An innovative way to save energy in building

Approximately 50% of all heat loss from the average domestic building is a result of air infiltration, defined as the uncontrolled leakage through deficiencies and imperfections in the structure, as distinct from natural ventilation resulting from the designed provision of vents - such as windows and ventilators - which can be controlled by the occupants.

The significance of this heat loss is recognized in the new regulations, which extend air leakage testing to all new buildings.

A recent study ("Air tightness in UK dwellings", BRE Information Paper: IP01/00: January 2000) suggests over 70% of air leakage through the external envelope of traditional UK dwellings can be attributed to the myriad cracks, joints and openings in the fabric of the building which result from poor workmanship (mortar joints not filled, badly fitted components), and from settlement and thermally induced expansion/contraction. It is beyond doubt that a significant improvement in energy use can be achieved by limiting air infiltration using a combination of careful detailing and airtight membranes. These membranes are engineered to provide specific performance characteristics which allow them to control the transmission of air, moisture and heat.

The innovative system we are proposing consists of combining traditional insulation materials in conjunction with "energy efficient" membranes. The gain in performance is significant without increasing the building envelope thickness, as a result of the physical effects listed below;

1)air tightness : most traditional insulation only works correctly if it is not subjected to air movement created by differences in atmospheric pressure.

2)moisture control : fibrous insulation material will have a higher lambda value if their moisture content is high. The use of membranes with the right resistance to vapour transfer will prevent condensation occurring whilst preventing rain/snow to penetrate into the thermal barrier.

3)low emissivity surface : the use of a special metalized coating provides a low emissivity surface which minimizes the radiated heat loss in winter and reflects external heat in summer, minimizing the heat ingress in summer.

On the warm side of the thermal barrier one will install a membrane, highly resistant to the passage of both water and water vapour, it will also be airtight and have a low emissivity surface. Providing all joints and laps of this membrane layer (and all penetrations through it) are carefully sealed, then it will form both a vapour control layer (VCL) and a flexible air leakage barrier (ALB) able to accommodate settlement and movement without cracking.

On the cold side of the thermal barrier one will install another type of membrane that is highly permeable to water vapour, but have a high resistance to the passage of liquid water and air. . Provided all joints and laps in this membrane (and all penetrations through it) are sealed, then it will form an effective flexible rain shield and an ALB; any risk of damaging condensation will be avoided as the membrane will allow the building to "breathe" through its external skin. A special metalized coating is providing an ALB

which is vapour open and has a very low surface emissivity. Installed on one side of a cavity such a membrane can achieve further energy savings by slowing the rate at which heat is transferred across that cavity.

Example of insulation performance improvement (without taking into account the improvement in air tightness - only radiation and conduction transfer are considered).

Warm roof insulation 45 deg. pitched roof.

R value (m2.K/W)	air layer 2cm + energy efficient membrane	10 cm fiber insulation	air layer 9cm + energy efficient membrane	Total	**energy membrane contribution**
Summer	0.52	3.13	0.63	4.28	**27%**
Winter	0.42	3.13	0.45	4	**22%**

Conclusion

The use of membranes is not new as such, but the innovation comes from the unique combination of properties: air tightness, low water vapour resistance, resistant to liquid water, and finally low emissivity surface.
This unique combination dramatically boosts the performance of traditional insulation materials which are limited by their thickness, and cannot prevent the convective losses.