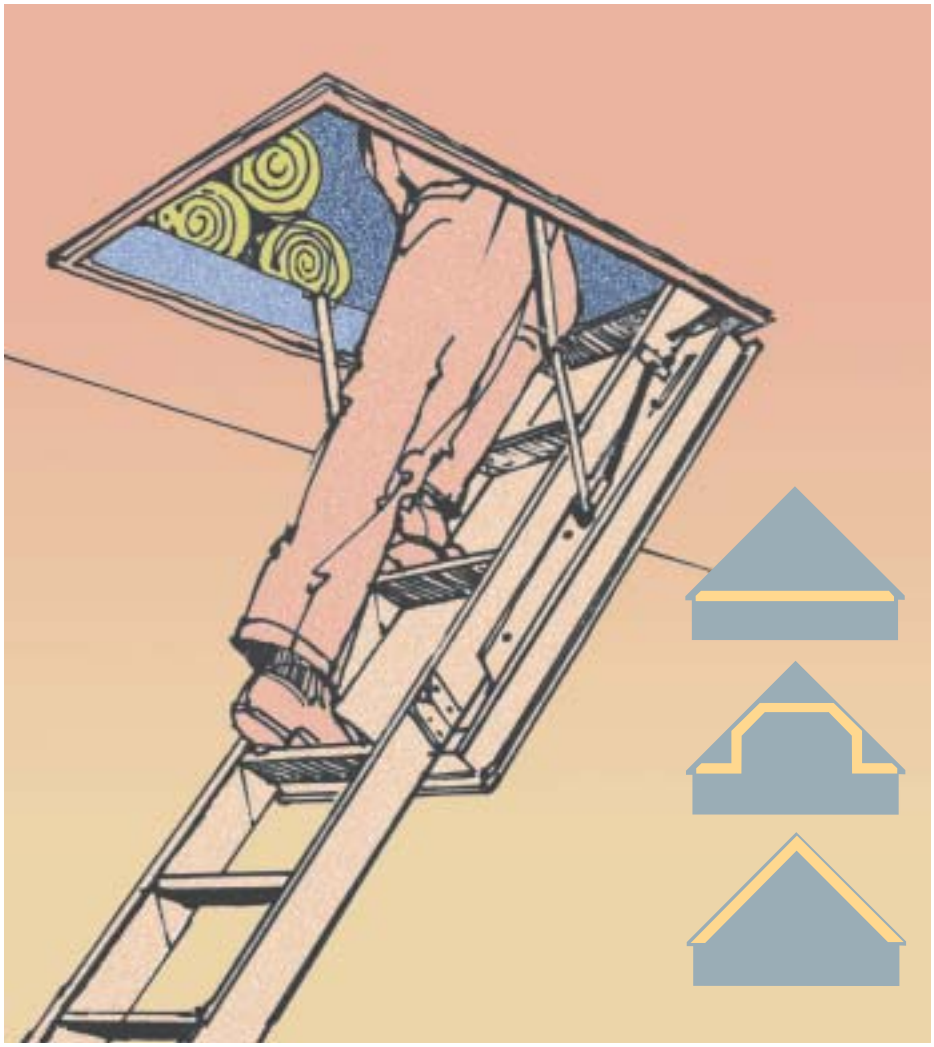
GOOD PRACTICE GUIDE 296

Refurbishment site guidance for solid-walled houses – roofs



- What energy savings to aim for
- Key points to consider
- Energy savings and SAP ratings
- Environmental considerations

2002 EDITION

HOUSING ENERGY EFFICIENCY

BEST PRACTICE PROGRAMME

GOOD PRACTICE GUIDE 296

INTRODUCTION

THE STATIONERY OFFICE

The Stationery Office, London
Tel: 0870 600 5522, web:
www.tso.co.uk

Regulations (National Details)

These documents can be obtained from The Stationery Office, London www.tso.co.uk/bookshop.

- The Building Regulations 2000 (England and Wales) Part L1 are set out in *The Building Regulations 2000, Approved Document L1 Conservation of Fuel and Power*
- The relevant Building Standards for Scotland are set out in *The Building Standards (Scotland) Regulations 1990, 6th amendment, Technical standards to Part J, Conservation of Fuel and Power*
- The relevant Building Standards for Northern Ireland are set out in *Building Regulations (Northern Ireland) Part F Conservation of Fuel and Power*

This is one in a series of Guides aimed at architects, builders, local authorities and housing associations. It provides advice on which insulation methods are most appropriate for roofs and the thickness of insulation needed to achieve a good level of energy efficiency.

Other relevant Guides are:

GPG 294 Refurbishment site guidance for solid-walled houses – ground floors
GPG 295 Refurbishment site guidance for solid-walled houses – windows and doors
GPG 297 Refurbishment site guidance for solid-walled houses – walls
GPG 155 Energy efficient refurbishment of existing housing

The Guide lists the technical points to be aware of and the most suitable insulation materials.

REGULATIONS

Building regulations vary between the nations. Building control at the local authority should be consulted for individual national standards (see left). Where applicable all aspects of national building regulations should be met.

TERMS USED IN THIS GUIDE

U-value. The measurement used to express the rate of heat loss through a wall, roof, window, etc. A roof with a U-value of 1 W/m^{2}K would lose 1 Watt of energy through a 1 m^2 area of roof for every 1°C difference in temperature between the inside and outside. The lower the U-value, the better insulated the construction. The diagram below shows the U-values required for roofs to achieve best practice.

Breathable sarking membrane. A roofing membrane located below the tiling battens, which is water repellent, but allows water vapour to pass through it. Its use in roofs minimises the risk of condensation forming in the roof structure.

Vapour control layer. An impervious membrane, usually a polythene sheet. It is placed on the warm side of insulation to prevent water vapour generated in the house from entering and condensing on the cold parts of the construction.

SAP RATINGS

The Standard Assessment Procedure (SAP) is an energy rating which estimates the space and water heating costs (based on the size of the property and its heating and hot water system) and converts them into a rating on a scale from 1 to 120. The higher the number, the lower the energy consumption. The SAP rating can be used to compare the relative benefits of different energy efficiency measures. See 'The Government's Standard Assessment Procedure for the energy rating of dwellings. 2001 edition' (available from **www.bre.co.uk/sap2001** or call 01923 664258).

SAP rating		Typical annual heating and hot water costs
43	typical mid-terrace house basic gas central heating	£500
53	200 mm of loft insulation added	£400
85	fully insulated and double glazed	£210
102	fully insulated, double glazed and with gas condensing boiler	£160

PITCHED ROOF WITH LOFT CEILING LEVEL INSULATION

Insulating the loft space is usually a simple job well within the capabilities of most DIYers.

WHAT TO AIM FOR

For best practice aim for U-value of 0.16 W/m^{2}K or better.

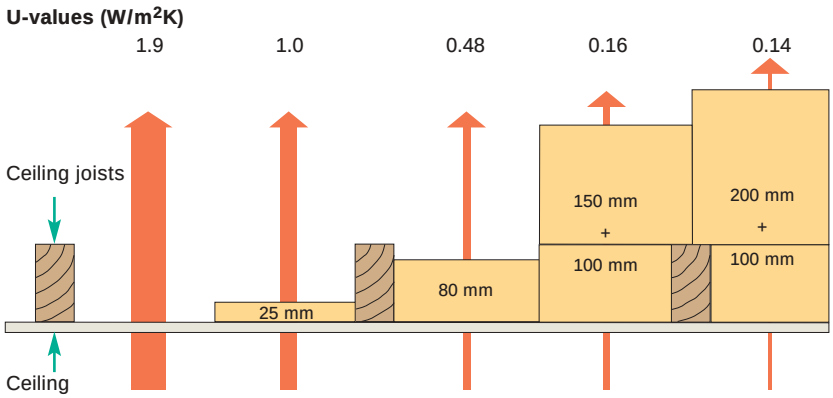
This can be achieved by a 250 mm thickness of insulation installed in two layers, 100 mm between the joists and 150 mm over the joists.

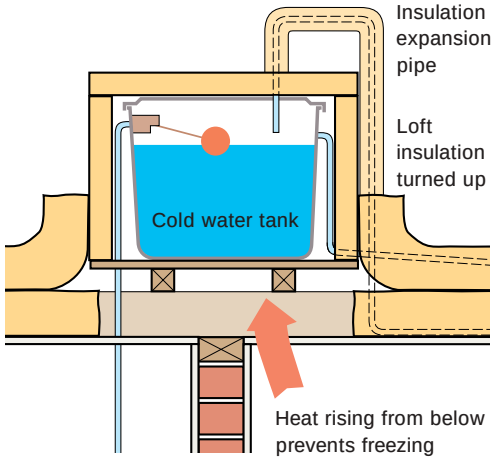
If you have some existing loft insulation, top this up to give a total thickness of 250 mm.

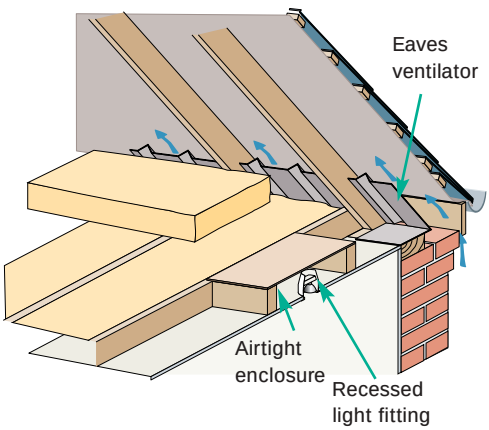
For sloping ceilings in attic rooms a U-value of 0.16 W/m^{2}K may not always be practical, in which case a U-value of 0.2 W/m^{2}K should be aimed for.

KEY POINTS

- If the ceiling has a sloping area, do not stuff insulation down between the roof timbers – this may obstruct vital cross ventilation of the roof. Instead, fix insulation-backed plasterboard through the existing ceiling. (if over a stairwell or landing ensure that minimum required headroom is maintained).
- Ensure that there is the equivalent of a 10 mm gap at the eaves and install purpose-made eaves ventilators to maintain cross ventilation of the roof space and prevent condensation.
- Insulate all cold water tanks and pipes – adding loft insulation makes the loft space colder (don't insulate under tanks unless they are raised well above the rafters).
- Seal all cracks and holes around pipes and cables where they pass through the ceiling. This prevents moist air from the house entering the loft and condensing on cold surfaces.
- Keep electrical cables above the insulation if possible to minimise overheating.
- Avoid recessed lights in the ceiling, unless you can provide an airtight, fire-proof enclosure around them.
- Add battens to provide a walkway or storage surface, without compressing the insulation.
- Insulate and draught seal the loft hatch, or fit a proprietary insulated access hatch.
- Follow advice on the packaging about any precautions to take before laying the insulation.







MATERIALS

- Mineral wool in roll form, available 400 mm and 600 mm wide and 100, 150 and 200 mm thick. Readily available, can be installed by DIYer. It is recommended that overalls, gloves and a face mask are worn during installation to prevent irritation and the inhalation of fibres.
- Blown in mineral wool or recycled cellulose. This must be carried out by a specialist contractor – NALIC has a register of approved contractors (see back page for contact address).

FLAT ROOF WITH INSULATION ABOVE THE ROOF DECK

FLAT ROOFS

The preferred method of insulating a flat roof is to locate the insulation above the roof deck. The insulation can either be placed below the weatherproof membrane, in a warm deck (sandwich) construction, or above the weatherproof membrane in an inverted warm deck construction.

It is most economic to add insulation when work is to be carried out to replace the existing roof covering.

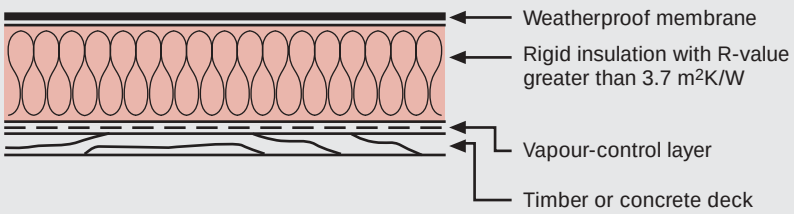
WHAT TO AIM FOR

For best practice aim for a U-value of 0.25 W/m²K or lower. If conversion to a pitched roof is carried out these should be insulated to the same standard as conventional pitched roofs (value of 0.16 W/m²K).

R-value (thermal resistance - m²K/W).

The R-value represents the resistance that a series of elements will provide to the passage of heat energy. It is affected by the conductivity of the element and its thickness. The higher the R-value the greater the resistance (the better the insulation effect). Because thermal properties of individual products vary, conductivity value (λ) should be checked with the manufacturer.

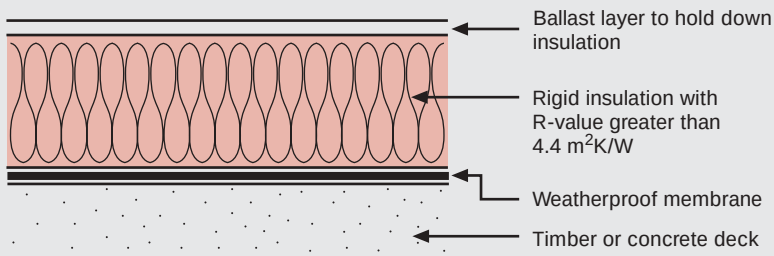
WARM DECK



U-value: 0.25 W/m²K

- Insulation boards to be rigid.
- Insulation materials must be compatible with any bonding materials used for the weatherproof membrane.
- Voids in timber roof must not be ventilated to the outside.

INVERTED WARM DECK



U-value: 0.25 W/m²K

- The existing roof structure must be capable of supporting the extra weight, particularly of the ballast layer.

ROOM-IN-THE-ROOF – INSULATION INSTALLED FROM INSIDE

This method of insulating the roof is suitable for existing attic rooms, or new attic conversions.

WHAT TO AIM FOR

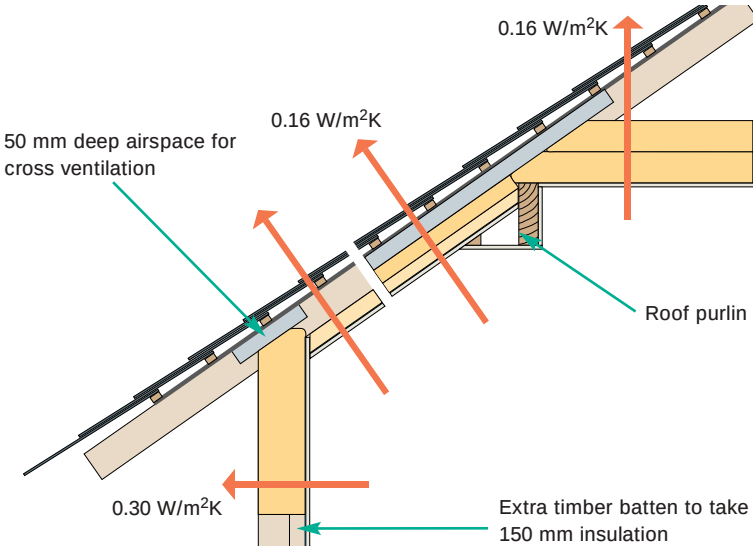
For best practice aim for a U-value of 0.16 W/m^{2}K (see page 3 for method of insulation) for horizontal ceilings.

For sloping ceilings in attic rooms a U-value of 0.16 W/m^{2}K may not always be practical, in which case a U-value of 0.20* W/m^{2}K should be aimed for.

For stud walls a U-value of 0.3* W/m^{2}K should be aimed for to achieve best practice.

KEY POINTS

- Install purpose-made eaves vents and ventilation at the ridge to maintain cross ventilation of the roof space and prevent condensation.
- Provide minimum 50 mm wide ventilation path behind insulation to sloping ceilings.
- Provide a vapour control layer, usually 500 gauge polythene, on the warm side of insulation to prevent moist air passing through insulation.
- Seal any holes (eg at services) and tape all joints in the vapour control layer.



U-values assume timber rafters are at 400 mm centres

Note: an uninsulated roof has a U-value of 1.9 W/m^{2}K

Sloping ceilings

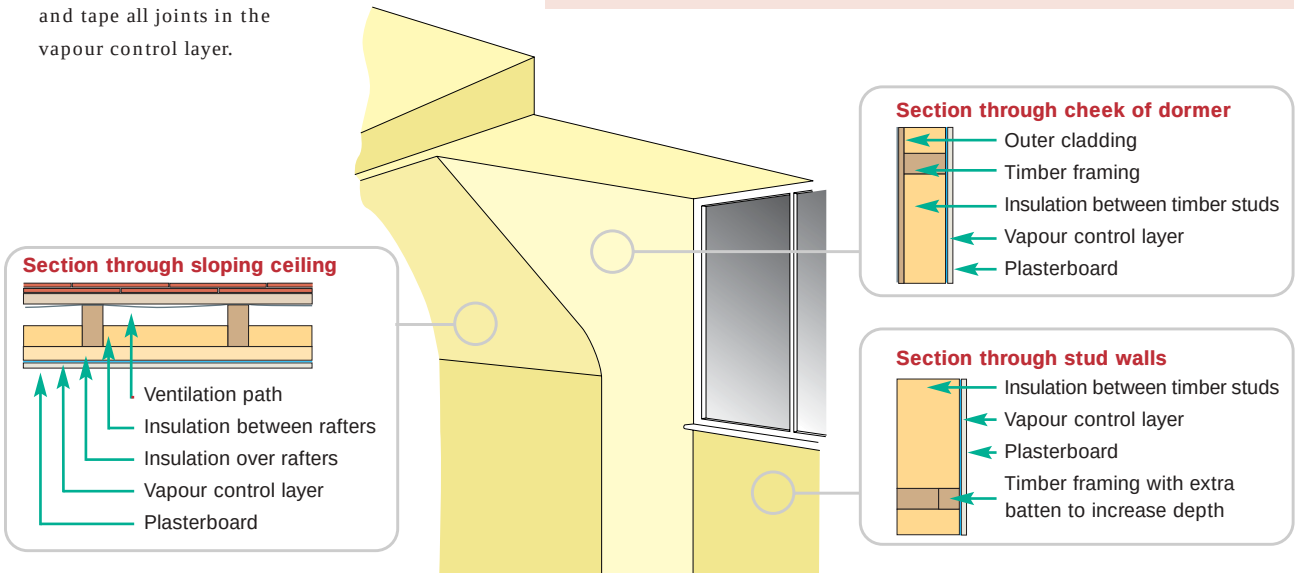
- 50 mm mineral wool batts between rafters, plus 100 mm urethane or phenolic foam (U-value: 0.16 W/m^{2}K)
- 130 mm urethane foam (U-value: 0.16 W/m^{2}K)

Ceiling level insulation

- 250 mm mineral wool or cellulose fibre (U-value: 0.16 W/m^{2}K)

Stud walls

- 150 mm mineral wool quilt or cellulose fibre between studs (U-value: 0.29 W/m^{2}K)

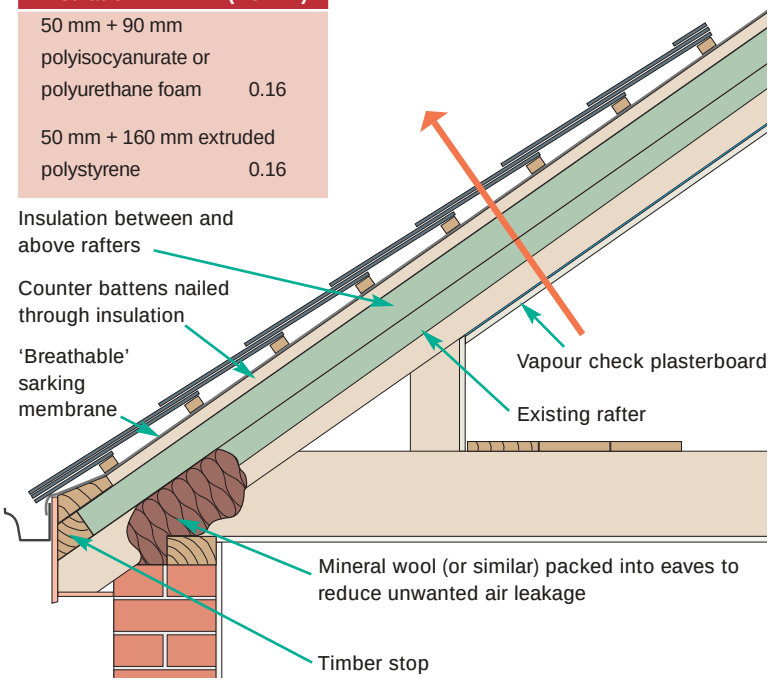


*REQUIREMENTS FOR SCOTLAND

For new attic conversions better U-values may be required. The local authority building control department should be consulted if there is any doubt.

ATTIC CONVERSION – INSULATION OVER RAFTERS

Insulation	U-values (W/m^2K)
50 mm + 90 mm polyisocyanurate or polyurethane foam	0.16
50 mm + 160 mm extruded polystyrene	0.16



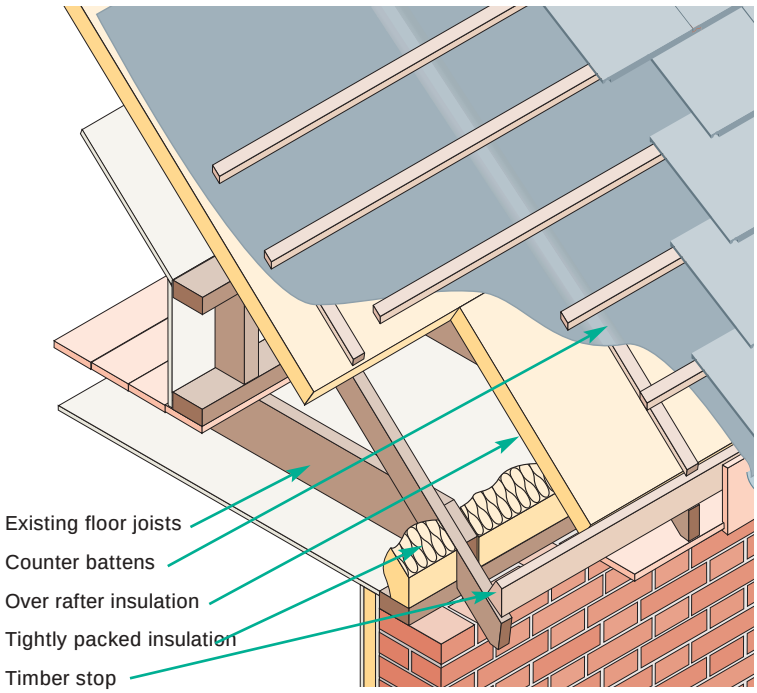
This method of insulating the roof is for use when the existing roof tiling is being renewed.

WHAT TO AIM FOR

For best practice aim for a U-value of 0.16 W/m^2K.

KEY POINTS

- The thickness of insulation raises the finished height of the new roof, so this method is not suitable for terraced housing where the roof tiling is continuous with that of neighbouring houses.
- Fill the gap at the eaves between wall and roof insulation to reduce air leakage.
- Use a 'breathing' sarking membrane to avoid trapping moisture in the roof timbers.
- Tape the joints of foil-faced boards with self-adhesive aluminium tape.
- Batten and counter batten the roof so the sarking membrane drains away moisture to the gutter.
- Special helical shaped nails are usually used to fix the counter battens.
- Line the underside of the rafters with plasterboard to provide fire protection.



MATERIALS

- Extruded polystyrene boards, preferably with interlocking edge joints, available in range of sizes. Will probably have to be ordered from a builders' merchant.
- Foil-faced polyurethane and polyisocyanurate boards, available in range of sizes. Will probably have to be ordered from a builders' merchant.

ENVIRONMENTAL CONSIDERATIONS

There is growing global pressure to ensure that construction materials are sustainable. Whilst energy efficiency initiatives over the last 30 years have reduced the energy needed to heat a typical house considerably, initiatives to reduce the impact from construction materials have been comparatively slow.

The Green Guide to Housing Specification (Anderson and Howard, BRE, 2000) provides a useful reference for construction products, giving A,B,C environmental ratings for over 250 specifications. This definitive guide, developed over 20 years and supported in its current form by the National House-Building Council (NHBC), is predominantly based on life cycle assessment data from the DETR-supported BRE Environmental Profiles scheme. The Guide contains an extensive list of references to all of its sources of data.

The use of insulation in the building fabric will significantly reduce the operational environmental impact of the building over its lifetime. This benefit will outweigh the embodied environmental impact of the insulation materials. To minimise the embodied impact however, specifiers should avoid foam insulation materials that use blowing agents which cause ozone depletion or global warming, such as HCFCs or HFCs. Alternative blowing agents such as carbon dioxide or pentane are less environmentally damaging.

For best overall environmental performance, look to renewable or recycled materials such as cork, recycled cellulose, flax or sheep's wool, foams blown using pentane or CO_2 and low density mineral wool or glass wool, all of which have high ratings in the Green Guide to Housing Specification and have similar insulation properties to mineral wool and expanded polystyrene. Lower density glass and mineral wools should be used in preference to denser ones where possible, as their environmental impact increases proportionally with their weight.

FURTHER INFORMATION

HOUSING ENERGY EFFICIENCY BEST PRACTICE PROGRAMME DOCUMENTS

The following Housing Energy Efficiency Best Practice programme publications are available from the HEEBPp Helpline, telephone 01923 664258, or visit the website www.housingenergy.org.uk.

Good Practice Guide (GPG)

GPG 155: Energy efficient refurbishment of existing housing
GPG 294: Refurbishment site guidance for solid-walled houses – ground floors
GPG 295: Refurbishment site guidance for solid-walled houses – windows and doors
GPG 297: Refurbishment site guidance for solid-walled houses – walls

BRE

Available from www.brebookshop.com
email brebookshop@emap.com
01923 664262

- BR 262: Thermal insulation: avoiding risks (2002 edition)
- BR 390: The Green Guide to Housing Specification

FURTHER INFORMATION

National Association of Loft Insulation Contractors (NALIC)
PO Box 12, Haslemere, Surrey GU27 3AH
Tel 01428 654011

The Government's Housing Energy Efficiency Best Practice programme provides impartial, authoritative information on energy efficiency techniques and technologies in housing. This information is disseminated through publications, together with seminars, workshops and other events. Publications within the Best Practice programme are shown opposite.

Visit the website at **www.housingenergy.org.uk**

Call the Housing Helpline on **01923 664258**

Energy Consumption Guides: compare energy use in specific building types.

Good Practice: promotes proven energy efficient techniques through Guides and Case Studies.

New Practice: monitors first commercial applications of new energy efficiency measures.

Future Practice: reports on joint R&D ventures into new energy efficiency measures.

General Information: describes concepts and approaches yet to be fully established as good practice.

The Housing Energy Efficiency Best Practice programme is managed by the Energy Saving Trust (EST).

This publication was produced by BRE on behalf of EST.