



SWANSEA METROPOLITAN UNIVERSITY

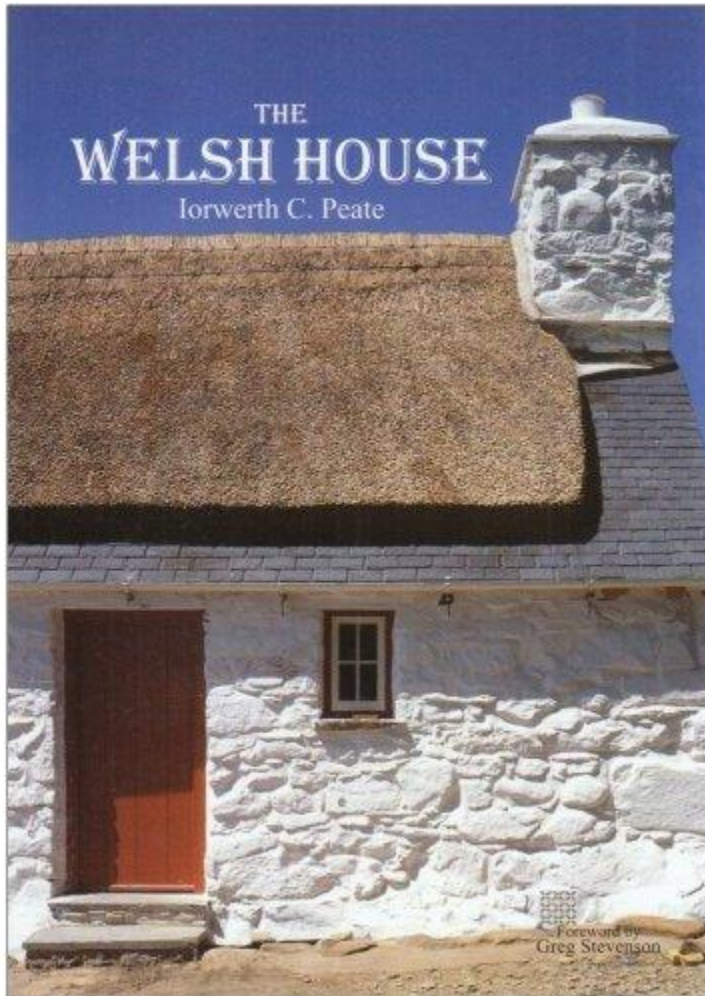
PRIFYSGOL FETROPOLITAN ABERTAWE

Repairing and Rebuilding the Welsh House

What's sustainability got to do with it?

Michael J Cullis

The Welsh House!



Sarah Featherstone's Welsh House

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...quite a lot!



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- UK ecological footprint 5.35ghp (2.1ghp)
- UK biological capacity 1.64ghp (1.3ghp)
- UK CO2 footprint 2.99ghp (0.99)

Source: WWF Living Planet Report 2008



Impact of construction materials on SD

- 19% of total national ecological footprint (1)
- 23% of total national greenhouse gas emissions (1)
- 420 MT material consumption (2)
- 30% of all road freight on UK roads (3)



Source:

(1) Stockholm Environmental Institute

(2) Biffa

(3) Freight Transport Association

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Some Facts (UK)

- Construction output >£100b
- Material consumption 420MT
- Materials and products cost >£30b
- UK housing materials & products >£10b
- Material salvage market >£1b
- Materials reclaimed 5MT

Welsh construction output some 10% of UK



Source: CIRIA



Source: Welsh School of Architecture

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“Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”

World Commission on Environment and Development (the “Brundtland Commission”), 1987



Sustainable development is about:
needs and limitations

The UK Sustainable Development Strategy

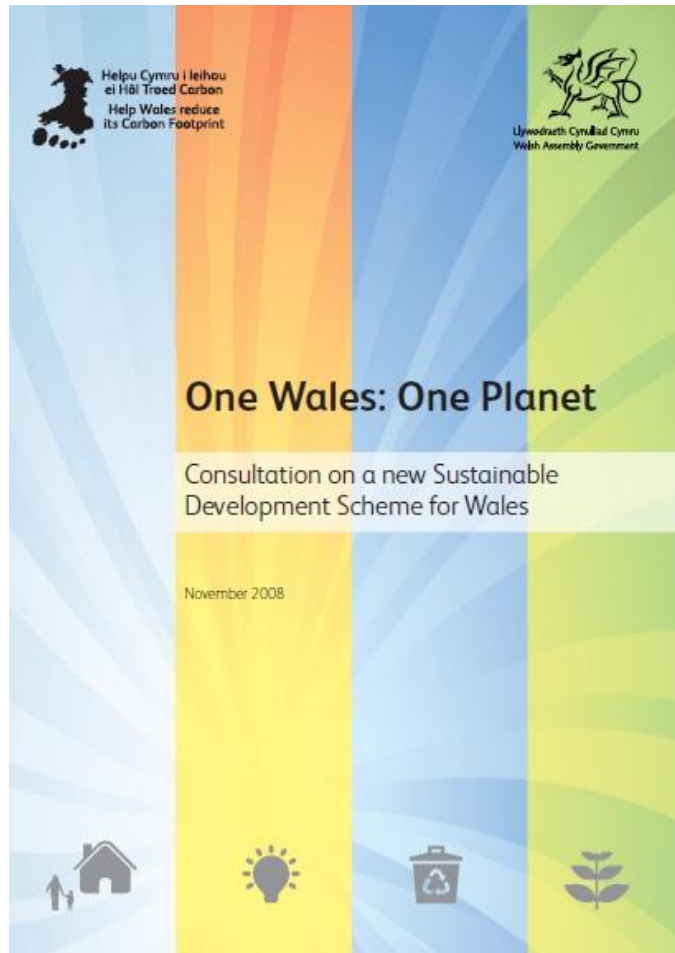


- Key principles:
 - Living within environmental limits
 - Ensuring a strong, healthy and just society
- Underpinned with:
 - Achieving a sustainable economy
 - Promoting good governance
 - Using sound science responsibly

The UK Sustainable Development Strategy

- Sustainable consumption and production  More from less
- Climate change and energy  Preparation and planning
- Natural resource protection and environmental enhancement  Environmental limits
- Sustainable communities  Local needs

Sustainable Development in Wales



- Core principle:
 - Involvement
 - Integration
- Supporting principles:
 - Decoupling
 - Costs and benefits
 - Precautionary principle
 - Polluter pays principle
 - Proximity principle
 - Reflecting distinctiveness

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Housing and sustainability

The planning, design, construction and maintenance of housing provide significant opportunities to contribute towards sustainable development.



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Housing and sustainability

Well built, safe and environmentally friendly housing is fundamental to our individual and community well-being.



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Housing and sustainability

The investment in new housing, refurbishment and maintenance provides opportunities for social and economic benefits to the local community and to the local economy

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The Welsh Quality Housing Standard defines quality homes as those that are:

- ☐ in a good state of repair;
- ☐ safe and secure;
- ☐ adequately heated, fuel efficient and well insulated;
- ☐ contain up-to-date kitchens and bathrooms;
- ☐ well managed (for rented housing);
- ☐ located in attractive and safe environments; and
- ☐ as far as possible suit the specific requirements of the household (e.g. specific disabilities).



Source: Bedcon

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Why is housing important to sustainable development?

The location, planning, layout and design of housing make an important contribution to the long term vitality and identity of communities

Well-designed, constructed and maintained housing is essential to supporting sustainable communities that reflect diversity and social inclusion



Source: The Urban Environment

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The quality, cost and availability of housing are key factors in the quality of life of local communities and their residents

Good housing contributes to health and well-being, educational attainment and access to employment

Housing can reduce major environmental impacts through its siting, its construction, its use of resources such as energy and water and its demands on transportation

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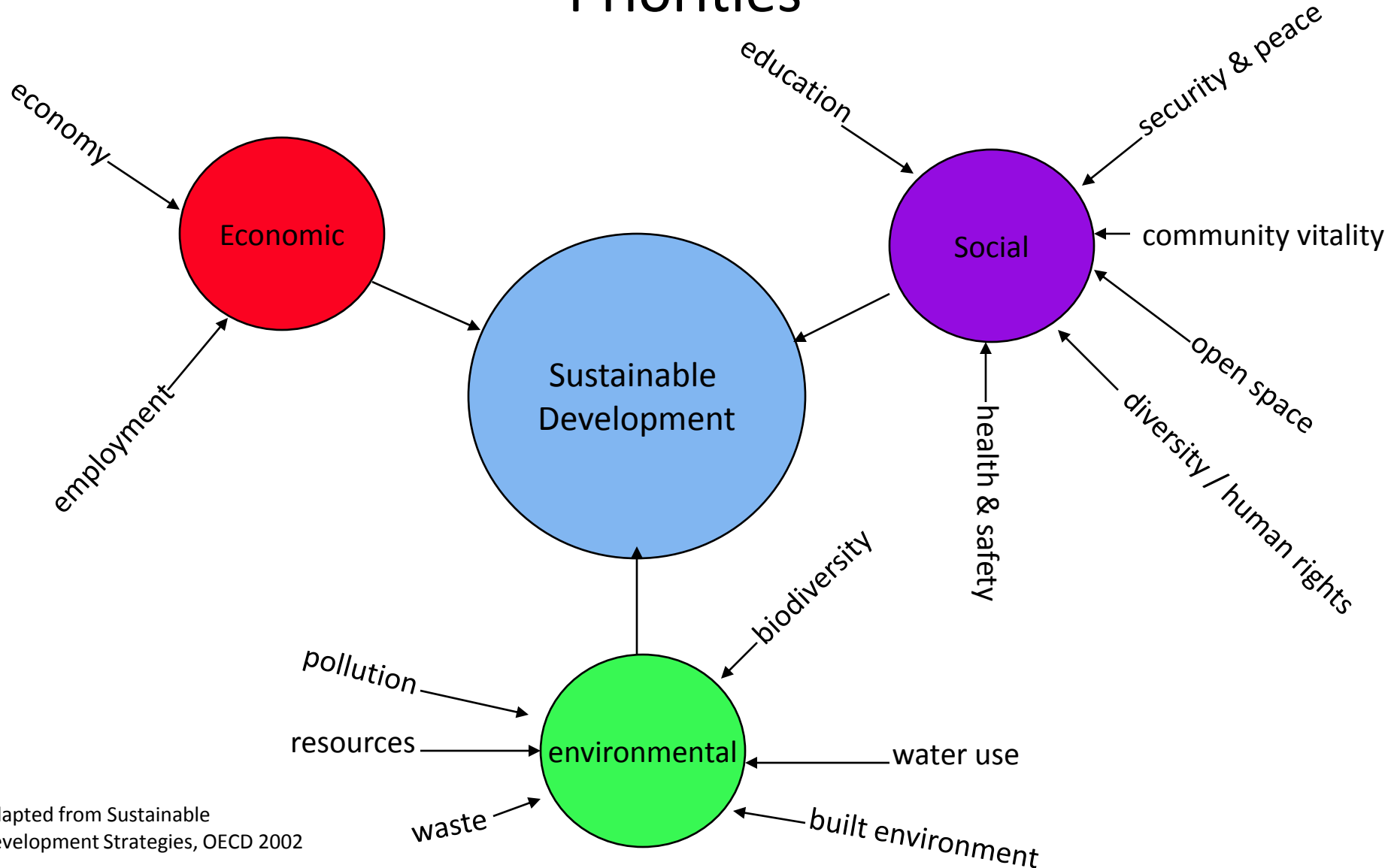


Housing can play an important part in alleviating poverty, in supporting people and generating employment

The location, cost and availability of housing are key factors in the safeguarding of Welsh speaking communities.



Construction's Sustainable Development Priorities



Sustainable Construction, a definition...:

“...is conducting business in a way that meets environmental and social responsibilities whilst at the same time improving profitability.”

Construction Best Practice Programme



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Sustainable construction is built on the need for integration involving all key players:

those who develop

those who produce

those who plan

those who build

those who alter and maintain

those who design and those who

use the built environment



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The 1.3 million homes in Wales contribute a significant part of the total impact on our local and global environment, particularly in carbon emissions and waste.



Should we then minimise construction waste?

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Reuse and recycling – challenges...



Source: Welsh School of Architecture

- Material mass
- Material volume
- Embodied energy
- Market value
- Toxicity
- Biodegradability

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Reuse: Key design principles achieved via...

- Mind set
- Life-cycle
- Drivers
- Education



Source: Design for Deconstruction

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Design for Deconstruction

Some questions...

- Why design for reuse or recycling?
- Is design for component reuse, or for material recycling?
- What type of reuse or recycling is being designed?
- Does the design for reuse / recycling apply to every component / element?
- What information needs to be provided?



Source: Design for Deconstruction

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The challenges...

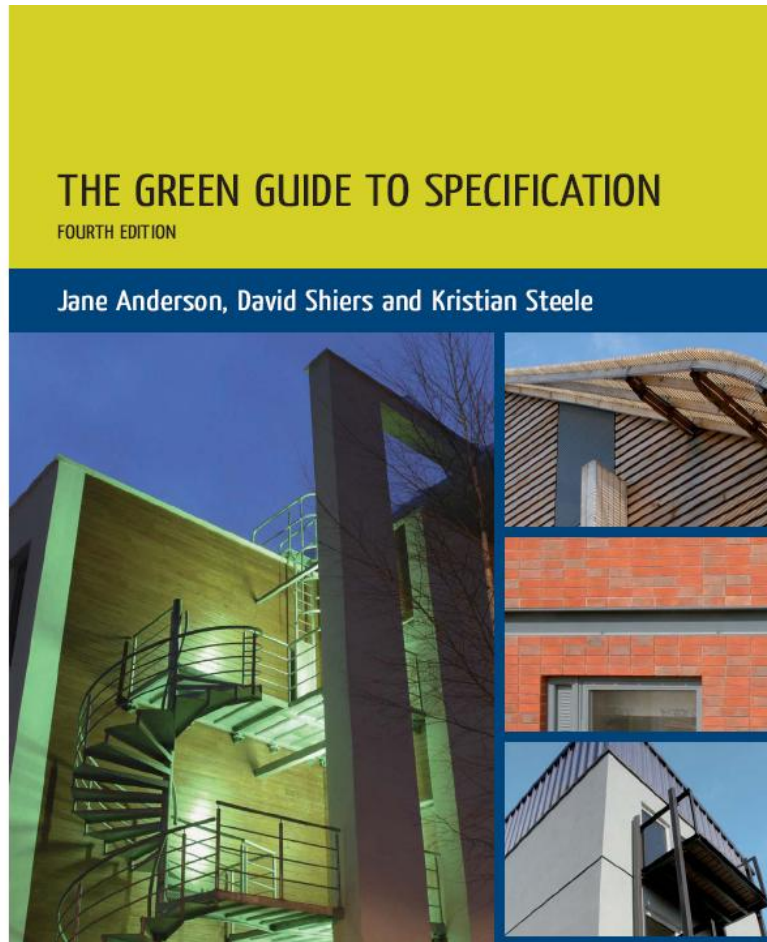


Source: Design for Deconstruction

Consider

- Whole life
- The potential of components for reuse
- The process of deconstruction in the design
- The ownership of buildings and their components

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- How to make the right choice when selecting materials and components
- Environmental impacts...
 - Climate change
 - Toxicity
 - Fossil fuels
 - Ozone depletion
 - Emissions & pollutants
 - Mineral & water extraction



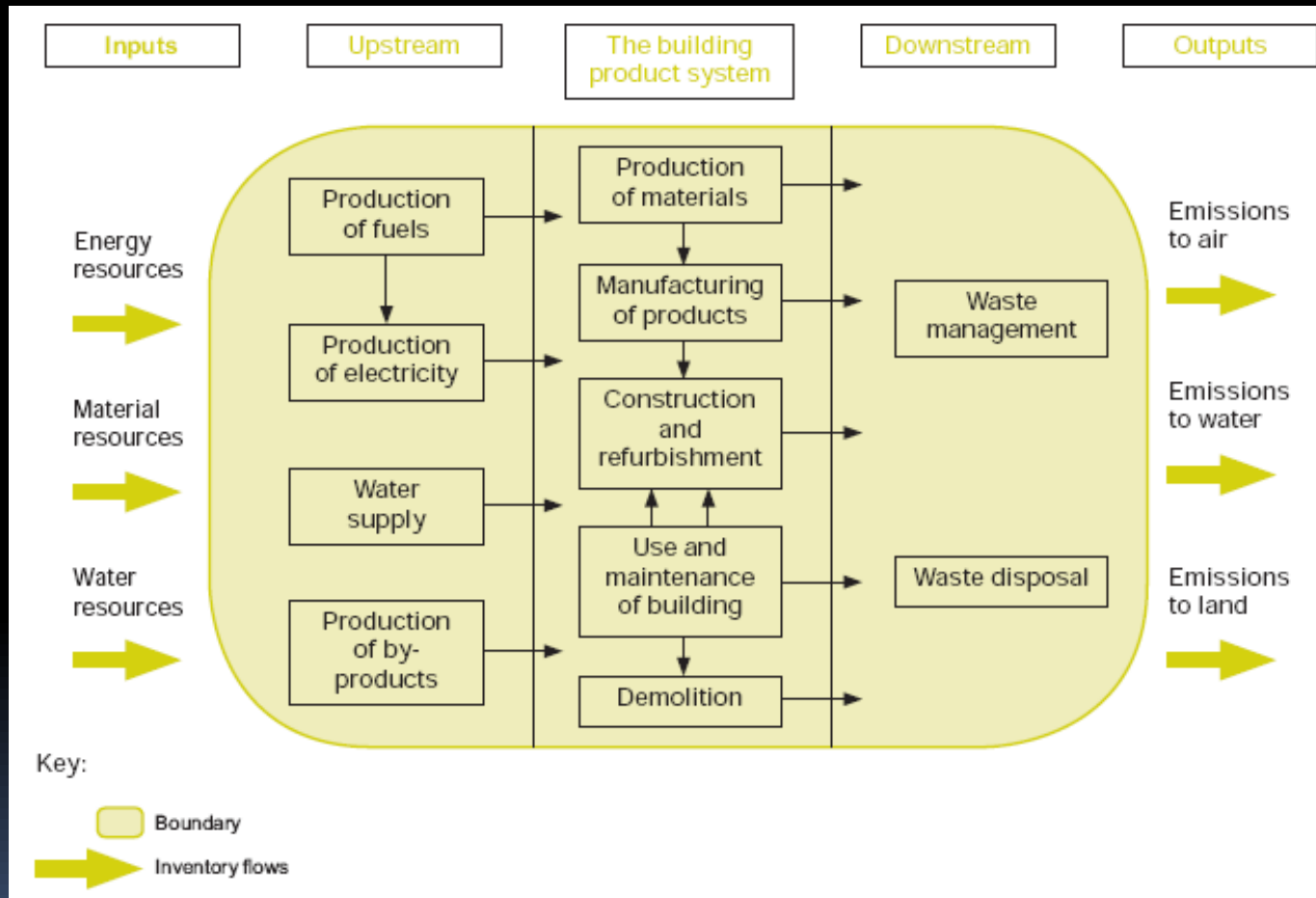
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WILEY-BLACKWELL

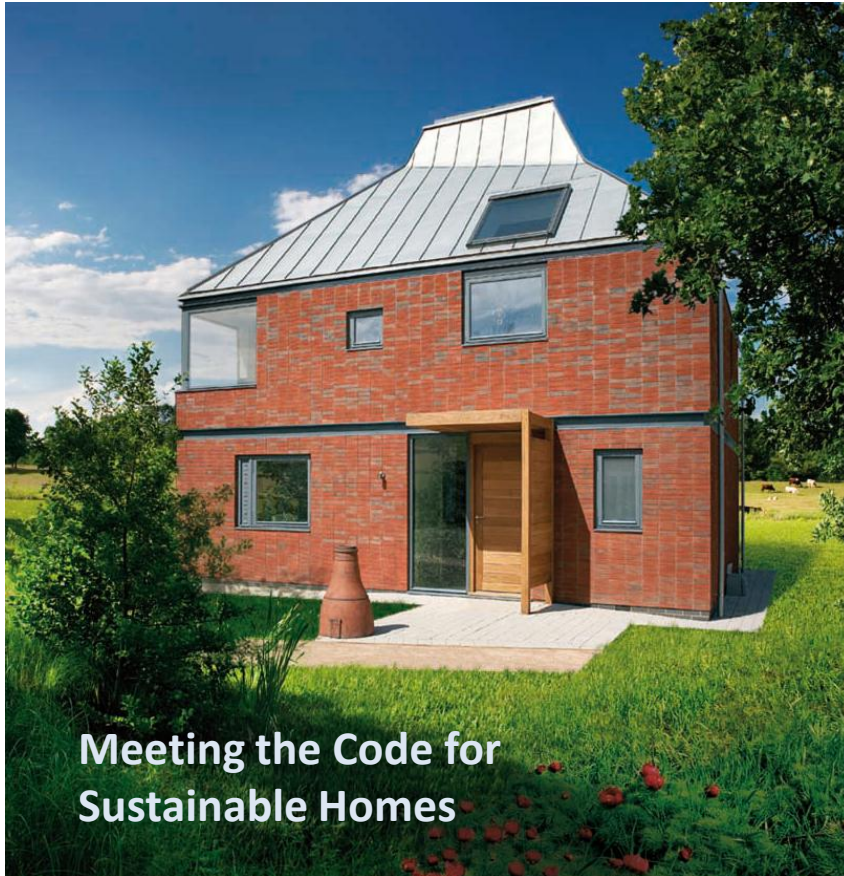
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An example life cycle system of a building and its interventions with the physical environment.

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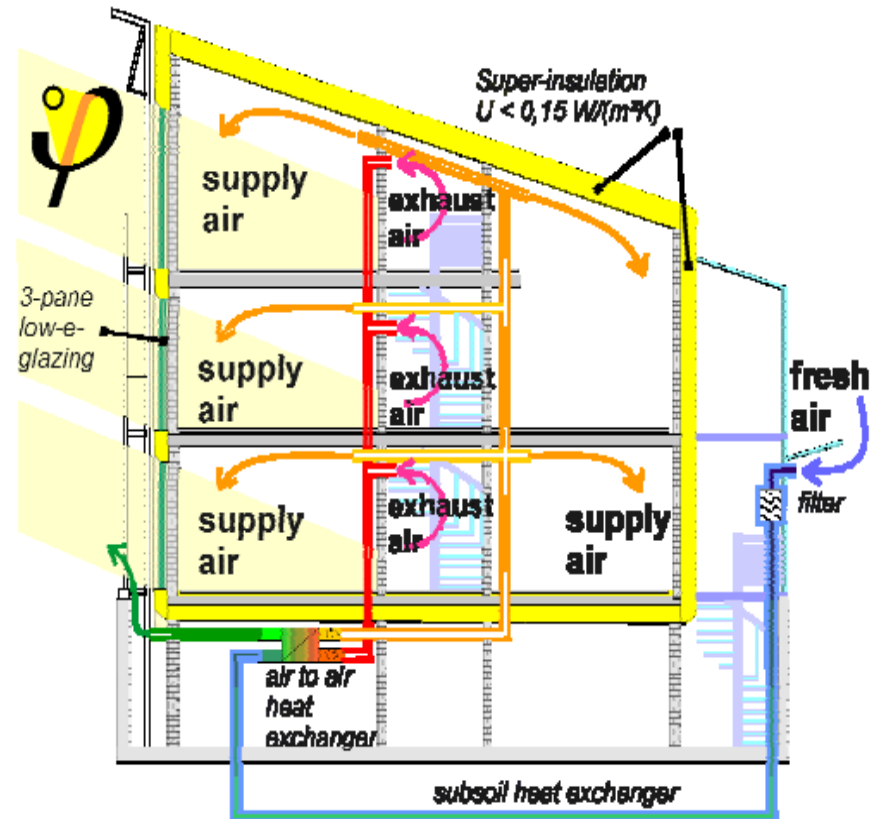


- Step change in sustainable home building
- Based on BRE's EcoHomes system
- Standard for key elements of design and construction
- A single national standard
- Basis for developments in Building Regulations
- A tool for developers
- The Code uses a sustainability rating system

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So can construction be sustainable?

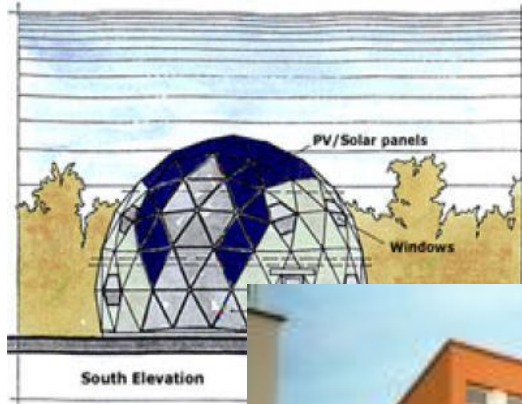
- Passive design
- Native landscape
- Attention to power
- Water conservation
- Reduction of emissions
- Design for operation and maintenance
- Materials efficiency
- Design for recycling



Perhaps an intelligent approach!

Source: Passive House Institute

An Intelligent Building is:



‘a building that is able to respond continuously to the needs of its environments, and its occupants in a cost-effective way.’

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Straw bale housing?



Low environmental impact

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❑ Low on-site wastage

Pre-fabricated solutions

❑ Speed of installation

❑ Versatility



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Premix concrete and mortars



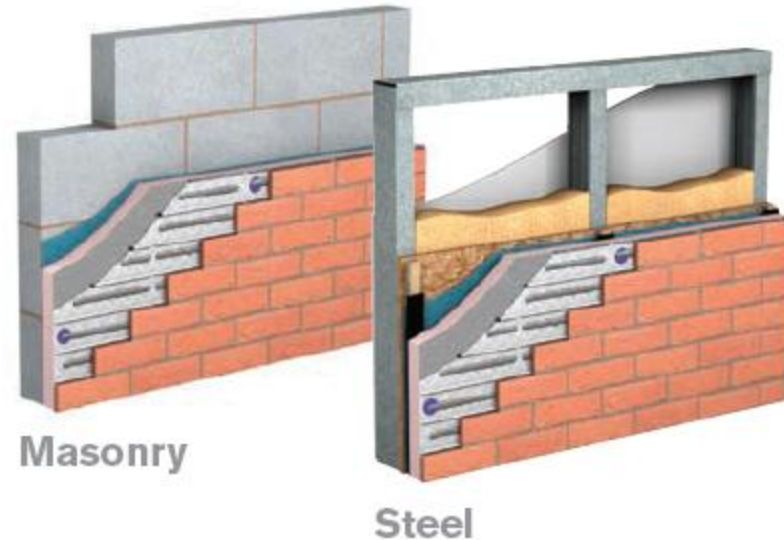
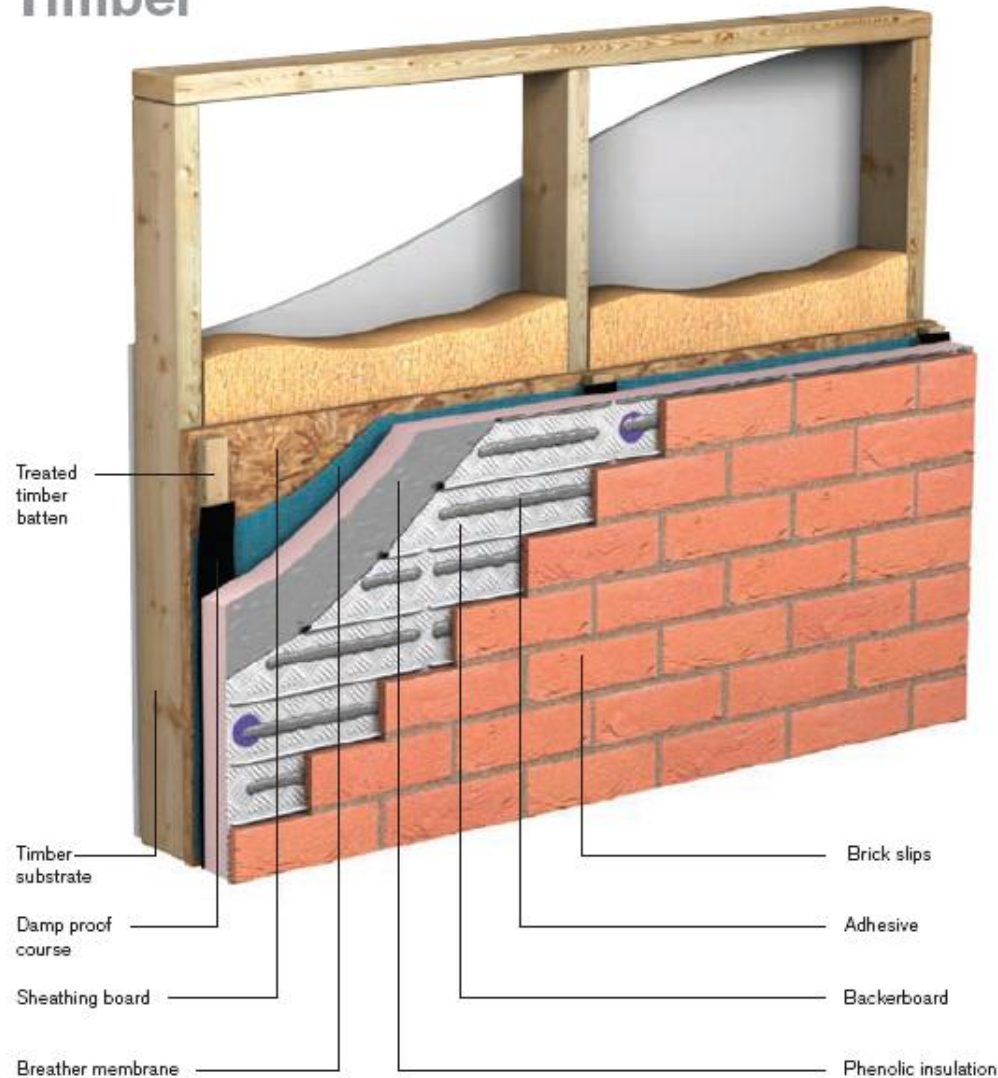
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Earth structures



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Timber



Source: Hanson

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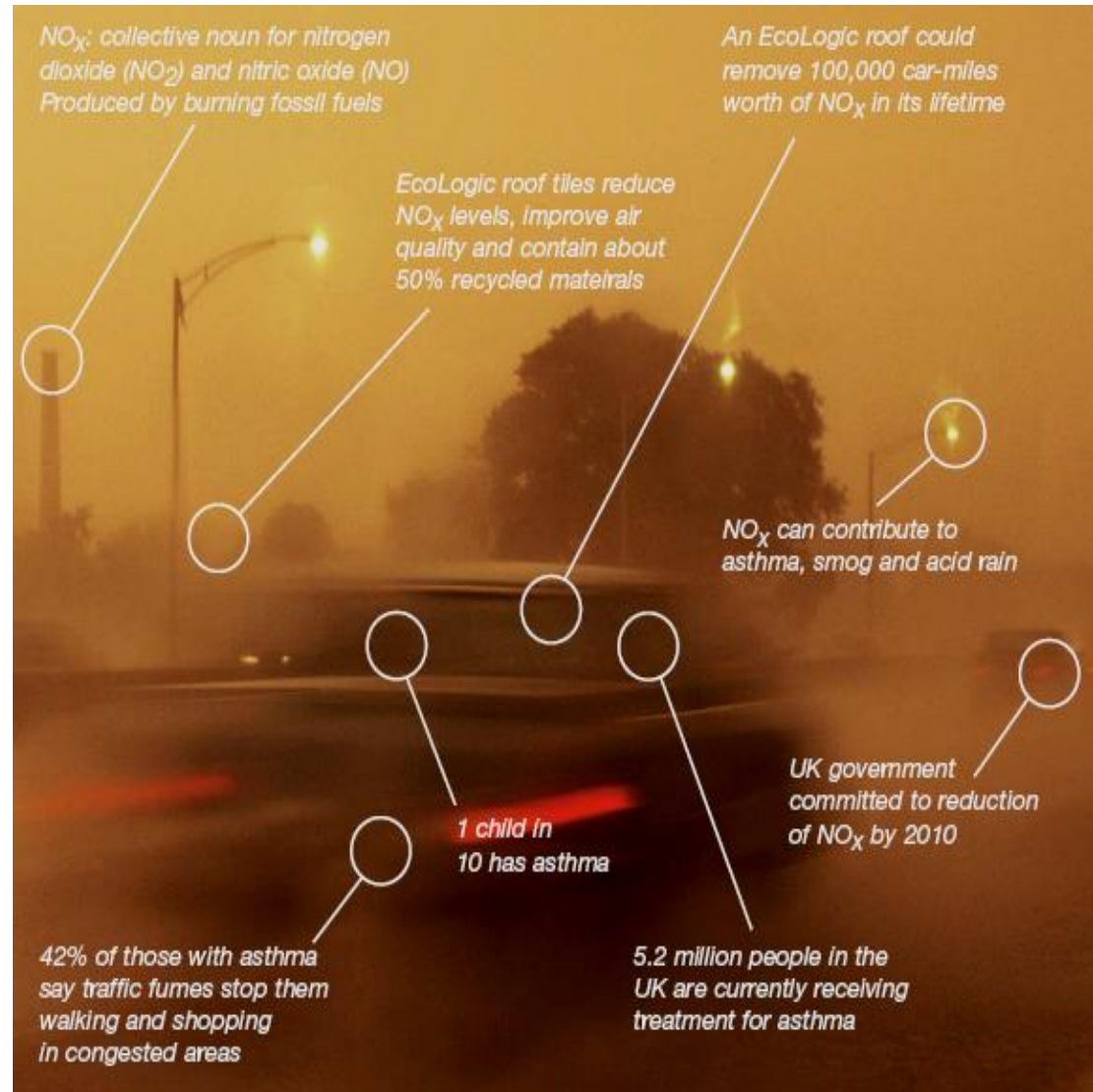


Cleaning the built environment!

- ❑ NO_x levels reduced by 2010
- ❑ Kerb & roadside testing
- ❑ Standards under EU Emissions Directive

Eco tiles can help!

- ❑ 50% recycled materials
- ❑ 'A' rating in Green Guide



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Beddington Zero Energy Development



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Source: Imerys roof tiles



Source: University of Southampton



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Repairing and maintaining

Why not retrofit?



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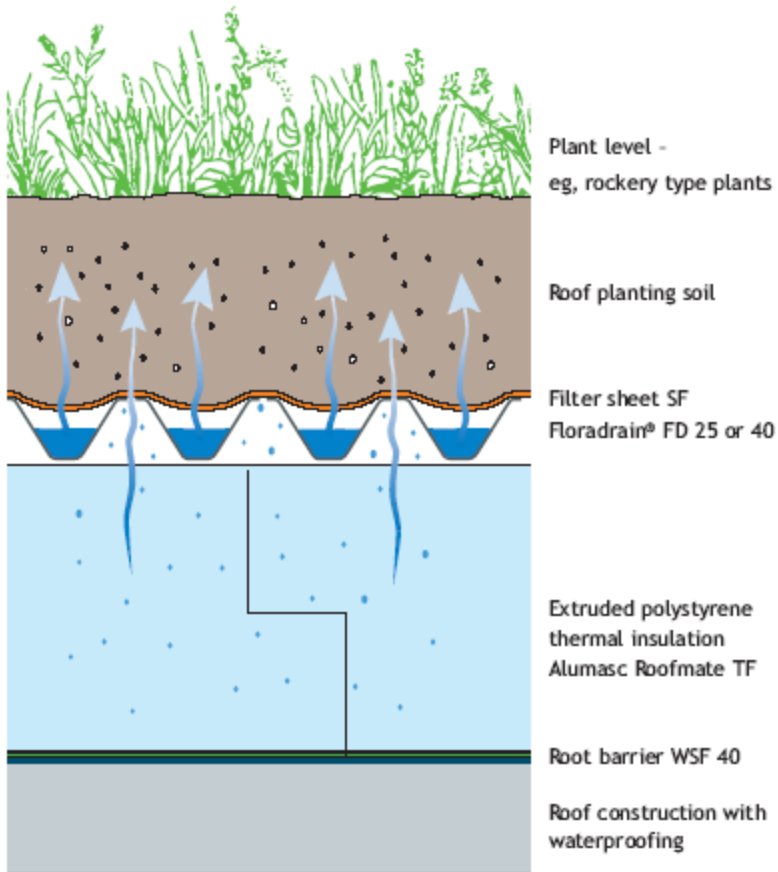
Why not a green roof?

- Water retention
- Climate control
- Life expectancy
- Pollution control
- Thermal insulation
- Space use
- Encourages natural habitats



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Inverted Green Roof



Some key points:

- ☐ Root barrier
- ☐ Wind uplift
- ☐ Water storage
- ☐ Irrigation

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- ❑ SmartLIFE: Focuses on MMC as a means to deliver sustainable affordable communities
 - ❑ Possible to build sustainable homes using either traditional or MMC methods.
 - ❑ Clarity regarding needs
 - ❑ Effective communication
 - ❑ Improved feedback
 - ❑ Knowledge transfer



Source: Urban Design Compendium

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Steel frame:

Cultural change

Sustainability

Cost efficiency



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❑ made from Portuguese cork granules, pressure-bonded into boards, using the cork's own self-contained resins as the binder.



❑ lowest amount of embodied energy of any equivalent insulation type



❑ raw materials obtained from fully renewable and sustainable sources (cork trees)

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Thermafleece sheep's wool

Natural insulation

Renewable source

40% moisture absorption

Controls condensation

Thermally and acoustically efficient

Local resource

Versatility



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Unfired clay bricks



- ☐ For use in internal non-loadbearing applications
- ☐ Low-energy input
- ☐ Minimal waste
- ☐ Highly recyclable
- ☐ Thermal mass
- ☐ Acoustic insulation
- ☐ Humidity control

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Thermowood



☐ Steam heated

☐ Ideal in exposed locations

☐ Durability

☐ Versatile

☐ Stability

☐ Reduced moisture content

☐ Enhanced physical properties



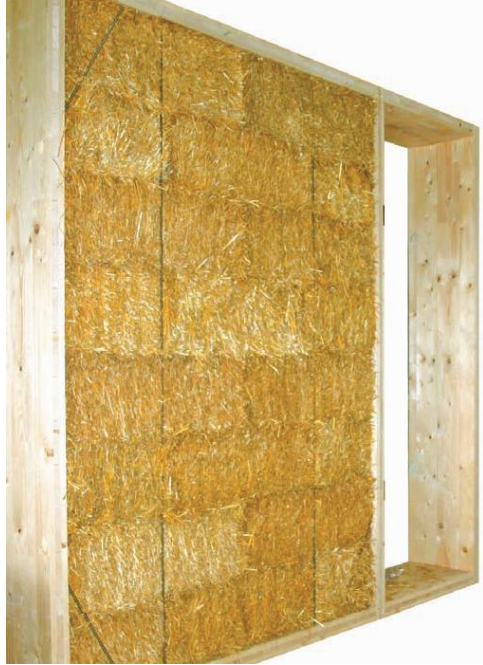
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- Timber frame:
 - Sustainable
 - Dry approach
 - Dimensional accuracy
 - Speed
 - Simplicity
 - Versatility
 - Cost-effective



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Prefabricated panels

Super-insulated

Low-energy

Locally sourced carbon-sequestering

PassivHaus standards

MODCELL

Straw bale and hemp construction



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HEMCRETE

Green concrete – a combination of lime binder with hemp

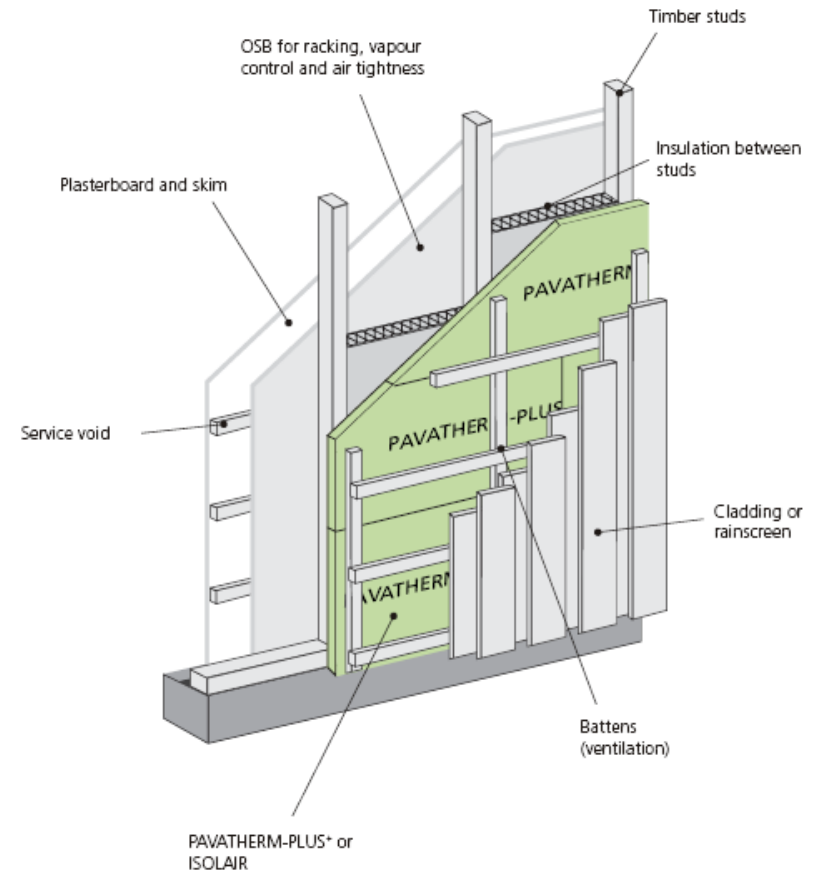


- ☐ Carbon capture ('better than carbon neutral')
- ☐ • Low density
- ☐ • High thermal insulation
- ☐ • High sound absorption
- ☐ • High thermal inertia (heat capacity)
- ☐ • Good vapour permeability ('breathability')
- ☐ • Creates comfortable healthy buildings
- ☐ • Fire and pest resistant

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Pavatex



☐ Wood-fibre insulation

☐ Natural binder

☐ Resistant to aging

☐ Reusable

☐ Recyclable

☐ Compostable

☐ Heat energy

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Earthship Brighton



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Earthship Brighton



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Tyre bale use in embankments



- First UK use
- Alternative to concrete
- Improved drainage and slope stabilisation
- Environmental impact reduced
- Cost and environmental benefits

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Houses of the future?



Balancing the natural with the built!



Why not? It's detached,
gives off plenty of light,
uses local materials and
is aesthetically pleasing
to its environment!

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Workshop

Given the sustainability possibilities afforded to housing development put forward similar sustainable ideas that can be applied to other forms of construction



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Further information

- ☐ Strategy For Sustainable Construction
- ☐ Code for Sustainable Homes
- ☐ The Sustainable Development Commission
- ☐ The Strategic Forum for Construction and the Construction Industry
- ☐ Commission for Architecture and the Built Environment
- ☐ The Office of Government Commerce
- ☐ The Urban Environment, Royal Commission on Environmental Pollution
- ☐ UK Government Sustainable Procurement Action Plan
- ☐ UK Biodiversity Action Plan
- ☐ PPS3, Housing
- ☐ Biodiversity indicators for construction projects, Dti