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Air movement in & about buildings 4 of 9 + Q&As

© NGS GreenSpec 2007 CPD in 10 parts

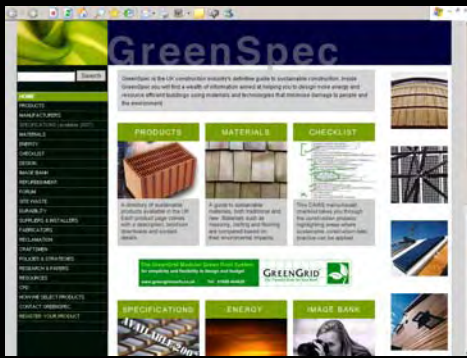
GreenSpec CPD Seminar Series

- **Educational Objective:**
 - Comprehensive introduction to subject: from wind to air-conditioning and a lot more in between
 - emphasis on environmentally sustainable solutions
 - design primer: addressing principles and solutions
 - technically rich: materials, construction, services & testing
 - Related GreenSpec CPD Seminars indicated
 - Questions and answers for each subtopic in file 10
- **Audience:**
 - Architecture Students Part 1 Year 2
 - CPD update for all levels of experience & knowledge
- **Delivery:**
 - 3 to 4 hours depending upon audience participation
 - Reading 1 hour
 - 26 subject breaks to enable subdivision

Air Movement in Buildings: 4 of 9

Sub-topics in 10 separate files

- Principles of Element Design
- Climate Change
- Wind
- Wind Tunnel Testing
- Wind Turbines
- Natural Ventilation
- Moisture Vapour & Condensation
- Thermal Insulation
- Breathing Construction
- Airtightness
- Wind & Airtightness Testing
- Building Elements
- Passive Ventilation
- Active Ventilation
- Stack Effect
- Atrium
- Solar Orientation & Solar Gain
- Conservatories
- Thermal mass
- Conduction, Convection, Radiation
- Solar Shading
- Thermal mass, Passive and active cooling
- Fluid dynamics
- Mechanical Ventilation
- Air-Conditioning
- Questions and Answers



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Moisture Vapour and Condensation

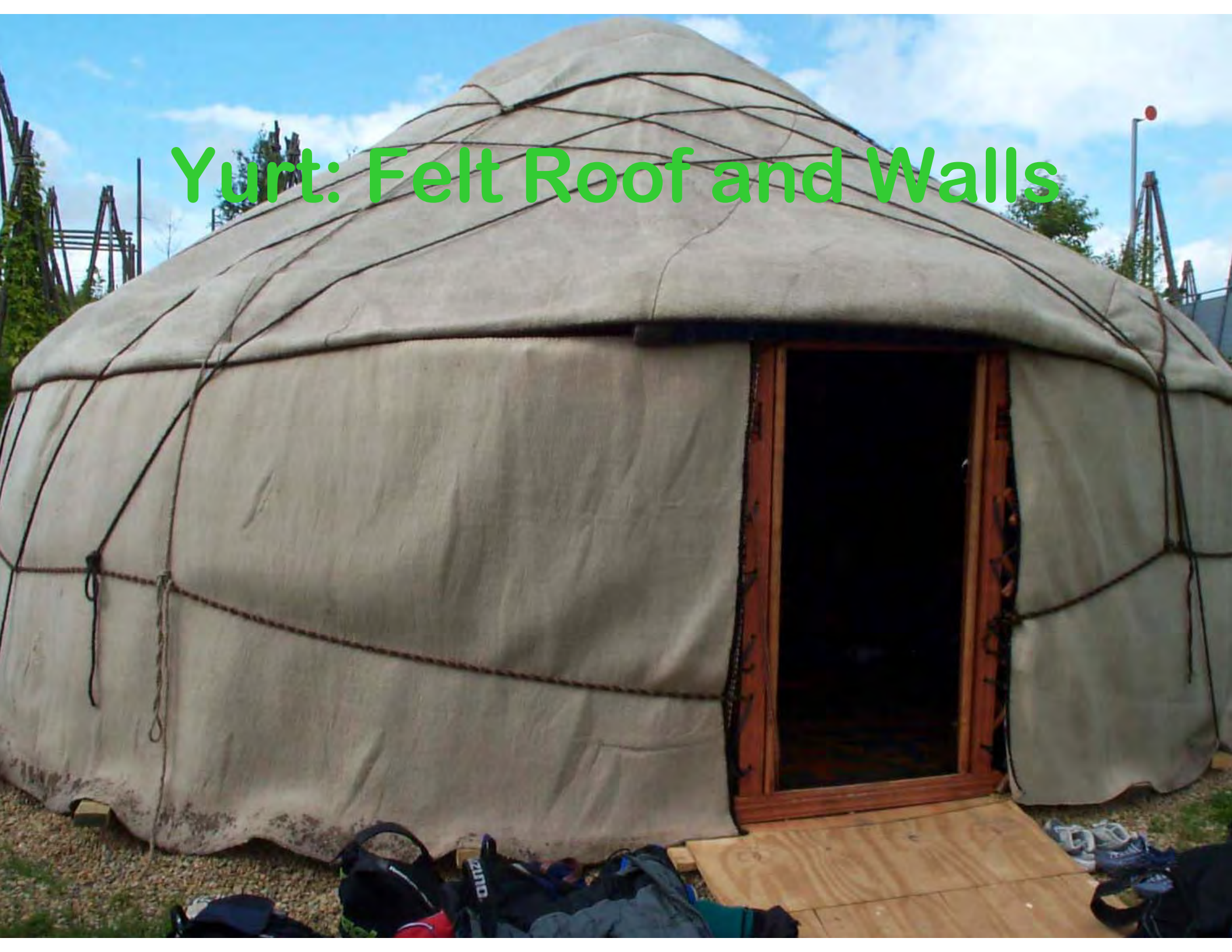
Moist air under pressure

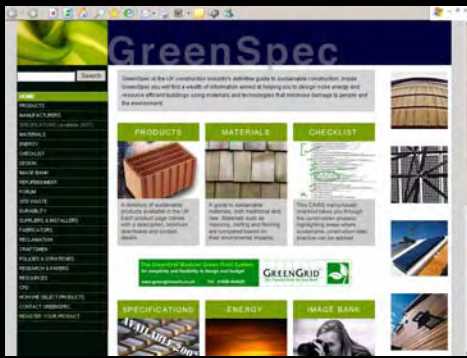
- Occupation of buildings
- Breathing, perspiring, bathing and boiling (clothes, water, food, bodies)
- Adds moisture to air, raising humidity
- When less humid outside, moisture laden air moves outwards through building fabric
- The moisture can be deposited in the fabric by interstitial condensation

Moisture Permeable Materials

- Traditional methods
- Lime: mortar, render, plaster, paints, crete
- Bricks, Blocks, mortar (not all)
- Earth: walls, mortar, plaster, render, paints
- Felt: Yurt roof and wall sheeting
- Micro-porous paints (but water repellent)
- New methods:
- Hemp-lime: insitu: walls, floors, roofs, insulation; blocks, screed,
- Moisture Mass (like thermal mass but for moisture)

Yurt: Felt Roof and Walls





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Wick Effect

- Building-in moisture absorbent materials can help to control moisture deposited from the air
- E.g. Straw bale above a shower
- Unfired clay bricks, blocks,
- Clay plaster, paint
- Moisture Mass

Condensation Eradication

- Don't let the temperature in the construction drop below the temperature at which the air can no longer hold moisture
- If it does it will deposit the moisture
- Vapour resistance inside ideally 5 times more resistant than outside
 - Vapour Barriers (VB):5 - Breather Membrane (BM):1
- VB & BM used in timber frame constructions
- With hydrophobic materials that do not perform well when wet (above 3% MC)

Vapour Barriers (VB)

- Often polyethylene or aluminium
- High moisture vapour resistance
- 5 times more resistant than Breather Membrane
- Inside of the insulation
- Lapped and continuous sealed at joints
- Joints supported on members and battened
- Penetrations sealed: lights, switches, sockets, etc.
- Stops moist air getting into construction and into hydrophobic insulation

Vapour Check (VC)

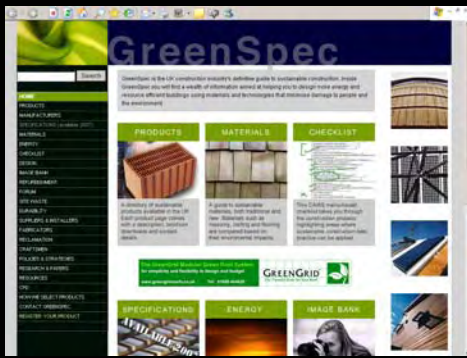
- In reality because of compromised construction, incomplete Vapour Barriers, leaky services penetration
- It is generally accepted that Vapour Barriers are not barriers
- We call them vapour checks because they slop down vapour entry not prevent it
- But they are likely to concentrate vapour passage into small spaces between frames with higher risk of problems

Air as insulation

- Air trapped in the spaces in the insulation
- Closed or open cells of foamed plastics or glass
- Air spaces between fibres
- Spaces between layers of multi-layer reflective insulation
- But fibre quilts act like a filter: air passes through, particulates may be held
- Needs a sheet on one or both sides to stop warm air passing through

Breather Membranes (BM)

- Often felt or brown building paper
- Low moisture vapour resistance
- 5 (or more) times less resistant than vapour barrier
- Outside of the insulation
- Lapped at joints over supports and battened
- Joints fastened on members
- Stops warm air being sucked out of open cell insulation into ventilation air stream

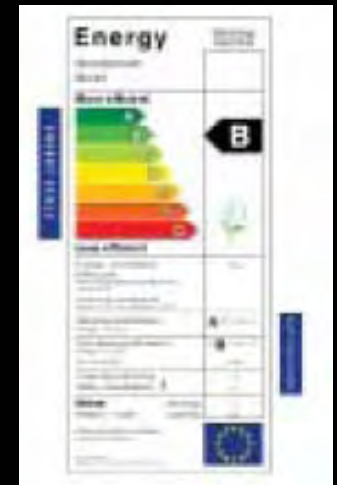


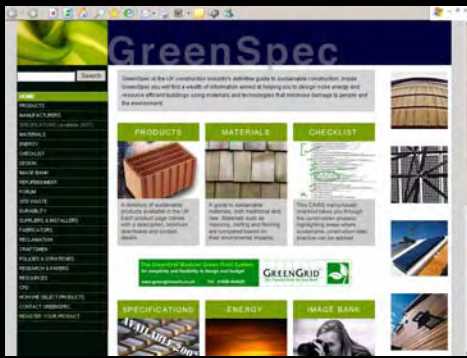
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Thermal Insulation

CO₂ and Carbon reduction

- Do not limit to complying with Building Regulations Approved Document L1A, L1B, L2A, L2B
- Set out to exceed Kyoto, EU or UK CO₂ targets
- Strive for Zero Carbon buildings now not 2016
- Insulation costs less than plant
- Reduce heating, cooling, ventilation and air-conditioning demands towards zero
- Windows: U value of 1.0 W/m².K or better
- Walls: U value of 0.1 W/m².K or better
- Airtightness: less than 1, not 10 of Building Regulations

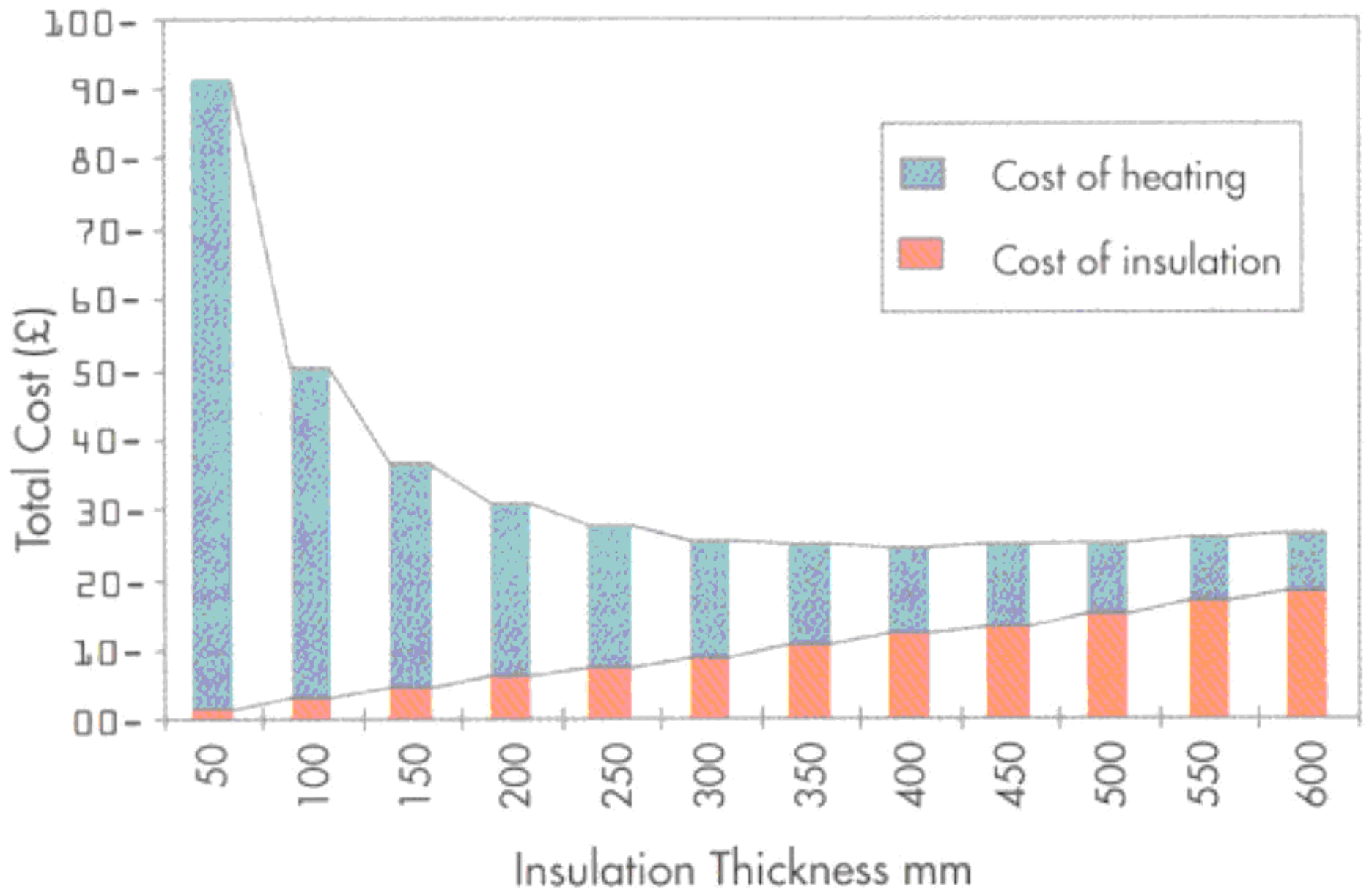




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Insulation

- Insulation Insulation Insulation
- Spend money on cheap insulation
- Save money on heating and cooling plant
- Save money on heating and cooling bills



50 mm. cavity
is history

300 mm. is
optimum

Ties and
tie spacings
may change





**Long ties and deep reveals
For 300 mm. insulation**

Hydrophobic Insulation in timber frame

- Glass and rock mineral wool thermal and acoustic insulation
- If used in dry construction e.g. timber frame wall the moisture content of the wall is expected to be low
- However compromised vapour barriers (VB) are only a Vapour check (VC) and some moisture will enter the construction
- Hydrophobic materials in these conditions will absorb moist air and water
- The moisture will occupy the air spaces and prevent the insulation from acting as insulation
- Its performance drops off unless it can lose the moisture
- High resin content and non absorbent materials offer resistance to moisture uptake into the fibre so it remains in the airspaces.
- 1:5 ratio is critical to the moisture passing through driven by warm air
- If the insulation holds the water it can hold the water against timber sections

Zero Fossil Fuel
Energy Development
High thermal mass
cavity walls and floors
Low U values
Rock Mineral Fibre
Long 2 part cavity ties



BedZED Beddington Sutton Architect: Dr Bill Dunster

Zero Fossil Fuel Energy Development

High thermal mass
cavity walls, roofs
and floors

Low U values
300 mm.

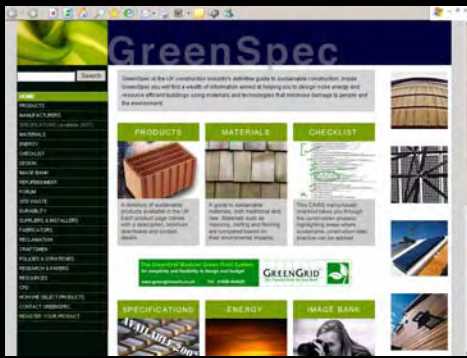
Rock Mineral Fibre
Long 2 part cavity ties



BedZED Beddington Sutton Architect: Bill Dunster

Hydrophobic Insulation in masonry

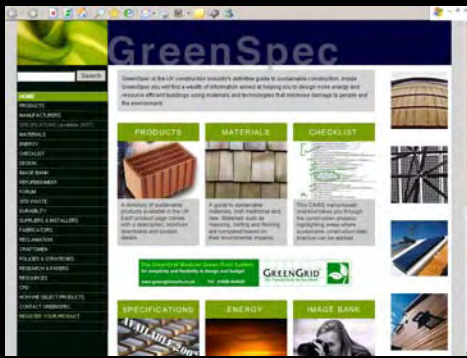
- Glass and rock mineral wool thermal and acoustic insulation
- If used in wet construction e.g. masonry cavity wall the moisture content of the wall is expected to be 3% MC
- Rainwater can pour down the inside face of the external leaf
- Hydrophobic materials in these conditions will absorb moist air and water
- The water will occupy the air spaces and prevent the insulation from acting as insulation
- Its performance drops off unless it can lose the water
- High resin content can offer some resistance to water uptake
- Fibre orientation or disorientation can discourage capillary attraction into the depth of the insulation
- Allegedly the insulation keeps the moisture close to the exposed surface



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Other Topics

- r and k values
- U values
- Thermal Mass
- G values
- Decrement (heat passage over time through insulation and thermal mass)
- When NGS know enough: another CPD



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Breathing Construction

Breathing Construction (BC)

- Breathing Walls: well known for some time
- BRE recently accepted roofs as well
- Opposite to traditional timber frame with VB and BM which prevent moisture entry and passage
- BC permits moisture into and through construction
- No vapour barrier
- Rock and glass mineral wool not suitable
- Requires airtightness layer (ATL), hygroscopic insulation and breathing sheathing board (BSB)
- 1:5 rule is less important moisture passes both ways

Compromised Breathing Construction (CBC)

- Blurring of the boundaries between Breathing Walls and traditional timber frame
- Uses polyethylene Vapour Barrier VB or Vapour Check VC inside
- It resists moisture entry and passage
- Rock and glass mineral wool are used
- Breather membrane BM outside
- 1:5 rule applies

Not For Luddites

You've probably heard it many times before: "This software will change your life." And guess what? It doesn't. But every so often, something comes along that lives up to its claims. Every so often a step change development causes a fundamental difference to our everyday work and becomes a 'must have' tool. Photocopiers, fax machines, word processors, e-mail.

Imagine

Imagine if you could cut your design time by 80%, no instead of taking 10 days to complete a building design, you did it in two. What's more, while you are creating the overall design, the software is simultaneously producing detailed manufacturing drawings and generating a cutting list.

Instead of drawing a line, you click a complete wall, or a floor, or a roof. All of the object's component elements are automatically drawn in.

Having done the design, you decide to move a window or a door. Two clicks, it's done. Along with the revised manufacturing drawings and a 3D model cutting list, no undoing the design line by line and re-drawing its all functions automatically behind the scenes.

This is TIMEFRAME

This is TIMEFRAME, integrated design software running on the industry standard platform, AOTI, AutoDesk's latest version of AutoCAD for the construction industry. Developed for Filcrete by specialist construction software house, COVIS, TIMEFRAME is set to become the



benchmark by which all design programs will be judged.

Ultimate Compatibility

TIMEFRAME was developed to create buildings in traditional timber frame and Masonite Beams and is equipped to incorporate all of the components used in EVT structures. Importantly, as well as

being able to create designs from scratch, TIMEFRAME can translate any ordinary line drawing produced on any AutoCAD product and can switch a design created in brick and block or standard timber frame to a Masonite-based design in two mouse clicks.

The TIMEFRAME design package is able to do this because it is object based, rather than just linking in (conventional) CAD line drawings. This means that the design program 'understands' what the various components or elements are, what material they're made of, what function they perform and how they interact at junctions.

In TIMEFRAME, you are effectively constructing an actual building within your computer. So once it's complete, you can spin it around and look at it from any angle, have a 3-D perspective, look at things from front to back and inside out.

Walls, Floors and Roofs

TIMEFRAME is offered in three modules for designing walls, floors and roofs. Output can be direct to spreadsheets, word processors and can also be formatted to be produced as a web page.

This means that a drawing can be instantly e-mailed anywhere in the world, so recipients can use their web browser to look at designs and details without being

(Continued on page 2)

In This Issue

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Psychical Construction is Easier Than ABC

EVT Technology Creates Perfect Home



Page 3

Sustainable and Urban: Benchmark Housing Development Offers Dramatic Savings



Page 4

New Face at Filcrete: 'Zero Heat' House Concept Unveiled



Fillcrete Unveils TRADIS-2

Filcrete has unveiled the latest version of its award-winning TRADIS range of factory manufactured wall panels, floor cassettes and roof plates. The new TRADIS-2 design features improved airtightness, and a service zone for cable runs and pipework that is now incorporated into the structural frame, thereby simplifying the design and delivering cost reductions by negating the need for additional battens.

Simplified Design

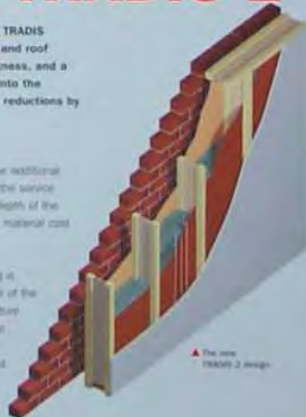
In the TRADIS-2 design, the internal Pansline sheathing board is now installed on the internal flange shoulder of the Masonite Beams used to create the structural frame, thus automatically creating a service zone the depth of the flange. Once the services have been installed on site, plasterboard is fixed to the outer face of the flange to enclose the service zone. On original TRADIS structures, Pansline is nailed to the outer face of the flange, with additional battens used to create the service zone before the final plasterboard finish is applied.

Cost Savings

In the TRADIS-2 design these additional battens are not required as the service zone is included within the depth of the Masonite Beam, resulting in material cost savings.

Permanent external sheathing is installed on the external side of the frame to complete the structure of TRADIS-2 wall panels. The same principles apply to TRADIS-2 floor cassettes and roof plates.

(Continued on page 4)



▲ The new TRADIS-2 design

Fifth Award for TRADIS



Contract Journal

Filcrete has been named an Honorary Member of award-winning, being voted this year's Construction Product Manufacturer of the Year for its

(Continued on page 4)

EVT Enhanced Vapour Transfer™

Enhanced Vapour Transfer (EVT) and rainscreen

Hygroscopic insulation
maintain their performance
even when wet

Vapour and water released
when conditions permit

No need for Vapour Barrier

Use vapour permeable
construction

5:1 ratio VR inside:outside
and an air tightness layer



Airtightness layer (ATL)

- Usually recycled paper sheet e.g. Pro Clima DB+
- High resistance to air passage
- Low resistance to moisture passage
- Can absorb moisture on one face & release it on the other
- Inside of thermal insulation
- Lapped and sealed at joints over supports
- Joints fastened on supports and battened
- Stops warm air leakage out of the building
- Allows moisture through into hygroscopic insulation which can tolerate it and then out of the building
- Used in Breathing construction

Enhanced Airtightness layer (ATL)

- All of the characteristics and applications of ATL
- Variable resistance to moisture passage
- Size of micro-pores varies with the seasons
- Material: _____
- E.g. Pro Clima Intello
- Study:
 - Study Calculating Potential Freedom From Structural Damage Of Thermal Insulation Structure in Timber Built systems

Hygroscopic Insulation

- Any natural plant based material: hemp, straw, flax, coconut husk, cellulose, sheep's wool, grass, etc.
- Air trapped in material is what makes insulation work
- Water does not work in the same way
- Moisture laden air or interstitial condensation occupies the space that air would
- Stops hydrophobic insulation from insulating
- Hygroscopic insulation absorbs the moisture into the fibre leaving the air spaces to insulate
- Releases the moisture when conditions are right and it leaves the construction and building

Hygroscopic Thermal Insulation



Newspaper
Flax
Hemp
Sheep's wool
Cellulose



Construction Resources Showrooms Southwark London

Hygroscopic Insulation: Sheep's Wool



Designated by Government
to issue
European Technical
Approvals

Second Nature (UK) Ltd

Soslands Gate
Soulby
Dacre
Penrith
Cumbria CA11 0P
Tel: 01768 486285 Fax: 01768 486825
email: info@secondnatureuk.com
website: www.secondnatureuk.com

CU/98



Agrément
Certificate
No 02/3950

THERMAFLEECE

Isolation thermique
Wärmedämmung

Product



• THIS CERTIFICATE RELATES TO THERMAFLEECE, THERMAL INSULATION BATTS FOR USE IN DWELLINGS AND BUILDINGS WITH SIMILAR TEMPERATURE AND HUMIDITY CONDITIONS.

• The batts are for use in:
loft applications between joists in ventilated and unventilated lofts under pitched roofs and between rafters for tiled or slated pitched roofs designed and constructed in accordance with the relevant clauses of BS 5534-1 : 1997, and
timber-frame wall applications between studding with a weather-resistant cladding, and a ventilated and drained cavity.

Regulations — Detail Sheet 1

1 The Building Regulations 2000 (as amended) (England and Wales)

The Secretary of State has agreed with the British Board of Agrément the aspects of performance to be used by the BBA in assessing the compliance of insulation with the Building Regulations. In the opinion of the BBA, Thermafleece, if used in accordance with the provisions of this Certificate, will meet or contribute to meeting the relevant requirements.

General

Requirement: B3

Comment:

Requirement: L1

Requirement: L2

Comment:

Requirement: Regulation 7

Comment:

Interval free spread (structure)

Lofts, roofs and walls incorporating the product can meet this Requirement. See the Behaviour in relation to fire section of the relevant Detail Sheet.

Conservation of fuel and power in dwellings

Conservation of fuel and power in buildings other than dwellings

The product can meet or contribute to meeting this Requirement. See the Thermal insulation section of the relevant Detail Sheet.

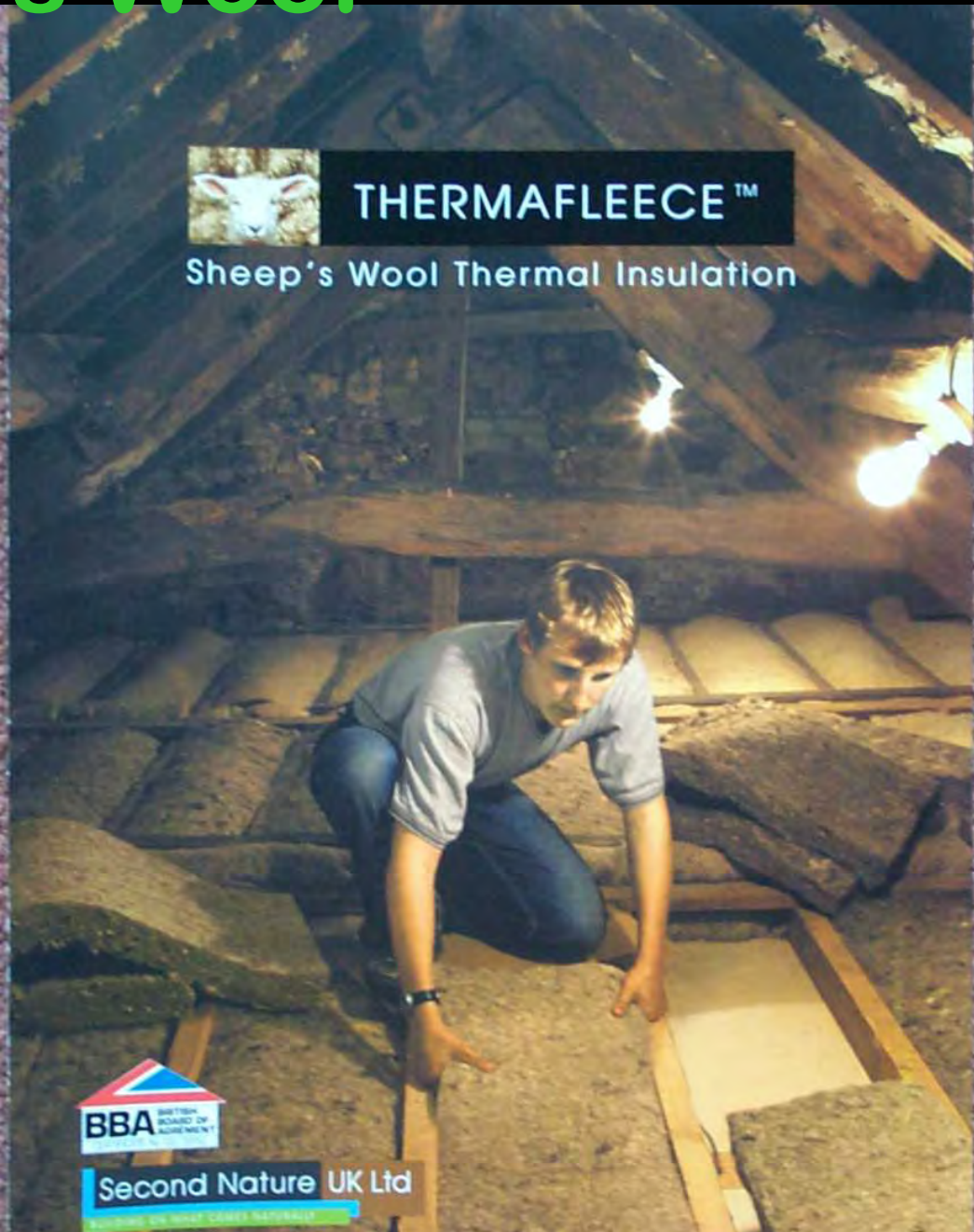
Materials and workmanship

The product is acceptable. See the Durability section of the



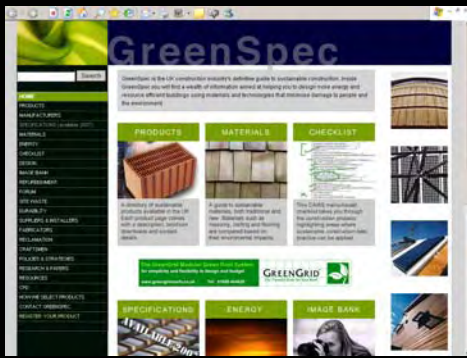
THERMAFLEECE™

Sheep's Wool Thermal Insulation



Second Nature UK Ltd

Member of the Group: COMEX INTERNATIONAL



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Sheep's wool

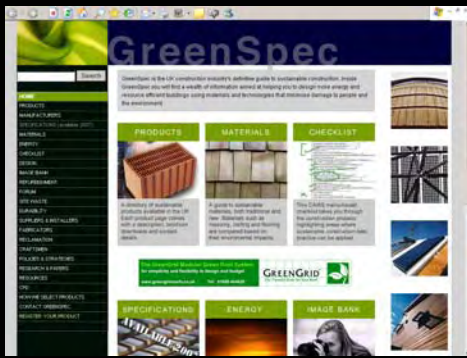
- When on the sheep's back they are kept warm
- Hygroscopicity absorbs moisture and the insulating effect is maintained
- Sheep's wool has other characteristics whereby it warms up when wet
- But I do not know enough to explain

Breathing Sheathing Boards (BSB)

- Usually cellulose fibre board
 - some with bitumen impregnation
 - some with cellulose's own natural resins
- E.g. Panelvent
- Low moisture resistance
- Airtight: stops warm air being dragged out of insulation into ventilation air stream
- Moisture permeable: Breathing
- Some with racking strength, some not
- Fixed butt jointed to timber framing sections

Breathing Sheathing Boards (BSB)

- Wheat Straw fibre board
- e.g. invotek strawboard www.invotek.co.uk
- Bound with fibre's own natural resins
- Low moisture resistance
- Airtight: stops warm air being dragged out of insulation into ventilation air stream
- Moisture permeable: Breathing
- Racking strength: _____
- Fixed butt jointed to timber framing sections



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Airtight & Permeable finishes

Paints & Stains

- Oil based paints form skins and usually act like vapour barriers in both directions
- Once paint fails say on an edge or corner it will let wet in, which will then travel inside the pores of the timber
- If the moisture is warmed the vapour tries to move to outside but the paint film traps the moisture inside
- The wood can start to rot and the paint film is likely to be compromised and fail early
- Consider micro-porous paints and high build stains which resist water intake but allow any moisture out
- Consider more resistant finish inside, less resistant finish outside to encourage moisture outwards

Materials

Protection:

Full hbmpp scheme

No absorbent surfaces

Pallet

Stability bracing

Corner & edge Protection

Moisture control

But:

Rain Cover needed

Not Remote storage

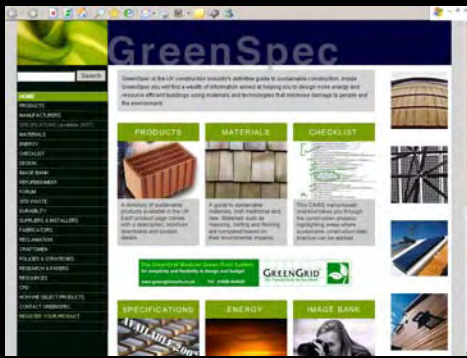
Not off the ground

Not JIT but JIC

How many doors to push over the windows?

BedZED Beddington Sutton Architect: Bill Dunster

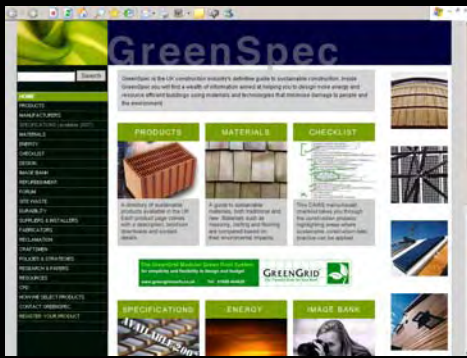




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Test Yourself

- Part 4
- Where can you use Hydrophobic insulation?
- Where can Hygroscopic insulation be used?
- How does Hygroscopic insulation work when in damp conditions?



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How did you do?

- Part 4
- Hydrophobic in dry wall construction and even in external cavity walls
- Hygroscopic in breathing walls
- Hygroscopic insulation absorbs moisture into the fibre leaving the airspace to insulate

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