Renewable materials in construction

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- Partnership between University of Bath and Building Research Establishment
- 30 staff and PG students
- Areas of work:
  - Advanced composites
  - Low carbon materials
  - Reuse of materials
Current research work

- Innovative concrete structures
  - FRP strengthening and reinforcement
- Structural masonry
  - Lime mortars
- Timber materials and engineering
  - Engineered timber products; Traditional carpentry; Timber concrete composites
- Natural fibre composites
- Low carbon materials
  - Earthen architecture; Hemp-lime; Straw bale
- Geotechnical engineering
  - Dry-stone wall masonry
Research motivations

- Improved performance
- Carbon
- Waste
- Training
- Commercial development
- Dissemination and uptake
Arguments for renewable materials

DEFRA (2006) Creating value from renewable materials

- Reduced reliance on non-renewable resources (quarried mineral products; fossil fuel products; glass; metals)
- Reduced embodied carbon content
- Reduced waste
- Socio-economic benefits
- Improved construction performance
  - Biodegradable geotextiles
  - Natural paints (air borne pollutants)
  - Insulation materials (improved performance when damp)
  - Compost materials on end use
- Local processing/manufacturing
- Healthier buildings
- Enhance biodiversity
Crop based materials

- Insulation
  - sheep's wool
  - hemp
  - flax
- Light structural walls
  - straw bale
  - straw-clay
  - hemp-lime
- Paints and finishes
- Wall and floor coverings
- Geotextiles
- Thatch
- Timber and timber products
Renewable materials research

- Hemp-lime composites
- Pre-fabricated straw bale panels
- Natural fibre composites
Hemp-lime construction

- A composite mix of hemp particles (shiv), hydraulic lime and, sometimes, sand
- Hemp particles are woody plant stem by-product left over from hemp fibre production. Lightweight filler
- Main use in-situ built solid wall infill in timber frame buildings. Also used for floors and ceilings
- Lime:
  - Binder
  - Preservative
  - Fire protection
- Mix proportions: 1 part hemp: 2 parts lime (by mass)
- Carbon sequestration: 110 kg/m³
  - Sequestrates 12-20 kgCO₂/m² (300 mm thick wall)
  - Masonry cavity wall emits 100 kgCO₂/m²
  - Carbon saving 12 - 15 tonnes per home
Hemp production

• 1 hectare (UK) produces 8-10 tonnes of hemp – sufficient to build one house

• It takes around 14 weeks to grow from seed to 4m high

• 60% of the plant consists of shiv
Characteristics of hemp-lime

- Low density
- High thermal insulation
- High sound insulation
- High thermal inertia
- Good vapour permeability
- Creates comfortable healthy buildings
- Fire and pest resistant
- Fast and economic construction
Monitoring April 2007

- The first floor offices are being monitored for temperature and relative humidity whilst empty
- 500mm Hemcrete® walls to the south and west elevations as part of the office refurbishment
- North wall is original brick and block
- East wall is the internal concrete block wall to the warehouse
- The first floor ceiling is 220mm thick Hemcrete®
Barriers to crop material uptake

- Cost
- Industry awareness
- Lack of technical information on material performance
- Supply concerns
  - Variable crop yields
  - Seasonal crop availability
  - Uncertainty over future costs (subsidy levels)
- Need for training in material use
Research needs

• Development of material performance understanding
  – Mechanical properties
  – Durability
  – Environmental properties

• Robust details

• Hybrid systems

• Supply chain issues

• Models/guidance for environmental performance

• Life Cycle Analysis/Life Cycle Costing

• Building performance tests - demonstration buildings
Thank you