AHI Roofing

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REPORT TITLE: THERMAL TRANSMITTANCE OF ROOF TILES:

NO. OF PAGES:

APPENDICES: Appendix A - Test Apparatus
Appendix B - Heat Flow Calculation

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SUMMARY:

Laboratory testing to simulate roof cavity and ceiling temperatures achieved in practice with various roof cladding types and colours was carried out by A.H.I. Technical Centre (Report 83/211).

The test rig was constructed to reproduce roof temperatures achieved in natural sunlight on test pieces using an Infra-red heater.

The results indicated that the difference between ceiling temperature and ambient temperature varied only slightly due to Decrabond tile colour, and was negligible once Building Paper or Aluminium Foil underlay was used. Concrete Tiles performed similarly to Decrabond Tiles, although with slightly less heat transmission.

TEST METHOD:

Samples:

Decrabond Tile	-	Charcoal
Decrabond Tile	-	Coffee Brown
Decrabond Tile	-	Painted White (non standard)
Concrete Tile	-	Brown

Each sample was exposed in direct sunlight and the maximum underside surface temperature reached was recorded. The samples were then in turn placed in the test apparatus (Appendix A) and brought to the same temperature with the Infra-Red Heater. (Variac Voltage Controller).

The temperature of the test rig ceiling was measured after equilibration, and compared with the ambient air temperature.

Without altering the Infra-Red Heater voltage setting, the measurements were repeated using Decracraft Building Paper and Decrafoil Aluminium Foil underlays for the brown tiles.

RESULTS:

	TEMPERATURE °C		TEMPERATURE °C		CEILING TEMPERATURE
TILE DESCRIPTION	SUNLIGHT	TEST RIG	CEILING	AMBIENT	MINUS AMBIENT TEMP °C
Decrabond Charcoal	54	55.0	23.6	21.6	2.0
Decrabond White	42	42.2	20.6	19.2	1.4
Decrabond Coff.Brown	55	56.3	23.3	20.5	1.8
+ Building Paper	-	60.7	22.5	22.8	-0.3
+ Alum. Foil	-	58.6	23.2	23.0	0.2
Concrete Brown	47	45.7	23.0	22.0	1.0
+ Building paper		48.7	22.0	22.8	-0.8
+ Alum. Foil		46.5	21.7	22.7	-1.0

COMMENTS:

1. The effect of tile heat transmission is in practice noticed by the degree to which the ceiling temperature is raised above the ambient room temperature.

2. The non-standard white painted Decrabond Tile was significantly cooler in the sunlight, but the temperature difference of 12°C below Decrabond Charcoal was not apparent in the degree to which the ceiling temperature rose above the ambient temperature. The dark colour caused only a 0.6°C effect on the ceiling-ambient gradient.

3. The results for the Decrabond Coffee Brown tile were intermediate between the Charcoal and White tiles. The use of Building Paper or Aluminium Foil reduced the ceiling temperature rise above ambient temperature to a negligible level, within experimental tolerances.

4. The Brown Concrete Tile reached a lower temperature than the Decrabond Coffee Brown Tile in sunlight, and affected the ceiling-ambient gradient by 0.8°C less. While this margin may have some significance in living space comfort the use of Building Paper or Aluminium Foil for both Decrabond and Concrete roofing negates any difference in heat transmission by the roof cladding material.

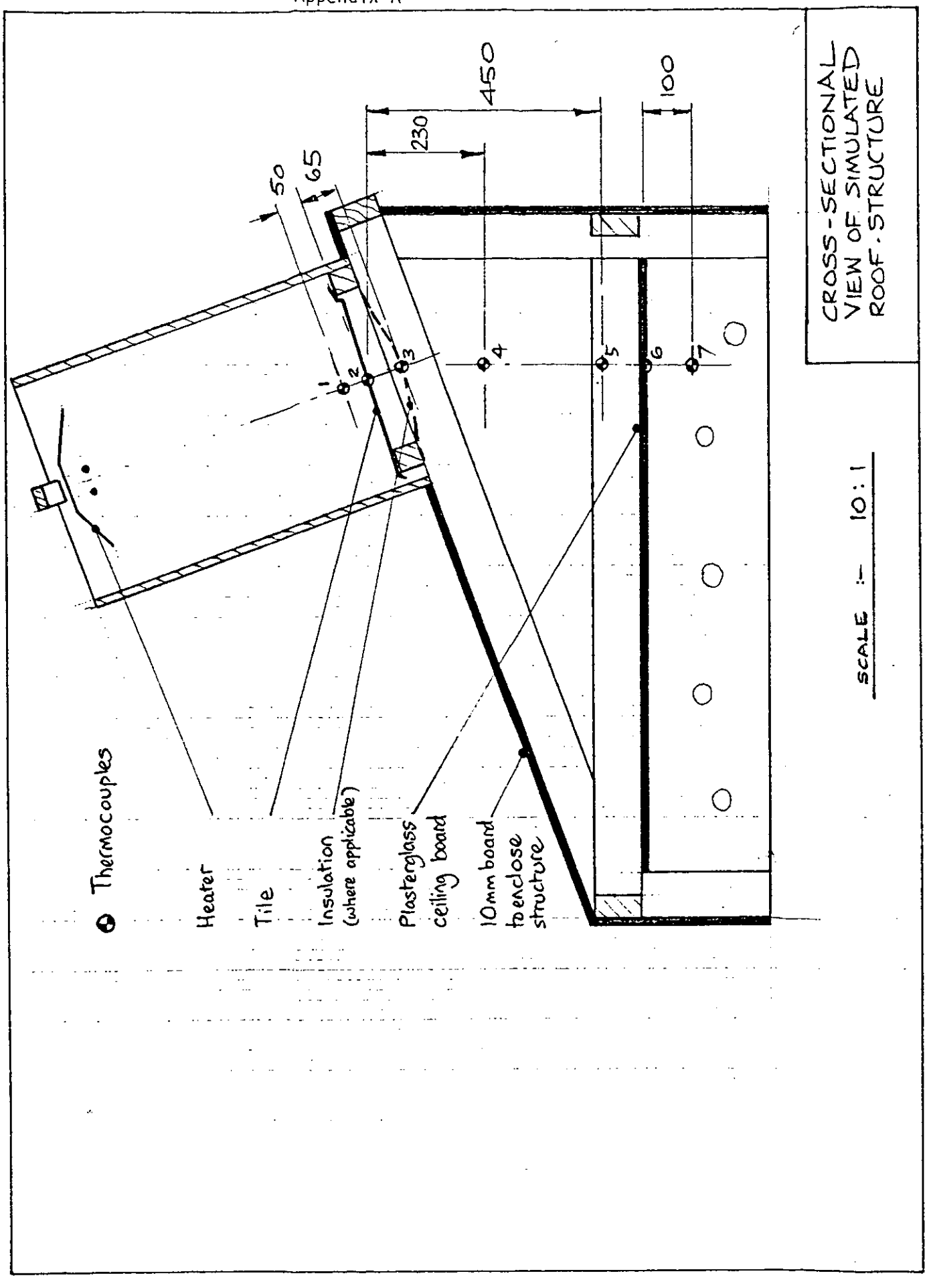
CONCLUSIONS:

1. Light coloured Decrabond Tiles reach a lower temperature in sunlight than dark coloured Decrabond Tiles, and Concrete Tiles reach a lower temperature in sunlgiht than the same coloured Decrabond Tile.

2. The different tile temperatures, however, have only a slight effect on the ceiling temperature measured with no roof underlay in use.

3. The use of Building Paper or Aluminium Foil resulted in the different tile temperatures having negligible effect on the ceiling temperature, the differences measured being within experimental error.

I.K.McClew
DEVELOPMENT MANAGER


CROSS-SECTIONAL VIEW OF SIMULATED ROOF-STRUCTURE
SCALE :- 10:1
450
230
100
50
65
1
2
3
4
5
6
7
Thermocouples
Heater
Tile
Insulation (where applicable)
Plasterglass ceiling board
10mm board to enclose structure

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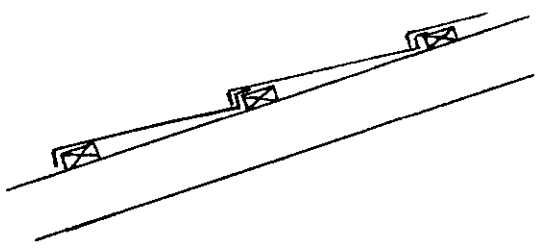
APPENDIX B - HEAT FLOW CALCULATION:

The following table summaries estimates made of heat flow through roof structures. The basis of the calculations is:

1. Thermal Resistance data taken from ASHRAE Handbook.

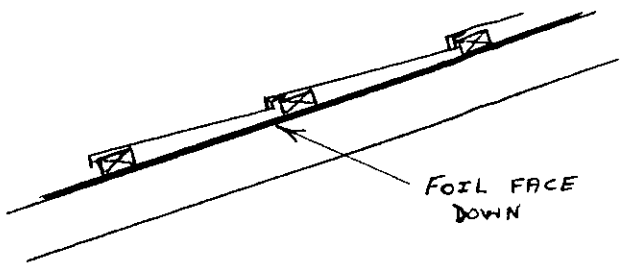
2. Temperature gradients determined by experiment (AHI Roofing Report 84/908/04)

ROOF STRUCTURE:	THERMAL RESISTANCE M^2 °C/W		TEMP GRADIENT °C	DOWNWARD HEAT FLOW W/m^2
1. Tiles only, no underlay and no ceiling White Decrabond (Experimental colour only)	Top Surface	0.044		
	Tile	0.000		
	Bottom surface	0.148		
	Total	0.192	21.6	112
2. As for 1 except Coffee Brown colour		0.192	33.0	172
3. As for 1. except Brown Concrete Tiles	Top surface	0.044		
	Tile	0.014		
	Bottom surface	0.148		
	Total	0.206	22.7	110



4. Tiles with Aluminium Foil underlay, no ceiling
Coffee Brown Decrabond

Top Surface	0.044		
Tile	0.000		
Enclosed air gap	0.148		
Bottom surface	0.595		
Total	0.787	35.4	45

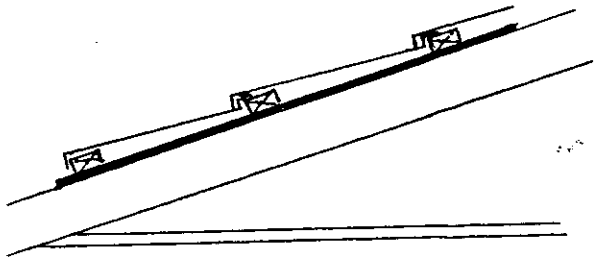


5. As for 4 except Brown Concrete tiles

Top surface	0.044		
Tile	0.014		
Encl Air Gap	0.148		
Bottom surface	0.595		
Total	0.801	24.8	31

6. Tiles with Aluminium Foil underlay and gypsum board ceiling.
Coffee Brown Decrabond

Top surface	0.044		
Tile	0.000		
Encl Air Gap	0.148		
Ceiling space	1.356		
Gypsum Ceiling	0.069		
Bottom surface	0.162		
Total-	1.779	35.6	20



7. As for 6 except Brown Concrete Tiles

Top surface	0.044		
Tile	0.014		
Enclosed Air gap	0.148		
Ceiling space	1.356		
Gypsum Ceiling	0.069		
Bottom surface	0.162		
Total	1.793	23.8	13

NOTE:

The values of Downwards Heat flow in this table are estimates only, and their accuracy is restricted by experimental error, ambient temperature variation, and assumptions made in the compilation and use of ASHRAE data.

The Heat Flow results do, however, indicate the important trends summarised in the conclusions to the report 84/908/04

I.K. McClew

2nd April, 1985