Energy Efficiency Best Practice in Housing

Cavity wall insulation in existing housing

A guide for specifiers and contractors

- Cavity fill reduces heat loss through walls by up to 40%
- After loft insulation, it is the most cost-effective single insulation measure
- Rain penetration problems are rare in retrofit installations

ENERGY EFFICIENCY™ SAVE ENERGY MONEY ENVIRONMENT

Introduction

The aim of this Guide is to give technical guidance to installation supervisors on the various aspects of cavity wall insulation.

Cavity wall construction in older housing generally consists of two leaves of masonry, an outer leaf (often of facing brickwork) and an inner leaf of brickwork or blockwork separated by a nominal 50mm wide cavity. The cavity width can vary and walls with wider cavities when filled will have a better insulation value and be less at risk from rain penetration than cavities 50mm or less. In reality most cavities are 65mm wide (BRE report for the Energy Saving Trust concerning EEC4, 2001).

The majority of existing cavity walls up to 12 metres in height are suitable for cavity fill. The British Board of Agrément (BBA) certify some products for use in walls up to 25 metres.

The suitability depends mainly on the local exposure to driving rain and the condition of the existing construction. A few buildings above 25 metres in height have been filled following special assessments.

Cavity fill reduces the heat loss through the walls by up to 40%, thus giving significant savings in heating costs. The reduction in heat loss also leads to an increase in air temperature in the dwelling and, as a result, more comfortable living conditions. Cavity fill is the most cost-effective single insulation measure after loft insulation.

Occupants can remain in the dwelling during installation as the insulation is pumped into the cavity through the outer masonry leaf and causes little disturbance compared with other methods of wall insulation.

Note:
When substantially replacing an exposed wall or external or internal renders, a reasonable thickness of insulation should be installed. National regulations should be checked.

Building Regulations
Building regulations for the thermal insulation of walls vary between the nations. Advice should be sought from the building control at the local authority. Contact details for building regulations are given at the back of this document.

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.

For more information on environmental issues see the Green Guide to Housing Specification (www.brebookshop.com or email brebookshop@emap.com).

Choice of Insulation

The insulants available for cavity fill are commonly blown mineral wool, UF foam and polystyrene beads. Blown mineral wool systems should be certified by the British Board of Agrément (BBA). Two British Standards deal specifically with UF foam: BS 5617 covers material standards and BS 5618 is the Code of Practice for installation. For other systems, only those certified by the BBA should be used.

Polyurethane foams also improve the thermal insulation of the wall. They are more expensive than any of the other fills, but have slightly better thermal insulation properties. They should have BBA Certification, or be to BS 7457: 1994 standard and be installed in accordance with BS 7456: 1991.

Cavity Wall Insulants

Mineral wool

- Glass wool
- Rock wool

Beads or granules

- Expanded polystyrene (EPS) beads
- Expanded polystyrene (EPS) granules
- Polyurethane (PUR) granules

Foamed insulants

- Urea-formaldehyde (UF)
- Polyurethane (PUR)

There are some concerns about the health effects of formaldehyde cavity wall insulation. Allergic skin reaction to formaldehyde is unlikely at the concentrations used for cavity fill. However, some individuals may suffer irritation to the eyes or upper respiratory tract. If in doubt seek medical advice.

There are other materials on the market but they are not commonly available for cavity wall insulation.

Suitability of walls for cavity insulation

Although most traditional cavity walls can be filled, an assessment of each property should always be carried out to determine the suitability of the walls for cavity fill.

Methods of assessment are given in BS 8208 and in best practice guides from the Cavity Insulation Guarantee Agency (CIGA).

When necessary due to the choice of insulant, the exposure of the walls to wind-driven rain should be assessed and related to any restriction on the particular type of cavity fill being considered. Where defects are identified, these should be satisfactorily rectified before work begins. Any dampness problems should be investigated to determine the cause and then remedied.

Exposure rating

Walls up to 12 metres in height

Beads and mineral wool can be used in any exposure up to 12 metres in height, provided the installation is to the BBA or British Standards Institution (BSI) appropriate standard and installed by approved installers.

UF foam is normally only permitted for walls that have a relatively sheltered exposure, unless the wall is protected by over-cladding.

Figure 1: Map showing categories of exposure to wind-driven rain

Key to map

Exposure Approximate wind-driven rain zones (litres/m² per spell)

1	Less than 33
2	33 to less than 56.5
3	56.5 to less than 100
4	100 or more

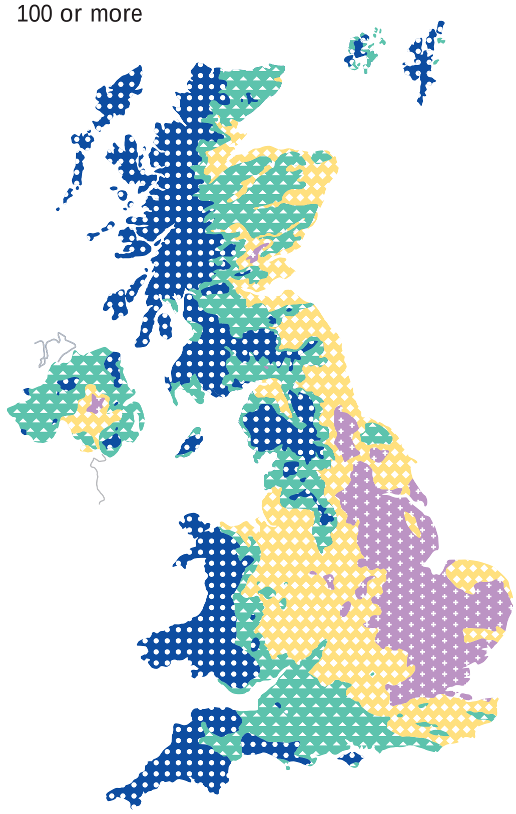

Figure 1 illustrates approximate exposure categories in relation to the severity of wind-driven rain, but the classification of a wall can be modified where there is local sheltering or alternatively a concentration of wind-driven rain. Buildings that are sheltered by surrounding buildings or trees can be considered to be located in an exposure category one lower than shown on the map. Buildings on escarpments facing the prevailing wind should be rated one category higher. A more accurate estimation of exposure can be determined by reference to BS 8104, BS 5628: Part 3 or the relevant BS for the insulation material being used.

Walls up to 25 metres in height
The BBA has issued a number of cavity wall insulation certificates for walls up to, and including, 25 metres in height. These contain the following provisos.

- The maximum permitted height of the wall to be insulated is 25 metres.
- From the ground, the maximum height of continuous cavity must not exceed 12 metres. Maximum height of continuous cavity above 12 metres from the ground must not exceed 7 metres.
- When calculated using BBA Information Sheet No 10, equation 8, the exposure factor of the building to be insulated must not exceed 120 (this will be assessed by the installer).
- The external masonry facing must not include recessed mortar joints.
- BBA Certificate 97/3361 deals with infill masonry panels in a framed structure and sets out certain conditions.

Walls above 25 metres in height
In special cases, BBA have approved cavity wall insulation in walls above 25 metres in height. Each project has to be assessed by BBA for suitability before approval is given.

External inspection of the wall
The external leaf of the wall should be in good condition – if it is not any necessary repairs should be undertaken. Cracks in the wall should be carefully inspected and the causes ascertained. Cracks may be caused by shrinkage and are easily repaired. Alternatively, cracks may be due to sulphate attack, ground subsidence or wall tie corrosion in which case specialist advice should be sought. Guidance on inspection, causes and remedies is given in BRE Digests 217, 251, 329, 352 and 359 (details are at the back of this document).

Areas of spalled masonry (caused by frost action or by the crystallisation of salts) should be identified and cured. Where areas are isolated, cavities may be filled after repairs have been made. Properties with widespread spalling are unsuitable for cavity filling and may be best insulated using external insulation. Similar criteria should be applied to spalled or hollow renderings.

Mortar joints should be inspected for excessive cracking of mortar and defective pointing. Any necessary repairs should be made. External walls should be checked for bowing and leaning. Similarly, lintels and windows out of plumb should be identified and the cause rectified.

The cause of any moisture ingress should be identified and repaired, eg. leaking gutters, downpipes, etc.

Walls painted externally with paints that are impermeable to water vapour are unsuitable for cavity fill.

Holes in the outer leaf at wall heads may need sealing to prevent loss of cavity fill material. This is unlikely to be the case when using mineral fibre cavity insulation.

Internal inspection
Damage to internal decoration caused by penetrating rising damp should be investigated and rectified.

If there is any indication of condensation, the cause should be identified and remedial measures taken (see later under **Thermal Bridges**).

Dry lining should be properly sealed and be in good condition. Holes in the inner leaf and open cavities at wall heads may need sealing to prevent ingress of fill into the property.

Services, ventilation ducts, and flues should be sleeved through both leaves of the wall and precautions taken to isolate polystyrene and polyurethane insulation from hot flues.

Cavity inspection
The cavity should be continuous. Where bricks have been used as wall ties and bridge the cavity, as in some older properties, the wall is unsuitable for filling.

A cavity must be at least 50mm wide to be considered for filling.

Cavities should be checked for the presence of electrical wiring. Where present, the wiring should be relocated before filling.

Other defects, eg. missing wall ties, debris or mortar blocking the cavity, should be identified and, if they cannot be remedied, the cavity may be unsuitable for filling. These items are covered in the assessment of the wall for filling.

Supervision and Installation

Cavity wall insulation is a specialist job and must be carried out by a contractor registered by the British Board of Agrément (BBA). The contractor is normally responsible for assessing that the walls are suitable for filling.

The installation method varies with the type of system. The principal checks that should be made by supervisors during installation are given below. This is not a comprehensive checklist and reference should be made to the relevant standards for each system, BBA certificates, documentation prepared by the System Supplier and Cavity Insulation Guarantee Agency's (CIGA) Best Practice Guides.

Blown mineral wool (BBA Certificated)
The recommended pattern of injection holes for the system is given in the relevant British Board of Agrément Certificate.

The insulant should be blown into each injection hole in turn, starting at one end of an elevation at the bottom of a wall. All the holes in the lowest row of the elevation should be filled, before moving up to the next row.

It should be possible to see the insulant in the fill hole, and to confirm that the insulant falls freely away from the nozzle. Tightly packed insulant at the nozzle may indicate a blockage. The nozzle and hole should be cleared before continuing the filling procedure.

If the filling time is less than normal, the cavity may not be full. Remove the nozzle and repeat the filling procedure again. If the filling time seems very much longer, you should stop and investigate.

On completion, the quantity of insulant used should be compared with the estimated quantity. A variation of more than 10% may indicate missed areas, wrong filling density, or that areas of the structure other than the external cavity may have been filled. If this is the case then check the density setting on the blowing machine, internally inspect the cavity to check the density and look for any gaps in the fill, and check the interior of the property to make sure that the fill hasn't entered the dwelling.

After filling, the following areas should be checked and cleared of any material: air vents, service ducts, venting equipment, chimney flues, combustion air ducts adjacent to the filled cavity, and weep holes. Injection holes should then be made good.

Beads and granules (BBA Certificated)
EPS beads are spherical with diameters varying between 2mm to 8mm. They are very free flowing and therefore require fewer injection holes through the outer leaf. Granules, being irregular in shape, are less free flowing.

Due to the free flowing nature of EPS beads, particular care must be taken to avoid loss through holes in the inner leaf, around service entry points etc. Beads may be coated with adhesive as they are injected, limiting their escape through cracks and openings.

When the cavity is full, back pressure will stop the flow of beads, at which point the adhesive valve should be closed.

It is not necessary to fill gable peaks, unless they form part of a heated living space. If that is the case, the drilling and filling process should be extended to the apex of the gable walls.

Conventionally constructed cavity walls filled with EPS or polyurethane should present no unacceptable fire hazard where the cavity is capped (see BRE Digest 294 details on page 7). Polystyrene should not come into contact with PVC-coated electric cables to avoid embrittling the cable insulation.

Urea Formaldehyde (UF) foam (to BS 5617: 1985 and BS 5618: 1985)
UF foam consists of a resin and hardener solution injected with compressed air into the cavity. Injection holes are normally about 1 metre apart and drilled to a predetermined pattern (see BS 5618).

A closer spacing may be necessary for wider than normal cavities and the holes in all cases should be at 500mm to 600mm centres immediately above the damp proof course (DPC).

The cavity is filled from the bottom of the wall upwards, using indicator sticks in the adjacent injection holes to show the extent to which the cavity is filled. If an indicator stick fails to move when expected, the reason for this should be investigated.

During the filling process, the running conditions of the foam gun should be monitored to maintain quality and efficiency.

After injection, the foam hardens and, as it dries, shrinks leading to fissuring. BS 5617 specifies allowable shrinkage limits and guidance on foam systems that are suitable for cavity fill.

UF foam produces formaldehyde vapour as it hardens which may enter the dwelling if the inner leaf is not well sealed. Ventilation of the dwelling will remove any traces of formaldehyde (see BRE Information Paper IP 7/84, details on page 7).

Polyurethane foam (to BS 7457: 1994 or BBA Certificated)
Polyurethane cavity wall foam consists of thin liquids mixed together and injected into the cavity via 12mm diameter holes through one leaf of the wall. The mixture expands in the cavity adhering to both leaves. The thermal insulation value of the foam is exceptionally good.

Thermal Bridges

By the nature of their construction, traditional cavity walls may have areas where thermal bridges occur. Staining and mould on surfaces around windows can often be caused by damp penetration, so check first that there are DPCs in place and frames are properly bedded and pointed. If the dampness is being caused by condensation, internal insulation can be applied to the affected parts of the wall.

Condensation is often confined to the reveals adjacent to the window frame, in which case an insulated lining to the reveals and soffit is normally sufficient to deal with the problem. If condensation around the windows has been more extensive, insulating the inside face of the lintel, or providing a border of thermal board about 600mm wide around the window opening, may be needed (see figures 2 and 3).

Sills and the wall under sills, can also be wetted by condensation running off the windows. Insulating foamed PVC sills, or insulation under the sill, can be used and it may be necessary to insulate the wall under the sill if this area is damp from condensation.

Condensation can also occur where concrete floor slabs pass through the external wall to support an upper-level wall (figure 4). The ceiling can be protected with internal insulation taken back 1000mm from the window. Ideally, the floor above should also be insulated, if not already provided for acoustic insulation, but this may prove impractical and extremely expensive.

If the cavity closer at the top of the wall is made of brick, it may cause a thermal bridge. This can be reduced by extending the loft insulation over the wall head, but this may require access via the fascia or soffit board. An alternative might be to fit a deep insulated coving internally (figure 5).

Whilst the application of internal insulation in selected areas can assist in the prevention of condensation, it may sometimes be unacceptable visually and can present problems in placing furniture. If possible, the need for additional internal insulation should be assessed by calculation using the method in BS 5250.

See BRE Report BR 262 Thermal Insulation: Avoiding risks (details on page 7).

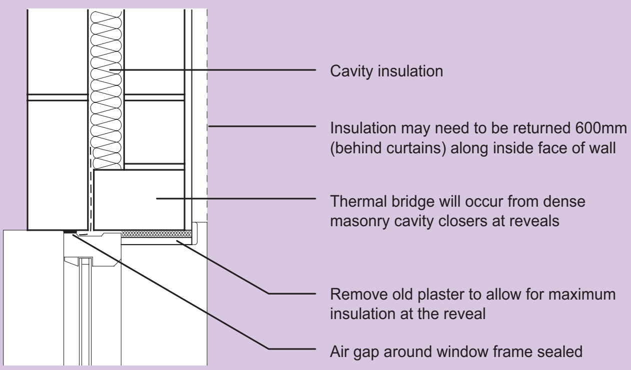

Figure 2: Insulating thermal bridge at reveal

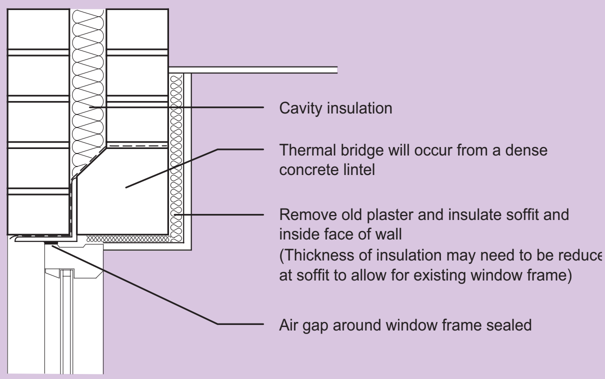

Figure 3: Insulating thermal bridge at lintel

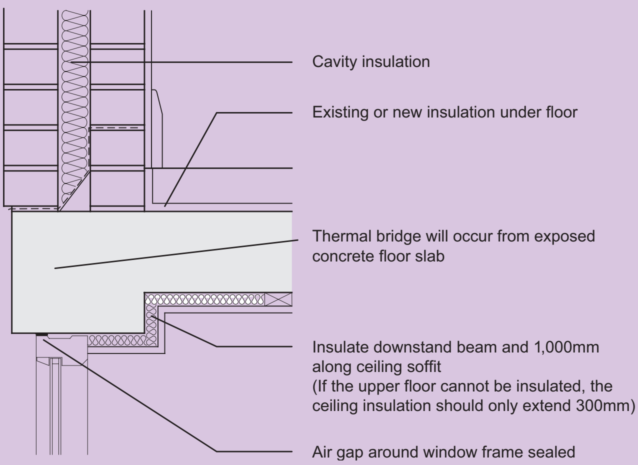

Figure 4: Insulating thermal bridge at floor slab

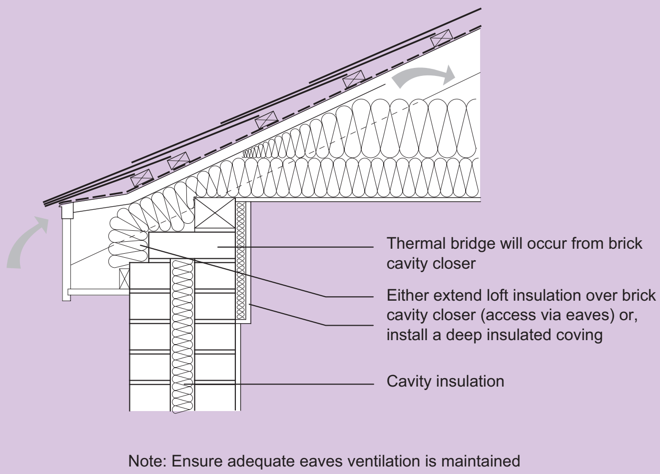

Figure 5: Insulating thermal bridge at eaves

Further sources of information

Energy Efficiency Best Practice in Housing

The following publications are available from the Energy Efficiency Best Practice in Housing helpline on 0845 120 7799 or by visiting the website at www.est.org.uk/bestpractice

Cavity wall insulation: unlocking the potential in existing dwellings (GIL 23)

Energy efficient refurbishment of existing housing (2002 edition) (GPG 155)

Domestic energy efficiency primer (GPG 171)

BRE

The following are available from www.brebookshop.com
Tel: 01923 664262
Email: brebookshop@emap.com

Reports

Thermal insulation: avoiding risks (BR 262)

Assessing traditional housing for rehabilitation (BR 167)

Defect Action Sheets

Brickwork: prevention of sulphate attack (design) (DAS 128)

Digests

Wall cladding defects and their diagnosis (Digest 217)

Cavity insulation (Digest 236)

Assessment of damage in low-rise buildings with particular reference to progressive foundation movement (Digest 251)

Fire risk from combustible cavity insulation (Digest 294)

Installing wall ties in existing construction (Digest 329)

Underpinning (Digest 352)

Repairing brickwork (Digest 359)

Building mortar (Digest 362)

Information papers

Urea-formaldehyde foam cavity wall insulation: – Reducing formaldehyde vapour in dwellings (IP 7/84)

Good Building Guides

Choosing between cavity, internal and external wall insulation (GBG 5)

Insulating masonry cavity walls: Part 1: Techniques and materials, Part 2: Principal risks and guidance (GBG 44)

British Board of Agrément

PO Box 195, Bucknalls Lane, Garston, Watford WD25 9BA
Tel: 01923 665 300
Web: www.bbacerts.co.uk

BBA publish a monthly directory which includes a list of approved cavity insulation installers

British Standards Institution (BSI)

389 Chiswick High Road, London W4 4AL
Tel: 020 8996 9000
Web: www.bsi.global.com

British Standards (BSI)

BSI publish a list of registered contractors for installing UF foam. To order BSI standards telephone 020 8996 9001.

BS 5628: 2001: Part 3. Code of Practice for use of masonry materials and components, design and workmanship

BS 5617: 1985. Urea-formaldehyde (UF) foam systems suitable for thermal insulation of cavity walls with masonry or concrete inner and outer leaves

BS 5618: 1985. Code of Practice for the thermal insulation of cavity walls (with masonry or concrete inner and outer leaves) by filling with urea-formaldehyde foam systems

BS 7456: 1991. Code of Practice for stabilisation and thermal insulation of cavity walls (with masonry or concrete inner and outer leaves) by filling with polyurethane (PUR) foam systems

BS 7457: 1994. Polyurethane (PUR) foam systems suitable for stabilisation and thermal insulation of cavity walls with masonry or concrete inner and outer leaves

BS 8104: 1992. Code of Practice for assessing exposure of walls to wind-driven rain

BS 8208: Part 1: 1985. Guide to assessment of suitability of external cavity walls for filling with thermal insulants

BS 5250: 1989. Code of Practice for control of condensation in buildings

Good Practice Guide 26

Energy Efficiency Best Practice in Housing

Cavity wall insulation in existing housing

Further sources of information

Cavity Insulation Guarantee Agency (CIGA)
CIGA House, 3 Vimy Court, Vimy Road
Leighton Buzzard, Bedfordshire LU7 1FG
Tel: 01525 853 300
Web: www.ciga.co.uk

Energy Saving Trust
21 Dartmouth Street, London SW1H 9BP
Tel: 0845 727 7200
Web: www.saveenergy.co.uk

National Cavity Insulation Association
PO Box 12, Haslemere, Surrey GU27 3AH
Tel: 01428 654 011
Web: www.ncia-ltd.org.uk

The Cavity Foam Bureau
PO Box 79, Oldbury, Warley,
West Midlands B69 4PW
Tel: 0121 544 4949

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

These documents can be obtained from the Stationery Office.

Regulations (National Details)

- 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

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