

**Project Information**

Reference IS411  
 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 - IS411 - 90mm studs 1.0mm thick @ 400 with render  
 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 : 0.536  
 Correction for mechanical fasteners :-  
 Alpha : 1.6 per m Thermal conductivity of fastener : 50.00 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 double triangle 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	-	-
Render (BS5250)	5.0	0.800	0.006	100.00	0.50
Expanded polystyrene (BS5250)	40.0	0.035	1.143	300.00	12.00
20mm drainage cavity	-	-	0.180	-	0.00
Bitrock	22.0	0.050	0.440	51.00	1.12
Mineral Wool Insulation	50.0	0.038	1.316	5.90	0.30
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 - 0.35W/m<sup>2</sup>K**

U-value, Combined Method : 0.35 W/m<sup>2</sup>K (upper/lower limit 3.369 / 2.324 m<sup>2</sup>K/W, dUf 0.0091, dUg 0.0000, dUp0.0000, dUr0.0000)  
 (Correction for mechanical fasteners, Delta Uf = 0.009W/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 1 bridged layer.

### Non-bridged layers

Outside surface resistance	0.040 m <sup>2</sup> K/W
Render (BS5250)	0.006 m <sup>2</sup> K/W
Expanded polystyrene (BS5250)	1.143 m <sup>2</sup> K/W
20mm drainage cavity	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>2.058 m<sup>2</sup>K/W</u>

### Bridged layer

Mineral Wool Insulation (L1) bridged by Steel studs (B1)

Path 1 - Mineral Wool Insulation

Path 2 - Steel studs

### Resistance and fraction of heat flow paths

$$R_{P1} = R_{NB} + R_{L1} = 2.058 + 1.316 = 3.374 \text{ m}^2\text{K/W} \quad F_{P1} = 99.750\%$$

$$R_{P2} = R_{NB} + R_{L2} = 2.058 + 0.001 = 2.059 \text{ m}^2\text{K/W} \quad F_{P2} = 0.250\%$$

### Upper resistance limit

$$R_{upper} = 1 / \left( \frac{F_{P1}}{R_{P1}} + \frac{F_{P2}}{R_{P2}} \right)$$
$$R_{upper} = 1 / \left( \frac{0.998}{3.374} + \frac{0.002}{2.059} \right) = 3.369 \text{ m}^2\text{K/W}$$

### Lower resistance limit

$$R_{lower} = R_{NB} + 1 / \left( \frac{F_{L1}}{R_{L1}} + \frac{F_{B1}}{R_{B1}} \right)$$
$$R_{lower} = 2.058 + 1 / \left( \frac{0.998}{1.316} + \frac{0.002}{0.001} \right) = 2.324 \text{ m}^2\text{K/W}$$

### 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 : 0.536

$$R_T = ( p \times R_{upper} + (1 - p) \times R_{lower} ) = (0.536 \times 3.369 + (1 - 0.536) \times 2.324) = 2.88 \text{ m}^2\text{K/W}$$

Correction for mechanical fasteners, Delta U<sub>f</sub> = 0.009W/m<sup>2</sup>K. Correction for air gaps, Delta U<sub>g</sub> = 0.000W/m<sup>2</sup>K

(Delta U<sub>f</sub> + Delta U<sub>g</sub> + Delta U<sub>p</sub>) is less than 3% of (1 / R<sub>T</sub>) so U = (1 / R<sub>T</sub>) + (Delta U<sub>r</sub>) = 0.35 W/m<sup>2</sup>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 Render (BS5250)	3.7	1.4	0.67	0.80			No
3 Expanded polystyrene (BS5250)	3.7	1.4	0.68	0.80			No
4 20mm drainage cavity	9.3	1.6	0.69	1.17			No
5 Bitrock	10.2	1.6	0.69	1.24			No
6 Mineral Wool Insulation	12.3	1.6	0.69	1.43			No
7 Polythene,1000 gauge (0.25mm) (BS5250)	18.8	1.6	0.69	2.17			No
8 Lafarge Standard Wallboard	18.8	9.2	1.16	2.17			No
9 Lafarge Firecheck	19.1	9.2	1.16	2.21			No
10 Inside surface resistance	19.4	9.2	1.16	2.25			No

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

