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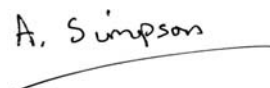
Client Eco Decking Systems, Fenton House, 10 Fenton Street, Lancaster, LA1 1TE

Thermal Performance of New Tech EcoSlate – Conventional Roof System

Introduction

This report is an assessment of the improvement in the thermal performance of a pitched roof covered with New Tech EcoSlate Conventional Roof System instead of a traditional slate system. The investigation is in response to a meeting with Peter Nisbet on 7 June, 2011. The Ecodecking roof slate system is a substitute for traditional tiles in pitched roof buildings. The system is comprised of 100% recycled plastic slate substitute with a felt underlay fastened to 16.5mm ply board. Eco Decking are looking to demonstrate improved thermal performance over traditional slate / underlay coverings on pitched roofs in the built environment.

Measurements of the thermal resistance of a sample of New Tech EcoSlate Conventional Roof Systems have been conducted under steady state conditions of 5°C simulated outdoor air temperature and a 10°C temperature gradient. The increase in thermal resistance due to the New Tech EcoSlate – Conventional Roof System has been used to evaluate the potential reductions in U value and the energy savings to be expected through a pitched roof. The sample was tested as supplied by the client and included horizontal overlap tile joints but did not include vertical joints (see Figure 1).



The Thermal Measurement Laboratory is a UKAS accredited laboratory for the measurement of thermal resistance to EN 12664 / 12667 and ISO 8302. We are not accredited for the measurements detailed in this report. However, the heat flow meter apparatus was calibrated against UKAS accredited guarded hot plate apparatus with calibration traceable to National Standards.

Thermal Resistance Tests

The thermal resistance was measured with upward heat flow under steady state conditions of a simulated outdoor air temperature of approximately 5°C, with a minimum 10°C temperature gradient, and the results reported in Test report No.TT11/187. The temperatures approximately simulate the real conditions at roof surfaces of dwelling.

The thermal resistance of New Tech EcoSlate Conventional Roof System was $R = 0.250 \text{ m}^2\text{K/W}$. The sample thickness varied from a minimum of 29 mm to a maximum of 39 mm.

The tests were carried out using a single specimen heat flow meter method, after pre-conditioning samples at 23°C and 50% RH to constant mass to eliminate any moisture issues.

The heat flow meter apparatus was calibrated against UKAS accredited EN 12667/ EN 12664 guarded hot plate apparatus, traceable to National and International standards.

Thermal Resistance of New Tech EcoSlate Conventional Roof System including Standard Surface Resistance values

The thermal resistance of the EcoSlate System was measured as $R = 0.250 \text{ m}^2\text{K/W}$ with a surface air layer adjacent to the cold tile surface for upward heat flow. The magnitude of the external surface resistance R_{so} , partly depends on the wind speed across the surface. Standard values of R_{so} are for severe, normal or sheltered exposures with values ranging from 0.02 to 0.06 $\text{m}^2\text{K/W}$ (Values obtained from CIBSE Guide A 2006). For calculation purposes, normal exposure has been assumed, giving an $R_{so} = 0.04 \text{ m}^2\text{K/W}$.

Therefore the thermal resistance of New Tech EcoSlate Conventional Roof System including the normal exposure standard surface resistance value is

$$R = 0.250 + 0.04 = \mathbf{0.290 \text{ m}^2\text{K/W}}.$$

A pitched roof is combined with a horizontal ceiling, therefore a correction is necessary to take account of the difference in area between the sloping roof and the ceiling. The effective thermal resistance of the sloping roof is the resistance of the EcoSlate system including external surface resistance multiplied by the cosine of angle of pitched roof.

Allowing for slope of 35°, Cosine 35° = 0.82 giving:

$$R = 0.82 \times 0.290 = \mathbf{0.238 \text{ m}^2\text{K/W}}.$$

The effective thermal resistance of the system can now be combined with the resistance of loft space/ insulation material/ plasterboard ceiling/ internal surface resistance in order to determine the U-value of a roof.

Thermal Resistance of Traditional Slate Roof Coverings including Standard Surface Resistance values

A traditional pitched roof (35°) covering consists of felt, airspace between felt and tiles, tiles, and external surface resistance with a typical total thermal resistance for the roof covering of

$R = 0.216 \text{ m}^2\text{K/W}$ ("Thermal Insulation of Buildings", DOE, 1971, Material values obtained from reference books).
Allowing for 35° slope

$$R = 0.216 \times 0.82 = \mathbf{0.177 \text{ m}^2\text{K/W}}.$$

Potential Reduction in U Value and Potential Energy Savings through roofs with New Tech EcoSlate Conventional Roof System

The increase in thermal resistance of the New Tech EcoSlate Conventional Roof System over that for traditional slate roof covering is **0.061 m²K/W**.

The thermal transmittance or U-value of a building element (eg. a wall, a floor or a roof) is computed by taking the reciprocal of the total thermal resistance R_T of the element ie. $U = 1 / R_T$. The U-value represents the heat flowing through the element per unit area per unit temperature difference.

Under the 2010 Building Regulations, pitched roofs with insulation between the joists, are required to have a U value $< 0.16 \text{ W/m}^2\text{K}$. The U value is mainly determined by the level of insulation within the roof structure. Older type buildings without upgraded loft insulation levels may have roof U values $> 1 \text{ W/m}^2\text{K}$.

For a roof of U value = $0.16 \text{ W/m}^2\text{K}$, by incorporating the New Tech EcoSlate Conventional Roof System, the U value is reduced to $0.158 \text{ W/m}^2\text{K}$, a reduction of **1.0%***.

For a roof of U value = $1.0 \text{ W/m}^2\text{K}$, by incorporating the New Tech EcoSlate Conventional Roof System the U value is reduced to $0.94 \text{ W/m}^2\text{K}$, a reduction of **5.7%***.

* Please note that the calculated reductions in U value represent energy savings through roofs in the absence of ventilation in the loft space. However, most roofs are ventilated to some extent. It is a requirement under BS5250 that roofs are ventilated to remove the risk of damp/condensation and decay, particularly in timber elements in the rafters. As a consequence, the calculated reductions in U value and the energy saving benefit, may be less than the above values, depending on the level of air infiltration necessary to remove the risk of damp/condensation.

Also, it should be borne in mind that the sample supplied was not fully representative of an EcoSlate system in practice. Although the sample included horizontal overlap tile joints it did not include vertical joints, see figure 1. Consequently, the thermal resistance of the system with vertical joints included may be slightly different from that tested.

Technical Report

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Figure 1