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Low Carbon Green Building

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Definitions & Understanding

- Green v Violet
- Environmental v Sustainability
- Urgency
- Stuff

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Are you Green or Violet?

Sustainability Definition
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Violet Materials

- **Non-renewable, finite**
 - Fossil derivatives, fuel
 - Petrochemical, chemicals, synthetics:
 - Paints
 - Plastics
- **Unsustainable**
 - Carbon based: e.g. Fuel
 - Release Carbon in manufacture or use: e.g. Cement
- **High embodied energy: e.g.**
 - Metals: Aluminium
 - Plastics
 - Cement
- **Hazardous materials and hazardous waste:**
 - Wet, sticky or flows:
 - resins, paints, sealants, chemicals,
 - Fine particulate: cement, asbestos, ceramic fibre
 - Corrosive, acidic, alkali,
- **Ozone depleting**
 - Foamed plastics HFCa HFAs

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Green: Environmentally Sustainable Materials

- **Renewable:** timber,
- **Rapidly renewable:** Plant based materials
- **Abundant:** Site subsoil, rocks, sand, gravel,
- **Recycled & Recyclable:**
 - post consumer content,
- **Reclaimed & Reused:** on site materials, timber not chipboard
- **Carbon already out there:**
 - reclaimed bricks, slates, stone
- **Carbon sequestration: Carbon negative:**
 - Plant and timber based
- **Low embodied energy:** Plant based
- **Local: low transport miles: low transport emissions**

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Sustainability Definitions

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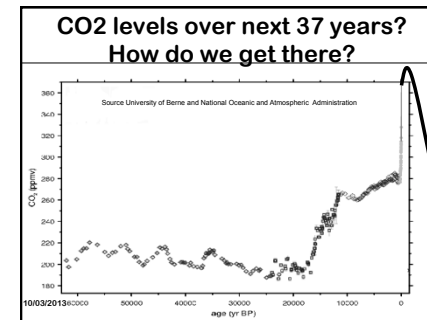
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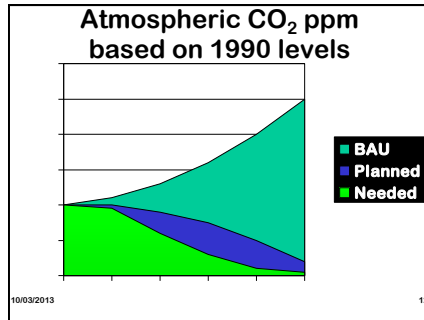
Route to the Future

© Forum for the Future
Idea from Forum for the Future

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Low Carbon Green Building

▶ High or Low

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Low Carbon Green Buildings

- Carbon in isolation?
- Can you ignore other issues?
 - Water
 - Material Resource efficiency v Waste
 - Natural v Chemicals & Health & Safety
- They all have a Carbon load
- So I think not

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Carbon in Fuel, Energy, Heat?

- Fossil Fuels release CO₂ when burned
- Transport: people and goods: fuel
- Heating Lighting Cooling Ventilating
- Power to engines, pumps, etc.
- Communications & IT power to and cooling of computers and servers
- Wasted fuel, energy, heat and coolth

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Carbon in Water?

- Chemicals & Purifying, Pumping, Irrigating, Softening, Heating, Washing, Cleaning, Bathing, Power Showering,
- Wasted water: leaks, excess and evaporation
- Bottled water from any distance
 - Food miles

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Carbon in Materials?

- Embodied carbon in materials
- In buildings, purchases, goods,
- Food, water and drink miles
- And in wasted materials
- And don't forget methane from waste in landfill (21 x GWP of CO₂)

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Low v High Carbon Buildings & Lifestyles

Implied criticism
Green v Violet
Good v Bad

▶ Hierarchy

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Buildings:

- Winter Gardens Sun spaces v Heated Conservatories
- Weather lobby v Portico & Porte Cochere
- Insulated v heated
- Solar Shaded v cooled
- Solar Shading v Architectural frippery
- Airtight v cold, windy, noisy
- Moisture mass v extractors or air conditioning
 - Or mould, relevant to fuel poverty
- Thermal mass v lightweight
 - Appropriate heating/cooling to suit building fabric weight

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Services

- Natural v artificial
- Appropriate services v EcoBling
- Passive design v mechanical/electrical services
- Passive & Active v mechanical services

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Services: water

- Busy plumber v Dripping taps
- Short showers v deep baths
- Generous Showers v Power Showers
- Water saving taps v water hammer
- Aerated/Sprinkler v percussion / push taps
- Foaming soap dispenser v Liquid soap
- Rain forest v Soya plantation (liquid soap)
- Proximity taps v germs or soap residues

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Services: Heating/Cooling

- Cheap Insulation v expensive heating/cooling plant
- Airtightness v heating
- Cold bridge elimination v heating
- Solar orientation v heating
- Solar Gains v heating
- Thermal mass v heating and cooling
- Purging heat by passive venting v Air-conditioning Cooling
- Solar shading v Air conditioning

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Services: Ventilation

- Fresh cool air v Conditioned Air
- Open windows v Mechanical ventilation
- Stack Effect v Mechanical Ventilation, Fires or Heaters
- Wind pressure v Fans or Pumps
- Purging heat by passive venting v Air-conditioning Cooling

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Services: Lighting

- Sun & Daylight v artificial lighting
- Eye relaxing views v solar control blinds
- PIR detection v switching
- Zoned lighting at glass v all on, all time
- Task lighting v uniformly high light level
- Timed lighting v 24 hours
- Alarm triggered safe lighting v 24 hours

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External works and landscape:


- Daylight & moonlighting v floodlight
- Observation v indicator lights
- Food Growing v Decoration
- Indigenous species v exotic
- Drought tolerant v sprinkler & irrigation
- Natural ponds v Heated pools
- Clay lined ponds v plastics membrane

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External works and landscape

- Bike Parking v Car standing
- Bus drop off v 4x4 jam
- Green Grids v isolated and unsafe
- Blue Ribbons v isolated and unsafe
- Natural Ribbons v isolated pockets
- Leisure for health v bike shed smoking
- Play spaces v no balls, sports, fun, life
- Healthy competition v equally dull world
- Summer track & field v winter gymnasium
- Winter gymnasium v sick notes

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Carbon Hierarchy

Carbon Fuel or Energy Warmth & Coolth

Commercial Green

Carbon Hierarchy: Ambition

Cost effective Effort

Remove
Reduce
Reuse
Recycle
Recover
Return
Reject

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Carbon Hierarchy: Reality

Missed Opportunity Status quo Prevails

Remove
Reduce
Reuse
Recycle
Recover
Return
Reject

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Remove Demand: Fuel Energy Heat

- Remove the need to heat and cool, by design:
 - Do keep doors and windows between conservatories and buildings
 - Maximise heat capture and exploit it later
 - Use thermal mass to store heat for later
 - Ventilate top and bottom or both sides or across corners to enable natural cooling

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Remove Demand: Wasted Fuel Energy Heat

- Do not install heating in conservatories
- Do not remove doors and windows between building and conservatory

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Reduce: Fuel Energy Heat

- Reduce the heat loss
 - insulation, airtightness, cold bridges, weather stripping
- Reduce the heat gains
 - External solar shading of glass
 - External solar shading of walls
- Reduce the use of internal solar shading

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Reuse: Fuel Energy Heat

- Heat from energy generation in CHP
- Reuse heat gained in conservatories in the buildings
- Reuse the heat gained in the day into the evening

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Reuse: Wasted Fuel Energy Heat

- Hot air from plant rooms
- Heat from compressors
- Heat from transformers
- Heat recovered from mechanical ventilation extraction to heat building or hot water
- Heat from Appliances, Equipment, People, Cooking, etc.

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Recover: Fuel Energy Heat

- Energy from waste
- Anaerobic digestion: Methane/Fuel
- Combustion of waste with heat recovery
- Extra care with pollutants

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Return: Fuel Energy Heat

- Return excess to requirement to the grid
- collects from grid when demands are higher

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Reject: Fuel Energy Heat

- Wasting energy
- Leaving lights on: Control it
- Excess Heat: Question it
- Squandering lifestyles: Challenge it
- Make it your responsibility


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Commercial Green

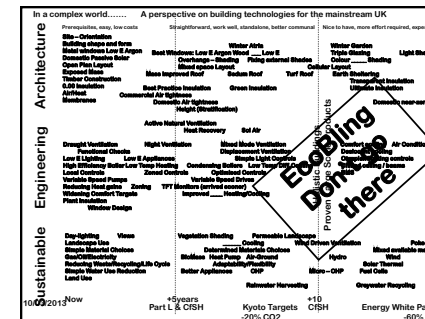
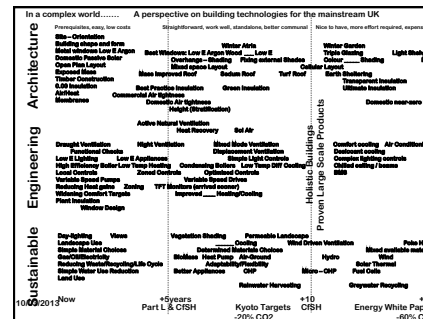
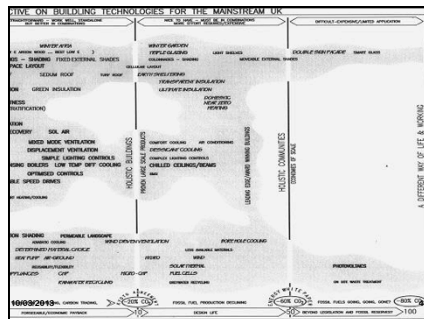
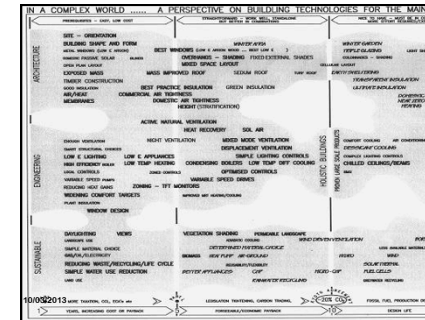
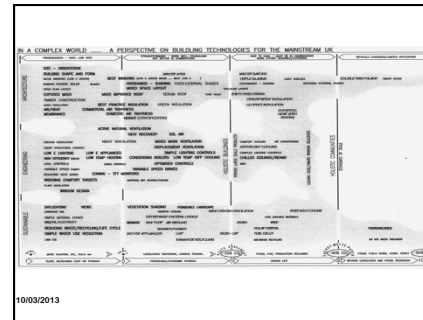
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Gifford and Partners



Mind Maps

- Gifford have a number of mind maps
- The following is the first
- Inspired by early Archigram work
- They have more, but despite GreenSpec attempts they do not want them in the public domain via GreenSpec
- One day we hope they will bring them to the market themselves

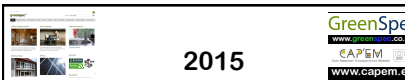
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Green Material Olympics
BRE Green Guide

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2015

- If we have not made significant changes by 2015
- 2050 is melt down day
- The one planet will survive
- Unable to support humans living a three planet lifestyle
- UK average citizen

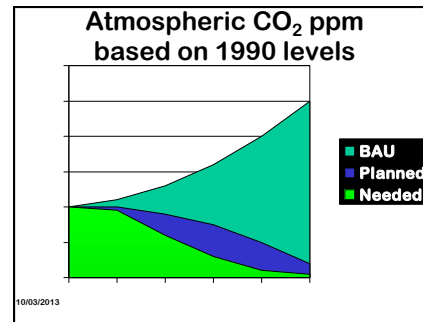
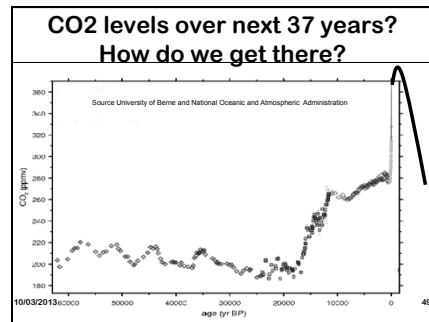
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We (average UK Citizen) live a 3 planet lifestyle, we only have one



Ethiopia has already been there Darfor is there now and there are not enough of them to share between us. We each need to sponsor two Darforians to keep them on the brink of death to maintain our lifestyles

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High Carbon 'Green' Building

BRE Green Guide

High or Low

- ### BRE Green Guide Scope
- Missing elements
 - Missing materials
 - Missing methods of construction
 - Missing permutations of materials
 - Missing properties
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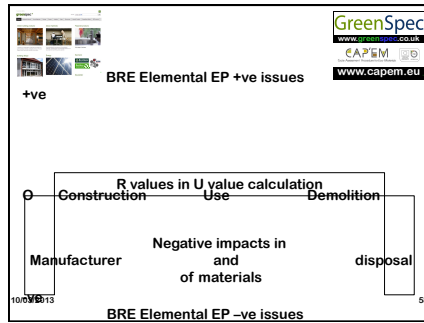
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- ### Missing elements
- **Foundations**
 - BRE argue the site is a 'given',
 - you have no choice
 - BS Bovine Staccato
 - There is always choice if given the opportunity
 - You still need floors and walls another 'given' there are choices here too
 - **Services**
 - PVC free, Low-Smoke, Halogen-free
- Solar shading
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- ### Missing materials
- Clay plasters, boards and finishes
 - Lime mortars renders and Limecrete
 - Lime:sand screeds
 - Unfired clay bricks and blocks
 - Hemp-lime
 - Breathing materials and insulation
- Renewable and natural insulation
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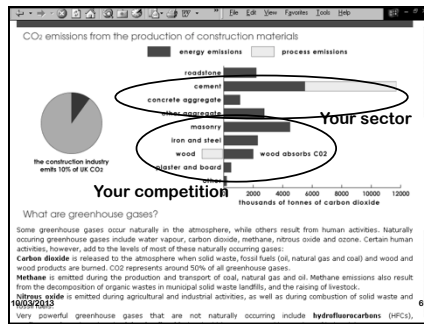
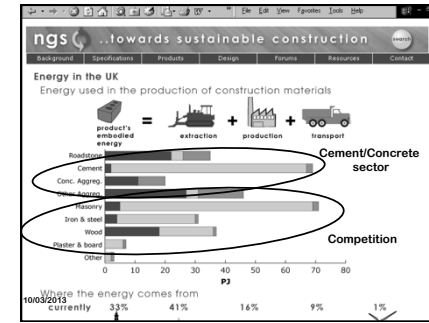
- ### Missing methods of construction
- **breathing wall construction, (air tight and moisture permeable)**
 - Hemp-lime walls, roofs, insulation, blockwork
 - Rammed earth walls
 - Limecrete foundations and ground floors,
 - Insulation wrapping framing to avoid cold bridging
 - Cross laminated timber panels
- Non-structural insulated panels (not SIPS)
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- ### Missing permutations
- 700 elements have grown to 1200
 - Many but not all material permutations
 - Need to be able to choose
 - Sometimes there seems to be no logic to the EP and ratings
 - Unable to interpolate
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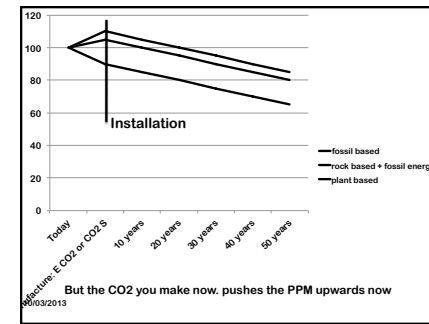
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- ### Missing properties
- Positive attributes are ignored
 - **Only negative impacts from manufacture**
 - No in use properties accounted for
 - Not just in manufacture and disposal
 - R value of insulation is taken into account
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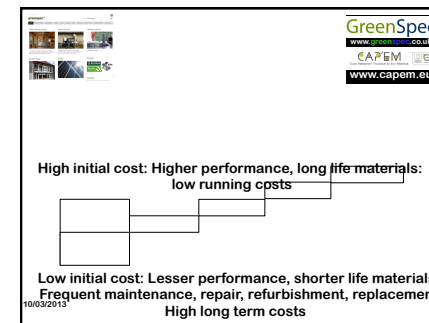
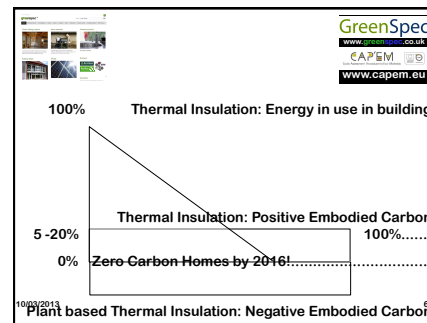
- ### BRE: Negative manufacturing impacts
- Abiotic depletion
 - Global warming
 - Ozone layer depletion
 - Human Toxicity
 - Fresh water aquatic ecotoxicity
 - Terrestrial ecotoxicity
 - Petrochemical oxidation
 - Acidification
 - Eutrofication
 - Solid waste
 - Radioactivity
 - Mineral extraction
 - Water extraction



- ### Embodied Energy comparison
- Mainstream manufacturers don't want us to worry about this
 - Their materials don't score well here
 - Short term the energy and CO₂ levels go up with high embodied energy materials
 - Long term they go down equally if only comparing R values to calculate equal U values
 - What about all the other thermal properties?
- Decrement, thermal mass, thermal lag, hygroscopicity, G, Psi, y values, etc.



- ### Zero Carbon buildings in use
- As buildings get energy efficient other issues become important
 - What about zero carbon buildings in manufacture?
 - What about negative carbon building in manufacture?
 - Plant based building materials can do that



Environmental Profiles

- Environmental Profiles (EP):
 - Consider negative impacts in manufacture
 - Considering many negatives all get averaged out
 - Could consider positive attributes in use
- Generic EP:
 - averages out sector to a level playing field
 - Good and bad performers are made equal
- Product EP:
 - Compares manufacturer/product with sector average to stand out from the crowd
- Material EP:
 - Shows a material to be good or bad compared to other materials doing same job
 - Mainstream products would feel exposed using this method, so avoid it
- Element EP
 - Averages out good and bad materials within any element
 - You can bury bad Material EP scores and lose them in an average Element EP scores
- Scope of the BRE Green Guide Elemental EP
 - Negative impacts in manufacture and waste
 - Almost no positive attributes during manufacture and use
 - But R value of insulation is considered in 'Functional unit' U values
 - But this is not the only way to judge insulation

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Negatives Marketing

- Cement used to spend £3m/year on marketing
- Tell the thermal mass story
- Cement, concrete and minerals sectors joined forces to promote concrete
- £12m/year marketing budget
- Plastics sector do 6 page spread telling why timber is bad & PVC is good

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GreenSpec interests +ve attributes

Positive contribution of in use performance of materials or products or elements in buildings in use Over life of the building (60 years)

Construction Use Deconstruction

Manufacturer Negative impacts in and of materials disposal

BRE Elemental EP -ve issues

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Green materials +ve attributes

Positive contribution of in use performance of materials or products or elements in buildings in use Over life of the building (60 years)

Construction Use Deconstruction

Positive attributes and Negative impacts in Growing, Manufacturer and Reclaim, Reuse, Recovery of materials

BRE Elemental EP -ve issues

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GreenSpec Positives

- Renewable materials
- Carbon sequestration in growth of in production (Carbon lock-up)
- Natural materials
- Abundant materials
- Healthy to handle and apply
- Healthy to be present in a building
- Not harmful to air quality
- Energy efficiency in production and in use
- Water efficiency in production and in use
- Resource efficiency in production
- Waste efficiency in design and application
- Local sourcing
- Recycled & Recyclable materials
- Reclaimed & Reused
- Traditional trades well understood and reproducible without major skills gap.
- Conservation quality work compatible materials

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Environmental Construction & Material Properties

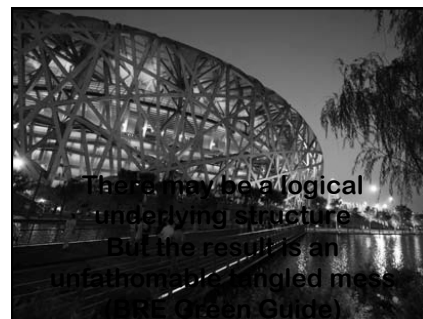
- Airtightness
- Moisture permeability
 - to enable moisture egress - Inwards and outwards
 - Hygro-thermal moisture movement
- Energy in use
 - not just R and U values
 - U Values in elements - Not just in SAP & SBEM
 - Psi values and y values
 - G values in glazing
 - Thermal Mass
- Decrement in insulation
 - Thermal inertia
 - Hygroscopicity in insulation & Breathing Walls
 - Moisture Mass
 - Reuse potential
 - Stewardship:
 - Timber
 - Metals
 - Plastics
 - Stone
 - Sustainable packaging

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Fundamentals

- Methodology
 - Must be right and compliant consistent and not prone to human intervention
- Transparency
 - Or nobody will believe it
- Accountability
 - To whole industry
- Verification
 - Independent 3rd party & regularly
- Scope
 - Include all or it is not a level playing field

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What industry needs

- Specifiers want the truth (the whole truth) and choice
 - not just what mainstream industry and BRE want to tell us
- Wider range of issues addressed
 - Positives as well as negatives
 - Visibility and use of Material EP to be able to choose greenest materials
- Wider range of materials and methods
 - Natural, green, innovative, higher performance materials
 - Not just mainstream, business as usual materials
- Ability to create unique combinations
 - Instant Environmental Profiling
 - BRE's Invest2 needs to be grown
- Code for Sustainable Homes
 - Alternative EP not just BRE Green Guide until it gets better

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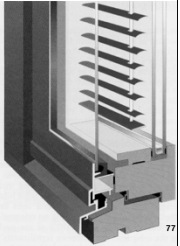
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Windows

You need them they cost a packets
so lets make them work hard for the money

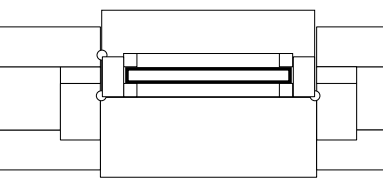
High Performance Windows

- Aluminium outer casement durable
- Long life coating
- Low maintenance
- FSC Timber inner casement
- Permeable natural finishes
- Laminated timber with cork insulation layer
- Treble glazed
- Plastic edge spacer
- Dust free sun blinds



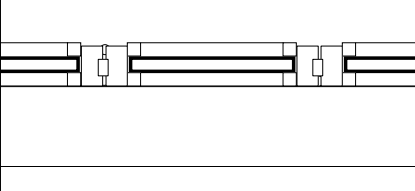
Windows in walls

Plan View



Composite Window Wall

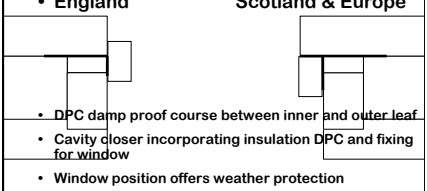
Plan View



Masonry wall window opening

- England
- Scotland & Europe

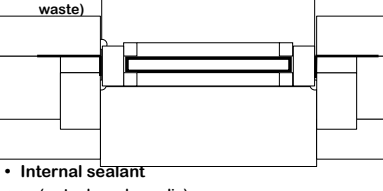
- DPC damp proof course between inner and outer leaf
- Cavity closer incorporating insulation DPC and fixing for window
- Window position offers weather protection



Windows in walls: Sealants

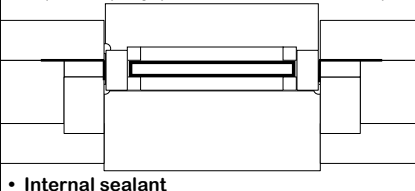
Plan View

- External sealant **Avoided**
- (synthetic, petrochemical, non-renewable, hazardous waste)
- Internal sealant
(water based, acrylic)

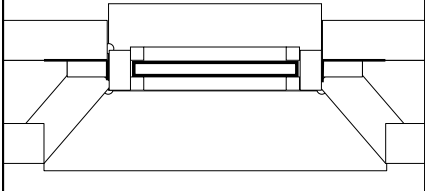


Windows in walls: Natural Sealants

- External sealant **Sealant Avoided**
- (linseed putty, plant based, natural solvent)
- Internal sealant
(linseed putty, plant based, natural solvent)



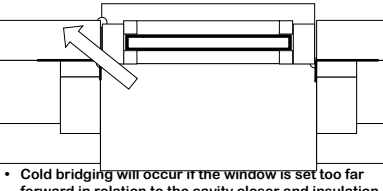
Maximise light penetration Minimise glare



Windows in walls: Position

Plan View

- The position of the window in the opening can maintain its performance or suffer significant loss of performance
- Cold bridging will occur if the window is set too far forward in relation to the cavity closer and insulation
- Whole window subject to greater weather exposure



Windows in walls: Position

Plan View

- The position of the window in the opening can maintain its performance or suffer significant loss of performance

- Cold bridging will occur if the window is set too far backwards in relation to the cavity closer and insulation
- Whole window gains better weather protection set back in opening

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Windows in walls: Position

Plan View

- Cavity closers form a cold bridge even if insulated
- Omit inner leaf returns close cavity with window box

- Install window in box avoid jamb return cavity closer

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Scope 2

- Low carbon Buildings
- Heavyweight v lightweight
- In manufacture/construction & use
- Insulation Airtightness & Cold bridges
- Insulating the less obvious elements
- Heating, DH&CW, Cooling & Ventilation

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Scope 3

- UK lessons
 - Party Walls
- Passivhaus lessons
 - PHPP v BRE SAP
- AECB research
 - Moisture and energy consumption
 - CLP & Website
 - Windows and thermal comfort

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Scope 4

- Climate Issues
- Radiant heat in coming summers
- Solar heat gains
- Solar shading
- Thermal Mass
- Ventilation and cooling

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Scope 5

- Code for Sustainable Homes
 - Level 4 5 & 6
 - Materials Scores
 - Elemental deficiencies
- BRE Environmental Profiling
 - Methodology deficiencies
- Green Guide to Specification
 - Elemental deficiencies

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Scope 6

- High Performance Natural materials
- Characteristics:
 - Carbon Sequestration
 - Decrement & radiant heat
 - Hygroscopicity & performance
 - Breathing walls

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Feedback

- These files are created by generalists with a big dollop of green flavour
- These files are updated from time to time
- We are not experts so from time to time these file may get out of date or may be wrong.
- If you feel that we have got it wrong please let us know so we can put it right

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- **Architect by Training**
- **Specification Writer by Choice**
- **Greening up my act since 1999**
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