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Australian
Solar Energy Society
Tasmanian Branch

# CONSTRUCTION DETAILS FOR COOL TEMPERATE CLIMATES

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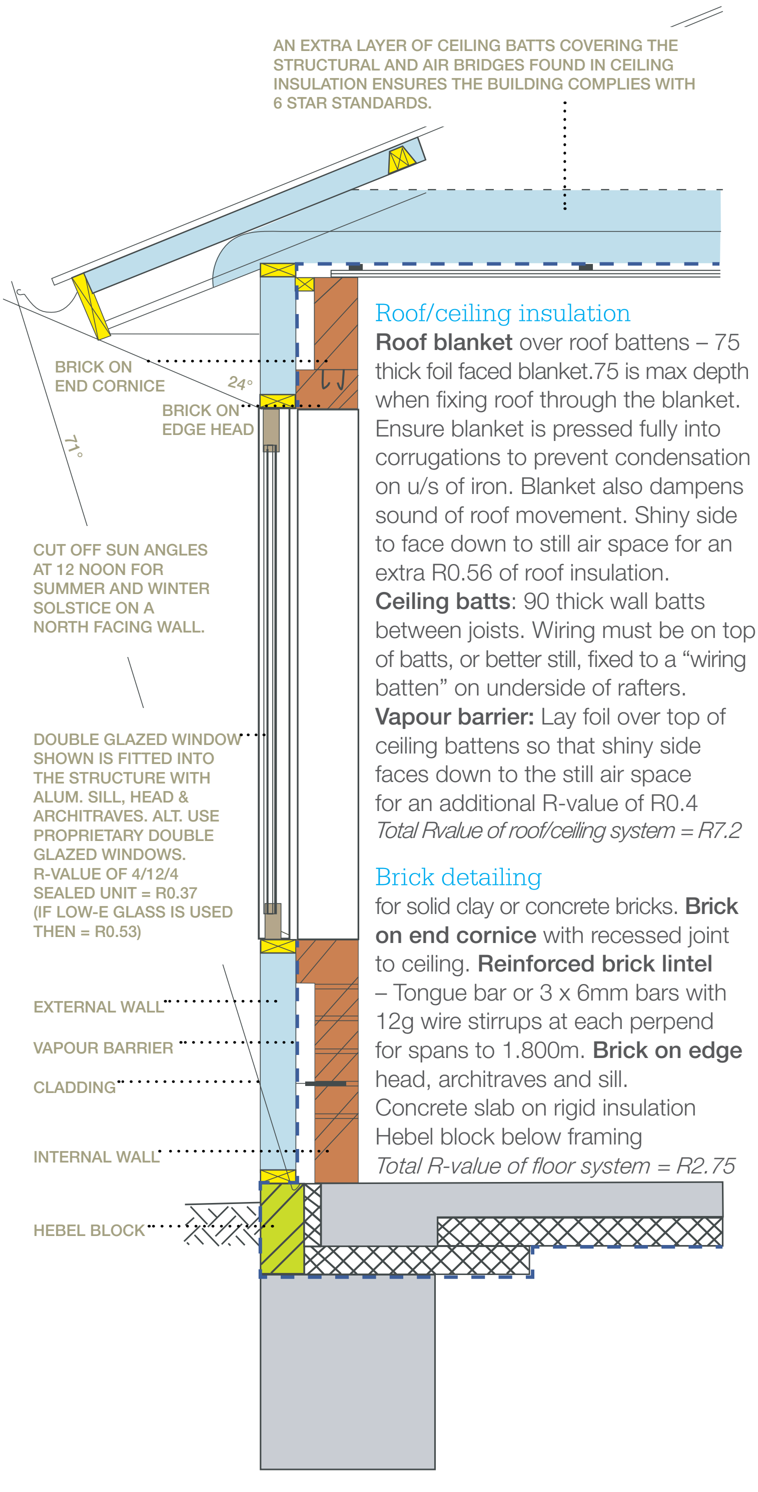
With increased insulation levels, many in the building industry are overlooking or unaware of the importance in a cool temperate climate of the details dealt with in this pamphlet – cold bridging, reverse brick veneer walls, condensation, sealing construction gaps, edge insulation and "super" insulation.

It's the construction details that are the building blocks, the stock in trade of anyone designing or building a home. The whole of a building is obviously the sum of its parts – without details a coherent, graceful and functional whole cannot be created. The details in this pamphlet show how some architects have set about solving the particular problems posed by these issues. Rarely is the detail arrived at the ultimate solution. Often it is a starting point for adaptation and development. The art of building is largely an empirical art, which acquires refinement and maturity by a process of successive technical and aesthetic developments. Thanks are due to all the Builders, Architects, Designers and Householders who have given criticism, comment, and sketches for the development of the details in this pamphlet.

## Fig 1 SIX-STAR REVERSE BRICK VENEER

Minimum total system R-values for 6-star "deemed to satisfy" dwelling in Climate Zone 7:
**Roof/Ceiling:** R4.1/R4.6/R5.1 **Walls**: R2.8 **Floors:** R2.75




### Roof/ceiling insulation

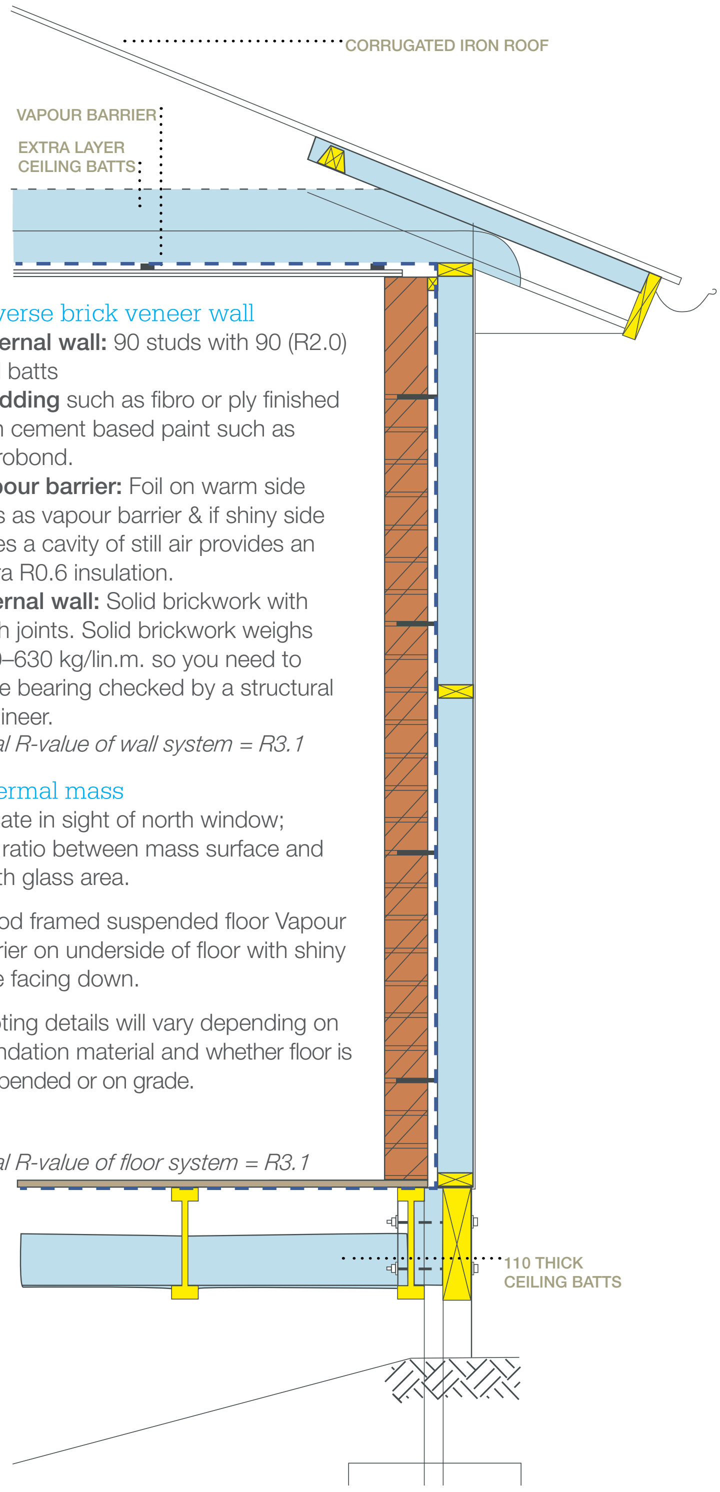
**Roof blanket** over roof battens – 75 thick foil faced blanket.75 is max depth when fixing roof through the blanket. Ensure blanket is pressed fully into corrugations to prevent condensation on u/s of iron. Blanket also dampens sound of roof movement. Shiny side to face down to still air space for an extra R0.56 of roof insulation.
**Ceiling batts**: 90 thick wall batts between joists. Wiring must be on top of batts, or better still, fixed to a "wiring batten" on underside of rafters.
**Vapour barrier:** Lay foil over top of ceiling battens so that shiny side faces down to the still air space for an additional R-value of R0.4
*Total Rvalue of roof/ceiling system = R7.2*

### Brick detailing

for solid clay or concrete bricks. **Brick on end cornice** with recessed joint to ceiling. **Reinforced brick lintel** – Tongue bar or 3 x 6mm bars with 12g wire stirrups at each perpend for spans to 1.800m. **Brick on edge** head, architraves and sill.
Concrete slab on rigid insulation
Hebel block below framing
*Total R-value of floor system = R2.75*

## Fig 2 SIX-STAR REVERSE BRICK VENEER

The bricks are on the inside where they're needed to store the heat and the insulation's on the outside where it's needed to keep the heat in. Same amount of materials, no extra cost, more comfortable house.




### Reverse brick veneer wall

**External wall:** 90 studs with 90 (R2.0) wall batts
**Cladding** such as fibro or ply finished with cement based paint such as Murobond.
**Vapour barrier:** Foil on warm side acts as vapour barrier & if shiny side faces a cavity of still air provides an extra R0.6 insulation.
**Internal wall:** Solid brickwork with flush joints. Solid brickwork weighs 550–630 kg/lin.m. so you need to have bearing checked by a structural engineer.
*Total R-value of wall system = R3.1*

### Thermal mass

Locate in sight of north window; 6:1 ratio between mass surface and north glass area.

Wood framed suspended floor Vapour barrier on underside of floor with shiny side facing down.

Footing details will vary depending on foundation material and whether floor is suspended or on grade.

*Total R-value of floor system = R3.1*

## COLD BRIDGING reduces R- values.

The cold bridge is a bypass in the thermal insulation system along which heat can flow more readily than through the insulation. Once insulation levels get above R0.8 cold bridging reduces the effectiveness of insulation. Common sources are the structural bridge (Figs 5,6,7), the air bridge (Fig 8), the circulation bridge (Fig 9) and the compressed batt – where too large a batt in the space probably reduces its R-value by 25%

Source: H.A.Trethowen (BRANZ) in Thermal Insulation May 1980.

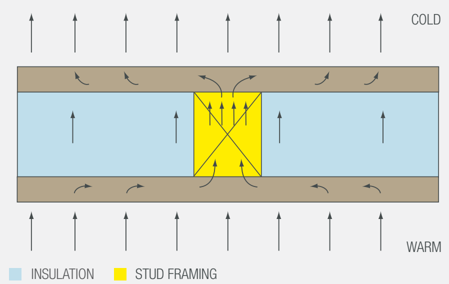



**Fig. 5** Structural Bridge. Most common example is stud framing.

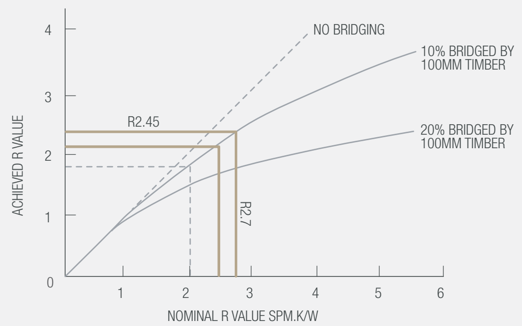
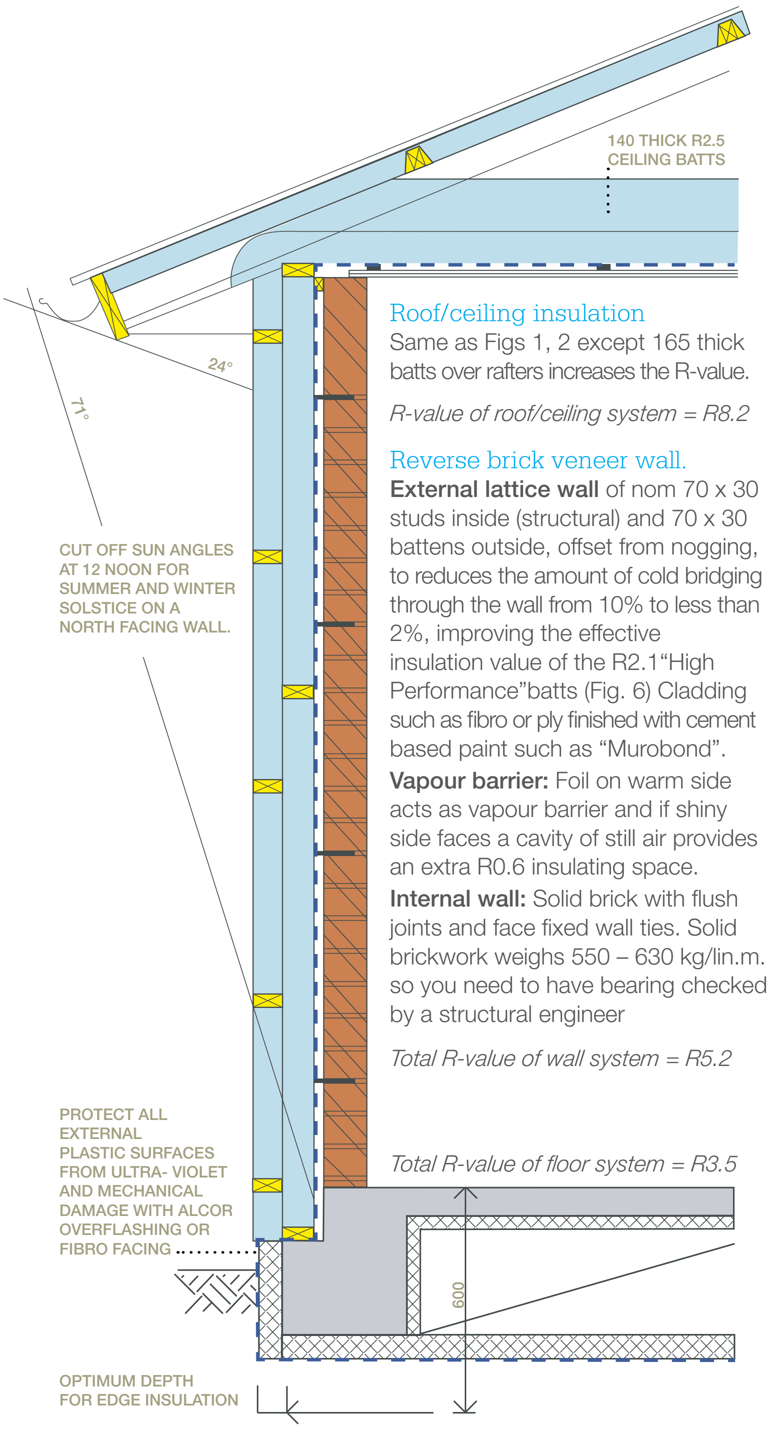



**Fig. 6** Structural Bridge. Effect of wood framing bridging an insulation cavity.

## Fig 3 "SUPER-INSULATED" REVERSE BRICK VENEER

With the bricks on the inside the heat they store interacts with the internal environment, not the outside weather. You let the climate do your heating and large heaters become unnecessary.




### Roof/ceiling insulation

Same as Figs 1, 2 except 165 thick batts over rafters increases the R-value.

*R-value of roof/ceiling system = R8.2*

### Reverse brick veneer wall.

**External lattice wall** of nom 70 x 30 studs inside (structural) and 70 x 30 battens outside, offset from nogging, to reduces the amount of cold bridging through the wall from 10% to less than 2%, improving the effective insulation value of the R2.1"High Performance"batts (Fig. 6) Cladding such as fibro or ply finished with cement based paint such as "Murobond".

**Vapour barrier:** Foil on warm side acts as vapour barrier and if shiny side faces a cavity of still air provides an extra R0.6 insulating space.

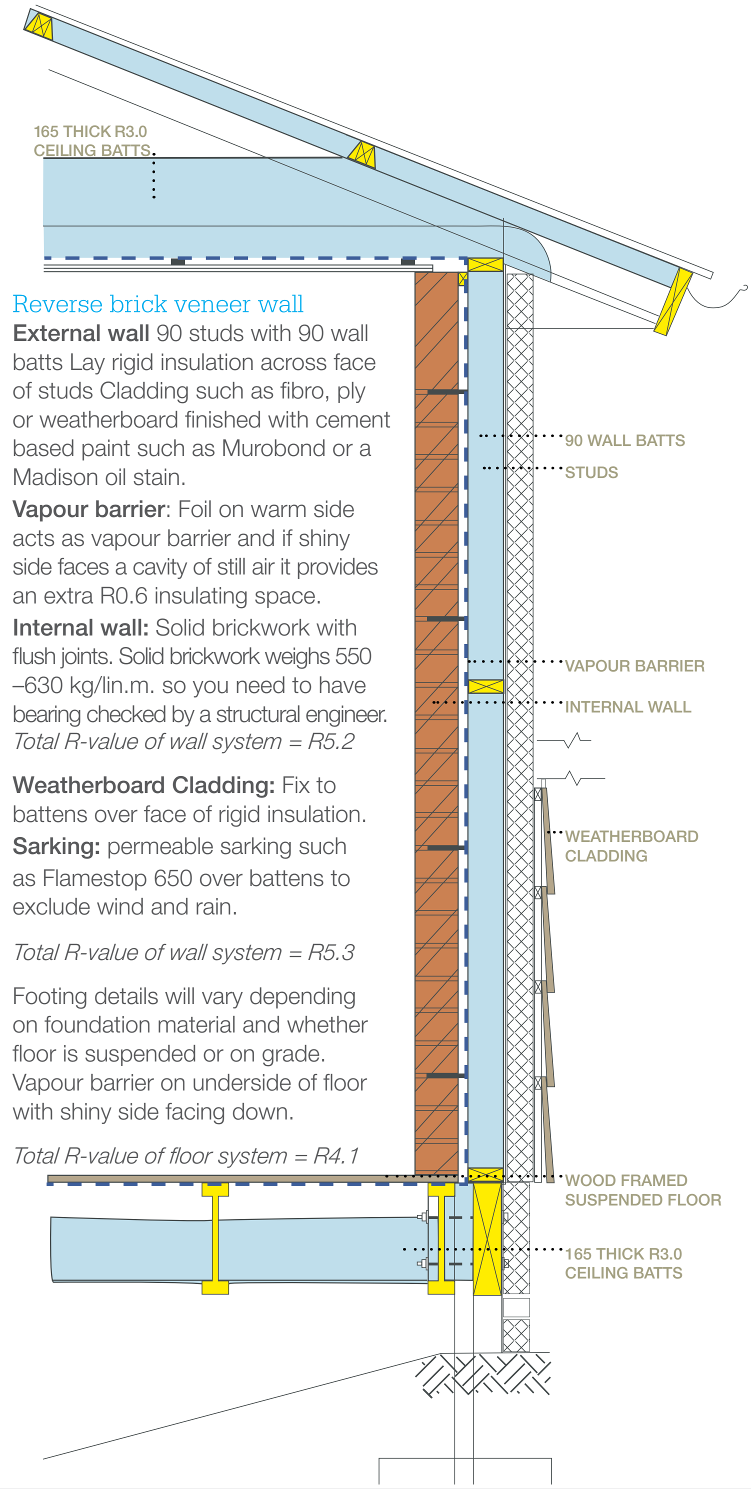
**Internal wall:** Solid brick with flush joints and face fixed wall ties. Solid brickwork weighs 550 – 630 kg/lin.m. so you need to have bearing checked by a structural engineer

*Total R-value of wall system = R5.2*

*Total R-value of floor system = R3.5*

## Fig 4 "SUPER-INSULATED" REVERSE BRICK VENEER

Passive solar design of housing is the key to providing a sustainable lifestyle. A passive solar house has "thermal mass" on the inside. This gives you the marketing edge over standard housing.




### Reverse brick veneer wall

**External wall** 90 studs with 90 wall batts Lay rigid insulation across face of studs Cladding such as fibro, ply or weatherboard finished with cement based paint such as Murobond or a Madison oil stain.

**Vapour barrier**: Foil on warm side acts as vapour barrier and if shiny side faces a cavity of still air it provides an extra R0.6 insulating space.

**Internal wall:** Solid brickwork with flush joints. Solid brickwork weighs 550 –630 kg/lin.m. so you need to have bearing checked by a structural engineer.

*Total R-value of wall system = R5.2*

**Weatherboard Cladding:** Fix to battens over face of rigid insulation.

**Sarking:** permeable sarking such as Flamestop 650 over battens to exclude wind and rain.

*Total R-value of wall system = R5.3*

Footing details will vary depending on foundation material and whether floor is suspended or on grade. Vapour barrier on underside of floor with shiny side facing down.

*Total R-value of floor system = R4.1*

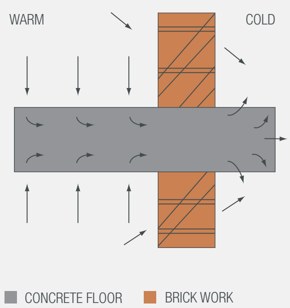



**Fig. 7** Structural Bridge. Projecting balcony floor slab.

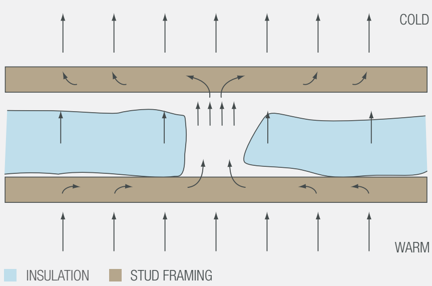



**Fig. 8** Air Bridge. Shrinkage or workmanship creates gaps around parts of the insulation.

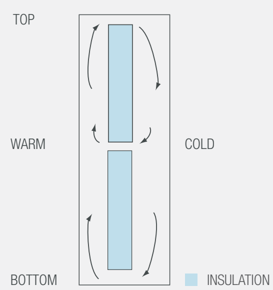
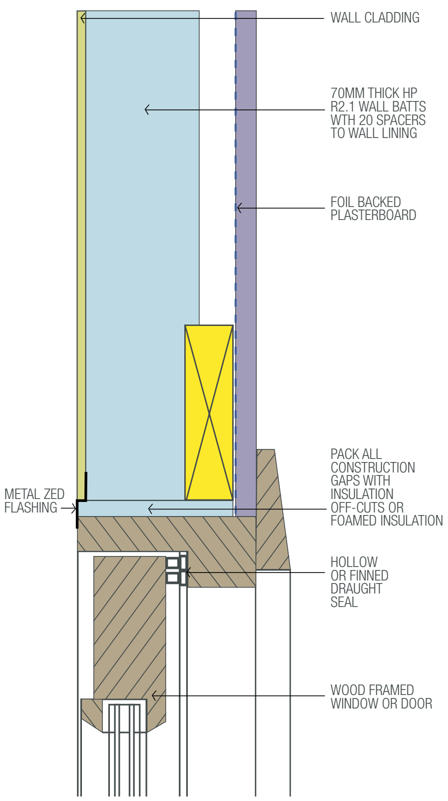



**Fig. 9** Circulation Bridge. Gaps of a few mm. can set up convection currents resulting in a drop to about half the rated value. It probably won't drop much further

## SEALING CONSTRUCTION GAPS

A house contains about half a tonne of air, which is replaced between one and six times an hour, depending how leaky it is. In cool temperate climates the new air must be heated to maintain indoor comfort. Obviously reducing the number of times per hour the air needs to be heated is going to reduce heating costs. By paying careful attention to sealing gaps, fitting sheathing, window & door seals and flue dampers as the house is being built it is possible to reduce this infiltration rate to one or two air changes per hour. A healthy indoor environment is maintained, heat losses are reduced and large heaters become unnecessary.

**Fig 10** Window & Door Head
Source: Nigel Legge Architect, 2012




### Wall construction

90 thick stud wall with 70 thick High Performance R2.1 batts with 20 spacers to wall lining. Foil eg foil backed plasterboard facing 20 air space puts the vapour barrier on the warm side and provides an extra R0.6 insulation. Pack all tolerance and construction gaps with insulation off-cuts or foamed insulation.

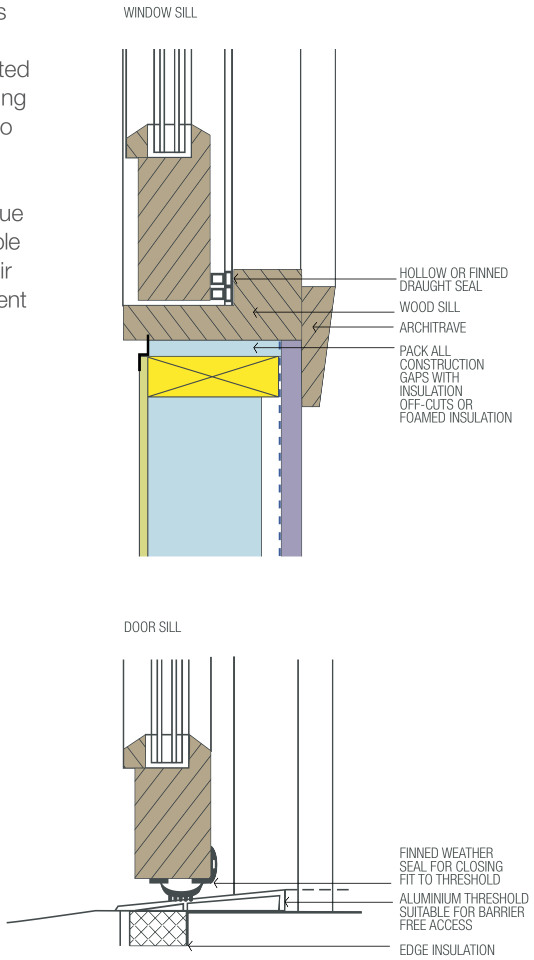
### Double glazing

A wood framed window or door with a 4/12/4 sealed unit has an approximate R-value of R0.37. If low-e glass is used then it's R0.53 Frames are usually made of wood, plastic or aluminium. Metal frames act as a heat sink and considerably reduce the R-value of a window unless a thermal break is fitted in the frame.

### Insulative air spaces

For an airspace to insulate it must be sealed to prevent air-flows.Foil surfaces must be free of dust or moisture and must face the airspace. The side is unimportant.

**Fig 11** Window & Door Sills
Source: Nigel Legge Architect, 2012



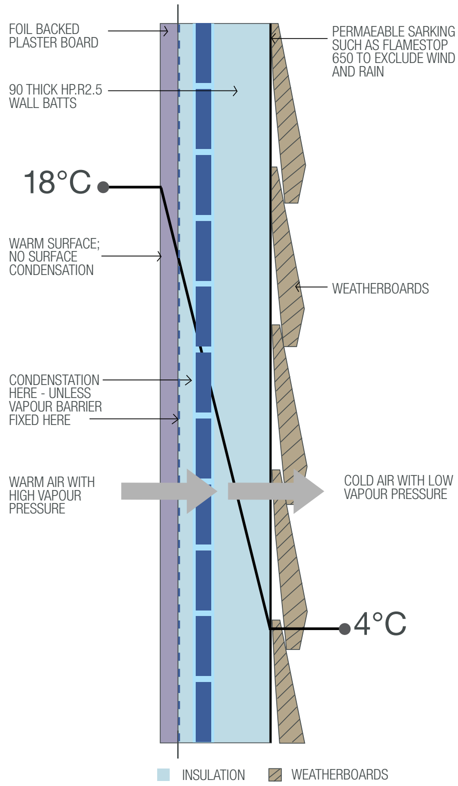

Total R-value of wall system = R3.1
Note: These wall details comply with 6-star deemed to satisfy requirements, but today's min standards are sub-standard tomorrow.

## CONDENSATION

Water vapour is a component of air and is always present within a house, varying with the season and the household's domestic habits. In cold weather, vapour pressure is greater indoors than outdoors and because most building materials are permeable the water vapour diffuses outdoors as surely as water flows downhill. As it diffuses through the wall the temperature drops and when the dew point is reached the vapour condenses into liquid water. In places with consistently cold weather, say a mean min. winter temperature of 4ºC or lower, this condensation can accumulate to the point of doing damage such as staining, rotting, corroding, and mould growth. Some places with a mean min. winter temperature ≤4ºC are Launceston, Wynyard airport, Glenorchy, Bendigo, Canberra, Armidale & Stanthorpe

Water vapour can be prevented from getting into the structure by placing a vapour barrier on the warm side of the walls, floors and ceiling. A vapour barrier must have a permeance of no more than 1 perm – aluminium foil is perfect. For it to be effective all joints tears and holes must be sealed with tape. Getting continuity between ceiling, walls and floors can be difficult with some construction methods. Perhaps only a major reduction can be achieved, so it becomes important when re-evaporation occurs for the vapour to reach outdoors without further hindrance – that all layers on the cold side are permeable. Wet and soggy insulation has no insulation value.

**Fig 12** Diagram of temperature gradient and flow of water vapour through a frame wall.
Source: Experimental Building Station NSB No 32 1954.




Total R-value of wall system = R3.0 Note: This wall detail complies with 6-star "deemed to satisfy" requirements, but today's minimum standards are sub-standard tomorrow. Extra insulation is extremely good value for money.

### Further Information


This phamplet is produced by the Tasmanian branch of the Australian Solar Energy Society **www.auses.org.au**

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