

## Why vapour resistant insulation materials can be used in traditional granite buildings.

There is a common belief in certain architectural circles that vapour resistant insulation materials should not be used to insulate traditional granite houses. Why this is incorrect is explained below.

### Vapour flow

In any wall or ceiling that is porous to vapour, which is almost every material, vapour in the air flows from the heated warm interior to the cooler exterior. If this were the only mechanism at play, insulation would need to be porous to stop the insulation becoming wet.

### Equilibrium moisture content (emc)

In a Kingspan or Celotex insulated wall, the PIR foam is sandwiched between two aluminium films to make a vapour resistant insulated board. A plasterboard (PB) sheet, made from gypsum, sandwiched between paper, acts as a dry lining to cover the insulation board. This is, in part, a fire-resistant barrier and, in part, a surface suitable for applying wallpaper or paint. Vapour can enter the plasterboard, so again can become wet from vapour movement from the warm to cold side of the plasterboard.

However, the plaster board has an equilibrium moisture content that is related to the relative humidity of the air within the room. The table below shows the moisture contents of the plasterboard in my Celotex insulated house. For comparison, the pitch pine timber in the skirtings also has an emc, with readings shown in the table.

**Table.** Electrical resistance of room walls and skirtings, measured using Eco Stoves two pin moisture meter. (No mention is made as to the resistance being dry or wet basis) 16/10/23

Room, external wall	Electrical resistance, plaster board or L&P	Skirting board pitch pine resistance
	%	%
Lounge (L&P)	0.7	13
Bathroom (PB)	0.5	14
Kitchen (PB)	0.5	9
Dining Room (PB)	0.4	12
Master bedroom (PB)	0.6	11
Spare bedroom (PB)	0.6	9
Workshop (PB)	0.6	9
Hallway (PB)	0.4	13

<https://ecostovesonline.co.uk/product/moisture-meter/>

Plasterboard, timber, wood fibre, hemp, will all have different EMC/RH ratios. All emc's will rise and fall as RH rises or falls.

(When I was in Nigeria, my timber wardrobe door used to jam shut in the wet season and suddenly open in the dry season, as the wood expanded and shrank as the local climate's relative humidity increased and reduced).

### Bathrooms and kitchens

In a bathroom or kitchen, where the highest house relative humidities are likely to exist, the likely periods for high humidities are 0.5-1.0 hours in 24 hours. Even then the operation of an extractor fan may limit the RH rise during showering or cooking. The period for potential vapour movement into the plasterboard is therefore 4% of the day. For the other 96%, emc is the dominant physical influence. If the room is heated by radiators, this reduces the RH in

rooms, so that even in very humid areas of the country, the room RH will be 60% or lower. The warmth, and therefore its impact on lowering the room's RH, ensures that any vapour movement into the PB, is negated by the natural drying impact caused by the emc process.

### **Mould on the plasterboard**

Mould on the plasterboard is a sign that something is going wrong. The combination of insulation board covered with plasterboard, ensures that the plasterboard is similar in temperature to that of the room, as the insulation minimises heat escape from the plasterboard. The moisture content of the plasterboard will therefore stay low.

If the insulation board is removed, the plasterboard will reduce in temperature, compared to the room air, and as such may drop below the dewpoint temperature of the room air, causing condensation to form on the plasterboard surface. This condensation can cause mould spores to develop on the surface of the plasterboard. If there is enough condensation, it will wet the plasterboard through capillary action, making it soggy. The combination of insulation board and plasterboard is therefore important in keeping the plasterboard dry.

In traditional lath and plaster lined houses, plaster falling in the cavity from above the lath above can form cold bridges when it lands on wooden pegs securing the studs. In the same way that plasterboard-only linings can get wet, plaster cold bridges can result in circles of condensation, and the development of salt crystals on the plaster surface, which sparkle in the light.

### **Insulation values of plastic foam and wood wool insulation**

While it appears wholesome to use traditional, natural, biodegradable, materials as insulation in houses, their conduction to heat flow is considerably greater than with plastic foam. Their Lambda values are 0.036 for wood fibre compared to 0.022 W/m<sup>2</sup> °C for PIR materials, almost twice the heat loss. While their embedded carbon footprints are somewhat less than PIR, this figure is a fraction of the heat savings that better insulation can achieve over its 50-year life.

### **My house**

My house has Celotex and Kingspan in its external walls, with a plasterboard dry lining, with the EMC levels stated in the table above.

I have invited various people to my house over the 14 years since my insulation was installed, all of whom said that my walls would become saturated with moisture if I used Celotex or Kingspan and plasterboard. I have invited them all to come and inspect my house, but none have risked coming.

Those invited are as follows: Moses Jenkins, Historic Scotland, James Roy, Architect, RICS environmental representative, Neil Stuart, Home energy Scotland (Scarf), Shirley Forbes, Home Energy Unit, Aberdeen City Council, Duncan Robson, Architect, Aboyne and the head of Scarf, whose name I cannot remember. Most seem to have been influenced by Roger Curtis, and Moses Jenkins, who seem to be very influential.

### **The trade**

In the meantime, the trade, including Dave McGrath, successfully work away installing Kingspan, ignoring what the architects are saying.

### **Why this is important?**

The lack of action by government and homeowners on the insulation of private homes is bad enough, but having large sections of the building industry peddling conflicting advice is inexcusable. It also puts into question the competence of the architectural community, while putting at risk life on our planet.

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