Sustainable Architecture: Materials and Design

ecofab© An Assessment of Building Performance

Building Fabric

One wool-insulated building and one straw, are analysed for temperature and relative humidity (RH) control.

Method

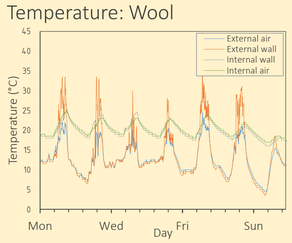
- Internal and external air and surface measurement
- Two performance indicators:
  - Decrement factor: $f = {}^{\Delta\zeta_i}/_{\Delta\zeta_e}$
  - Decrement delay: $\varphi = \tau_{i.max} - \tau_{e.max}$

ζ=Temp. or RH
τ=time
i=internal
e=external

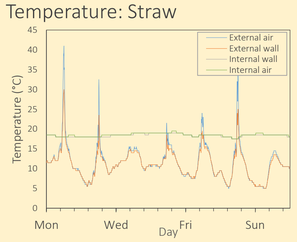
Results

Both buildings smooth and delay external extremes. Generally the straw building performs better.

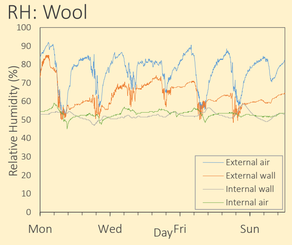
Temperature: Wool



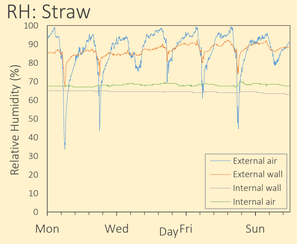
Temperature: Straw



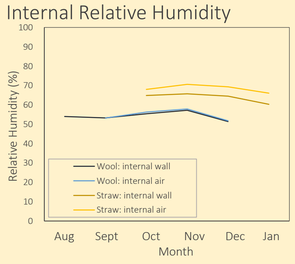
RH: Wool



RH: Straw



Internal Relative Humidity



Straw building RH is just below levels likely to encourage microbial growth. Equilibrium moisture content of bales should not exceed 13.5%, or approach dangerous levels.

AIMS

ecofab build using highly-insulated prefabricated straw or wool-insulated panels. The company wish to identify aspects of their building fabric which would benefit from design improvements, to be able to quantify their claims of performance through research, to raise the profile of the company and to have their good design fairly represented in SAP ratings

Develop Design

Identify areas for immediate change
Investigate future R&D opportunities

Provide Information to Clients

Provide technical information
Confirm building performance claims

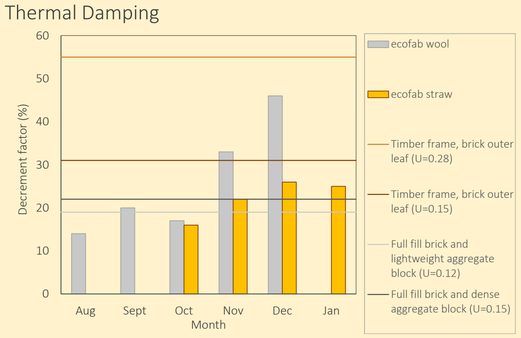
Improve SAP Ratings

Validate ecofab junction details

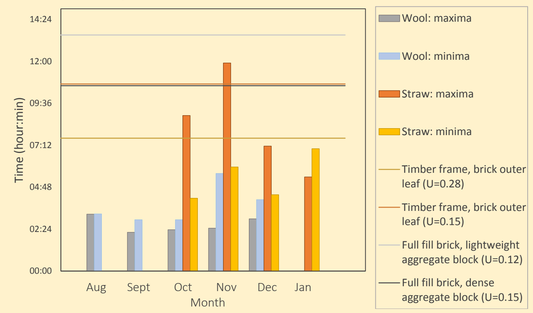
Analysis

In comparison to conventional construction types the buildings damp thermal extremes well. Straw performs better than wool.

Thermal Damping



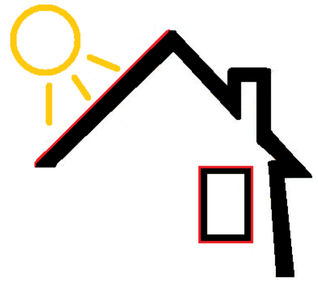
Thermal Delay



The thermal delay delivered by walls which incorporate block or brick is not achieved. The straw generally outperforms wool.

Policy Framework

- New buildings must be nearly zero-energy by 2021
- Fabric energy efficiency has new targets
- Energy performance should consider primary energy consumption and CO_2 emissions [1]



Outcomes

- THERM reports for use in SAP
- Bridging house model and dynamic response analysis for use in client advisory material

Further Work

- Thermal bridge improvements to be investigated
- Further testing on building fabric planned

Project by Rosie Gillam with ecofab

Acknowledgements
With thanks to Richard Cochrane, Ian Armstrong, Martin Penk, Alan Hughes and all at ecofab.

References
[1] - European Parliament. (2010, May 19). Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings (recast). *Official Journal of the European Union* . Brussels, Belgium: European Parliament

Footnotes
1 - Standard Assessment Procedure
2 - Using SAP Accredited Details

Thermal Bridging

Heat loss through thermal bridges is represented in SAP[1] by default values unless real values are found through thermal modelling. Modelling can also be used to identify issues and their solutions.

Method

- Model ecofab building junctions in *THERM6.3*
- Calculate psi values, Ψ, of junctions
- Prepare reports for use in SAP2009
- Compare ecofab details to an example conventional building and to SAP defaults
- Improve underperforming junctions

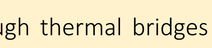
Results

- Many ecofab details outperform the example by a considerable margin
- ecofab eaves junction performs poorly

ecofab ground floor

ecofab pitched roof

Key (W/mK)



	Example Ψ (W/mK)	ecofab Ψ (W/mK)
Ground floor	0.16	~0.03
Eaves	0.06	~0.15

Analysis

The SAP default dictates that junctions add 20-30% additional heat loss to a house. ecofab junctions allow just ~5% additional heat loss.

	Wool	Straw	Example	SAP[2]
y-value (W/m²K)	0.02	0.03	0.09	0.15
Total house heat loss (W/K)	104	106	118	130