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BEST PRACTICE PROGRAMME

Good Practice Guide 7

ENERGY

EFFICIENT

NEW HOUSING

ROOF INSULATION

P RICHMOND
IDEAL HOMES LTD.

Roof Insulation

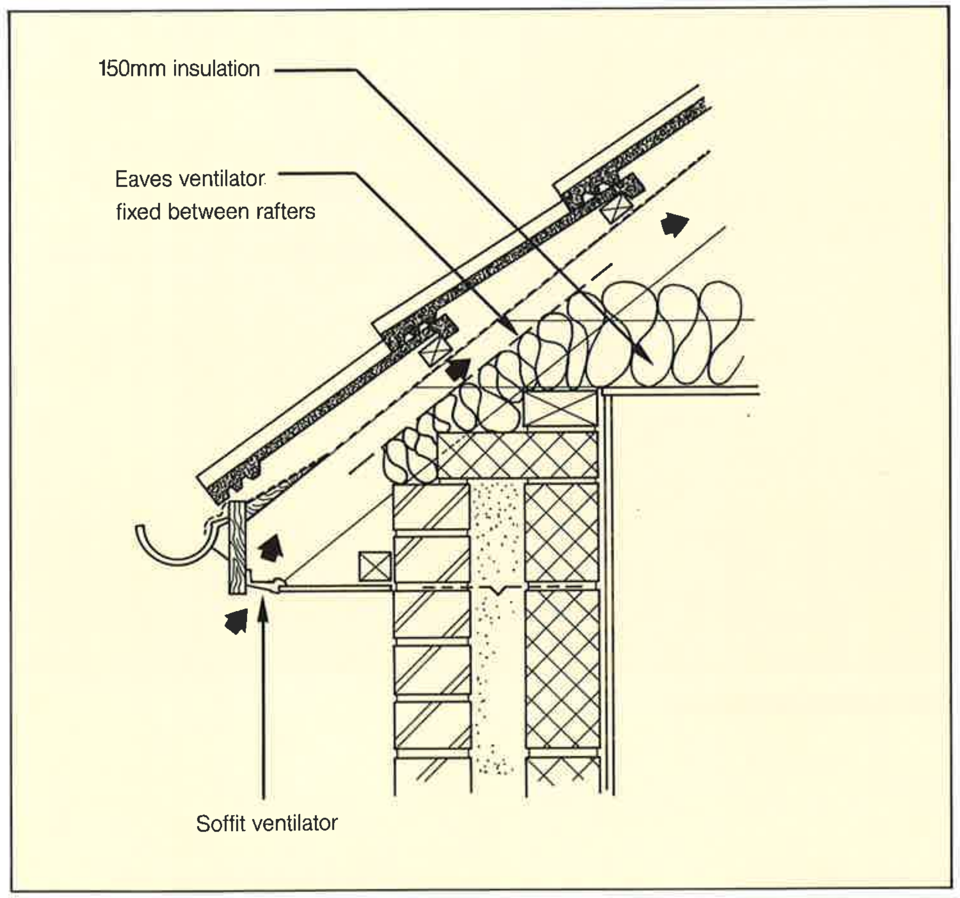
Ideal Homes London have consistently tried to produce highly insulated dwellings, without excessive increases in building costs which would have to be passed on to purchasers. We believe that the most thermally efficient construction method is still timber frame, simply because of the opportunity to easily install a reasonable thickness of insulation. Nevertheless, we do not exclude all-masonry construction and we build with both forms of structure to suit particular market or technical requirements. Our current rate of build of over 600 houses per year is approximately 60% timber frame to 40% traditional all-masonry construction.

The roof is one element of an integrated design to achieve a thermally efficient structure, and its construction is common to both forms of structural shell. One of the major problem areas with highly insulated roofs is the risk of condensation, causing deterioration of the roof structure. This aspect is addressed in the Building Regulations which require the provision of roofspace ventilation via correctly sized openings, and is an important consideration of any roof design. The requirement for low energy housing to be more airtight could result in higher internal moisture levels, increasing the risk of condensation in the roof if not correctly dealt with.

The method of roof insulation and design detail adopted by Ideal Homes are described in the following paragraphs.

Pitched Roofs

With conventional pitched constructions roof insulation is installed at ceiling level as one of the last operations, after second fix electrical work.



Roof and eaves detail masonry construction

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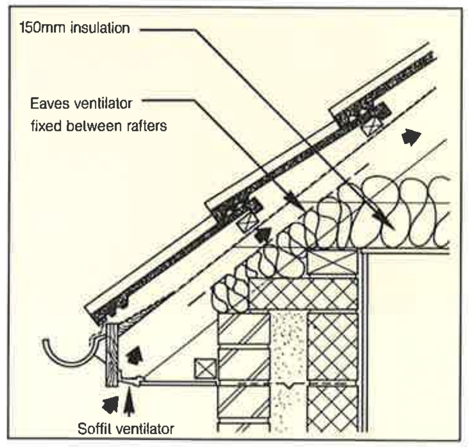

Figure 1: Roof and eaves detail masonry construction

The insulation used is 150mm thick glass wool quilt cut to fit tight between ceiling joists. This is used in preference to loose fill insulation which risks being disturbed by roof ventilation and cannot be easily lifted for further work or maintenance. Insulation quilt laid across the joists tends to obscure safe footholds.

It is important to provide continuity of insulation at the wall/roof junction to avoid possible cold bridging. Roof insulation is laid and pushed from the roofspace well into the eaves. To prevent it blocking the natural ventilation path from the eaves, purpose made tray units are fitted between rafters to restrain the insulation and maintain the required minimum clear airspace of 25mm.

A 150mm thick quilt is proud of the top of the joists (commonly 90mm-100mm deep). This requires that if the roofspace is to be boarded out for use as storage space then the boarding must be raised on bearers to prevent the insulation being compressed, and loosing efficiency.

Insulation must pass over and around water storage tanks and any associated pipework, and allow warmed air from the room below to circulate around the tank and prevent freezing.

A common roof construction comprising tiles on battens and roofing felt on trussed rafters at 35° pitch, with 150mm thick glass wool insulation above a 12.5mm plasterboard ceiling will give a U.value of 0.2.

To give the required ventilation at the eaves a proprietary ventilator is fitted with clips to the soffit board and to the fascia. The ventilator has perforations equivalent in area to a 10mm continuous air gap and has an insect resistant mesh incorporated. Additional ventilation may be provided at the ridge using ventilating tiles in a duo pitch roof, and must be provided in this position in a monopitch roof.

Continuity of insulation and sealing of air gaps at openings in the ceiling for pipes and wiring is clearly important. We have found that using a purpose made loft hatch which has factory fitted insulation material and fits tight to its frame is worthwhile.

There is a risk that electrical wiring which is run behind thermal insulation material will overheat and short circuit or catch fire. To avoid this happening, the wiring in the roofspace is up-rated and larger capacity cables are used as the wiring cannot everywhere be run clear of the insulation.

Flat Roofs

Flat roof constructions are generally avoided, the main exception being for garages. These roofs are uninsulated and should not need special precautions against condensation. However, flat roofs over living accommodation have been used by us, in conjunction with parapet walls, to match existing facades. Providing sufficient permanent ventilation is extremely difficult with parapet walls and therefore the unventilated 'warm deck' construction is preferred. The insulation is installed above the membrane, rather than below it, to form an inverted roof.

The construction is shown in Figure 2. The timber roof joists have a paper backed plasterboard ceiling, with no insulation between them. The roof deck is 25mm external quality ply with a 2 layer high performance membrane above, laid on treated softwood firrings at 1:40 minimum fall. The insulation is placed above the membrane and comprise 90mm rigid extruded polystyrene tongue and grooved slabs which interlock to prevent wind uplift. A mortar topping is factory bonded to the polystyrene slabs to protect them from foot traffic and ultra-violet light. Additional restraint against wind uplift is provided at roof edges by using a continuous line of concrete paving slabs.

In this particular application, which incorporates parapet walls, the flat roof falls to box gutters and internal rainwater pipes. Continuity of insulation is important at these positions and it may be necessary to insulate below the gutter in order to maintain sufficient gutter capacity. Insulation of the rainwater pipe, full height, is essential to avoid condensation.

Trimming of the insulation boards around roof penetrations and upstands requires some expertise and supervision to ensure that continuity of insulation is maintained. At the roof edge, the wall insulation should be carried up past the roof level to minimise cold bridging as it is impossible at this junction to achieve full continuity.

There is little risk of condensation with this form of roof construction since the roof structure is on the warm side of the insulation.

Further guidance is given in the BRE report reference BR143 'Thermal Insulation: Avoiding risks'.

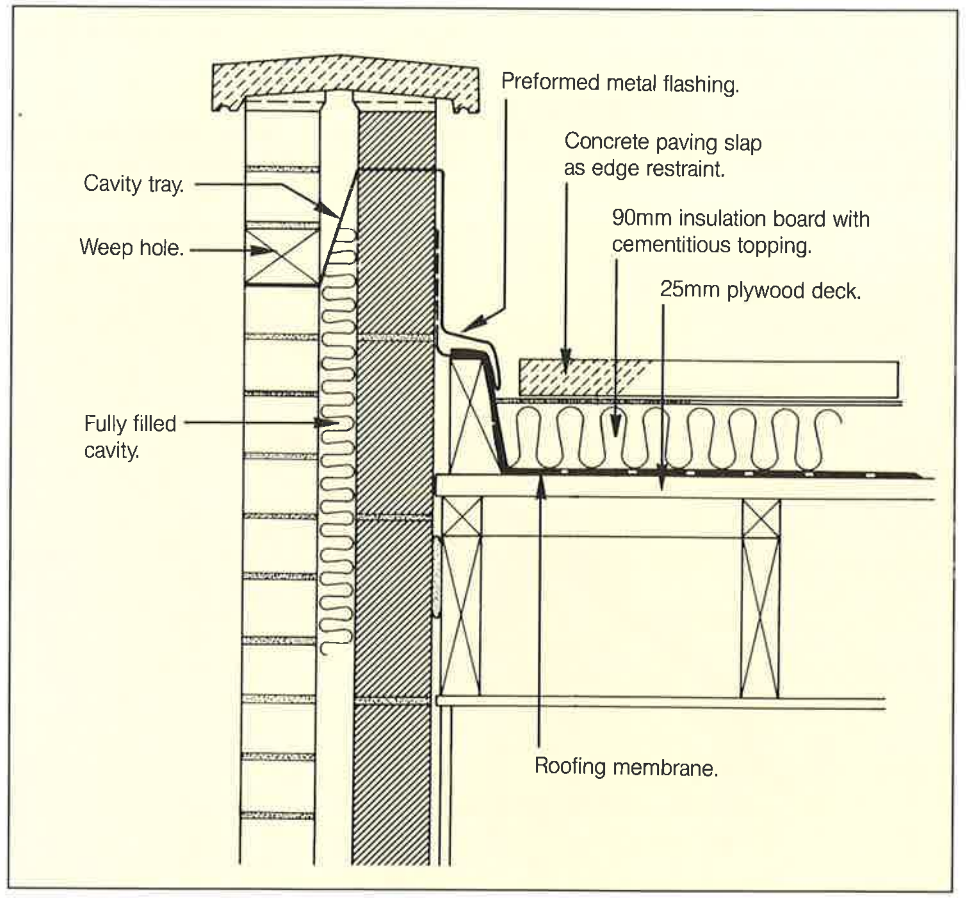

Figure 2: Warm deck flat roof

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Room-in-the-roof

This term describes a construction which is a hybrid of roof and wall. The walls are vertical and the ceiling is part horizontal, part sloping.

Roof spaces are formed behind the walls and above the ceiling, which have to be ventilated. It is quite possible to insulate along the rafter line only, but this would mean having to heat the roof voids unnecessarily. Insulation therefore runs along the ceiling tie line, down the rafter and then down the wall line. Continuity of insulation is important and the requirements for providing uninterrupted ventilation must be met.

The requirement for eaves ventilation is the same as for a conventional pitched roof. However, because of the circuitous route for airflow in the room-in-the-roof configuration it is advisable to provide ventilation also at the ridge through purpose made tiles.

A 50mm continuous airspace must be provided between rafter insulation and roofing felt and this may be difficult to achieve with insulation 150mm thick, without using rafters that are excessively deep.

Two alternative ways of dealing with this are:

- To batten out the rafters along their length to a depth of 200mm (see Figure 3)
- Select an insulation with a lower value of thermal conductivity so that a reduced thickness can be used.

If, for example, expanded polystyrene slabs are used then they have the added advantage of being rigid, so that they do not slump in the rafter space and they can be wedged in position before the plasterboard is fixed.

A vapour check must be provided on the warm side of the insulation. This could either be polythene loose fixed or by using polyester backed plasterboard, (eg Gyproc 'Duplex' board).

The sequence of building operations needs some care to ensure that both insulation and vapour checks are continuous. The insulation at normal ceiling height must be installed after plasterboard and electrical wiring, and, wall and ceiling insulation to the room-in-the-roof before plasterboard fixing. It may be advantageous to consider routing any vertical services on the warm side of the insulation to save the need to insulate the pipework separately, but this may create other problems of accessibility for maintenance. Similarly, any penetration of the vapour barrier must be effectively sealed, and it may be worth considering running services on the warm side of the vapour barrier so that it need not be penetrated.

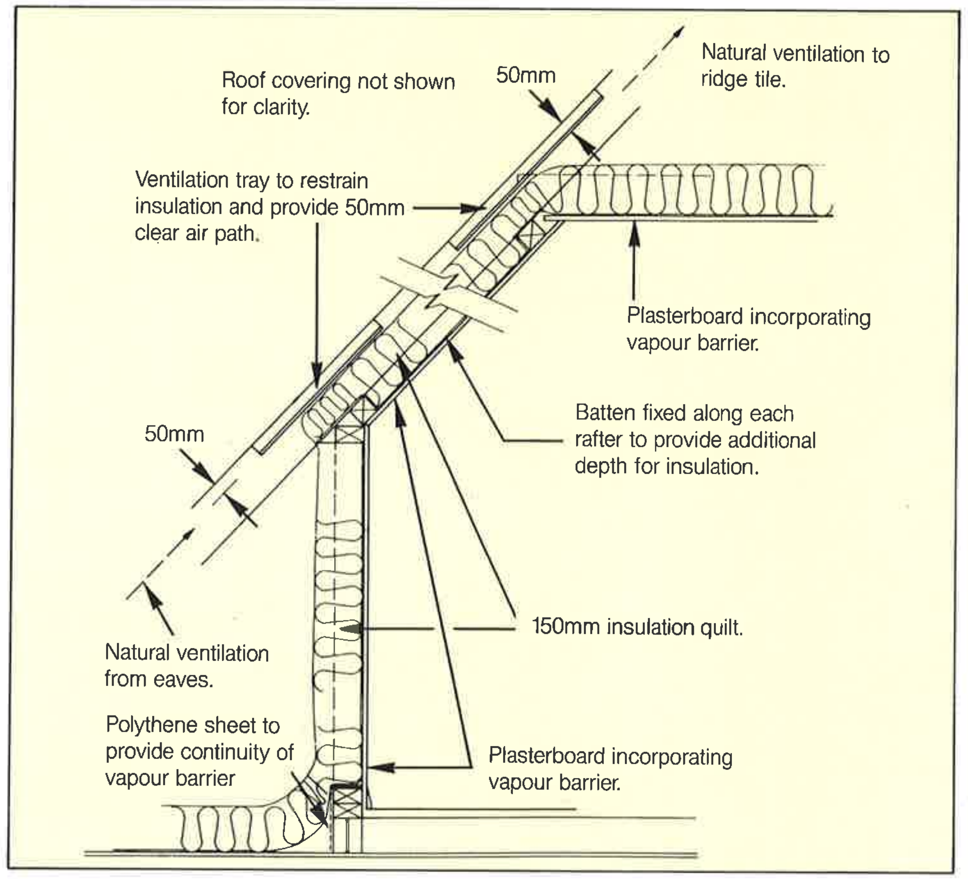

Figure 3: Room-in-the-roof construction.

Conclusion

Our experience has been that if the correct and adequate amount of ventilation is provided and maintained throughout the roof structure, condensation in the roofspace is successfully avoided. It is well worthwhile using purpose made products such as eaves ventilators, insulation restraint trays and ventilating tiles, so that the work can be more easily carried out and can be readily checked.

Continuity of insulation is essential and must be checked when all work is complete.

Acknowledgement

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