

**Project Information**

Reference IS 409  
 Date 10 May 2006  
 Client Scottsdale Steel UK Project Proposed Details for  
 500 Chiswick High Road BRE Approval  
 Centre 500 Suite 35  
 W4 5RG

**Construction type**

Element : Wall - IS409 - 140mm studs 1.0mm thick @ 600mm with brickwork  
 External wall insulation  
 Internal surface emissivity : High External surface emissivity : High  
 Light steel-frame construction - Cold frame or Hybrid type:-  
 Stud depth, d : 90.0 mm Stud spacing, s (mm) : 400.0 mm  
 Flange width : not exceeding 50mm p : 0.296  
 Correction for mechanical fasteners :-  
 Alpha : 6.0 per m Thermal conductivity of fastener : 17.00 W/mK  
 Fasteners per square metre : 9.00 off Fasteners cross-sectional area : 12.00 mm<sup>2</sup>  
 Wall with cavity fill, mild steel twist ties, 900 x 450 cntrs - walls upto 15m with >=90mm leaves

**Construction**

	Thickness (mm)	Thermal Conductivity (W/mK)	Thermal Resistance (m <sup>2</sup> K/W)	Vapour Resistivity (MNs/gm)	Vapour Resistance (MNs/g)
Outside surface resistance	-	-	0.040	-	-
Brick - outer leaf (BRE)	103.0	0.770	0.134	50.00	5.15
Cavity >=25mm, wall (CIBS)	-	-	0.180	-	0.00
Bitrock	22.0	0.050	0.440	51.00	1.12
Isowool Frame Batt HP 032	140.0	0.032	4.375	5.90	0.83
Polythene, 1000 gauge (0.25mm) (BS5250)	-	-	-	-	500.00
Lafarge Standard Wallboard	12.5	0.180	0.069	60.00	0.75
Lafarge Firecheck	12.5	0.250	0.050	60.00	0.75
Inside surface resistance	-	-	0.130	-	-

**U-value - 0.34W/m<sup>2</sup>K**

U-value, Combined Method : 0.34 W/m<sup>2</sup>K (upper/lower limit 5.376 / 2.098 m<sup>2</sup>K/W, dUf 0.0110, dUg 0.0000, dUp0.0000, dUr0.0000)  
 (Correction for mechanical fasteners, Delta Uf = 0.011W/m<sup>2</sup>K)  
 (Correction for air gaps, Delta Ug = 0.000W/m<sup>2</sup>K)

(Based on the combined method for determining U-values of structures containing repeating thermal bridges.)

## Detailed U-value Calculation Results

Construction includes 2 bridged layers.

### Non-bridged layers

Outside surface resistance	0.040 m <sup>2</sup> K/W
Cavity >=25mm, wall (CIBS)	0.180 m <sup>2</sup> K/W
Bitrock	0.440 m <sup>2</sup> K/W
Lafarge Standard Wallboard	0.069 m <sup>2</sup> K/W
Lafarge Firecheck	0.050 m <sup>2</sup> K/W
Inside surface resistance	0.130 m <sup>2</sup> K/W
Resistance of non-bridged layers, R <sub>NB</sub> =	<u>0.909 m<sup>2</sup>K/W</u>

### Bridged layers

Brick - outer leaf (BRE) (L1) bridged by Mortar (B1)  
Isowool Frame Batt HP 032 (L2) bridged by Steel studs (B2)  
Path 1 - Brick - outer leaf (BRE) / Isowool Frame Batt HP 032  
Path 2 - Mortar / Isowool Frame Batt HP 032  
Path 3 - Brick - outer leaf (BRE) / Steel studs  
Path 4 - Mortar / Steel studs

### Resistance and fraction of heat flow paths

$$\begin{aligned}R_{P1} &= R_{NB} + R_{L1} = 0.909 + 4.509 = 5.418 \text{ m}^2\text{K/W} & F_{P1} &= 82.530\% \\R_{P2} &= R_{NB} + R_{L2} = 0.909 + 4.485 = 5.394 \text{ m}^2\text{K/W} & F_{P2} &= 17.303\% \\R_{P3} &= R_{NB} + R_{L3} = 0.909 + 0.136 = 1.045 \text{ m}^2\text{K/W} & F_{P3} &= 0.138\% \\R_{P4} &= R_{NB} + R_{L4} = 0.909 + 0.112 = 1.021 \text{ m}^2\text{K/W} & F_{P4} &= 0.029\%\end{aligned}$$

### Upper resistance limit

$$R_{upper} = 1 / \left( \frac{F_{P1}}{R_{P1}} + \frac{F_{P2}}{R_{P2}} + \frac{F_{P3}}{R_{P3}} + \frac{F_{P4}}{R_{P4}} \right) = 1 / \left( \frac{0.825}{5.418} + \frac{0.173}{5.394} + \frac{0.001}{1.045} + \frac{0.000}{1.021} \right) = 5.376 \text{ m}^2\text{K/W}$$

### Lower resistance limit

$$R_{lower} = R_{NB} + 1 / \left( \frac{F_{L1}}{R_{L1}} + \frac{F_{B1}}{R_{B1}} \right) + 1 / \left( \frac{F_{L2}}{R_{L2}} + \frac{F_{B2}}{R_{B2}} \right) = 0.909 + 1 / \left( \frac{0.827}{0.134} + \frac{0.173}{0.110} \right) + 1 / \left( \frac{0.998}{4.375} + \frac{0.002}{0.002} \right) = 2.098 \text{ m}^2\text{K/W}$$

### Total resistance of wall

Light steel-frame construction - Cold frame or Hybrid type  
Stud depth, d : 90.0 mm Stud spacing, s : 400.0 mm  
Flange width : not exceeding 50mm p : 0.296

$$R_T = ( p \times R_{upper} + (1 - p) \times R_{lower} ) = (0.296 \times 5.376 + (1 - 0.296) \times 2.098) = 3.07 \text{ m}^2\text{K/W}$$

Correction for mechanical fasteners, Delta Uf = 0.011W/m<sup>2</sup>K. Correction for air gaps, Delta Ug = 0.000W/m<sup>2</sup>K

$$U = (1 / R_T) + (\text{Delta Uf} + \text{Delta Ug} + \text{Delta Up} + \text{Delta Ur}) = (1/3.7368) + 0.0110 + 0.0000 + 0.0000 + 0.3369 = 0.00 \text{ W/m}^2\text{K}$$

## Condensation Risk Analysis (no account taken of thermal bridges)

### 2 - Offices, Shops

Jan (worst)	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
20.0C 49.8%	20.0C 48.9%	20.0C 49.5%	20.0C 50.6%	20.0C 55.2%	20.0C 60.4%	20.0C 65.9%	20.0C 66.4%	20.0C 62.9%	20.0C 58.0%	20.0C 52.4%	20.0C 50.9%
3.5C 86.0%	3.8C 82.5%	5.7C 80.0%	8.0C 77.0%	11.3C 77.0%	14.4C 76.0%	16.5C 76.5%	16.1C 78.5%	13.8C 81.5%	10.7C 84.0%	6.4C 85.5%	4.5C 86.5%

	Interface Temp. °C	Dewpoint Temp. °C	Vapour Pressure (kPa)	Saturated V.P. (kPa)	Worst Cond. (g/m <sup>2</sup> )	Peak Buildup (g/m <sup>2</sup> )	Condensation
1 Outside surface resistance							
2 Brick - outer leaf (BRE)	3.6	1.4	0.67	0.79			No
3 Cavity >=25mm, wall (CIBS)	4.0	1.5	0.68	0.81			No
4 Bitrock	4.6	1.5	0.68	0.85			No
5 Isowool Frame Batt HP 032	5.9	1.5	0.68	0.93			No
6 Polythene, 1000 gauge (0.25mm) (BS5250)	19.2	1.5	0.68	2.23			No
7 Lafarge Standard Wallboard	19.2	9.2	1.16	2.23			No
8 Lafarge Firecheck	19.5	9.2	1.16	2.26			No
9 Inside surface resistance	19.6	9.2	1.16	2.28			No

Worst case internal / external conditions for graph : 20.0°C @ 49.8%RH / 3.5°C @ 86.0%RH

