Improving the black weatherboards

Issues to address

- 1. Relatively poor insulation: just boards over a solid block wall.
- 2. Poor detailing and warped boards lets in draughts (and mice)
- 3. Uninsulated void above large living-room doors

Existing structure





Element	Assumed thermal resistance m ² K/W	Notes
Outer surface	0.04	Taken from Celotex calculator
Outer weatherboards 24mm	0.1	Pine: approx 0.14W/mK across the grain, so 24mm board gives 0.17m ² K/W at best.
Inner weatherboards 24mm	0	These cover areas missed by outer boards
Bitumen paper	0	
Lightweight blocks 150mm	0.44	Assuming λ =0.34W/mK. This is probably pessimistic: Thermalite Shield gives 0.15W/mK so resistance could be as much as 1m ² K/W
Plaster skim	0.05	Taken from Celotex calculator
Inside surface	0.13	Taken from Celotex calculator
TOTAL	0.76	
TOTAL assuming block resistance is 1m²K/W	1.32	

Taking the reciprocal of the total resistance gives a U-value between 0.75W/m²K and 1.3 W/m²K. For comparison, the Buildings Research Establishment found that as-built 9" solid brick walls have a mean U-value of 1.75W/m²K (*Solid wall heat losses and the potential for energy saving*, BRE, Nov 2016). We would expect to do better than that as we know the blockwork is a lightweight (aerated) type. 1W/m²K might be a reasonable estimate.

Proposed Structure

This is mainly intended for the black wood sections above the kitchen, dining room, and living-room windows. It could be used elsewhere but there may be simpler approaches.



The inner layer of boards is replaced with 12mm ply on 12mm battens. Behind that is a breather membrane (Tyvek, Nilvent, etc) and a layer of solid insulation board (Celotex GA4000 or similar).

The overall structure is thicker than the existing one by the thickness of the insulation board. I suspect 25mm would be invisible to most people, but even 50mm might be acceptable if the details are right.

The plywood and PIR board layers make it easier to control draughts, but various details remain to be considered:

- 1. Detailing around windows, particularly the cill and rain path.
- 2. How to fix the (possibly warped) boards to the ply. There is a possibility to do this from the back and to mount entire panels that have been assembled at ground-level (heavy though).
- 3. How to get an adequate vapour barrier around the existing RSJ.
- 4. How to adjust the roof to cope with the extra thickness
- 5. How to adjust the guttering and downpipe: both will move forward by the thickness of the insulation. The downpipe must remain vertical, so the drain connection at ground level will need adjusting.
- 6. Is 12mm an adequate ventilation space to protect the back of the plywood?
- 7. How to allow air to circulate behind the plywood while keeping out wasps and mice.

Element	Assumed thermal resistance m ² K/W	Notes
Outer surface	0.04	Taken from Celotex calculator
Outer weatherboards 24mm	0.05	Not a continuous layer
Ply 12mm	0.05	These cover areas missed by outer boards
Membrane	0	
Insulation 25mm	1.1	50mm would give R=2.25m ² K/W
Lightweight blocks 150mm	0.44	Assuming λ =0.34W/mK. This is probably pessimistic: Thermalite Shield gives 0.15W/mK so resistance could be as much as 1m ² K/W
Plaster skim	0.05	Taken from Celotex calculator
Inside surface	0.13	Taken from Celotex calculator
TOTAL	1.86	25mm insulation
TOTAL assuming block resistance is 1m²K/W	2.42	25mm insulation
TOTAL	3.01	50mm insulation
TOTAL assuming block resistance is 1m ² K/W	3.57	50mm insulation

That gives U values between 0.54W/m²K (25mm board, assuming less-good blocks) and 0.28W/m²K (50mm board, assuming blocks like Thermalite Shield). Part L of the Building Regulations require 0.3W/m²K or better, so we would have to make a case for the thinner option based on legal and aesthetic factors.

Effect on heat loss

Applying the calculated U-values to the 2 Cedar Chase heat-loss spreadsheet shows that we currently lose 30W/K through black timber areas, and this would reduce to about 15W/K if the whole area was re-worked with 25mm of insulation board, saving us about £30/year on gas.

In practice we are more likely to only use this system above kitchen, dining, and living room windows: roughly half the total area.

Alternative approach

The black boards at the front of most houses are in much better condition than those at the rear, and do not hide any un-insulated voids. The argument for re-working them is much weaker.

An alternative is to apply insulation internally. At #2 we have already done this above the bathroom window during the bathroom re-fit. Where internal decoration permits, a system up to 75mm thick could be applied in bedroom 2 – leaving the wall flat all the way up. Similarly in the small front room a system up to 65mm could be applied (limited by the cupboard door-frame). Care is needed

to avoid condensation behind the new insulation, and its effectiveness will be limited by edge effects.

In the loft above the small bedroom work will be needed in any case before replacing the roof. As a bare minimum, a vapour barrier must be installed. Better still, apply an internal insulation system to the front wall, the cheek wall, and a thinner one to the underside of the rafters.

Loft walls:

Element	Assumed thermal resistance m ² K/W	Notes
Outer surface	0.04	Taken from Celotex calculator
Outer weatherboards 24mm	0.1	Pine: approx 0.14W/mK across the grain, so 24mm board gives 0.17m ² K/W at best.
Inner weatherboards 24mm	0	These cover areas missed by outer boards
Bitumen paper	0	
Lightweight blocks 150mm	0.44	Assuming λ =0.34W/mK. This is probably pessimistic: Thermalite Shield gives 0.15W/mK so resistance could be as much as 1m ² K/W
Plaster dabs cavity	0.17	Taken from Celotex calculator
Insulated plasterboard 77.5mm	2.89	
Plaster skim	0.014	Taken from Celotex calculator
Inside surface	0.13	Taken from Celotex calculator
TOTAL	3.784	
TOTAL assuming block resistance is 1m ² K/W	4.344	

This should achieve $U=0.23W/m^2K$ to $U=0.26W/m^2K$ on the walls

 $U=0.15W/m^2K$ is achievable for the loft roof by adding 25mm+12.5mm board under the rafters and continuing the between-rafter system planned for the rest of the roof.

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