

Project Information

Reference	IS 210		
Date	10 May 2006		
Client	Scottsdale Steel UK	Project	Proposed Details for BRE Approval
	500 Chiswick High Road		
	Centre 500 Suite 35		
	W4 5RG		

Construction type

Element : Wall - IS210 - 90mm studs 0.75mm thick @ 400mm 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	: 0.565

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 ²

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 ² 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
TW55	40.0	0.023	1.739	5500.00	220.00
Mineral Wool Insulation	50.0	0.038	1.316	5.90	0.30
Polythene, 1000 gauge (0.25mm) (BS5250)	-	-	-	-	500.00
Lafarge Firecheck	12.5	0.250	0.050	60.00	0.75
Inside surface resistance	-	-	0.130	-	-

U-value - 0.34W/m²K

U-value, Combined Method : 0.34 W/m²K (upper/lower limit 3.581 / 2.599 m²K/W, dUf 0.0223, dUg 0.0000, dUp0.0000, dUr0.0000)

(Correction for mechanical fasteners, Delta Uf = 0.022W/m²K)

(Correction for air gaps, Delta Ug = 0.000W/m²K)

(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 m²K/W
Cavity >=25mm, wall (CIBS)	0.180 m²K/W
TW55	1.739 m²K/W
Lafarge Firecheck	0.050 m²K/W
Inside surface resistance	0.130 m²K/W
Resistance of non-bridged layers, R_{NB} =	<u>2.139 m²K/W</u>

Bridged layers

Brick - outer leaf (BRE) (L1) bridged by Mortar (B1)
Mineral Wool Insulation (L2) bridged by Steel studs (B2)
Path 1 - Brick - outer leaf (BRE) / Mineral Wool Insulation
Path 2 - Mortar / Mineral Wool Insulation
Path 3 - Brick - outer leaf (BRE) / Steel studs
Path 4 - Mortar / Steel studs

Resistance and fraction of heat flow paths

$$\begin{aligned}R_{P1} &= R_{NB} + R_{L1} = 2.139 + 1.450 = 3.589 \text{ m}^2\text{K/W} & F_{P1} &= 82.513\% \\R_{P2} &= R_{NB} + R_{L2} = 2.139 + 1.426 = 3.565 \text{ m}^2\text{K/W} & F_{P2} &= 17.300\% \\R_{P3} &= R_{NB} + R_{L3} = 2.139 + 0.135 = 2.274 \text{ m}^2\text{K/W} & F_{P3} &= 0.155\% \\R_{P4} &= R_{NB} + R_{L4} = 2.139 + 0.110 = 2.249 \text{ m}^2\text{K/W} & F_{P4} &= 0.033\%\end{aligned}$$

Upper resistance limit

$$\begin{aligned}R_{upper} &= 1 / ((F_{P1}/R_{P1}) + (F_{P2}/R_{P2}) + (F_{P3}/R_{P3}) + (F_{P4}/R_{P4})) \\R_{upper} &= 1 / ((0.825/3.589) + (0.173/3.565) + (0.002/2.274) + (0.000/2.249)) = 3.581 \text{ m}^2\text{K/W}\end{aligned}$$

Lower resistance limit

$$\begin{aligned}R_{lower} &= R_{NB} + 1 / ((F_{L1}/R_{L1}) + (F_{B1}/R_{B1})) + 1 / ((F_{L2}/R_{L2}) + (F_{B2}/R_{B2})) \\R_{lower} &= 2.139 + 1 / ((0.827/0.134) + (0.173/0.110)) + 1 / ((0.998/1.316) + (0.002/0.001)) = 2.599 \text{ m}^2\text{K/W}\end{aligned}$$

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 : 0.565

$$R_T = (p \times R_{upper} + (1 - p) \times R_{lower}) = (0.565 \times 3.581 + (1 - 0.565) \times 2.599) = 3.15 \text{ m}^2\text{K/W}$$

Correction for mechanical fasteners, $\Delta U_f = 0.022 \text{ W/m}^2\text{K}$. Correction for air gaps, $\Delta U_g = 0.000 \text{ W/m}^2\text{K}$

$$U = (1 / R_T) + (\Delta U_f + \Delta U_g + \Delta U_p + \Delta U_r) = (1/3.0899) + 0.0223 + 0.0000 + 0.0000 + 0.3395 = 0.00 \text{ W/m}^2\text{K}$$

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/m²)	Peak Buildup (g/m²)	Condensation
1 Outside surface resistance							
2 Brick - outer leaf (BRE)	3.7	1.4	0.67	0.79			No
3 Cavity >=25mm, wall (CIBS)	4.3	1.5	0.68	0.83			No
4 TW55	5.1	1.5	0.68	0.88			No
5 Mineral Wool Insulation	13.1	4.2	0.83	1.51			No
6 Polythene, 1000 gauge (0.25mm) (BS5250)	19.2	4.2	0.83	2.22			No
7 Lafarge Firecheck	19.2	9.2	1.16	2.22			No
8 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

