REFLECTIVE FOIL LAMINATE MANUFACTURERS

SUBMISSION TO PARLIAMENT OF VICTORIA

CONSERVATION OF ENERGY RESOURCES COMMITTEE

USE OF INSULATION IN BUILDINGS.

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1: INTRODUCTION

In making this submission we appreciate that the Committe has already received considerable evidence covering the theory and application of insulation and is now familiar with the essential difference between bulk and reflective foil laminate insulation (R.F.L.). We do not propose to duplicate this type of information, but are prepared to answer any questions the committee may raise.

We will restrict our comments to the insulation of dwellings and particularly the application of R.F.L. It is most difficult to estimate the energy savings that will result from the insulation of dwellings and the reasons for this together with a possible practical approach are presented in this submission.

2: CLIMATE COMPARISON

European countries that have mandatory requirements for thermal insulation of buildings have quite a different climate to Victoria. The winters are long with low temperatures and the summers are mild by our standards. In terms of latitude they are equivalent to being below the southern tip of Australia or New Zealand. Also the climate is reasonably consitent over the whole country.

The energy used for heating in winter is high, but as the climate demands continuous heating, reasonably accurate forecasts can be made of the energy conserved by the proper use of thermal insulation.

It is interesting to note that in some countries, thermal insulation standards were introduced for economic reasons before there was concern for the conservation of energy reserves.

In summer the energy requirement for cooling is low, as airconditioning is used in a minority of commercial buildings to overcome heat gain from lighting and work activity, rather than heat gain from the sun. Airconditioning is virtually non existant in dwellings.

Under these conditions, thermal insulation requirements based entirely on winter conditions can be made with predictable energy conservation.

The climate in Victoria is not consistent over the whole state, but it is reasonable to consider the Melbourne climate as typical for the majority of the population. By comparison with Europe, the winter is mild and the summer very hot. An examination of daily termeratures during winter and summer would not immediately suggest the high level of winter heating experienced in Victoria. They do however suggest the need for summer cooling.

An individuals comfort level is influenced by the differnece in temperature extremes and in winter people tend to achieve this comfort level by heating the environment rather than the use of clothing. The traditional nature of the individual single storey dwelling compared with the high density housing in Europe is also an important factor. In Victoria, the exposure of these high external surface area dwellings to the cold prevailing winds in winter contributes greatly to heat loss.

Although the Victorian winter conditions are cold, they do not demand continuous heating or whole house heating. A large number of dwellings are not occupied during the day as both husband and wife work. There is also substantial solar heat gain available during the heating period, although this would not be the case during the evening when maximum occupancy of dwelling occur. The pattern of climate and occupancy indicates that intermittant heating would be used in the majority of dwellings. By intermittant, we mean that the heating is not continuous at a constant temperature throughout the dwelling or part of the dwelling.

The summer conditions give high termperatures and conditions of stress, but over a shorter duration than winter. These conditions are leading to the increased use of airconditioners, again on an intermittant basis. This trend to airconditioners is cause for alarm and this has again been highlighted in the editorial of the February, 1977 issue of the T.I.I.A. Journal. The Bureau of Statistics also show that the availability of air conditioning units both manufactured and imported, doubled during 1971-1973 and this growth rate appears to continue.

The Victorian climate could be summarised by saying that no amount of insulation in a dwelling will remove the need to use energy for heating on some basis during winter, but a properly insulated dwelling need not require energy for cooling during summer.

It is clear from this discussion, that the climate and pattern of energy usage in Victoria are different to Europe and it would not be prudent to base thermal insulation requirements for dwellings on European experience alone. The variables that exist make the reasonable calculation of conserved energy in winter extremely difficult. The increasing importance of summer energy use makes it important that summer as well as winter conditions be considered in any proposed thermal insulation requirements.

3: INSULATION

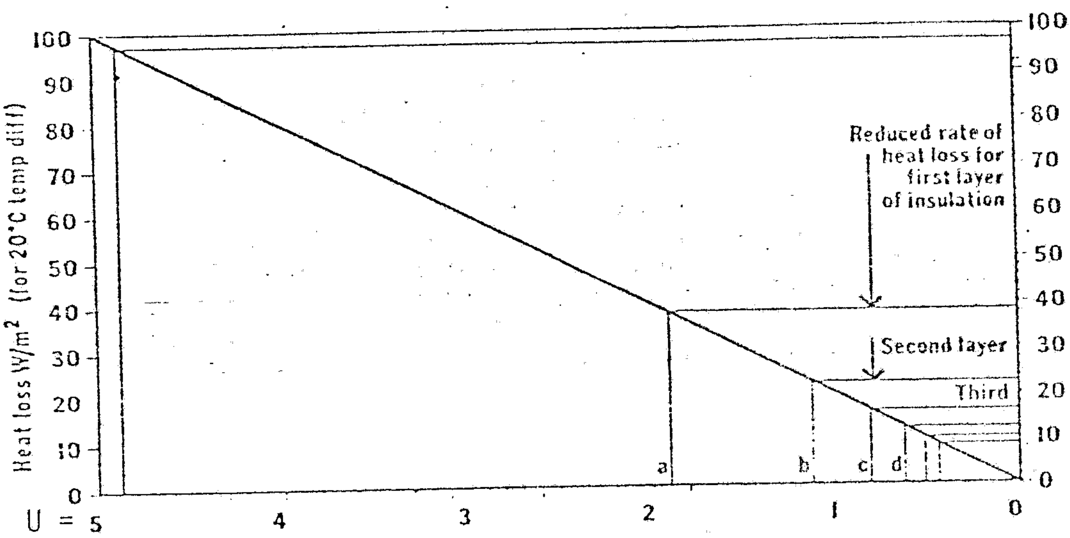
The general public concept of insulation is bulk insulation, either loose fill or batts placed in the ceiling. This is due to the marketing of the bulk insulation industry being aimed at the existing dwelling where it is comparatively easy to insulate the ceiling, but the walls are virtually impossible.

The advertising of the R.F.L. manufacturers, has in the past been aimed at the architect and builder as it is most effectively installed during construction of the dwelling. The public in general are unaware that R.F.L. is a multi-purpose material and when installed in a dwelling it usually performs as a weather proofing membrane as well as an effective insulation. It can also be installed to form a vapour barrier only, or as a vapour barrier and insulation. Reference to Australian Standard AS 1904-1976 Australian Standard Code of Practice for the Installation of Reflective Foil Laminate is recommended.

However we do not see the insulation of dwellings in terms of bulk insulation or R.F.L., but rather as the two types complimenting each other on a cost efficiency basis depending on the climatic conditions encountered. In metal deck roof constructions the two types are invariably used together to form a combined acoustic and thermal insulation. It is important that the thermal insulation requirements for buildings be expressed in terms of thermal resistance units, rather than a thickness of bulk insulation or number of reflective surfaces of R.F.L. This would provide the design freedom necessary to give the most economical solution appropriate to a particular application.

In considering levels of thermal insulation for buildings it should be appreciated that the law of diminishing returns applies and this is shown in the graph Fig. 1. The indications are that in winter there is not much advantage in having a roof/ceiling thermal resisitance greater than approximately 1.2 m^2K/W, or the equivalent of 50mm of fibre glass bulk insulation.

Fig. 1.



Comparative effectiveness on the rate of heat loss of successive layers of glasswoo insulation applied to 9·5 m asbestos cement sheeting wit a 20°C external internal temperature difference. The first insulating layer produc startling reduction in heat loss, but the benefits of insulation are considerably diminished as each successi layer is applied; The U-values are shown as follows: a with 12 mm glas wool, b with 24 mm, c wit 36 mm, d with 48 mm.

R = 0.2 0.25 0.33 0.5 1.0

U - VALUE W/m^2K

R - VALUE m^2K/W

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Summer tests in an occupied dwelling have been carried out by St. Regis-A.C.I. in Sydney over two consecutive summers on days with maximum temperatures of 40^0C. In the first test the roof was uninsulated and in the next R.F.L. had been applied to the roof. The results show that comfort conditions could be achieved with a heat flow down resistance of not greater than 1.35 m² K/W. However to take advantage of the daily temperature variations and have the dwelling cool at the same rate as when it was uninsulated, the heat flow up resistance should be lowered to 0.335 m² K/W.

The ability to give a high resistance to heat flow down combined with a lower resistance to heat flow up together with a low thermal capcity is a unique property of R.F.L. when installed in a roof or ceiling. This can be used to great advantage in a well desinged dwelling.

It can be seen from these tests that an excess of high thermal capacity insulation in a ceiling of a dwelling to reduce winter heat loss, could retard cooling of the dwelling in the summer and under some cirucumstances cause conditions of stress.

The C.S.I.R.O. Division of Building Research in a paper, "The Economic Thermal Resistance of Inuslation For Dwelling Roofs", concluded that there was little economic advantage in increasing the thermal resistance of a roof in winter above 0.7 m² K/W, or above 1.4 m² K/W in summer.

The Gas and Fuel Corporation are advertising a 25% saving in fuel cost if the roof of a dwelling is unsulated and a further 25% if the walls are also insulated. The inuslation of walls is most important, as not only does it substantially reduce heat loss, but it also contributes directly to comfort in that an acceptable wall surface temperature reduces radiation to or from a human and provides a more even temperature distribution within the room. Energy consumption is lowered because comfort conditions can be more easily achieved.

The important aspect of wall insulation is that it can only be carried out during construction of the dwelling and unless this is done a substantial heat loss or gain will continue for the life of the dwelling regardless of the amount of insulation in the roof.

On a cost/efficiency basis, R.F.L. is well suited to wall application, providing a thermal resistance both winter and summer approximately equal to 50mm of fibre glass bulk insulation with a 25% reduction in overall heating loss, and at the same time provides a weather proofing membrane. On current prices R.F.L. can be supplied and fixed to the frame of an average 14 square dwelling for between \$130 to \$140.

A recent survey by COMALCO LIMITED shows that in 1973/75, 37% of new dwellings incorporated R.F.L. in the walls, but due to economic considerations this had dropped to 25% in the period 1975/76. At the same time R.F.L. as a roof sarking under tiles varied between 19% to 18%.

All well designed and constructed dwellings should incorporate R.F.L. both as a roof sarking and around walls for weather protection and primary insulation. This would have the following effect on the thermal resistance of a typical brick veneer tile roof dwelling.

WINTER ROOF

Uninsulated resistance	0.344 m^2K/W
With R.F.L. sarking	0.569 m^2K/W
52% reduction in heat flow.	

WINTER WALLS

Uninsulated resistance	0.492 m^2K/W
Insulated with R.F.L.	1.274 m^2K/W
61% reduction in heat flow.	

SUMMER ROOF

Uninsulated resistance	0.747 m^2K/W
With R.F.L. sarking	1.645 m^2K/W
54% reduction in heat flow.	

SUMMER WALLS

Uninsulated resistance	0.497 m^2K/W
Insulated with F.R.L.	1.527 m^2K/W
68% reduction in heat flow.	

These results show the thermal resistance in summer to be quite satisfactory. The thermal resistance of the roof in winter gives a 52% deduction in heat flow which would be sufficient for a dwelling with low occupancy and intermittent heating. The addition of 25mm bulk insulation raises the resistance to a point where approximately 80% reduction in heat flow is obtained.

The cost of sarking an average 14 square dwelling, would be between $200 and $220 depending on the roof design, grade of R.F.L. used, and the individual roofing contractors fixing rate.

It can be seen that wall insulation can economically provide a 25% reduction in overall heat loss from a dwelling, but it must be incorporated during construction. The position for roof/ceiling insulation, is not quite so clear as an optimum thermal resistance value has to be based on both winter and summer conditions. However in this case insulation can usually be added after construction of dwelling to meet any thermal requirements.

The heat loss through floors is, by comparison, not large and not a problem except in elevated exposed positions. The use of carpet on the floors is most effective, not only for its insulating properties, but it provides a non radiant surface that contributes greatly to personal comfort.

4: HOW MUCH ENERGY WILL BE SAVED:

As stated earlier, the variables that exist in the Victorian situation makes a reasonable theoretical calculation of potential energy savings virtually impossible. We are aware that calculations of this type have been made based on various assumption, but we consider them as only indicating the magnitude of the problem. There is in addition the predominant unknown of the human factor which at this stage cannot be predicted or controlled.

When existing dwellings are insulated, it appears that a considerable proportion do not take advantage of the reduced fuel cost, but extend the range of their comfort level within the dwelling; in some cases with a slight reduction in energy, but others use the same or even more. It is reasonable to assume that occupants of new dwellings, insulated during construction, would develop a similar comfort range. This extension of the comfort range depends on the ability to pay energy costs and also the nature of the occupancy of the dwelling.

Similar disappointing results were experienced in New Zealand where the theoretical potential saving could be shown to exist but the actual energy usage increased.

There is however no doubt that mandatory requirements for insulation of dwellings will substantially reduct the energy required to provide an acceptable comfort level within a dwelling. We consider it unrealistic to believe that all individuals will, at this time, voluntarilly restrict their range of comfort to make this potential energy saving available in the national interest.

The only practical way to determine the energy usage trend in an insulated dwelling would be to carry out a survey on existing dwellings that have been insulated after a period of occupancy. The F.I.M.A. estimate that 15% of dwellings in Victoria are insulated and a survey of a representative sample from these would enable the energy usage pattern before and after insulation to be determined together with the level of insulation.

This information would be invaluable in determining the actual future energy usage and the potential energy saving that could be available from the use of insulation. It could also show if any form of restrictive use of energy would have to be imposed in the future to make this potential energy saving available.

5: ADDITIONAL METHODS OF CONSERVING ENERGY IN DWELLINGS

The thermal insulation of dwellings can be supplemented by a number of quite simple and inexpensive proceedures which will add to comfort and reduce energy consumption. All that is required is public awareness and co-operation. A few of these are suitable orentation and design of dwellings, the use of window drapes, sun blinds, garden layout and solar hot water systems etc. These methods would have been covered in detail by T.I.I.A. and the C.S.I.R.O. and we will not elaborate on this, but we do endorse their views.

We believe there is a need for an extensive education program aimed not only at the public, but also land developers, architects and builders so that future dwellings could incorprate some basic principle of good thermal design. This would bring about a significant natural reduction in energy consumption.

6: PRODUCTION CAPACITY OF REFLECTIVE FOIL LAMINATE MANUFACTURERS

The Reflective Foil Laminate Manufacturers in Australia have sufficient existing production capacity and access to raw materials to supply any increased demands that may result from mandatory insulation regulations.

7: RECOMMENDATIONS:

1. Thermal insulation requirements for buildings to be expressed in thermal resistance units, not dimensional units.

2. Introduce mandatory requirements for insulation of walls in new dwellings to a resistance value of approximately 1.2 m^2K/W as a first priority as this form of insulation must be carried out during construction.

3. Carry out a survey on existing dwellings that have been insulated to determine the likely trend in energy usage due to insulation and the potential saving.

4. Introduce mandatory requirements for insulation of dwelling roof/ceiling to a resistance level based on consideration of both winter and summer conditions.

5. A continuing public and building industry education program on domestic energy conservation based on work carried out by the C.S.I.R.O. and T.I.A.