Eco Home Decisions: Practical Steps to Sustainability

Structure & Materials

from foundations to finishes

Eco Home Decisions

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  - Haynes Eco House Manual
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AGENDA

Eco Home Decisions:

Structure & Materials

from foundations to finishes

- Types of built form
- Tyes of structure - Quick poll
- What is sustainability
- Construction Materials- Quick poll
- Finishes
- Landscaping - Quick poll

Questions

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Built Form

There are many types of built form:

Tall & thin or short & wide

Image: GG Archard / Arcaid Images

Image: Ted Stevens

Image: Chris Snook

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Built Form

"Form" refers to the shape and configuration of a building:

- Linear or curved
- Flat roofed or pitched
- Rectangular or L-shaped, C-shaped, Courtyard . . . etc

Image: Camilla Reynolds/Frame Technologies

Image: Camilla Reynolds

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Built Form

Responding to your site:

Your decisions may depend on:

- Existing features
- Passivhaus or other certification aims
- Need for outbuildings
- Slope and orientation
- Most importantly – the context of your site

Image: John Mayer

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Quick Poll

What kind of construction are you thinking of?

- Brick & Block
- Timber Frame
- SIPS
- ICF
- Something Else
- Don’t know yet

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Type of Structure

What determines the type of structure?

- It's what holds up the roof!
- Not always obvious
- For example we have:
  - Brick-clad timber-frame buildings
  - Masonry buildings with timber rainscreens
  - Anything that's rendered . . . can't tell by looking!

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Type of Structure

Types of structure

- Masonry
- Timber Frame
- SIPS
- ICF
- Passive Solar Design
- Deep Green

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Masonry

Cavity Wall Construction has advantages

- Construction industry is familiar with it
- (reduces risk)
- Specification can be adjusted to be more sustainable
- Price is reasonable
- Cement vs Lime

Image: Ken Price

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Masonry

Cavity Wall Construction has

some disadvantages too:

- Relatively high embodied energy
- Some opportunity to use natural or recycled materials
- Some restrictions on insulation

Image: Dave Burton

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Timber Frame

Timber frame is highly versatile:

- Large internal spans, cantilevers etc
- Easy to adapt and change later
- Variety of insulation materials can be used

Image: Potton

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Timber Frame

And there are other advantages

- Non-toxic
- Renewable material (as long as FSC or equivalent)
- Speed of construction
- Reduced foundations
- More space for insulation
- Low embodied energy, carbon negative
- Easier to handle and work
- Better suited to self-builders

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Structural Insulated Panel Systems (SIPS)

Structural Insulated Panel Systems (SIPS)

- Simply insulation between boards (OSB)
- Insulation is typically Polystyrene or Polisocyanurate
- No studs – less thermal bridging
- Easy to make airtight
- No thermal mass?

Image: Build-it Education House

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ICF

Insulated Concrete Formwork

- ICF
- Concrete poured into pre-made polystyrene formwork
- Structure and insulation in one - still needs finishes
- Looks like giant Lego
- Reinforced
- Instinctively simple
- However . . .

Image: Build-it Education House

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Modern Methods of Construction

Offsite construction

- Advantages:
  - Accuracy of Factory Build & Control
  - Reduction of impact on neighbours
  - Reduction of time on site
  - Pre-installed services

Image: Construkt CLT

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Modern Methods of Construction

Offsite construction

- Disadvantages:
  - Limitations in materials
  - Limitations in design
  - Crane access usually required
  - Costs?

Image: Hanse Haus

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Deep Green

Straw Bale

- Really is giant Lego (+ pins)
- Waste material
- Not attractive to vermin (no food)
- Carbon sequestration
- Load bearing or timber frame
- Masonry plinth
- DIY build
- Lime renders inside & out
- Easy to adapt
- NB Reveals

Image: CAT

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Deep Green

Hempcrete (Isochanvre)

- Mix of hemp (shiv) & lime
- Poured into formwork which is then removed
- Insulation and structural form in one
- More common in France
- Some good examples in UK eg Haverhill in Suffolk

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Deep Green

Hemp Block

- Mixed with Lime
- Does the same job as a cement and aggregate block
- . . at much lower embodied energy
- . . and carbon negative
- Still a block type construction
- Requires render

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Deep Green

Cob

- Mix of mud and straw
- Ancient building technique
- Insulation and structure in one hit
- Requires render & plaster
- And deep eaves
- West Country

Image: Alan Tierney

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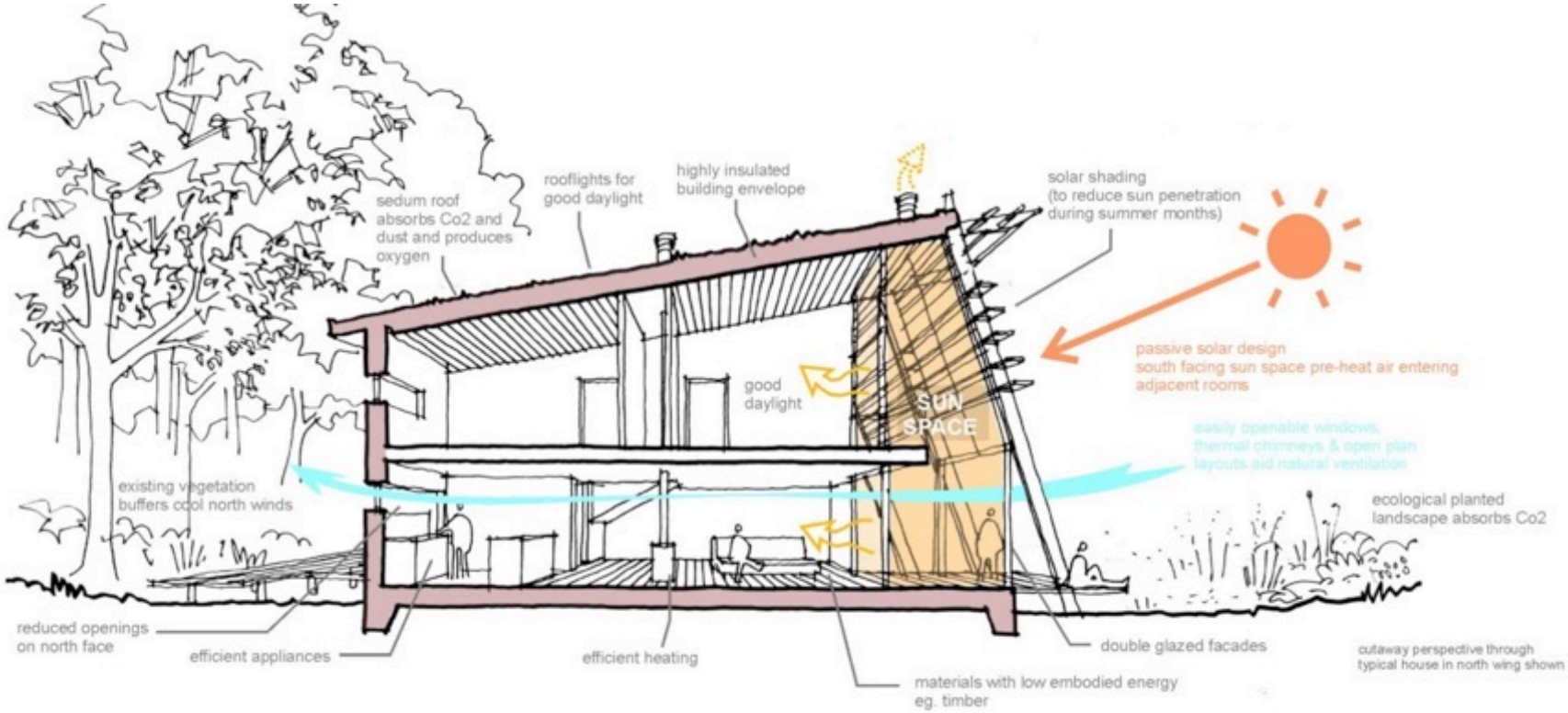
Passive Solar

Four Key Elements of Passive Solar Design

- Orientation
- Fenestration
- Thermal Mass
- Solar Shading

Plus:

- Superinsulation
- Air tightness



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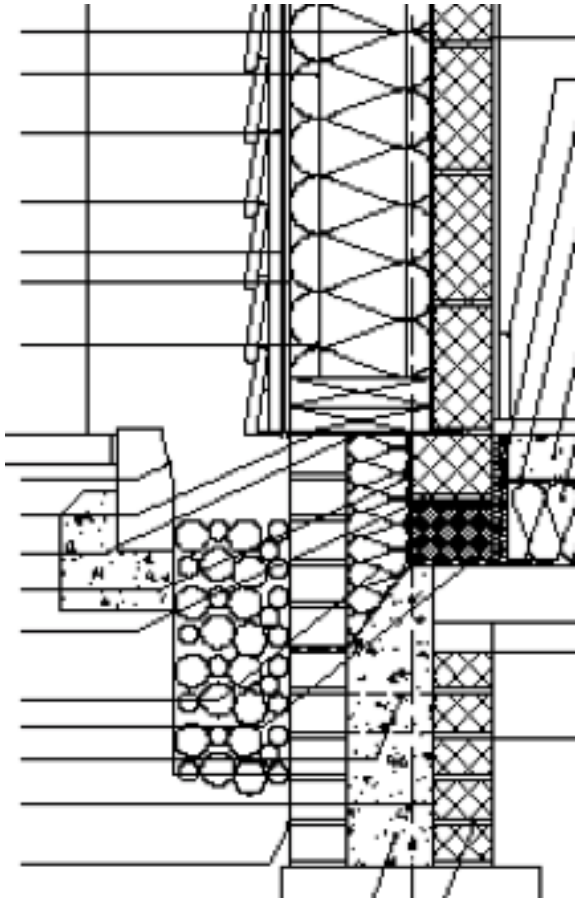
Passive Solar

Thermal Mass and Insulation Detail



Dense Masonry Core
Superinsulated Outer Shell
All masonry becomes thermal mass

Example of a masonry building
. . that looks like a timber building

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Passive Solar

Passive Solar Design

- Won award for the most energy efficient street
- The gas board were suspicious!

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Overheating

Designing out overheating

- Thermal mass
- Solar shading
- Deep eaves
- Coatings
- Automatic blinds
- Reactive glass
- Ventilated sun spaces
- Tree planting - deciduous

Image: IQ Glass

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Built Form and Construction Type

Summary

Summary

- Begin with where you are at (your site)
- Consider the potential for Passive Solar
- Think about the setting, the context
- Consider future adaptation needs
- Think about your own aims and principles

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Principles of Eco Home Design

What is a sustainable home?

What is sustainability?

Sustainability is about more than just energy use.

- It's about what kind of world we would like to leave to our children and grandchildren
- It's about providing fresh water to drink for the millions who don't have it

Brundtland Definition of sustainable development:

. . . meets the needs of the present without compromising the ability of future generations to meet their own needs

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Principles of Eco Home Design

What does sustainability mean to you?

Building a healthy home

Low energy demand

Natural light

Adaptability

Natural materials

Low water use

Renewable energy

Passivhaus Standard

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Principles of Eco Home Design

Establish Priorities . . . some suggestions:

- Build Beauty
- Promote Health
- Minimise environmental impact of materials
- Minimise waste
- Minimise impact on neighbours / considerate constructors
- Protect and Enhance Ecology
- Go beyond building Regulations ?
  - Energy Efficiency
  - Water Efficiency
  - Drainage

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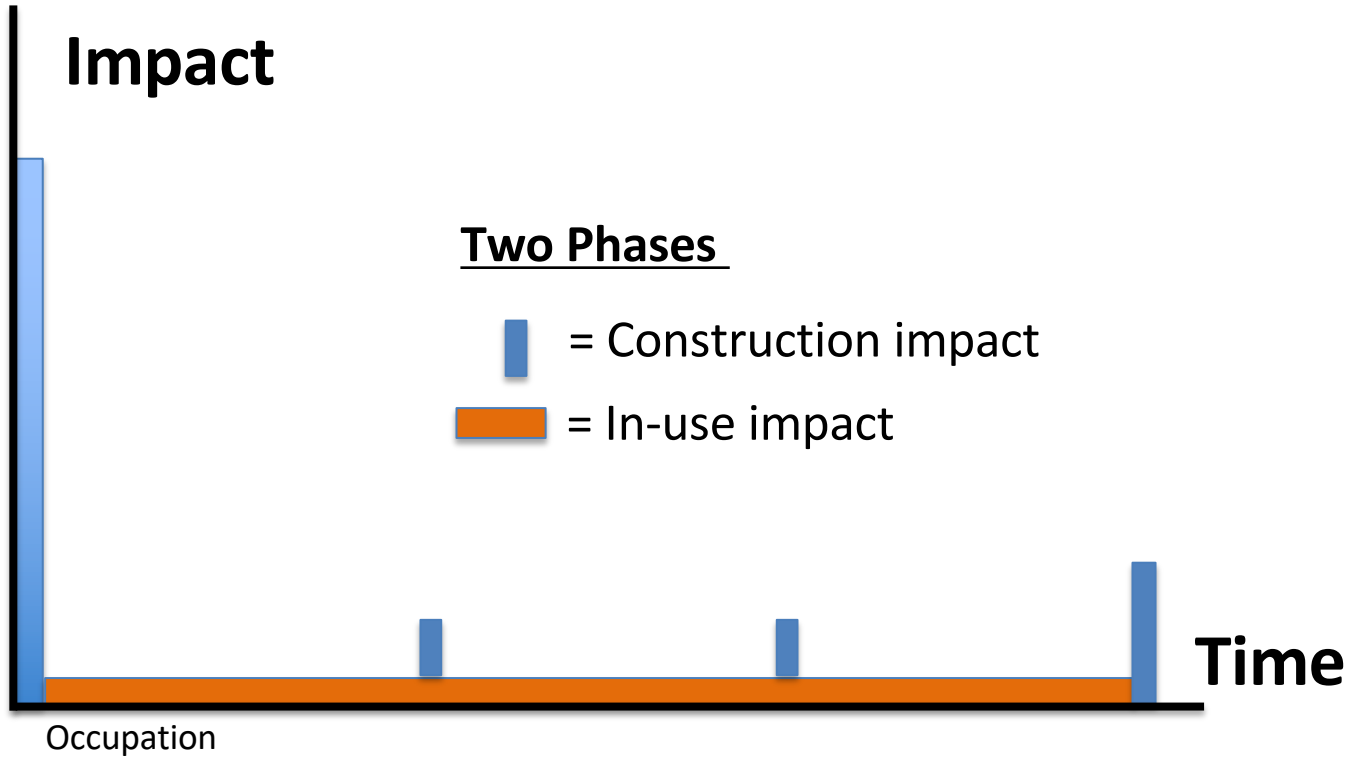
Materials:

Key Issues

Embodied energy vs energy is use

The importance of building materials



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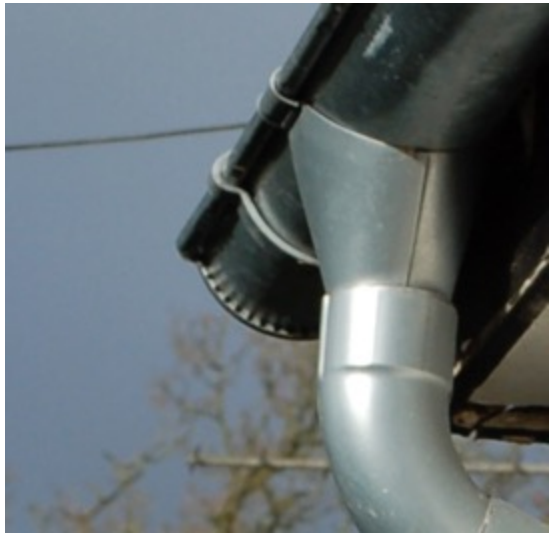
Materials:

Key Issues

Embodied energy

- wide variation between materials
- by volume or mass
- by % of overall build impact
- consider ongoing maintenance
- Greenspec
- Life cycle analysis



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Materials:

Key Issues

Pollution

- Groundwater pollution from mining of key minerals
- Gases given off in manufacture
- Air pollution from some coatings
- VOCs given off in use – e.g. formaldehyde
- Pollution during disposal, including burning

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Materials:

Key Issues

Beauty

- The “truth that dare not speak its name” about buildings
- Much of the impact lies in the external cladding materials used
- Steel & glass can be beautiful too (though often the beauty comes from the surroundings)

Image: CoolStays

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Materials:

Key Issues

Resource Scarcity

- Steel and other metals are finite resources
- Aggregates are finite but plentiful
- Cellulose materials are renewable
- Waste or reclaimed materials are ideal!

Image: Mata architects

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Materials:

Key Issues

Reclaimed and Recycled Materials

- Reused is best!
- Start with what you have on site
- Then Reclaimed
- Examine the specification carefully, substitute wherever possible
- Warranty issues?

Reclaimed telegraph poles used as bollards at Great Bow Yard

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Quick Poll

What matters to you about building materials?
(tick as many as you like)

- Embodied energy
- Avoiding pollution
- Natural Materials
- Healthy materials
- Appearance
- Cost

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Materials:

Foundations

Foundation Design

- Depends on structural form – masonry or lightweight
- Industry is used to trench fill and oversite concrete
- Lightweight construction can be based on pad foundations – “Post & Beam”
- Oversite concrete may not be needed in some floor constructions
- Limecrete floors
- Permeable floors

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Materials:

Foundations

Foundation Design

- Deep green construction sometimes uses reclaimed car tyres filled with aggregate

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Materials:

Walls

Wall structure and surfaces

- Brick & block & plaster(board)
  - high enbodied energy
- Timber frame
  - Low embodied energy, sequestered carbon
- Cladding – can be brick, render or timber
  - impacts vary, appearance critical
- SIPS
  - OSB but use of plastics
- Deep green
  - lime renders
  - earth plasters

Earth plaster with wax finish

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Materials:

Floors

Floor structure (not finishes!)

- Suspended timber worked fine for the Victorians! (and is still working fine now)
- Beam & block (construction industry default option) is heavyweight and carbon intensive
- Solid floors
- Timber I-beams – use less timber, OSB web
  - “engineered timber”

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Materials:

Floors

Floor surface (not finished surface/covering)

- OSB
- Solid timber
- Plywood
- Chipboard
- MDF

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Materials:

Roofing

. . and if you're ever tempted to design in an RSJ, think again!

- A Glulam beam will do almost any job than an RSJ can do
- Or Just Oak!

image: Oakwrights

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Materials:

Roofing

Roof structure

- Timber
- Engineered timber
- SIPS
- Trusses
  - No large members
  - Lightweight
  - Changes??

Image: FrameTec

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Materials:

Roofing

Roof coverings

- Tile (think about appearance)
- Slate (imported, Welsh or reclaimed?, PV?)
- Shingle (not common in the UK)
- Copper, Zinc, steel . . .
- Flat roofs
  - Flat roof materials (Quality, quality, quality)
  - Green roof – types, benefits, limitations

Image: Wallbarn

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Materials:

Insulation

Insulation Materials

- R-value (Sum: 1/R -> u –value)
- PIR, PUR, EPS
- Mineral wool (Rockwool / Glasswool)
- Natural Materials -> Sequestered carbon, Renewable and recyclable
  - Wood wool
  - Hemp, sheepswool
  - Recycled newspaper

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Materials:

Windows

Frame materials

- Timber – renewable, recyclable
- Metal – recyclable
- PVC – hard to recycle, toxic when burned
- Think about longevity, repairability, environmental impact

Image: Lomax & Wood

Image: Norrsken

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Materials:

Windows

Glazing

- Single
- Double
- Triple
- Coatings
- Gases
- Renovators: Secondary Glazing

images courtesy of Mitchell & Dickinson

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Materials:

Waste

Waste

- Segregation
- Reuse
- Returns
- Modular construction
- Packaging

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Finishes

Eco Kitchens

- Carcassing
- Doors
- Worktops
- Flooring

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Finishes

Paints

- Permeability
- Solvents & VOCs
- Pigments
- Binders
- Preservatives
- Titanium Dioxide
- Alternatives
  - Lime
  - Linseed
  - Earth/Clay paints
  - Low VOC Conventional Paint
  - Waxes and oils

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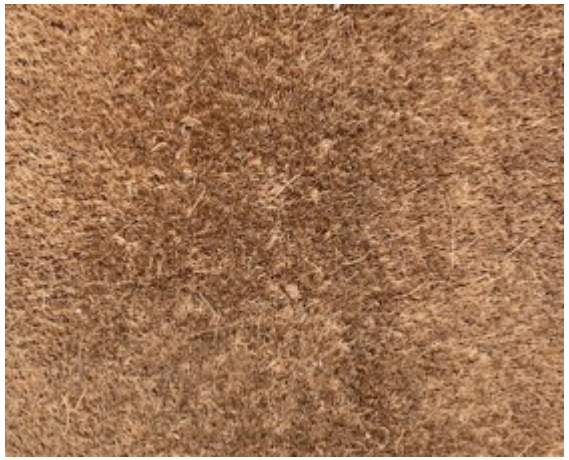
Finishes

Carpets

- Natural materials
  - Sisal, Jute, Wool, Seagrass, Coir
- Chemicals:
  - Fire retardants
  - Insecticides
  - Fungicides
- Underlay
- Rugs & Mats



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Finishes

Hard flooring

- Hardwoods
- Bamboo
- Cork
- Natural Linoleum
- Tile & Stone (NB Glues)

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Quick Poll

What's your atitude to the exterior space?

Tick as many as you like

- Low maintenance
- Entertainment area
- Food Production
- Wildlife
- A place to exercise
- It can wait until after

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Exterior space

Protection and pollution avoidance

- Wait & See!
- While building:
  - Protection of trees & shrubs
  - Watercourses & drains
  - Topsoil

Image: Michael Moore

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Exterior space

Hard landscaping

- Use what you've got
- Reclaimed materials
- Stone from China?
- Hedges or Fences?
- Raised beds
- Try dry stone walling

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Exterior space

Decking

- Low cost
- Quick to lay
- Low embodied energy
- Low chemical use
- Natural product
- Occasional maintenance

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Exterior space

Encouraging Wildlife

- Planting – variety of shrubs, trees, perennials
- Nectar rich plants
- Habitats
  - natural
  - bird boxes
  - bat boxes & bricks
  - swift nesting bricks
  - bee nesting cylinders
- Cleaning up?
- Wildlife corridors
- Hedges

Image: Green & Blue

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Exterior space

Eco-friendly Gardening

- Chemicals – who needs ‘em?
  - weed killers
  - insecticides
  - fertilisers (NB)
  - slug pellets etc
- Composting

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Exterior space

Food production

- Herbs, containers and small gardens
- Fruit trees
- A poultry affair
- Vegetables
- (Allotments)

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Summary

Build in harmony with the environment and with each other.

Image: CoolStays

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. . . my task today . . .

. . . was to give you the information you need . . .
now for you to decide according your priorities.

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Q&A

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