Sustainable Construction Materials from agricultural co-products:
Optimising straw bale insulation

Dr Shawn Platt and Prof. Pete Walker
BRE Centre for Innovative Construction Materials, University of Bath
The SB&WRC project is supported by European Union funding from the Interreg VA France (Channel) England programme, which is co-financed by the ERDF. The ERDF is contributing €1.26 million toward the project.

BRE Centre for Innovative Construction Materials

• Research Centre in partnership with BRE since 2006
• 20 academic staff; 40+ researchers
• Research fields:
  o Low carbon cements and concrete materials
  o Innovative concrete structures
  o Timber Engineering
  o Eco-materials (bio-based; mineral based)
  o Energy performance materials
• Facilities include:
  o Scientific laboratories
  o Structures laboratories
  o Building Research Park/HIVE
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Prototype aim

To develop a novel prototype straw bale insulation product, suitable for a wider range of non-loadbearing building applications, with optimal thermal resistance properties.
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Previous work: Thermal conductivity of straw bales

Figure 8. Thermal conductivity versus density for a range of straw samples in dry and humid states. RH: relative humidity; CEBTP: Centre d’Expertise du Bâtiment et des Travaux Publics; and FASBA: Fachverband Strohballenbau. 'Evaluation of the thermal performance of an innovative prefabricated natural plant fibre building system' Andy Shea, Katharine Wall and Pete Walker. Building Services Engineering Research, 2013.
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Previous work: Thermal conductivity of straw bales

• RH and temperature have a significant impact on the measured thermal conductivity.

• A least squares regression model for the determination of apparent thermal conductivity as a function of density results in a thermal conductivity value of 0.064 W/mK at 120 kg/m$^3$.

• Thermal conductivity depends on straw orientation:
  • 0.064 W/mK (straw oriented parallel to direction of heat flow)
  • 0.045 W/mK (straw perpendicular to direction of heat flow)
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Manufacture process

Harvest of the wheat straw

Standard dimensions

Production of rectangular or round bales in the field (balers)

Dimensions chosen

Production of rectangular bales in the field (balers)

Re-string bale to improve properties (new hydraulic machines) and line with breathable fabric?

Use

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Next steps

- Refine prototype manufacture process
- Characterise properties:
  - Density
  - Mechanical properties
  - Thermal conductivity
  - Fire resistance
- Demonstrate performance at full-scale
- Develop proposals for up-scaling prototype production
- Disseminate results

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