Curtin University

Bruhn Building Stone

Thermal Conductivity Assessment

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Prepare for	Bruhn Building Stone
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This Report has been written and tests performance in accordance with AS/NZS 4859.1

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1.0 Introduction

Client	Bruhn Building Stone
Sample description	Cream coloured stone, Second Strata

2.0 Test Procedure

Measurements were made using a Double Sided Guarded Hotplate Apparatus in close accordance with ASTM C-177, capable of accurate and reproducible measurements on a wide variety of insulating materials including loose fill cellulose, fibrous materials, solids etc.

The Guarded Hot Plate Apparatus is considered a primary (or absolute) method and is generally interchangeable with the Heat Flow Meter Apparatus used in other laboratories.

Two identical samples are located between two isothermal cold surface assemblies and a central guarded hot plate composed of a metered section in the centre thermally isolated from a concentric guarded area. The spacing between the plates is variable to accommodate a range of test thicknesses. Maximum sample thickness is dependant on the type of material and its thermal properties. Heat is applied to one face of each sample and the other side is cooled using a precision temperature controlled recirculation water cooler system.

Once a steady state thermal condition is reached and maintained various parameters are measured in triplicate and thermal conductivity calculated. The Apparatus can be operated with either vertical or horizontal heat flow directions. Unless requested and reported the standard heat flow direction is vertical.

For specimens of adequately high density (i.e. greater than 5-10 kg/m2) the relationship between thermal conductivity and thermal resistance is simply: R=t/k.

The R Value can be calculated for any reasonable thickness using this formula.

ASTM C-177 is the standard pertaining to the use and operation of the Guarded Hot Plate Apparatus. In addition to this we reference other specific material standards with minor modifications such as:

- ASTM C-653 "Determination of the Thermal Resistance of Low Density Blanket Type Mineral Fibre Insulation (Specifically using procedure C, average of three results at D_{av})
- ASTM C-687 for loose fill materials such as cellulose fibre, and,
- ASTM C-167 for guidance on thickness and density measurements

Any testing performed to AS/NZ 4859.1 rather than ASTM C-177 may require additional sample preparation and is costed based on client discussion and requirements.

3.0 Certification of Analysis

Measurement reference number		0091,0092,0093
Calibration Reference material		NIST SRM 1453
Sample		Bruhn Building Limestone, Second Strata
Specimen for Test ID (SFT		NA
Metering Area (A)	=	$0.038m^2$
Sample Thickness (t)	=	49.3 +/- 0.5mm
Sample Density	=	2360 +/- 50kg/m3
Temperature of cold plate (T_c)	=	14.9 +/- 0.1 deg
Temperature of hot plate (T_h)	=	32.6 +/- 0.1 deg
Temperature difference (Delta T)	=	17.8 +/- 0.2 deg
Mean Temperature	=	23.7 +/- 0.1 deg
Power to hot plate (VI)		(18.61)*(0.714) Watts
Thermal Conductivity (k)	=	0.49 +/- 0.04 $Wm^{-1}K^{-1}$
Thermal Resistance (R) @ 100mm	=	0.20 +/- 0.03 m^2KW^{-1}
(“R value”) (R) @ 120mm	=	0.25
(R) @ 120mm	=	0.29

Ambient Temperature	=	21.0 deg
Ambient Humidity	=	45.2 %
Date of Measurement		20/05/2005 – 26/05/2005

4.0 Insulation Values of Common Building Materials

Insulation materials are often characterised by their R value. In countries like Australia, which use metric measures, these are m2K/W. An R=2 insulation material passes 0.5 watts per square metre with a 1 degree temperature difference. In contrast, using imperial measure, R is based on imperial units and a 50mm rockwool batt would have an R of around 40.

The air film against a surface has a significant effect and must be included in the calculation. For example when calculating R of a weatherboard external wall the total R value is:

Outside air layer+ weatherboard+ air layer + plasterboard + air layer.

0.04 + 0.12 + 0.14 + + 0.077 + 0.14 = 0.517

Compare this with mud brick:

Outside air layer+ mudbrick + air layer.

0.04 + 0.27 + 0.14 = 0.45

Material	Thickness (mm)	R m^2K/W
Moving air layer (outside)	-	0.04
Still air layer (inside)	-	0.14
Aluminium	1.2	0.000
Brick	90	0.05 to 0.07
Concrete	100	0.07
Glass	6	0.006
Sarking foil	0.2	0.003
Timber	25	0.12 to 0.25
Chipboard	18	0.17
Plasterboard	13	0.077
Mudbrick	300	0.27