Eco-materials: busting some myths

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Workshop

Explore some myths and realities of eco-materials:

- What are they?
- What contribution can they make to modern building?
- What are the barriers to their mainstream uptake?
- What can we do to overcome these barriers?

Eco-materials

- ‘Low carbon materials’
- ‘Natural materials’
- ‘Renewable materials’
- ‘Recycled materials’
- Planted roofs

Low carbon natural ‘eco-materials’

- Inorganic materials
  - Earth construction
  - Lime based materials
- Renewable plant based materials
  - Timber and wood based products
  - Crop by-products: straw; hemp shiv
  - Fibres: hemp; flax, sisal, kenaf
  - Bamboo; reeds
- Animal based products
  - Sheep’s wool
  - Additives (horse hair fibres; blood; casein; urine; excrement)

Traditional & *Modern*

Earth building

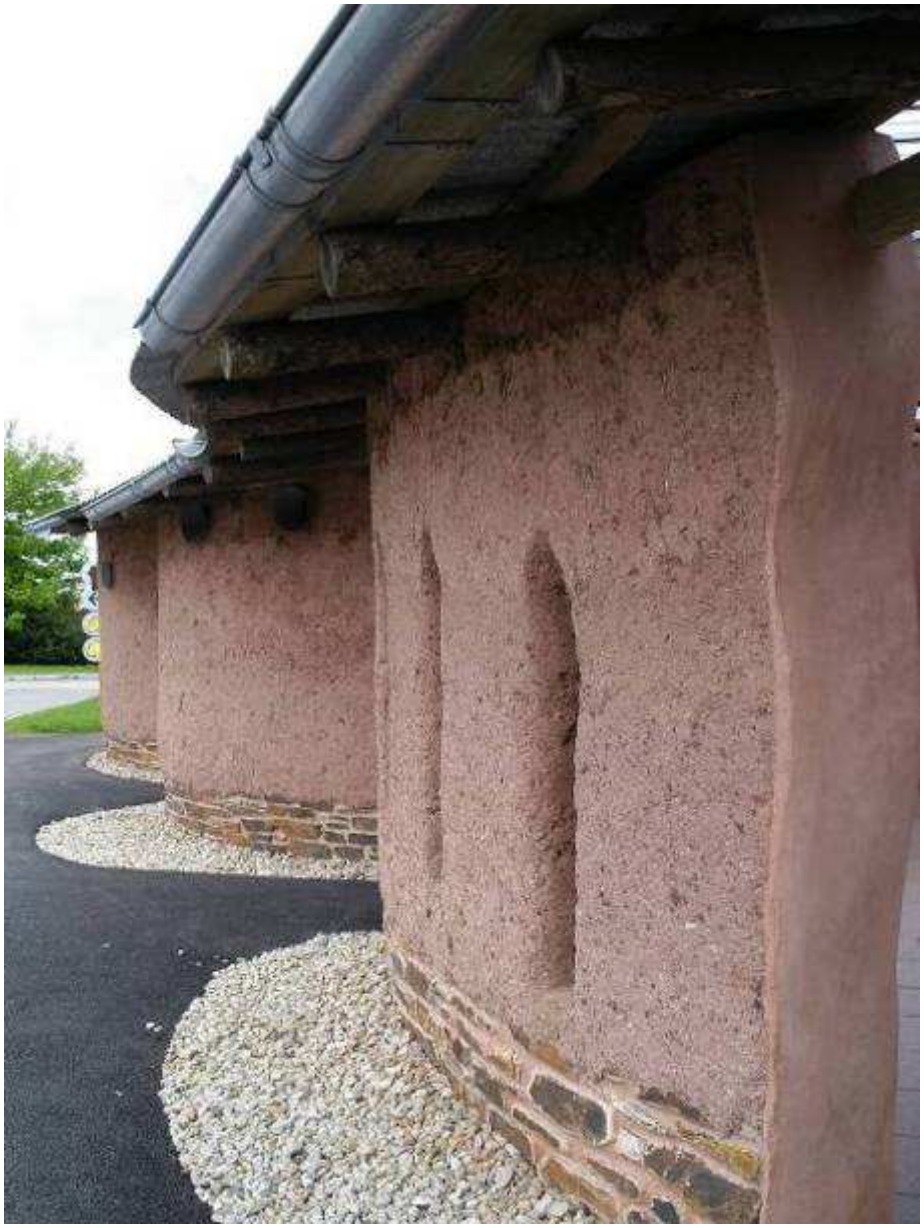
- Cob, rammed earth, adobe, plasters
- *Clayboards, pre-bagged plasters, extruded blocks, prefabricated elements*

- Binders
  - Lime mortars, plasters and washes; limecrete
  - *Formulated lime binders; spray application*
- Renewable materials
  - Timber, thatch and woven finishes, fibre additions, bamboo
  - *Engineered products, fibre insulation products, prefabricated straw bale, hemp-lime*

Building with earth:
Adobe

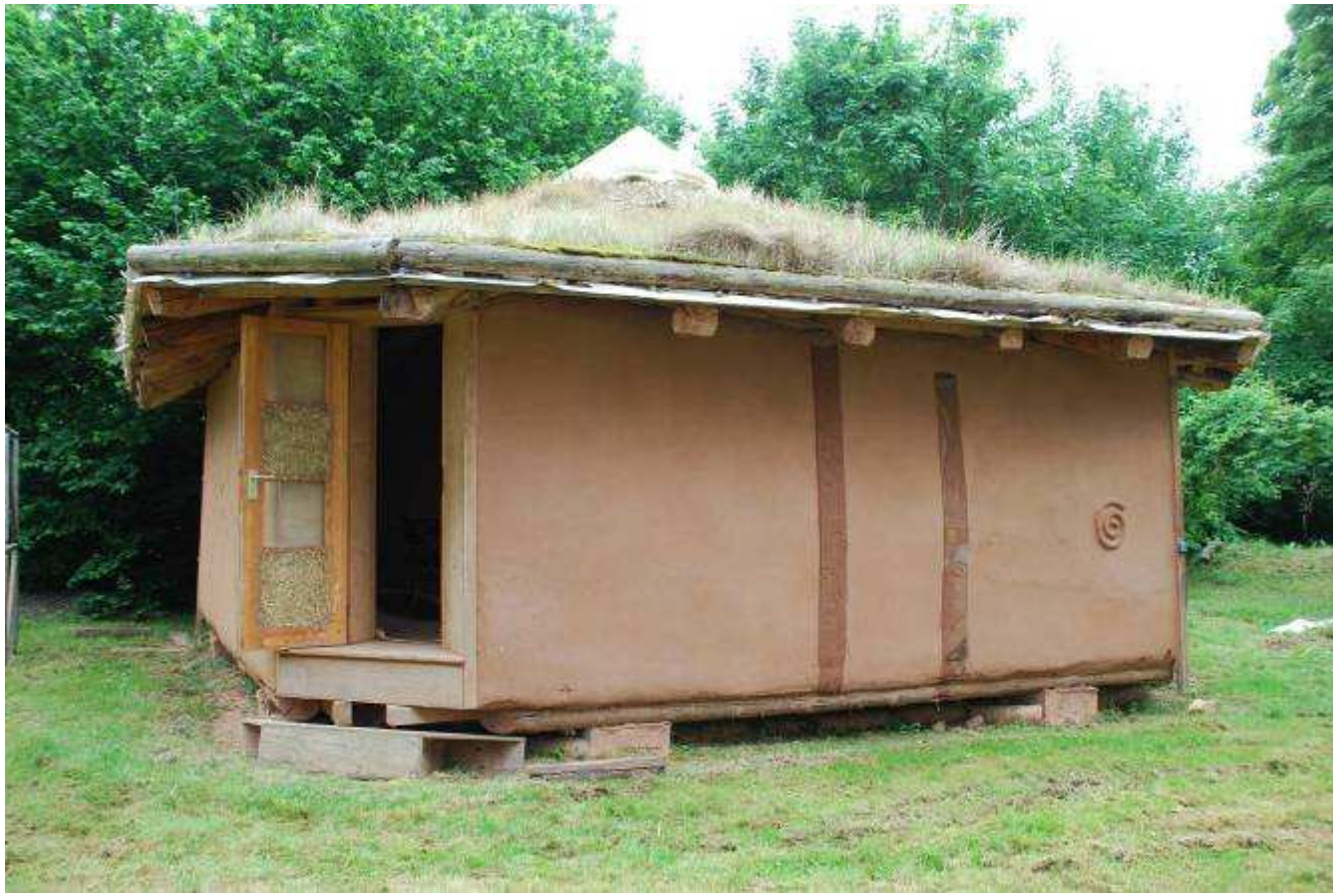
Building with earth:

Cob



Building with earth:
Rammed earth

Straw bale:
Loadbearing



Straw bale:
In-fill

Hemp-lime: Materials

Hemp-lime

Opportunities for eco-materials in modern construction

- Lower embodied carbon
- Building environmental performance
- Healthier buildings
- Renewable resources
- Reduced waste

Moving into the mainstream

- Economic barriers
  - Build cost
  - Insurance and finance
- Knowledge barriers
  - Materials
  - Design
  - Construction competence (unregulated, self-build)
  - Specification/certification
- Awareness barriers
  - Public and industry (image)
  - Supply chain
  - Skill base

Potential markets

- Mainstream
  - Lime renders and mortars
  - Insulation products
  - Paints
- Significant impact
  - Hemp-lime
  - Green oak carpentry
  - Factory made earth products ?
  - Prefabricated straw bale ?
- Self-build and niche
  - Traditional earth building
  - Load-bearing straw bale

Myth or reality?

1. Eco-materials are difficult to use

- In general industrial products easier to use (quick installation, fewer skills, more robust)
- Eco-materials require different skills
- Limited appreciation of materials


19/07/2007

2. Natural materials are not well suited to mainstream building practices

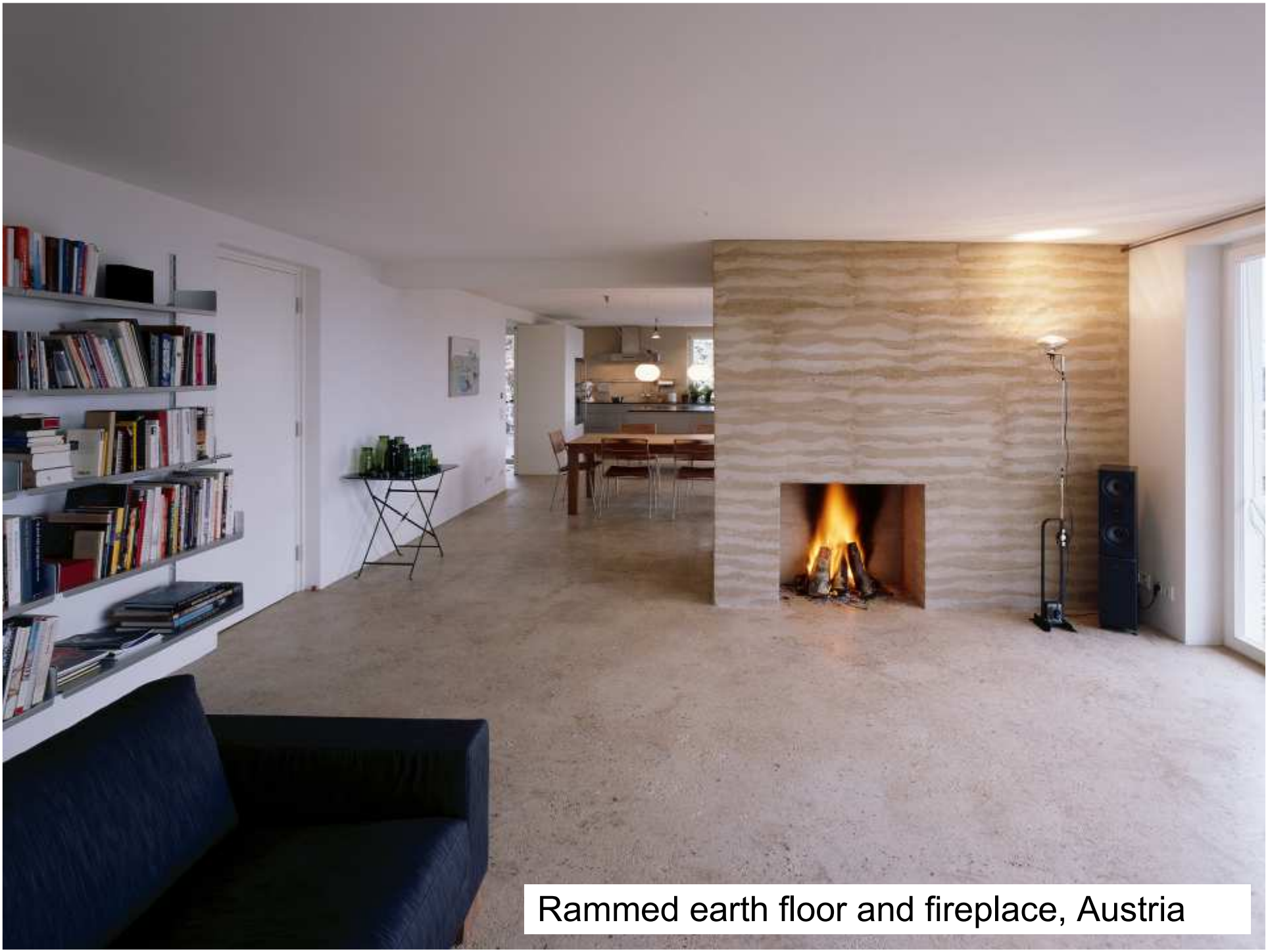
- Moisture sensitive
- Low strength
- Slow ‘setting’
- Performance less reliable

Changing situation….

- Lime products
  - renders, plasters, mortars, binders
- Insulation
  - cellulose
  - natural fibre products
  - cork
- Green roofing systems
- Engineered timber and bamboo products
- Hemp-lime

3. Eco-materials are (too) expensive

- '*How does it compare against the lowest common denominator?*'
- Costs often dependent on labour requirements (self build)
- Some materials are very cheap (straw, earth)
- For equivalent performance costs are increasingly competitive
- However, cost remains significant barrier to wider uptake



Rammed earth floor and fireplace, Austria

4. Renewable materials are carbon negative

- Carbon storage:
  - 1 kg timber uses 1.4 kg CO_2
  - 1 kg hemp uses 1.8 kg CO_2
- Carbon remains stored within material until it breaks down
- Delayed carbon release rather than sequestration
- Some LCAs are beginning to recognise this benefit (PAS 2050)

Significance of embodied carbon

- Cement production currently contributes around 5% global industrial CO_2 emissions (around 1.3bn tonnes p.a.).

- By 2050 cement based CO_2 emissions projected to rise to 2.5 - 5bn tonnes p.a..

Carbon footprint

- Hemp-lime **stores** around **110 kg.CO_2/m^3** (33 kg.CO_2/m^2 for a 300 mm thick wall)

- Straw bale **stores** around **145 kg.CO_2/m^3** (70 kg.CO_2/m^2 for a 490 mm thick wall)

- Masonry **emits** around **110 kg.CO_2/m^2** for an external cavity wall

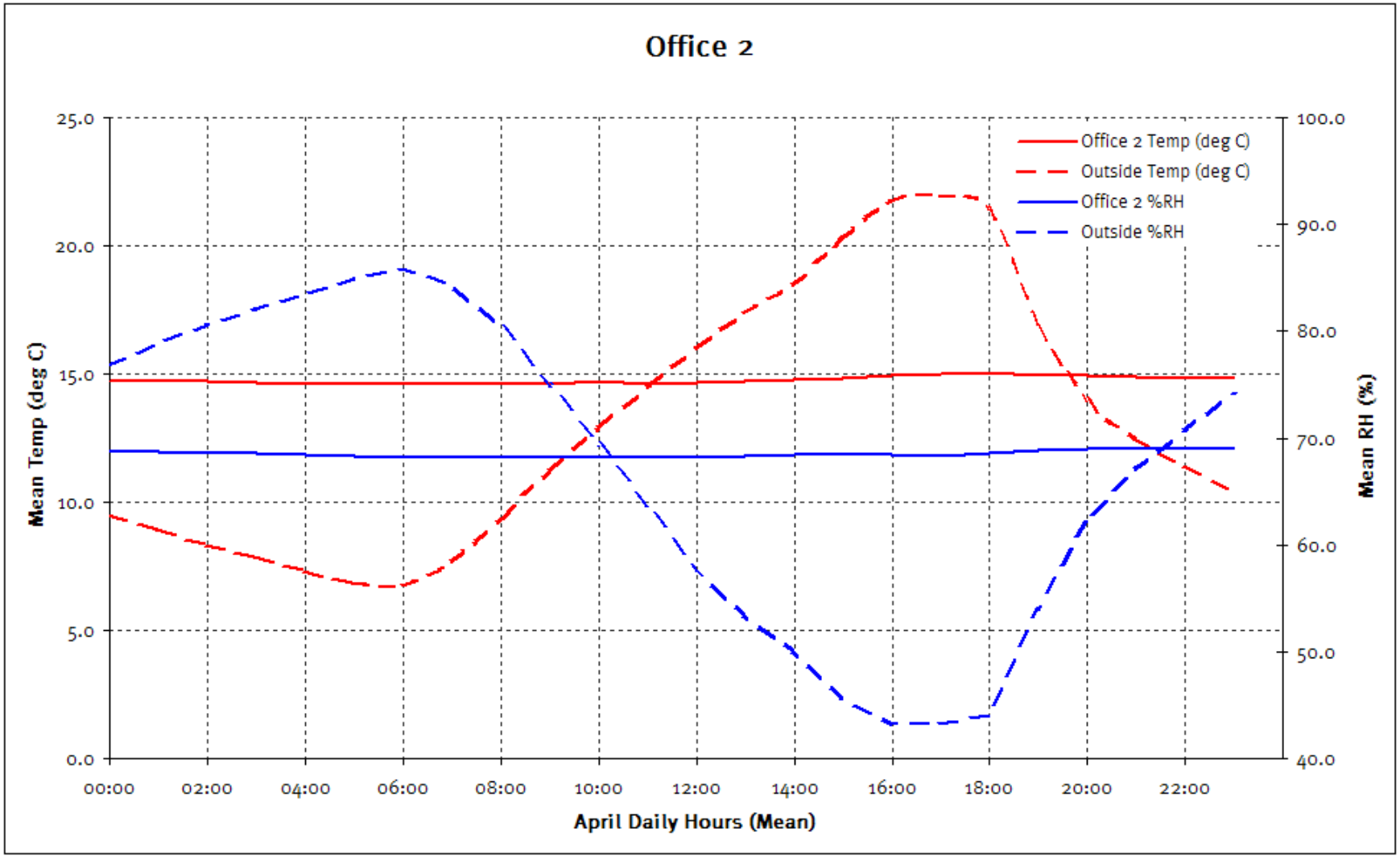
5. Renewable materials have hidden adverse effects

- Replace food crops: shortages and higher prices?
- Increased fertiliser use?
- Deplete natural world?
- Impacts on biodiversity
  - Potential benefits attributed to hemp and other crops
  - Need to be carefully managed

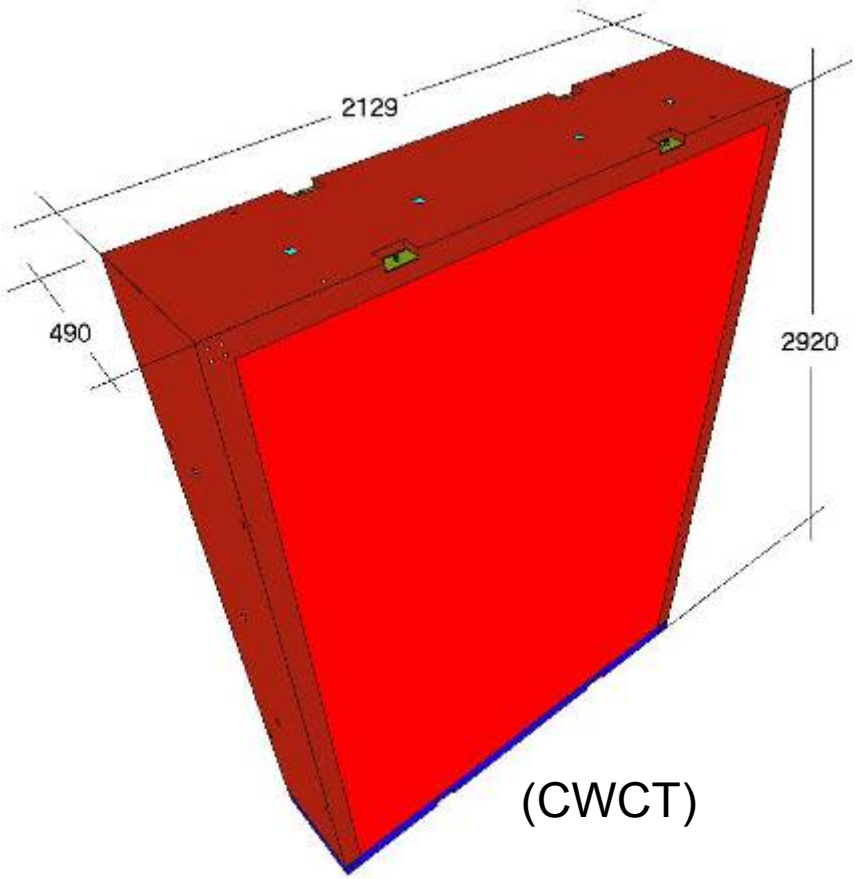
6. What's the U-value?

- Natural insulation products struggle to compete with conventional materials for thermal conductivity
- Generally thicker insulation (and walls) required
- Limits refurbishment applications?
- Offset by more holistic (realistic) approach to thermal performance:
  - Thermal lag
  - Thermal mass
  - Hygrothermal performance
  - Air tightness
  - Stored (off-set) carbon

Hygrothermal properties of hemp-lime



Thermal performance of straw bale panel



(CWCT)

Numerical modelling predicts thermal time lag around 12 hours

7. Lack of certification and design guidance limits uptake

- Certification:
  - BBA, BRE, TRADA, etc
  - Certification is requested by designers, specifiers, clients, finance, insurers
  - Obtaining certification can be very expensive and time consuming
- Guidance:
  - No British Standards or Euro-Codes
  - Various best practice books, technical notes, papers, training courses

Fire resistance of straw bale panels

8. Eco-materials are non-durable

9. Earth walls are massive

9. Only suited to new build and rural locations

Refurbishment

Rammed earth, Germany

10. Traditional low cost materials are seismically unsafe

11. Renewable materials have no recycled content

- Structural metals (approaching 100% recycled content)
- Structural concrete (routinely uses around 30% recycled aggregate and 30-40% cement replacement materials)
- Renewables are largely virgin materials, BUT they do recycle CO_2!

12. Eco-materials are hairy

Heather cladding, Scotland

Load-bearing straw bale, Germany

Rammed earth, Switzerland


Hemp-lime, England

Straw bale building, Bristol

The secret of a successful project?

- Team understands risks with innovation:
  - Client
  - Designers
  - Contractors
- All parties have signed ‘the grown-up clause’
- Delivering quality materials, products and services

Drivers for increased uptake

- Climate change
- Legislation (CSH)
- Energy costs
- New markets (agriculture)
- Corporate image
- Client/societal demand
- Improved material performance

Need to utilise all benefits

- Higher cost of construction remains a major barrier
- Future prospects:
  - economies of scale
  - increasing energy costs of competing materials
- Multi-functional materials
  - Structure
  - Comfort (thermal and humidity regulation, acoustic, air quality)
  - Health benefits
  - Sustainability (environmental, social, economic)

Thank You

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