended benefits of VE

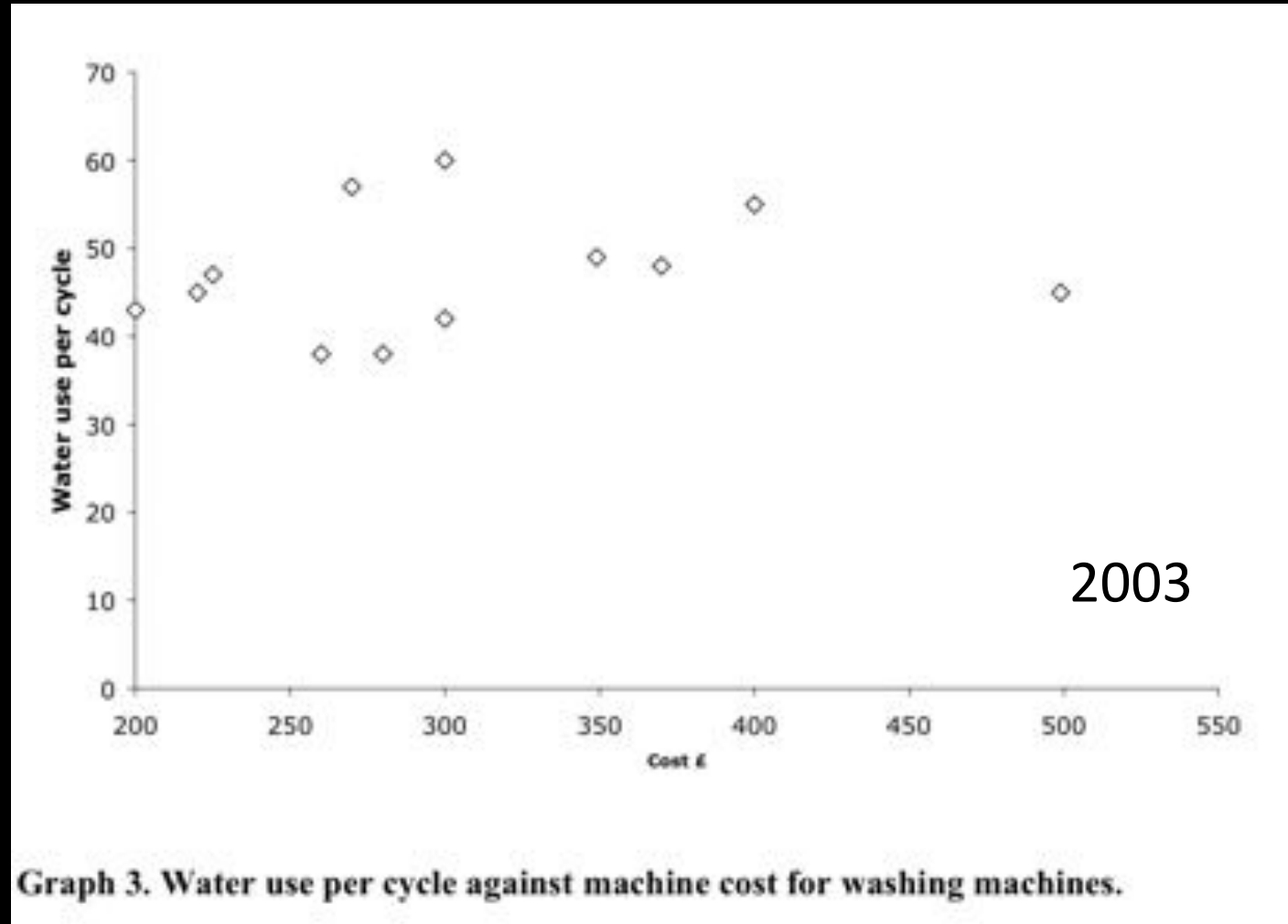
- Cost goes down but performance often goes up
- Less waste
- Less admin (e.g fewer components or variants)
- Sense of worth and team spirit if all involved and benefit shared

Cost benefit assumptions



Suggests cost/performance correlation with one anomaly.
Lowest water use, best score, middle price

Market transformation



Market transformation in 6 years

Constraints

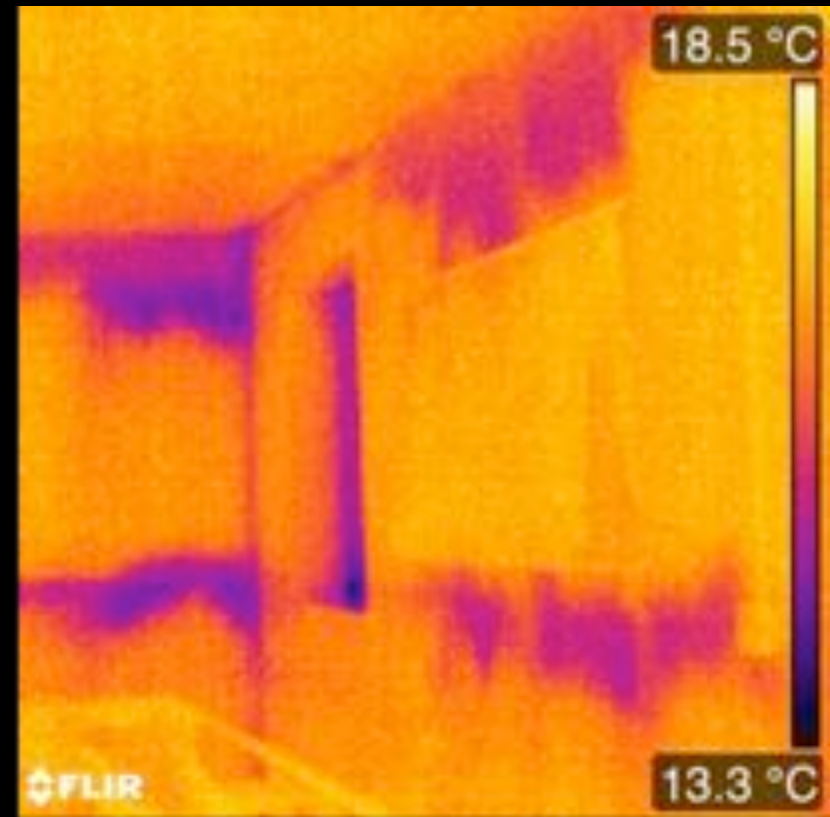
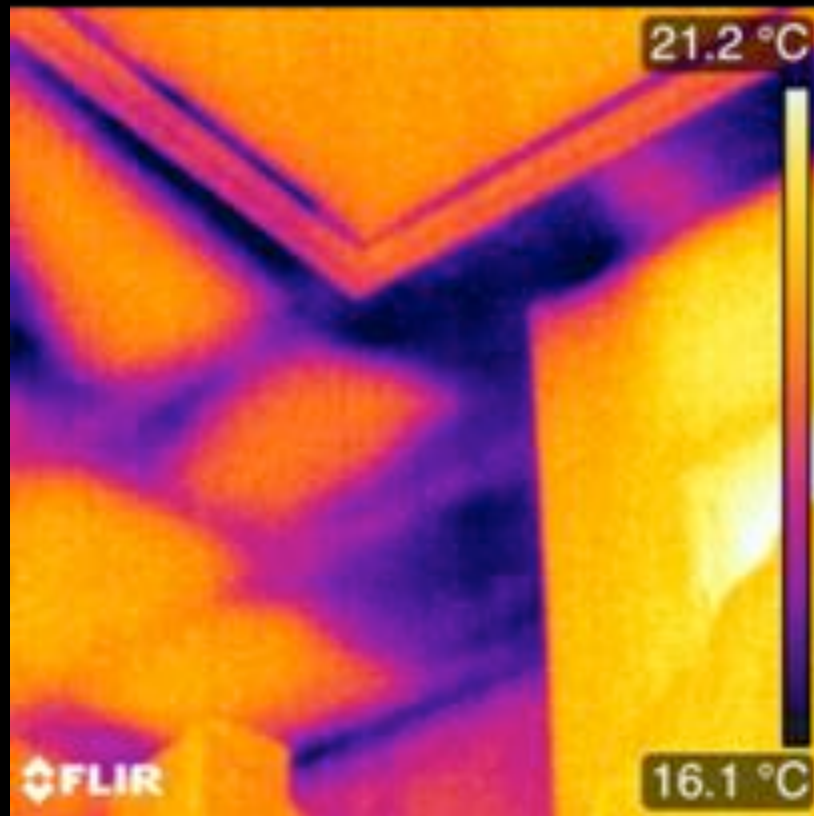
“Here is one of the few effective keys to the design problem — the ability of the designer to recognize as many of the constraints as possible — his willingness and enthusiasm for working within these constraints. Constraints of price, of size, of strength, of balance, of surface, of time and so forth.”

“I have never been forced to accept compromises but I have willingly accepted constraints.”

Charles Eames

Performance gap = low value
how to design out?

Code 4 buildings with comfort problems, a waste of insulation.



Value Engineered
(3.5 billion year design time)
Why do they always look like birds?



What can we guess
about this bird just by
looking at it?

Freedom



Design freedom



As free as a bird

Architecture?



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Form factor double whammy

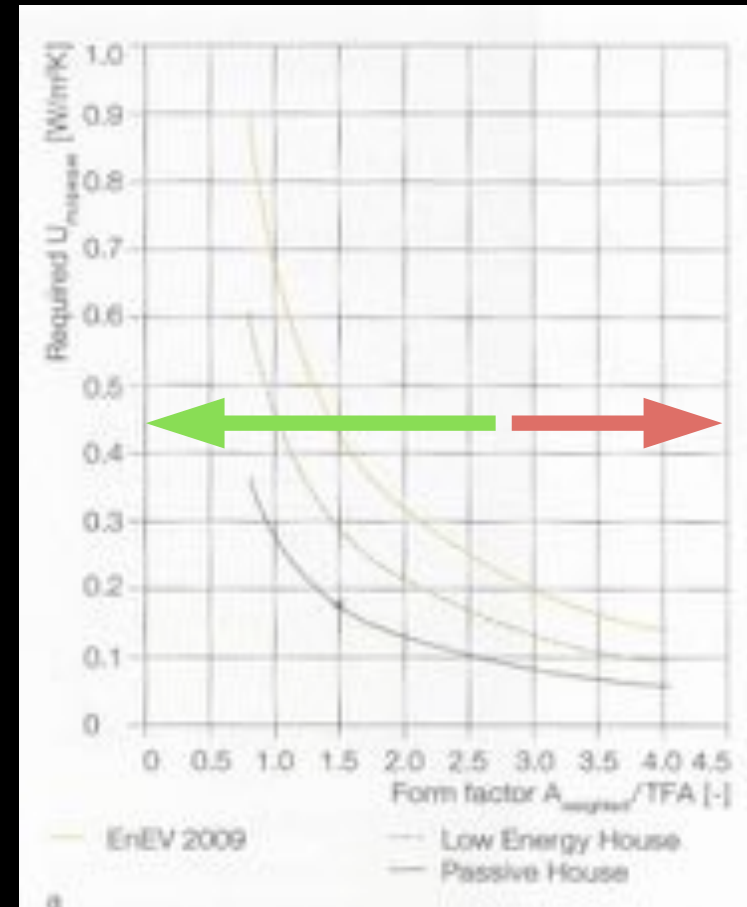
Higher FF = more wall and roof
= more cost

Higher FF = more heat loss =
more insulation

More insulation = more cost +
thicker walls = bigger footprint/
less floor = even more cost

Before we even think about
complexities of build, shading
etc

FF = Heat loss area/useful floor area



Passive House Design, Vallentin & Gonzalo

Form & Heatloss; not just buildings



Compensating for
too compact a form
by adding fins

Guess where
this owl lives



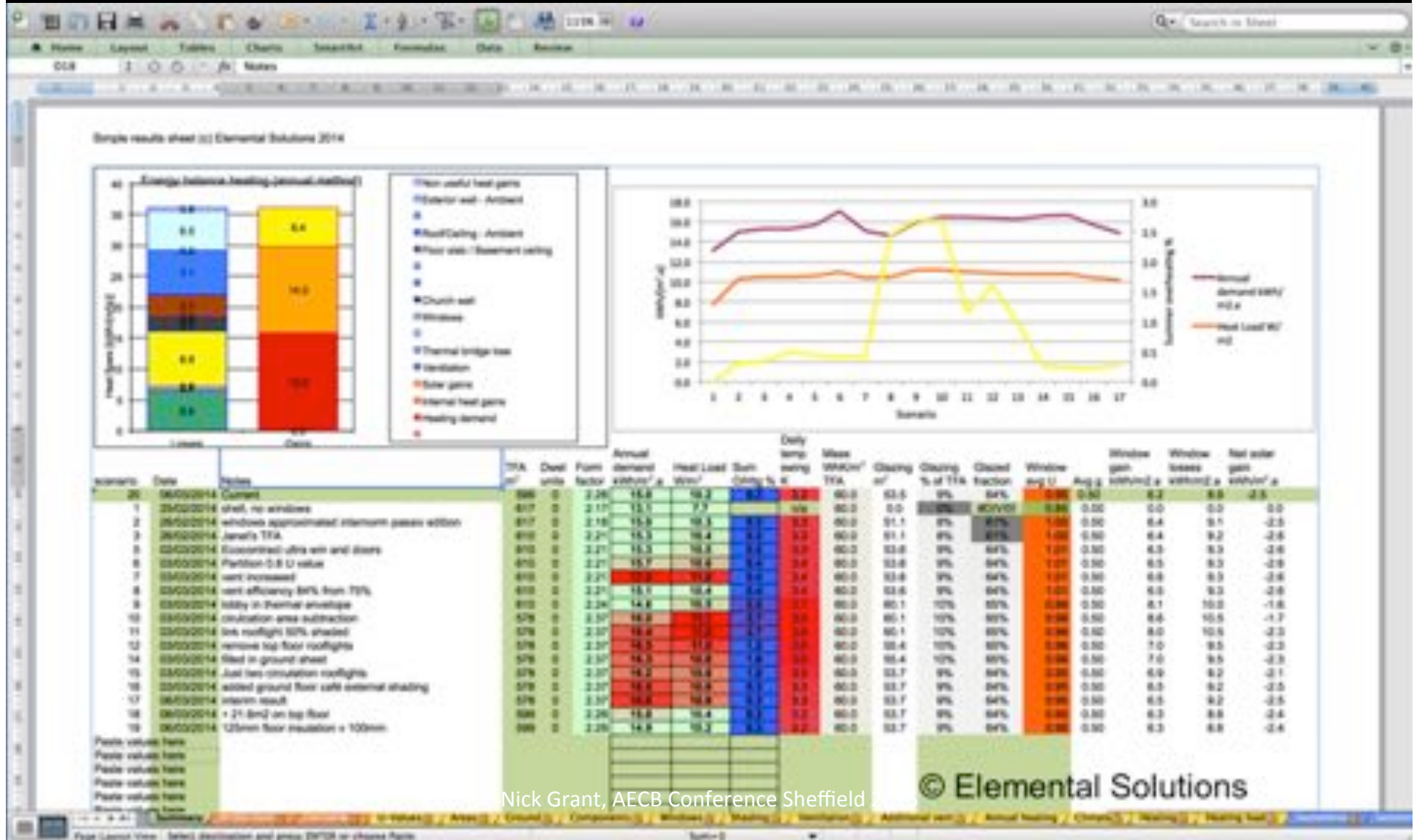
Optimum form?



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PHPP Tools to help maximise value

Simple scenario tracker



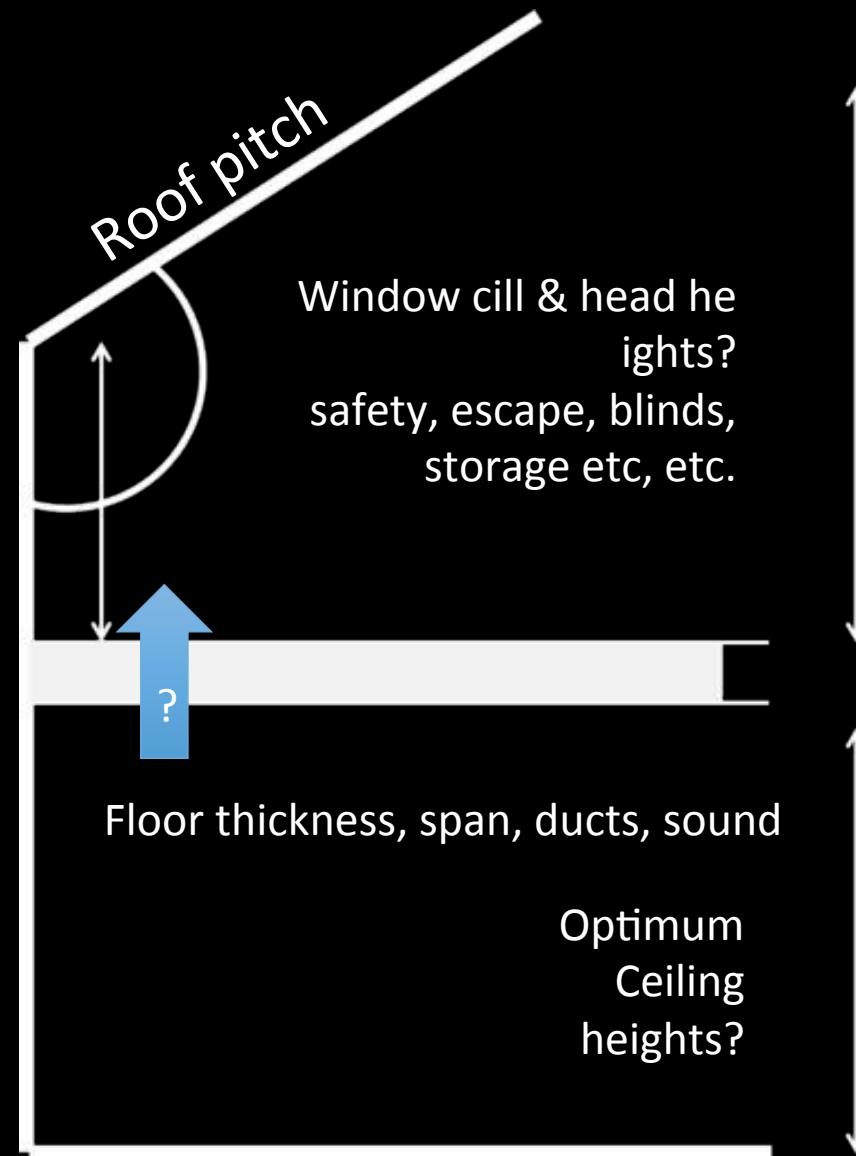
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Optimisation

Savings for negative cost

- Tall ceilings are nice but costly – heat loss area and materials plus planning constraints.
- Use the height where it has maximum benefit.
- Clever design can help deliver a Tardis illusion.



Fenestration

Windows - performance

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

But with PHPP, you have to calculate them individually

How could you optimise the window performance through design?



Poor Installation
Traditional
mullions

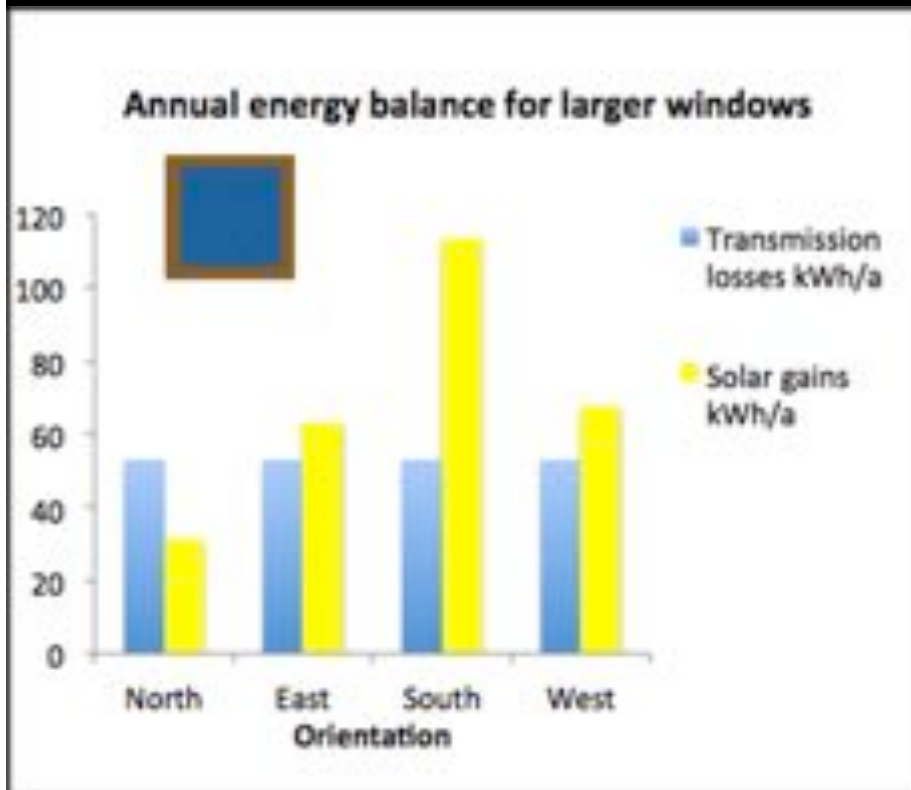
$$U_{\text{window}} = 1.8\text{W/m}^2\text{K}$$



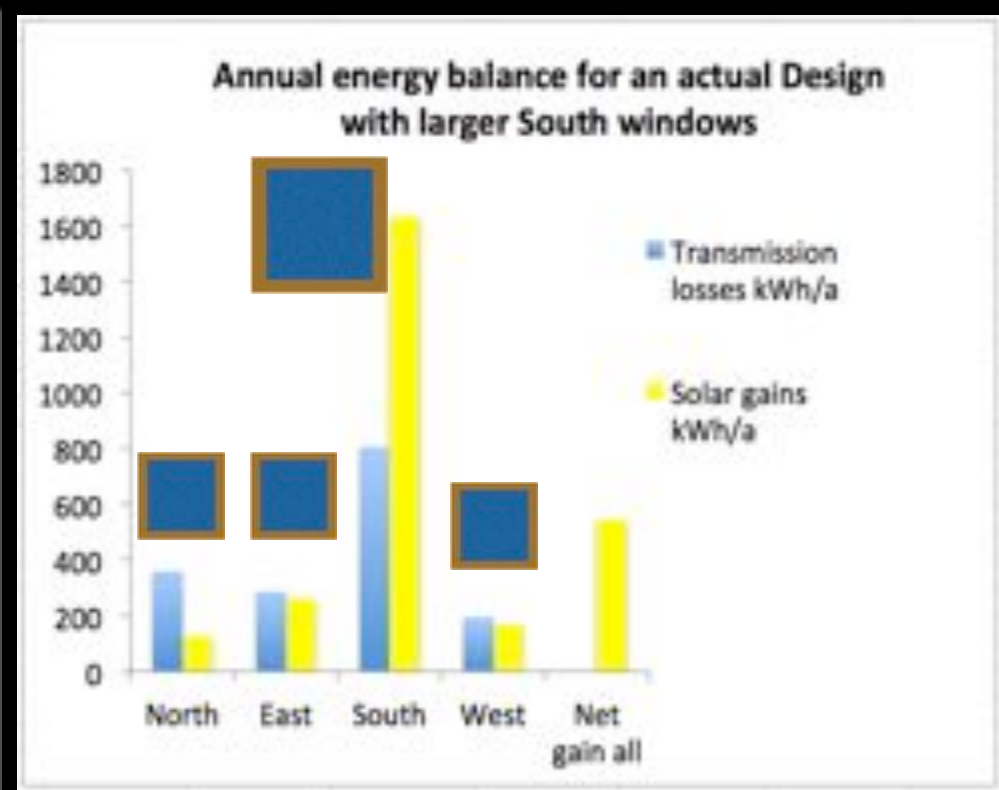
Thermal bridge
free installation
Simplified design

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

Fenestration Theory – (PH windows)



Larger windows with low frame factor, all the same size. Net gain except north.



Smaller windows on N, E & W have more frame and less glass. Only south has net gain.

Passive Solar

What does a free lunch cost?



Passive House verification

REDUCTION FACTOR SOLAR RADIATION, WINDOW U-VALUE

Building:

Annual heating demand: kWh/m²

Climate:

Heating degree hours:

Window area orientation	Global radiation (kWh/m ² per year)	Shading	SH	Non-temperature for incident radiation	Glaazing fraction	g-Value	Reduction factor for solar radiation	Window area	Window U-Value	Glaazing area	Average global radiation
North	105	0.70	0.95	0.88	0.000	0.53	0.32	18.90	0.83	10.8	196
East	234	1.00	0.90	0.88	0.000	0.80	0.80	0.00	0.80	0.0	234
South	632	0.88	0.90	0.88	0.678	0.83	0.48	36.23	0.77	24.8	428
West	248	1.00	0.95	0.88	0.000	0.80	0.80	0.00	0.80	0.0	248
Horizontal	260	1.00	0.95	0.88	0.000	0.80	0.80	0.00	0.80	0.0	260
Total or Average value for all Windows						0.53	0.48	36.13	0.78	35.2	

Transmission losses	Heat gains solar radiation
1863	341
1863	4000
2013	4341

Gains 4000 kWh/a – losses 1863 kWh/a
 Window area 36 m² = 59 kWhm².a

- About £6 'saved' per m² window per year @ 80p/kWh*
- Gets worse the more glass you add! (utilisation factor, solar shading, additional mass - all cost)
- BUT, free if you needed the window area anyway.

*(3% discount rate, 20 year life, £400/m² window cost, 100% utilisation – YMMV)

Do your own sums

data analyst

this spreadsheet of yours doesn't appear to make any sense

yeah its's bollocks innit



Modern Toss

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Design out mechanical shading (UK Climate)



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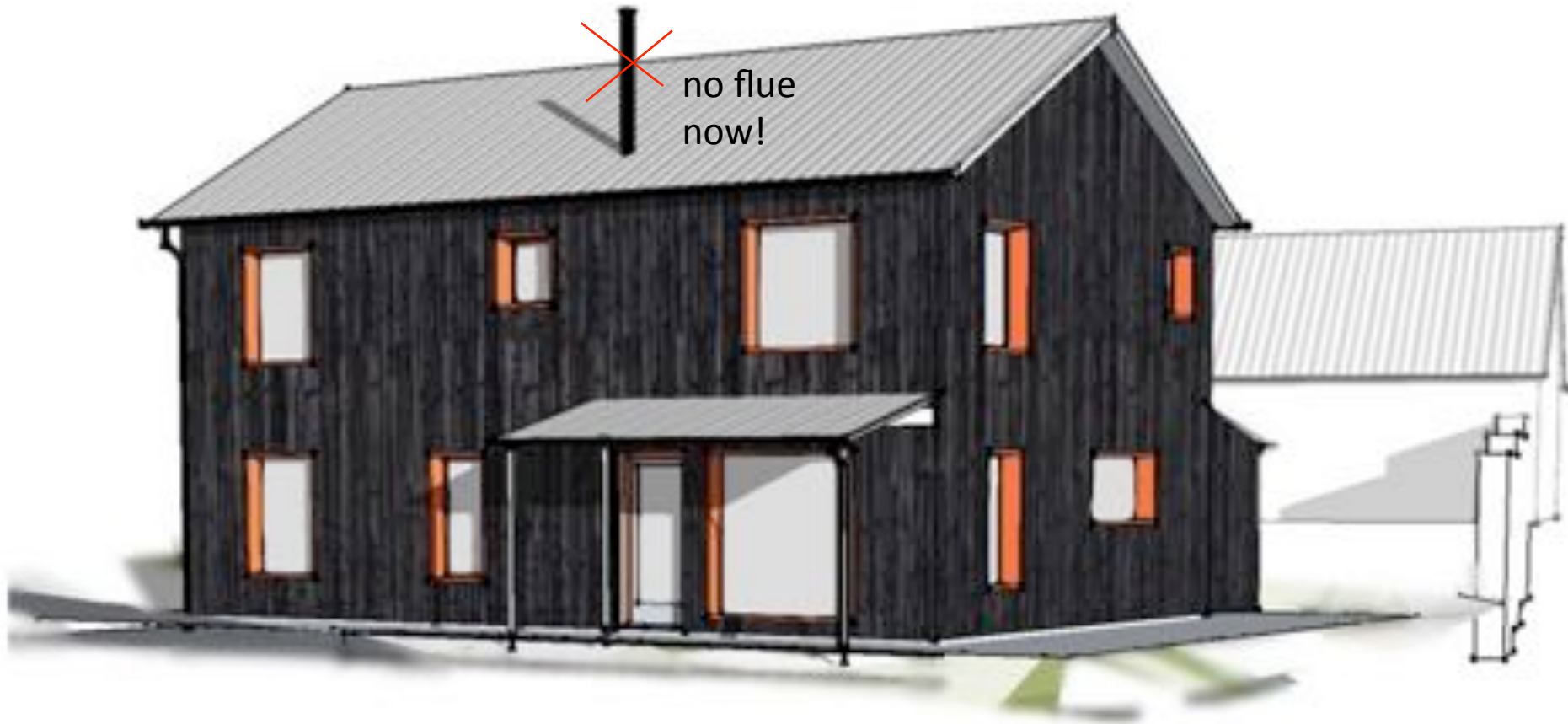
Wall depth as free shading

Progression windows from Green Building Store in Cae Duff
Passivhaus by Charles Grylls & Mike Whitfield

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No mullions, large, fixed

Fixed windows 30% cheaper – the larger windows are fixed



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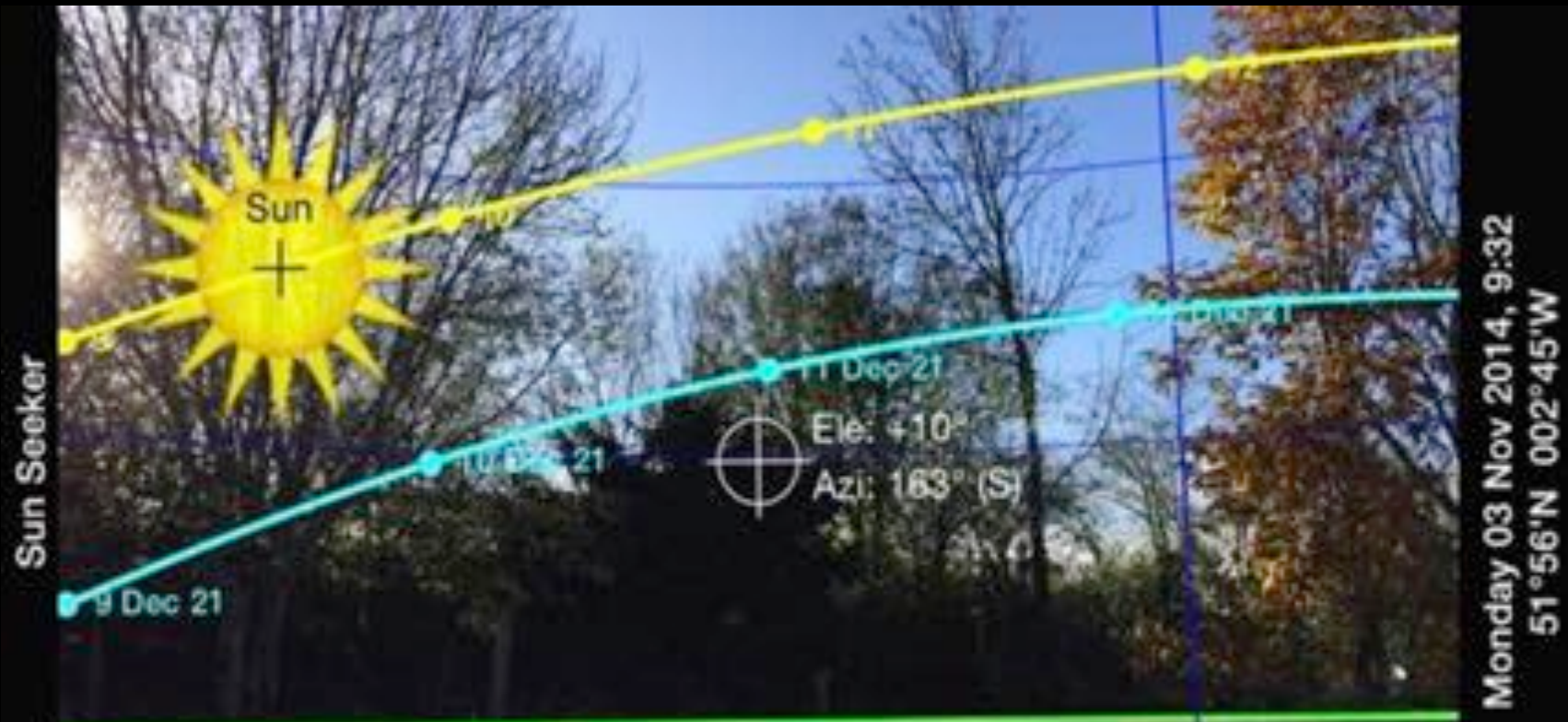
Dempsey Decourcy

Chartered Passivhaus Architects

The Crofts
Ross on Wye
Herefordshire
HR9 7AB
tel: 01989 56 25 16
mobile: 07957 33 22 62
email: cg@charlesgrylls.demon.co.uk

Free summer shading?

Trees shade in winter as well as summer



Glass to floor

- Glass below about 800mm does almost nothing to increase useful daylight.
- It provides solar gain in winter but is harder to shade in summer.
- It needs to be safety glass.
- Glazing to floor connections are harder to detail than walls plus more heat loss and airtightness is a challenge.
- IMHO it's a bit of a design cliché now.

High drama, low cost

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

Passivhaus by Bjørn Kierulf,
Cretera, Slovakia



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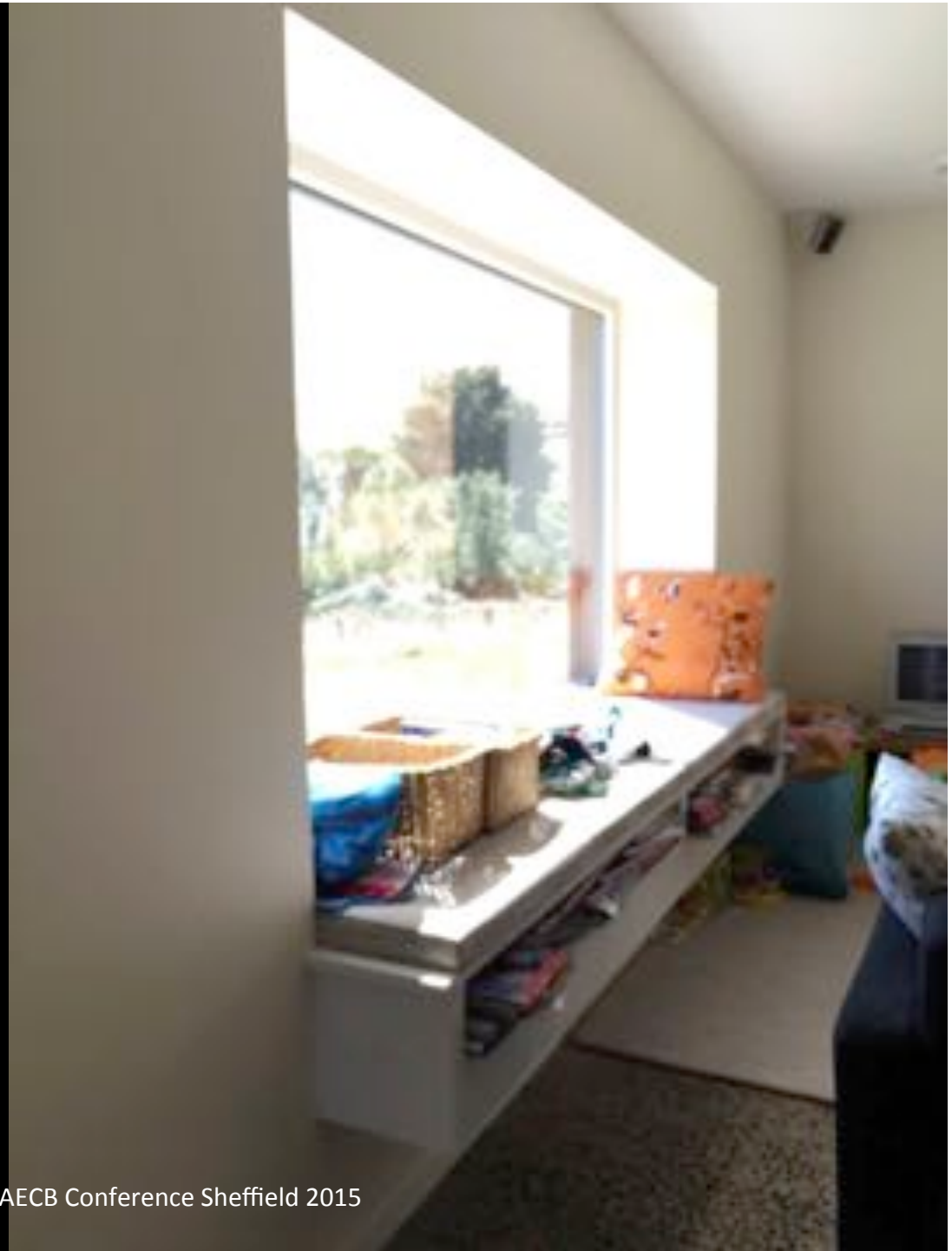
More examples



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More examples

Passivhaus in New Zealand



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More examples

Another NZ Passivhaus with T&T balcony doors but no other opening windows



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Jon Illiff, eHaus, Wanganui

m² window cost in UK

	Double	Passivhaus	Overcost/m ² Floor area	Additional Build cost
PVC High Quality	£180	£240	£12	+ 1%?
Timber High Quality	£230	£310-450	£16-£43	+ 1-3%

- Calculation based on a current Passivhaus Project, Cae Duff
- 26m² windows and doors
- 134m² TFA (PH methodology so c.a. 150m² GIFA)

How to make glazing expensive

- Add 50% glazing area
- Add extra shading to deal with subsequent overheating
- Add sliding doors
- Add steel structure to accommodate sliding doors
- Throw in some corner windows with sky hooks to hold the roof up
- Add 10 - 15% on build cost?

Clever skylight alternative

NZ Passivhaus LED virtual skylight in bathroom



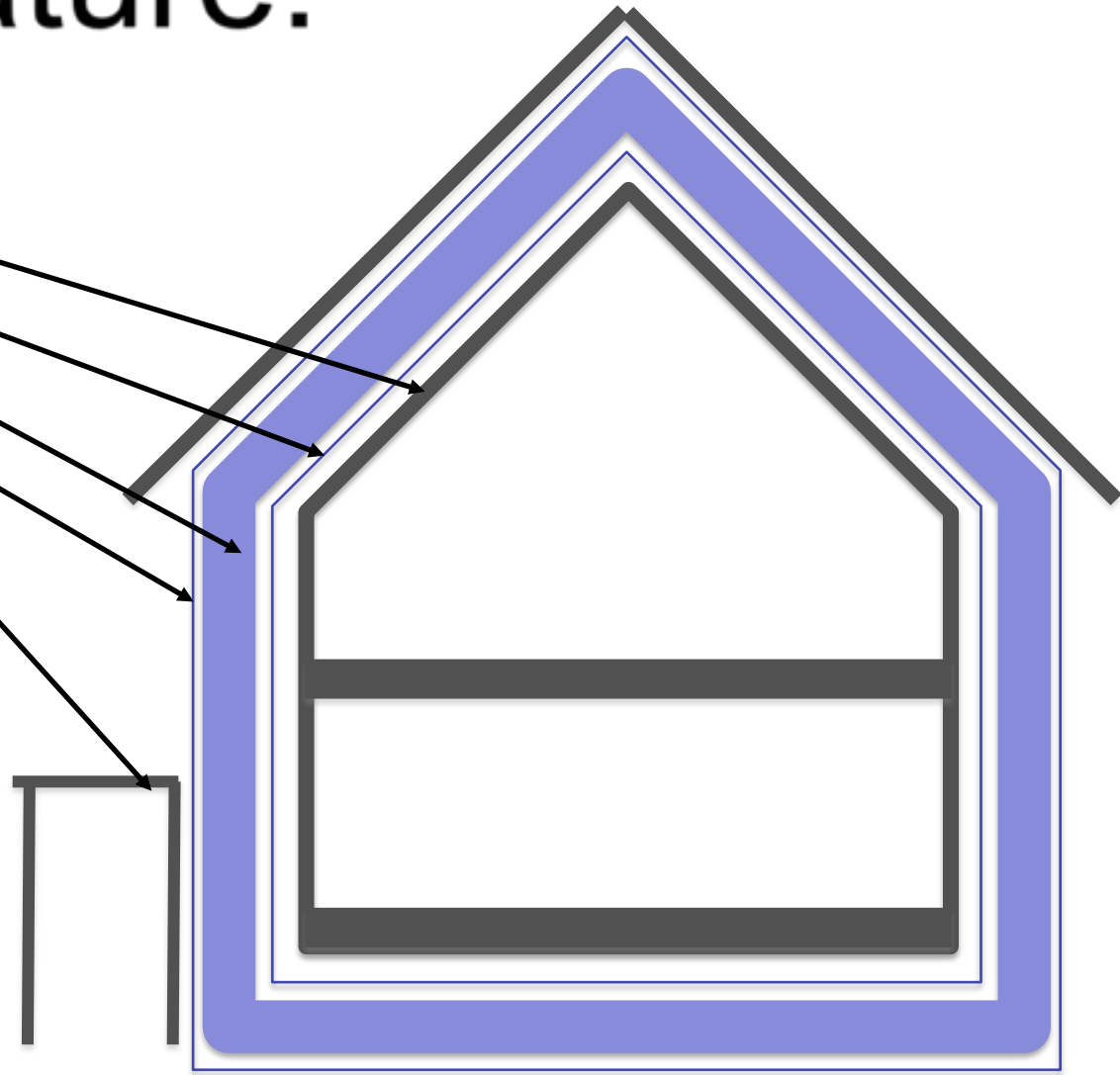
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Jon Illiff, eHaus, Wanganui

Structure

As in nature:

structure
air barrier
insulation
wind and weather
external structure



Not like these
Green style over function



This is good



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The image shows the interior of a traditional cruck frame extension. The structure is composed of large, dark wooden beams that form a series of interconnected arches and trusses. The ceiling is high and features a complex arrangement of these beams, creating a series of triangular and polygonal spaces. The walls are a light, warm color, and the overall atmosphere is cozy and rustic. In the background, there are bookshelves and a staircase, suggesting a living or library space. The lighting is warm and focused, highlighting the intricate details of the timber work.

This is good

Mike Whitfield super-insulated traditional cruck frame extension

Nick Grant, AECB Conference Sheffield 2015

This is good



Sjölander da Cruz

Nick Grant, AECB Conference Sheffield 2015



This is good

Cavity wall, (or ICF) floor joists don't penetrate plaster air barrier

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Also on the outside...



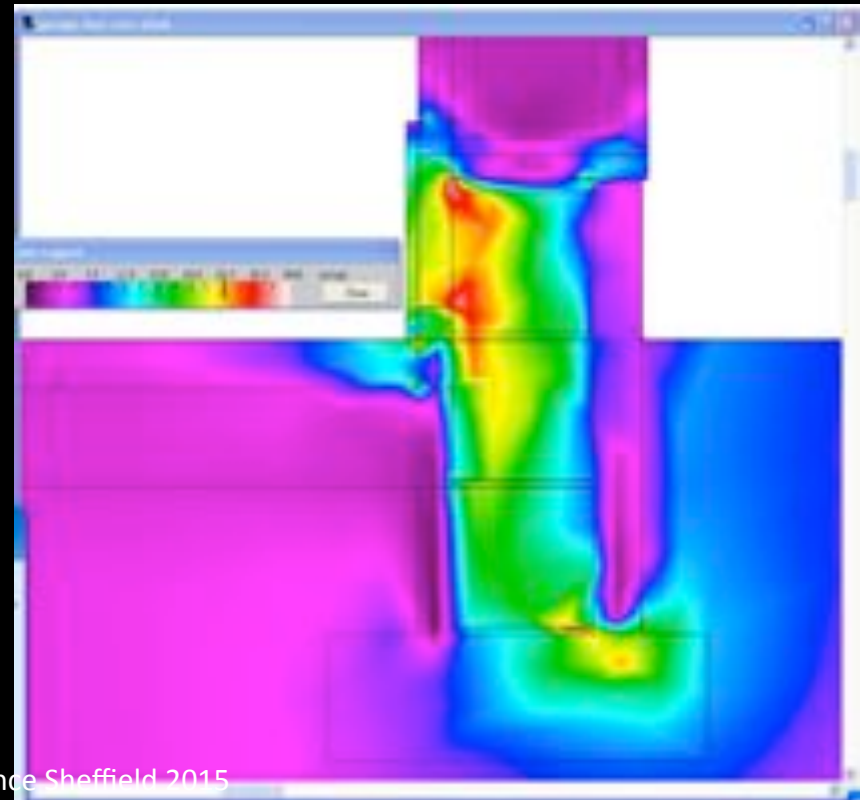
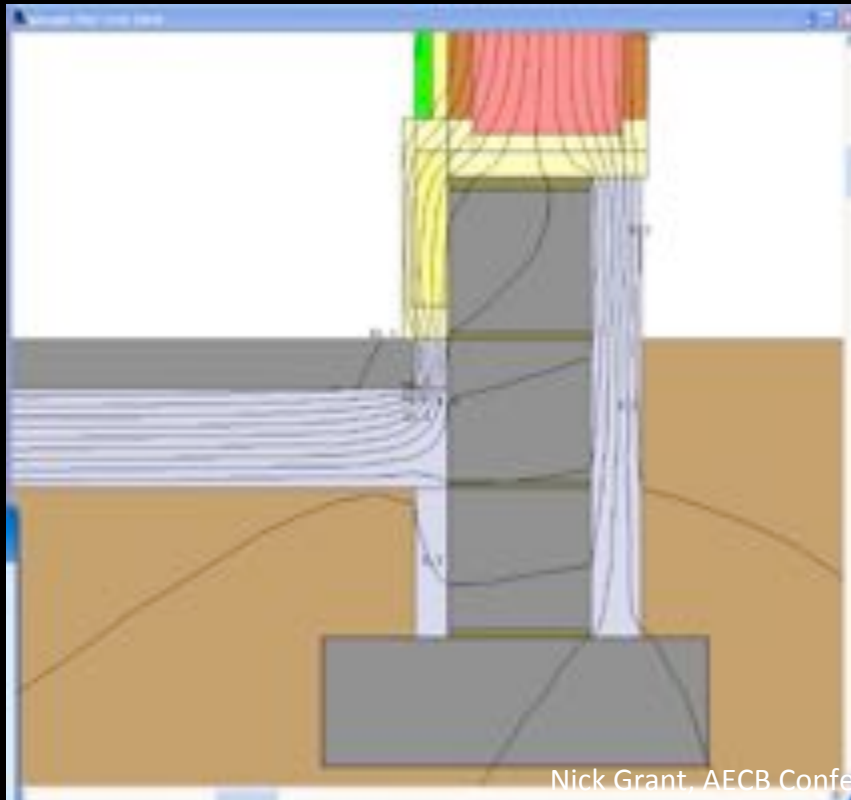
Very fiddly, lots of tape, not robust



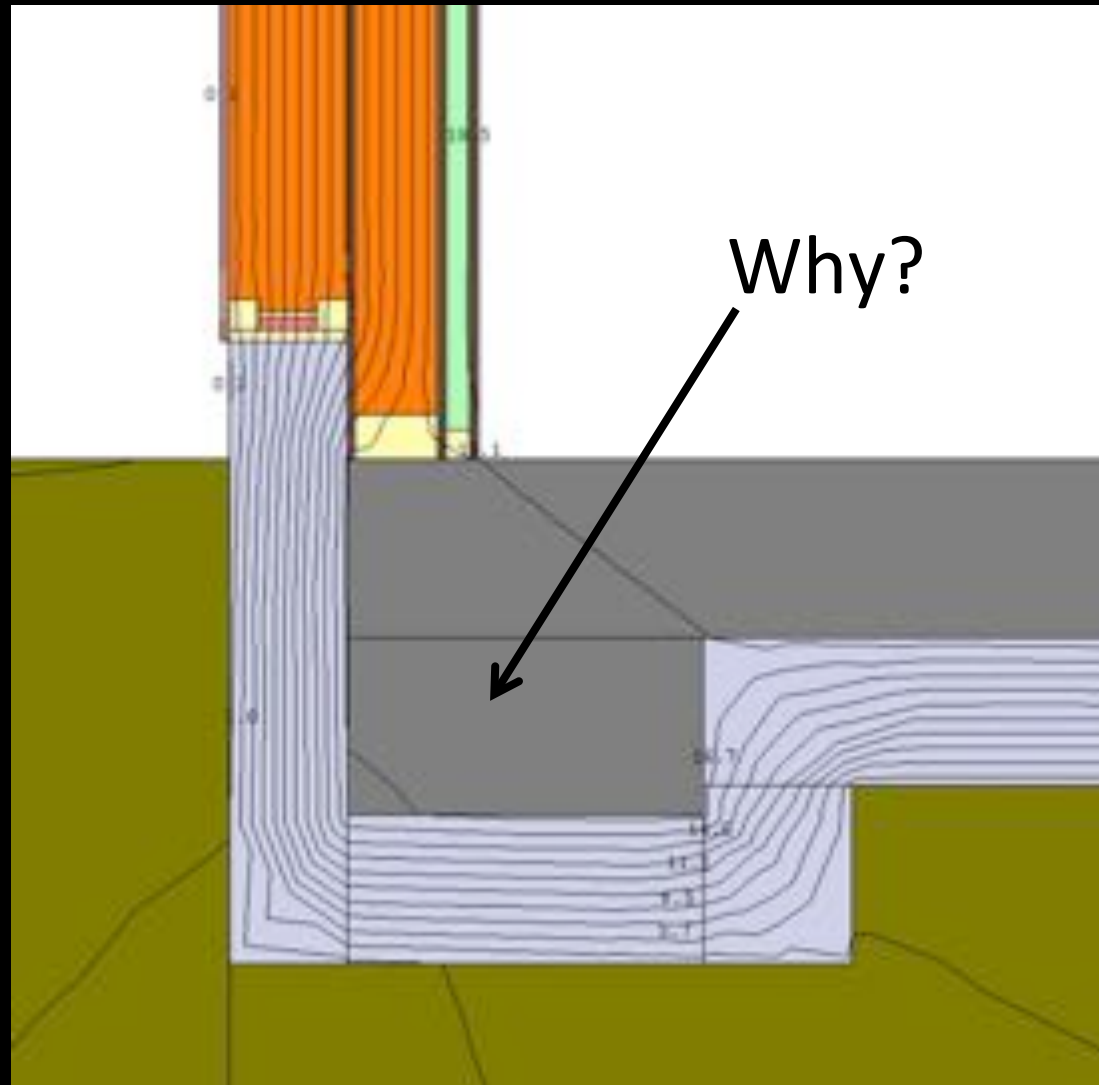
Wind & water tight & cheaper to build

Wall/floor junction

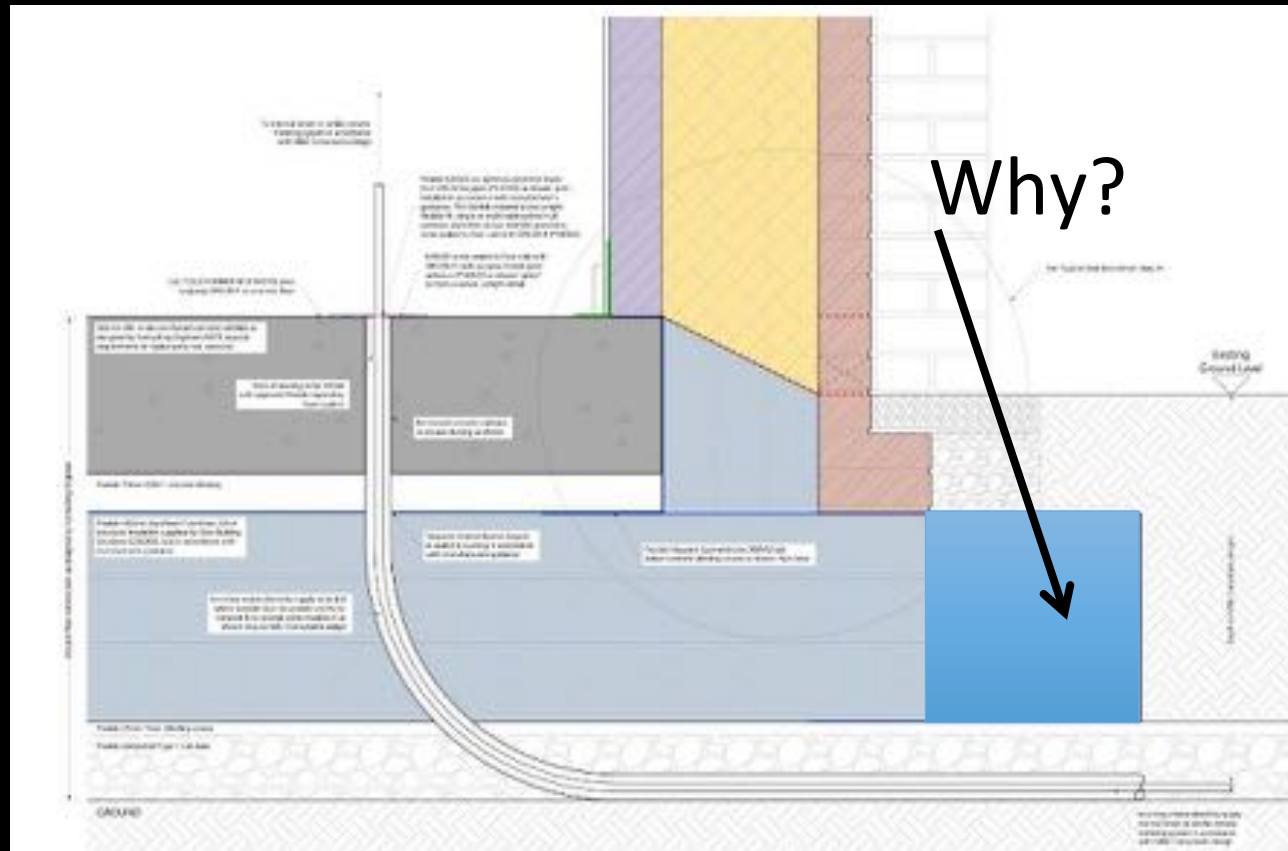
Adding complexity to standard detail to reduce heat loss
Expensive, difficult to build



After VE



More VE but not there yet!



Parsons Whittley

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Glasgow-marble floor/foundation



Image Ruth Busbridge
Wahroonga Passivhaus

Nick Grant, AECB Conference Sheffield 2015

Rendered ICF self-build Monmouth



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Sarah Brown Architect

A timber frame innovation



Nick Grant, Charles Grylls & Mike Whitfield

改善

As light as a balloon (frame)



Passivhaus Clehonger By Mike Whitfield

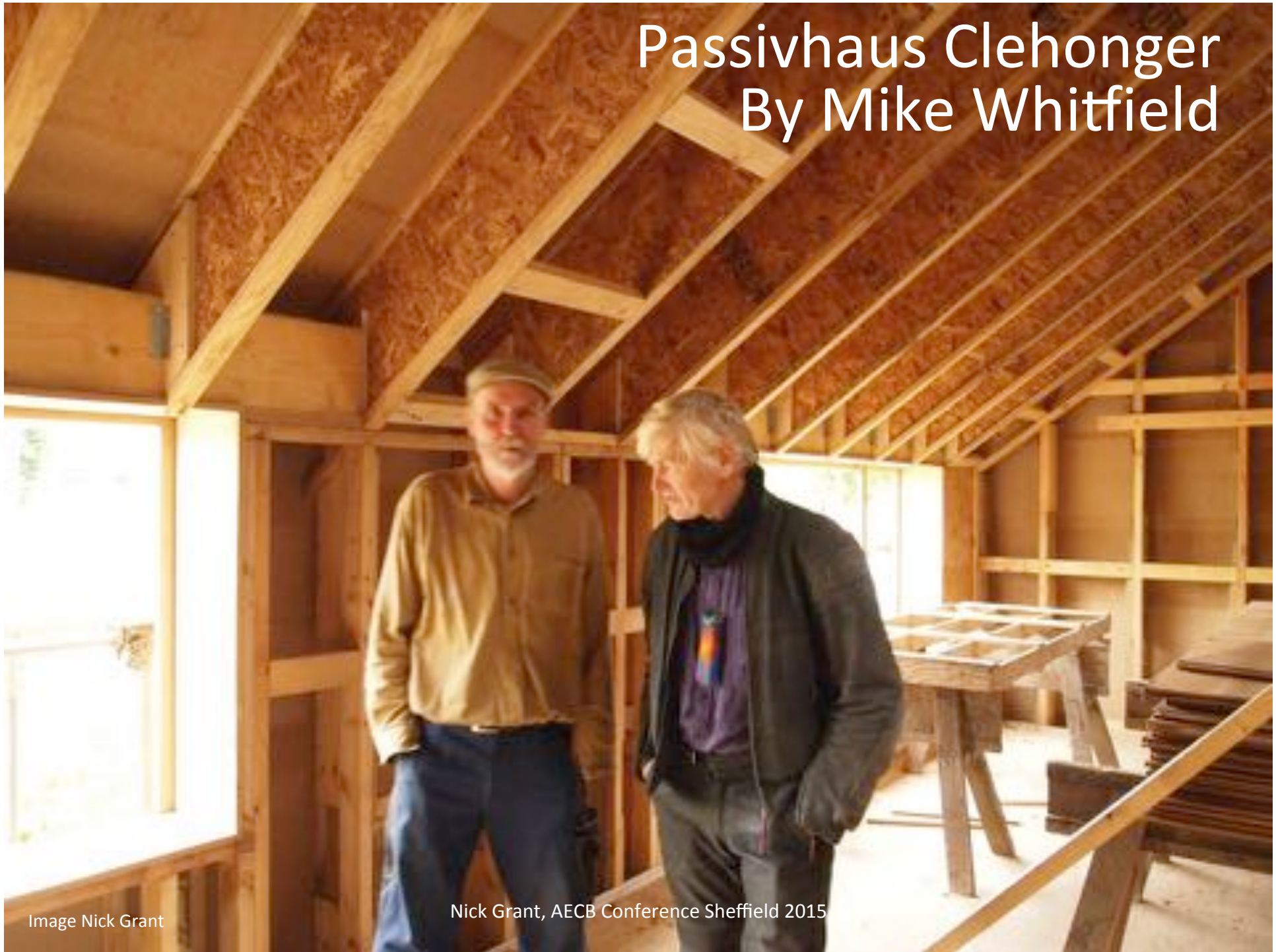


Image Nick Grant

Nick Grant, AECB Conference Sheffield 2015

Passivhaus Garway Mike Whitfield & Charles Grylls





改善

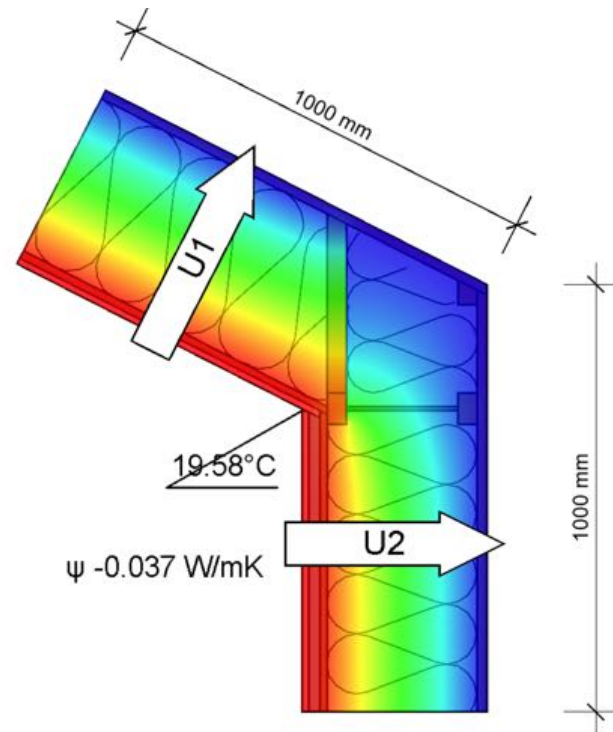
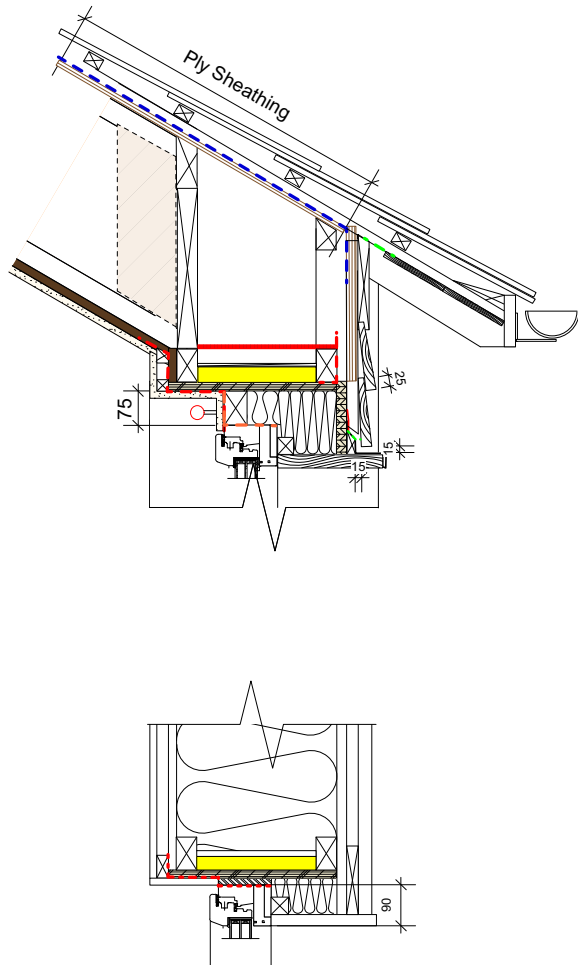


Details have evolved over a number of projects

Design for easy on-site build
Flexible window location

Nick Grant, Charles Grylls & Mike Whitfield





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Do Not Scale Off Drawing Copyright Dempsey Decourcy Architects

DEMPSEY DECOURCY CHARTERED ARCHITECTS The Crofts, Ross on Wye, Herefordshire, HR9 7AB tel 01989 562516 • email cg@charlesgrylls.demon.co.uk www.dempseydecourcyarchitects.co.uk		Project		Dwg Title PROPOSED EAVES WINDOW HEAD AND REVEAL DETAIL			
		Client		Dwg No.		Revision	
Drawn	CG	Checked	LSD	Scales	@A3	Date	19.11.14

Step for improved night vent and/or blind



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Nick Grant, Charles Grylls & Mike Whitfield
Simple services by Alan Clarke and Green Building Store

Turning clever ideas into actual savings

Barrier 1; change management



Floor joists ordered ready cut to save time but to wrong length because of another VE change (omitting strip of OSB behind ledger). Will work fine next time!

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The anchoring effect

Barrier 2; the existing budget



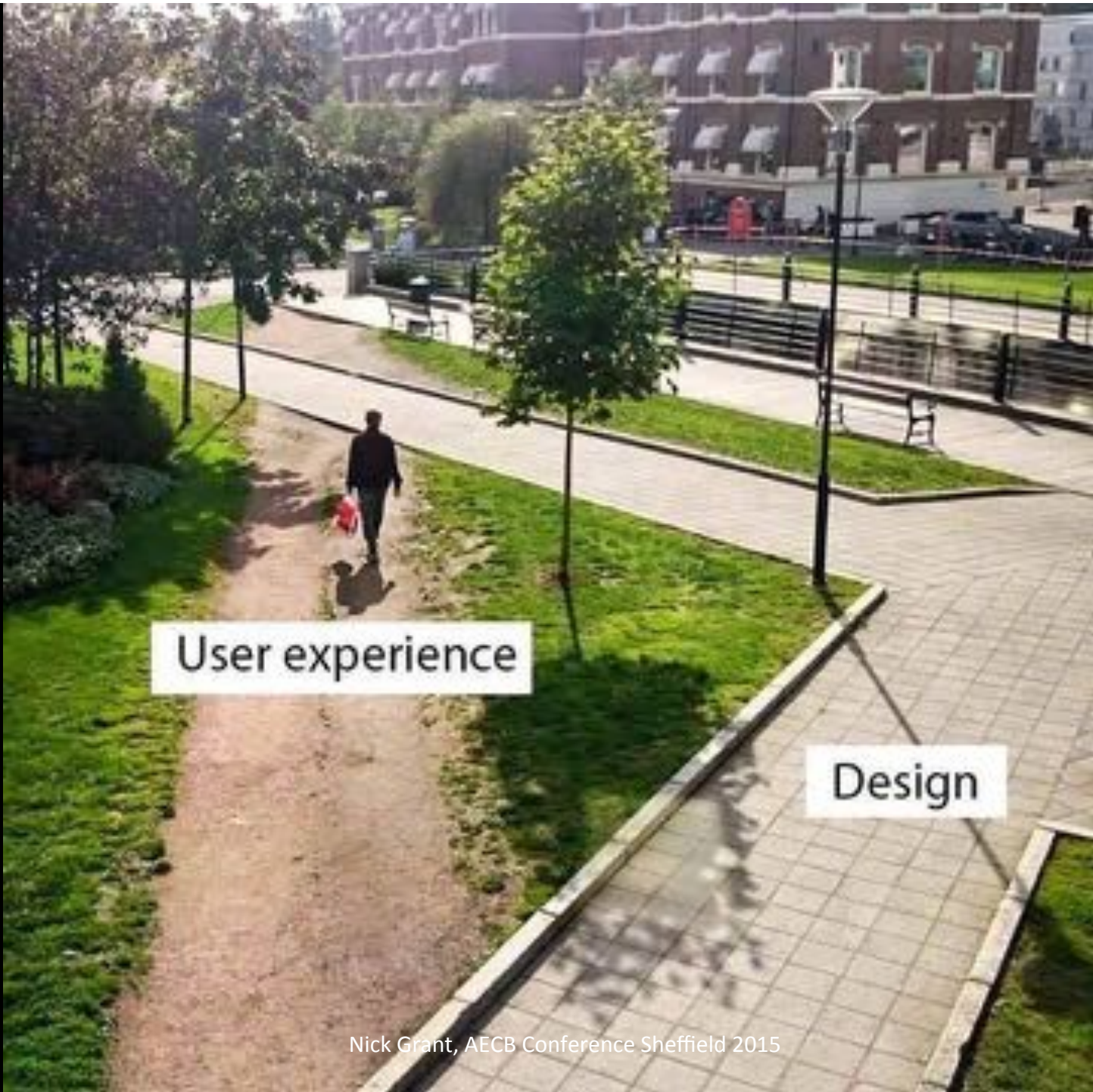
Value engineering makes it easier to stay on budget.
For cost savings you need to reduce the budget.
How many projects are under budget?

VE Services

See Alan Clarke's presentations.

What about design fees!

- Designer paid more to reduce costs?
- Designer can apply VE to design process so fees should reduce!
- % fee basis?
- Other ways to be paid?



User experience

Design

Summary

- Sustainability can't be an expensive aspiration
- VE can reduce cost AND improve function
- VE must be integral with the design process from day one
- The whole team need to be involved
- Keeping a team together allows progress
- Function and budget must be clear
- VE is a creative endeavour and is fun to do.