Field Test Of Sisalation Aluminium Foil Insulation

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Experimental Set Up

The field test was carried out in a house in Sydney, Australia, during the summers of 1968 and 1969 temperatures being taken at various places in the building using a 16 point recording potentiometer and copper constantan thermocouples (see Fig. 1).

During 1968 the tiled roof was without insulation whilst prior to the 1969 temperature recordings the tiles were removed and SISALATION was installed under the tile battens before the tiles were replaced (see Fig. 2).

The SISALATION was double sided foil, the upper surface, being blue coated. The blue coating for all practical purposes eliminates the reflective property of the upper surface so that the insulation value was entirely due to the low emissivity of the lower downwards facing surface (emissivity less than 0.05)

Over a period of time dust would accumulate on an upward facing surface and by simulating this condition, with the blue coating, the results are valid for the worst condition i.e. upward facing surface completely covered with dust.

Normal Sydney practice during the hottest weather is to keep windows and doors closed during the day and to open them at about sunset. This procedure was adopted by the occupants of the house for the duration of the tests. Sunset during the relevant times would be about 7.00p.m.

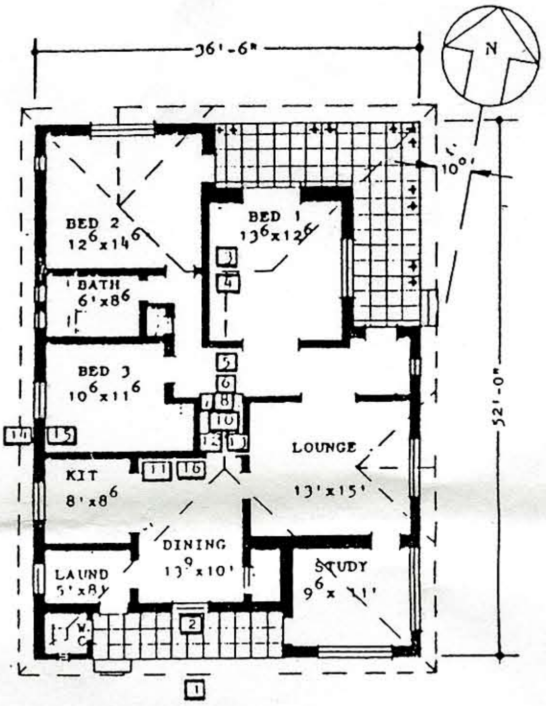

Fig. 1 Sisalation Test House.

Construction Details

Site	Strathfield (Sydney) N.S.W., Australia
Construction	External walls — 11" cavity brick dark coloured. Internal walls — single 4½" brick, rendered. Ceilings — fibrous plaster, 9' 6" Roof — baked clay tiles (terracotta) ¼ pitch dark coloured. Rafters spaced at 1' 6" Floor — T and G boards carpeted, average 1 6" air space between floor and ground.
General	Houses on all sides — large trees in rear garden not an exposed location. Height above sea level, 86'

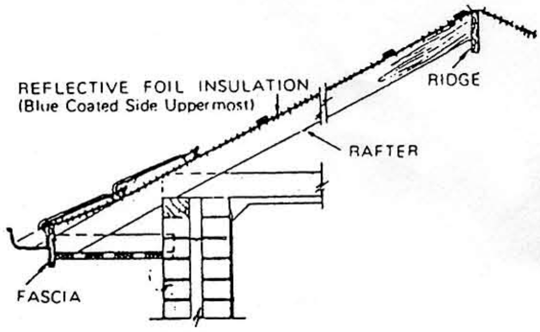

Fig. 2. Sisalation Installed As Sarking Between The Rafters And The Tile Battens For The Second Year Of The Test.

Temperature Charts

1) "Black Sol Air" temperature (mat black insulated aluminium disc)
2) Outside Ambient (Shielded from Radiation)
3) Terracotta Tile (thermocouple adhered)
4) 1968 Air Temperature level with underside of tile batten 1969 SISALATION temperature
5) Attic Space Air Temperature (half way between ceiling & ridge)
6) In Air-level with top of ceiling joists.
7) Ceiling Sheet — lower side
8) Inside Ambient — at ceiling (9' 6" level)
9) Inside Ambient — 5ft. from floor
10) Globe Temperature
11) Inside Ambient — at floor level
12) Air Temperature — under floor
13) Ground Temperature — under centre of dwelling
14) External wall (west) — outer surface
15) External wall (west) — inner surface
16) Internal wall.

The temperatures were recorded on temperature charts as Fig. 3 and 4.

Conditions at start (7.00 a.m Table I)

For a comparison, two almost identical hot days were selected, namely February 1, 1968 (uninsulated) and January 8, 1969 (insulated with SISALATION). Analysis of the temperature records shows that the condition of the house was almost identical at the start of each day.

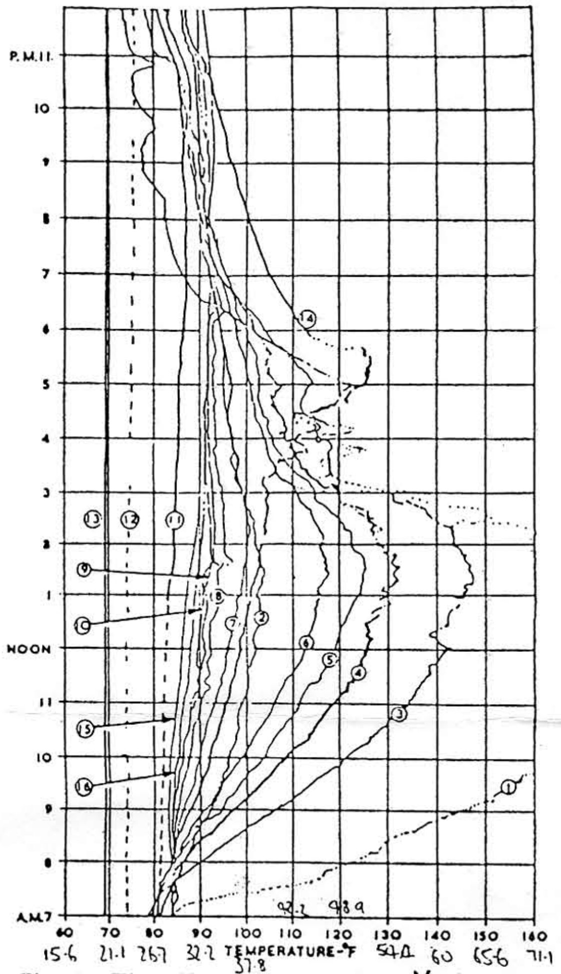

Fig. 3. Time Temperature Chart No Insulation, February 1, 1968.

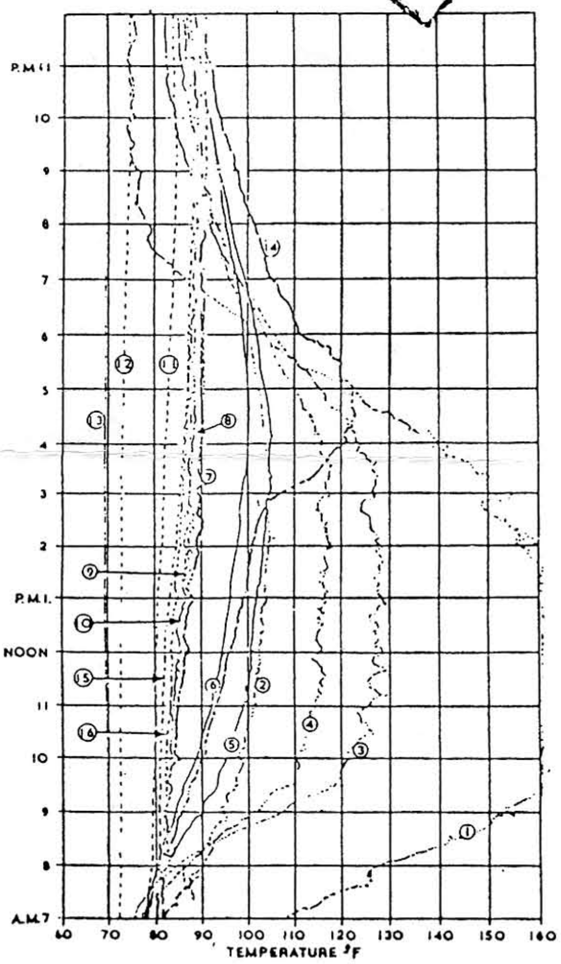

Fig. 4. Time — Temperature Chart With Reflective Foil Insulation, January 8, 1969.

Table I (7.00a.m.)

	1/2/68 No Insulation	8/1/69 Insulated Roof
Outside ambient	81	82
Inner wall	84	83
Attic space air (half way up)	79	79
Ceiling temperature	82	82
Inside ambient (5ft. from floor)	80	80
Inside ambient (floor level)	80	78
Air under floor	74	73
Ground temperature under house	69	70

This table shows an almost ideal matching of temperatures at the beginning of the days which was essential to indicate that any major differences, later in the day, were due to the inclusion of SISALATION aluminium foil insulation under the tiles for the results taken during the 1969 summer.

To make comparison easier, Tables II to VII have been compiled from the charts.

Analysis of Results

Before analysing the results it would be as well to state again that under humid tropical conditions where there is a strong interchange of radiation between people and their environment, and where conditions are warm enough to induce perspiration, air temperature alone is inadequate and can be misleading as an indicator of comfort.

Thus, whilst the ambient air temperatures are significantly reduced by the use of SISALATION, the major effect on comfort is the decrease in the temperatures of the ceiling and walls resulting in reduced radiation to the human body. This effect cannot be recorded by a dry bulb thermometer but is registered by the individual as a feeling of coolness.

(a) Temperatures

Maximum temperature reduction due to the use of SISALATION occurs at the higher levels and naturally the reduction in temperature becomes less in places down through the building until at the ground the temperature is common to both conditions.

The time of maximum outside temperature occurred at 1.30p.m. when the house was uninsulated and at 2.15p.m. when the house was insulated. At these maximums, the house was 12 degrees cooler than outside without insulation and 18 degrees cooler with insulation.

An interesting figure is the reduction of 22 degrees in the attic space temperature which has particular reference to air conditioning. Usually with central air conditioning, ducts carrying conditioned air would be run in the roof space in commercial as well as domestic buildings. A reduction of 22° in the air surrounding the ducts would affect considerable economies in the running costs of the air conditioning plant.

The reduced temperatures of surfaces are most important as they relate directly to reductions in the amount of heat transfer in radiant form.

(b) Radiation Conductance — h_r.

The simplified formula for radiation conductance which can be used is:

hr.	=	4.88 x F x Fe B.T.U./sq. ft. hr. Deg. F.
Where F	=	Configuration Factor
	=	0.22 for most building situations
and Fe	=	Emissivity Factor
	=	0.80 for non reflective ceilings
	=	0.05 for aluminium foil insulation.

	TABLE II			TABLE III			TABLE IV			TABLE V			TABLE VI			TABLE VII			
	1968	1969	Diff*	1968	1969	Diff*	1968	1969	Diff*	1968	1969	Diff*	1968	1969	Diff*	1968	Time	1969	Time
																	p.m.		p.m.
Outside ambient	104	105		97	103		94	101		90	93		87	88		104	1.30	106	2.15
	40	40.6		36.1	39.4		34.4	38.3		32.2	33.9		30.6	31.1		40		41.1	
Internal wall temperature single brick	88	84	−4°	90	86	−4°	92	87	−5°	91	88	−3°	93	91	−2°	93	10.00	91	10.00
	31.1	28.9	2.2	32.2	30	2.2	33.3	30.6	2.7	32.8	31.1	1.7	33.9	32.8	1.1	33.9		32.8	
Attic space (half way up)	125	103	−22°	105	95	−10°	100	102	+2°	92	96	+4°	88	92	+4°	125	1.30	105	4.15
	51.7	39.4	12.3	40.6	35	5.6	37.8	38.9	1.1	33.3	35.6	2.3	31.1	33.3	2.2	51.7		40.6	
Ceiling Temperature	100	89	−11°	97	90	−7°	94	90	−4°	91	90	−1°	90	89	−1°	101	2.15	91	5.00
	37.8	31.7		36.1	32.2	3.9	34.4	32.2	2 2	32.8	32.2	.6	32.2	31.7	.5	38.3		32.8	
Inner ambient (5ft above floor)	92	87	−5°	92	87	−5°	92	88	−4°	91	88	−3°	88	88	—	93	2.30	89	7.30
	33.3	30.6	2.7	33.3	30.6	2.7	33.3	31.1	2.2	32.8	31.1	1 7	31 1	31.1		33.9		31.7	
Inner ambient (floor level)	84	81	−3°	85	82	−3°	86	83	−3°	86	84	−2°	86	84	−2°	87	8.00	84	10.00
	28.9	27.2	1.7	29.4	27.8	1.6	30	28.3	1.7	30	28.9	1 1	30	28.9	1.1	30.6		28.9	
Air under floor	74	73	−1°	75	73	−2°	75	73	−2°	75	74	−1°	75	74	−1°	75	8.00	74	10.00
	23.3	22.8	.5	23.9	22.8	1.1	23.9	22.8	1 1	23.9	23.3	.6	23.9	23.3	.6	23.9		23.3	
Ground under house	69	69	—	69	69	—	69	69	—	69	69	—	69	70	+1°	70	9.00	70	midnight
	20.6	20.6		20.6	20.6		20.6	20.6		20.6	20 6		20.6	21 1	.5	21.1		21.1	
	1.30p.m. time of max. outdoor temp for first year.			4.00p.m.			8.00p.m.			8.00p.m.			10p.m. Internal walls at max. temp. in both cases.			Maximum irrespective of time of day.			

* Diff — Difference due to SISALATION insulation

NOTE: The 1969 day was slightly hotter than the 1968 day which would indicate that the satisfactory results indicated are conservative.

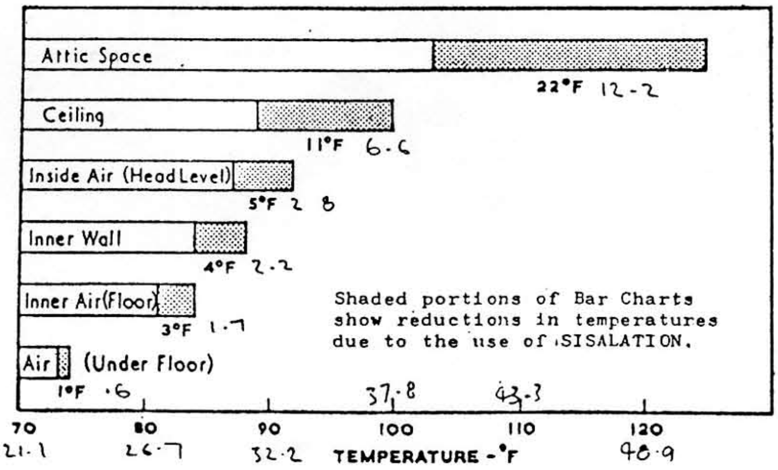

Fig. 5

The temperature of the human body surface is taken as 89°F. Note the configuration factor takes into account the spatial relationship of the small receiving surface with respect to the large emitting surface.

Without insulation ceiling hr. = 4.88 x 0.22 x 0.80 x 11
= 9.46 B.T.Us/sq. ft.

With SISALATION ceiling hr. = 4.88 x 0.22 x 0.80 x 0
= 0 B.T.Us/sq. ft.

The top of the head and the back of the neck are the most sensitive parts of the body as far as heat gain from a radiant source is concerned and the practical elimination of heat gain from ceiling is a major factor in the improvement of comfort conditions due to the use of SISALATION.

An examination of the inner wall surface temperatures will also show that radiant heat gain from this source is also virtually eliminated.

Where a ceiling is not installed such as factories, etc., the radiant exchange would take place between the roofing surface and the individual. Thus without insulation the maximum radiation conductance would be for the uninsulated tile roof:

hr. = 4.88 x 0.22 x 0.8 x (147 89) 147°F tile temperature
= 50 B.T.Us/sq.ft.

Insulated with SISALATION:

hr. = 4.88 x 0.22 x 0.05 x (118 89) 118°F SISALATION temp.
= 1.55 B.T.Us/sq.ft.

The radiation from an uninsulated factory roof would be greater than indicated above; its mass would be less than a tile roof and so it would rise to a higher temperature resulting in very unpleasant working conditions.

As stated in previous articles virtually all factories erected in the humid tropics should have insulated roofs in order to provide reasonable working environments. The latest Government to enforce this basic requirement is that of South Africa.

(c) Reduction in Rate of Heat Gain (Ceiling)
In both cases the temperature rise of the ceiling is almost linear between 9a.m. and 1p.m. Since the ceiling gains heat only from the roof mainly by radiation and loses it to the inside of the dwelling the percentage reduction in heat gain indicates the effectiveness of SISALATION aluminium foil insulation.

Rate of heat gain without insulation $= \frac{101 \quad 87}{4} = 3\frac{1}{2}°$ per hour

Rate of heat gain with SISALATION $= \frac{88 - 83}{4} = 1\frac{1}{4}°$ per hour
i.e. a reduction of 64%

This rate compares more than favourably with the 54% reduction stated in the SISALATION General Information Sheet.

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