BRE Housing Defects Prevention Unit

# Defect Action Sheet (Design)

CI/SfB 1976 8 21.1 (M2)

DAS 77

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## Cavity external walls: cold bridges around windows and doors

**FAILURE:** **Condensation, staining and mould growth on walls around windows and doors**

**DEFECTS:** **Insufficient insulation, discontinuities in insulation ('cold bridges')**

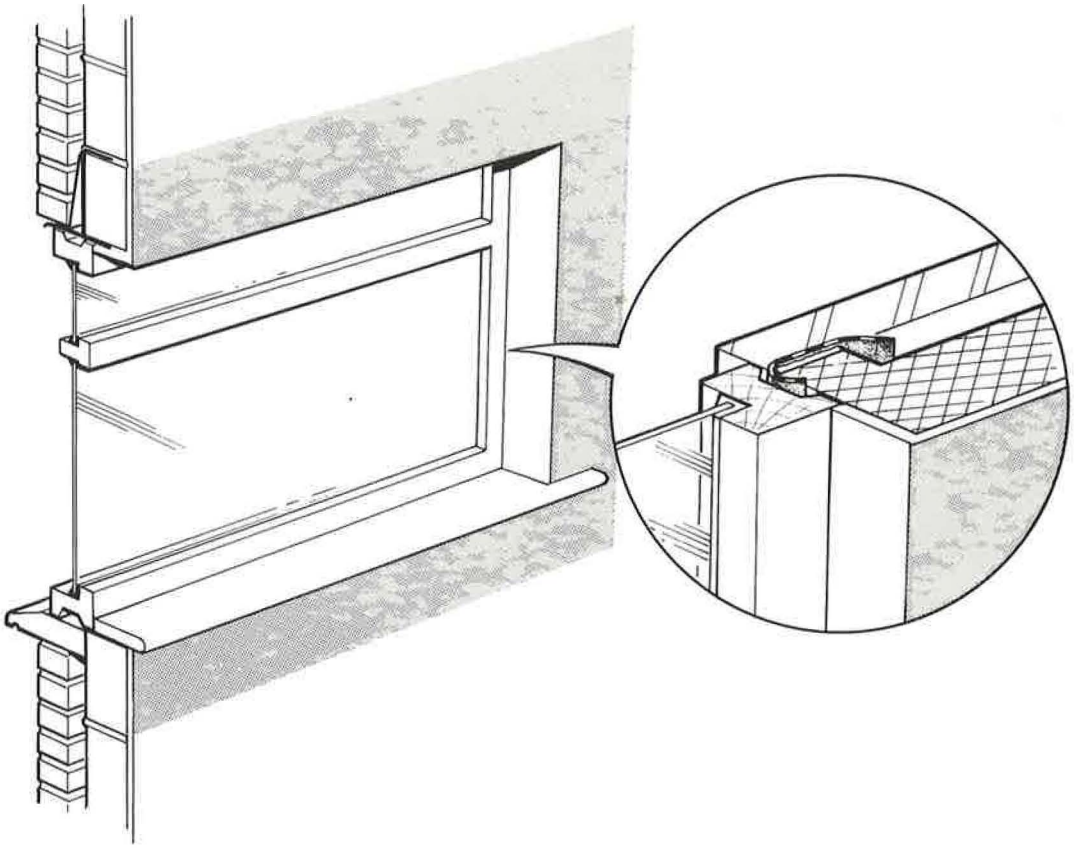

**Figure 1** The vulnerable areas

Condensation, with consequential staining and possible mould growth, often occurs on window and door reveals and heads, and under window sills. 'Cold bridges' can occur at openings even when the U-value of the surrounding wall is better than the 0.6 W/m²K permitted by the Building Regulations 1985 (England and Wales). Lintels, jambs and sills may be regarded as part of the opening when calculating the average U-value of the wall and thus the reveals of the opening may have high U-values locally*. The thermal resistance at these locations can be improved and risk of localised condensation reduced by adding even a small amount of insulation at the indoor surface.

If the ***wall around an opening permits*** substantially ***greater heat flow*** than elsewhere, its indoor ***surface temperature*** may locally ***fall below the dew point,*** leading to ***condensation, staining and mould growth.***

*For England and Wales, Approved Document L 2/3 of the Building Regulations 1985 states that 'in some circumstances it may ..... be desirable to limit the U-value ..... to 1.2 W/m²K. Building Regulations for Scotland and Northern Ireland specifically limit the U-value for these locations to 1.2 W/m²K.

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## PREVENTION

**Principle** — Walls at lintels, jambs and sills should be thermally insulated sufficiently to minimise the risk of local surface condensation.

### Practice

- Design walls to provide an overall U-value of 0.6 or better, treating lintels, jambs and sills as though part of each opening in a wall:
  - provide 10 mm of insulation near the indoor surface, when detailing reveals at lintels, jambs and sills; when heating is intermittent, surface condensation risk is reduced if insulation is near the indoor face.

OR

- Check whether reveals, head and window sill will provide a total resistance not less than 0.65 $m^2K/W$ (which value, together with surface resistances, gives a U-value of 1.2):
  - using Table 1, sum the resistances of the construction lying in the heat loss path, Figures 2 and 3 (ignoring surface resistances). If the sum of resistances is less than 0.65 (ie there is a 'resistance deficit') additional insulation will be needed to improve the U-value to 1.2. Table 2 gives appropriate thicknesses.

**EXAMPLE 1 — heat loss at the reveal**

Use Table 1 to sum the resistances of the materials in the heat loss path shown in Figure 2.

| | | Resistance |
|---|---|---|
| 12 mm plasterboard | | 0.08 |
| Inner leaf block (density 1100 kg/m³), for 50 mm path length | 50/100 × 0.29 = | 0.15 |
| Outer leaf brick | | 0.14 |
| Sum of resistances | | 0.37 |
| Total resistance needed for U-value of 1.2 | | 0.65 |
| 'Resistance deficit' | 0.65 - 0.37 = | 0.28 |

Approximately 11 mm of EPS or 8 mm of polyurethane board (refer to Table 2) would be needed to raise the total resistance of the construction of the reveal to 0.65 and give a U-value of 1.2

**EXAMPLE 2 — heat loss at window head**

Sum the resistances as in Example 1: Figure 3 gives the heat loss path.

| | | Resistance |
|---|---|---|
| 12 mm plasterboard | | 0.08 |
| Inner leaf block (density 1100 kg/m³), for 25 mm path length | 25/100 × 0.29 = | 0.07 |
| Air space | | 0.18 |
| Outer leaf brick | | 0.14 |
| Sum of resistances | | 0.47 |
| Total resistance needed for U-value of 1.2 | | 0.65 |
| 'Resistance deficit' | 0.65 - 0.47 = | 0.18 |

Approximately 7 mm of EPS or 5 mm of polyurethane board (refer to Table 2) would be needed to raise the total resistance of the construction of the reveal to 0.65 and give a U-value of 1.2

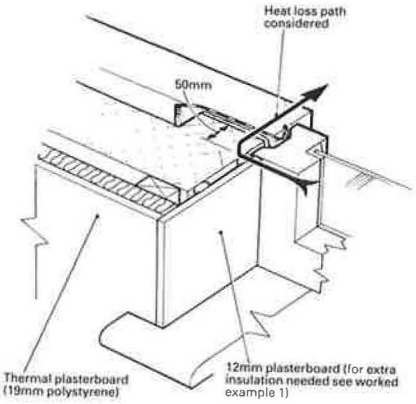


**Figure 2**

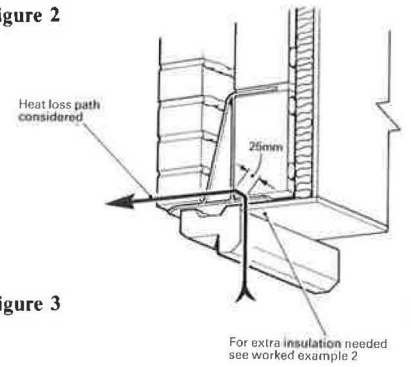


**Figure 3**

**Table 1**

| Materials/construction | | | Resistance $m^2$ K/W (for thickness given in col 1) |
|---|---|---|---|
| Outer leaf brick (105 mm thick, 1600 kg/m³) | | | 0.14 |
| Inner leaf block (per 100 mm thickness) | kg/m³ | W/m K | |
| High density | 1700 | 0.76 | 0.13 |
| | 1400 | 0.51 | 0.20 |
| | 1100 | 0.34 | 0.29 |
| Lightweight | 800 | 0.22 | 0.46 |
| | 600 | 0.19 | 0.53 |
| Ultra lightweight | 400 | 0.15 | 0.67 |
| Dense concrete (2200 kg/m³) per 100 mm | | | 0.06 |
| Cavity or airspace (not less than 25 mm) | | | 0.18 |
| Wood (per 25 mm) | | | 0.18 |
| Plaster, lightweight (19 mm thick) | | | 0.04 |
| Plasterboard: 12 mm thick | | | 0.08 |
| 19 mm thick | | | 0.12 |
| Mineral fibre batts | 25 mm thick | | 0.69 |
| U/F foam | 50 mm thick | | 1.39 |

**Table 2**

| Resistance deficit ≤ | Minimum additional insulation thickness (mm) | |
|---|---|---|
| | EPS or mineral fibre slab | Polyurethane board |
| 0.1 | 3 | 3 |
| 0.2 | 7 | 5 |
| 0.3 | 11 | 8 |
| 0.4 | 14 | 10 |
| 0.5 | 18 | 13 |
| 0.6 | 21 | 16 |
| 0.65 | 23 | 17 |

***Defect Action Sheets*** are produced by the BRE Defects Prevention Unit. A Technical Committee including representatives appointed by DOE and the Local Authority Associations advises upon the general approach and priorities for the Unit's work. *Defect Action Sheets* are intended to remind and inform designers and site supervisory staff of ways of avoiding some of the most troublesome defects which have beset Local Authority housing in recent years. The advice is based on the most authoritative information available at the date of issue and frequently also on field assessments, but it is inevitably generalised and users should ensure that it is relevant to the specific circumstances in which they seek to apply it. For technical enquiries arising from this sheet please contact the DPU at the address overleaf.