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DISCUSSION PAPER: SUSTAINABLE CITIES 2025

Introduction.

This submission is primarily concerned with the thermal performance of houses as affected by the materials used in their construction and the orientation of the main windows in order to thus reduce the greenhouse gas emissions associated with generating the energy used to maintain comfortable internal temperatures. It is acknowledged that insulation will improve the performance of lightweight walls, bur it is clear that heavyweight wall construction, even with no insulation, provides a superior performance. The wide use of heavyweight construction would bring about a greater increase in sustainability than will improving the performance of intrinsically unsuitable lightweight walls by requiring them to be insulated.

Also discussed is the waste of water associated with remotely located storage hot water services.

Submissions are made under the headings given in the discussion paper.

2. Ensure equitable access to and efficient use of energy, including renewable energy sources.

- Should higher efficiency standards be mandated for all new dwellings, appliances and business operations?

Response.

House construction methods. Later parts of this submission describe informed opinions indicating that the current practice of building lightweight framed walls is not well suited to the climate of most of Australia. It is recognised that building regulation requirements for the incorporation of insulation in those lightweight walls significantly improves their inherently poor thermal performance, but appreciably greater energy savings, particularly for house cooling, would be achieved by building uninsulated heavyweight walls, particularly in association with slab-on-ground floors. While I hesitate to propose that this superior method of construction be made compulsory, consideration should be given to more encouragement than currently exists in regulations for the construction of heavyweight walls. That current encouragement, or recognition, takes the form of an exclusion of such walls from the mandatory fixing of insulation or the need for a house that uses them to achieve a nominated Star Rating, using one of the approved computer simulation House Energy Rating Schemes (HERS). However, no positive proposal for the adoption of this superior practice has been found to be offered by the Discussion Paper or any of the regulatory authorities.

It is recognised that this desirable change in building practices from framed to heavyweight walls is likely to be resisted by the house building industry, most of whose members are trained as carpenters, but most of them are bright and resourceful and can learn new habits when necessary.

3. Establish an integrated sustainable water and stormwater management system addressing capture, treatment and re-use opportunities

- What incentives or market based instruments might be appropriate for residential and commercial enterprises to encourage responsible water consumption and re-use?

Response.

In the recent past my partner and I retired to the country after living in Melbourne where we had always been conscious that a lot of water can run to waste before any that is hot is available at the tap. The fact that our only water supply is now from our own rain-water tanks has caused us to be more conserving and to collect waste water for the garden. The pipe run from our storage HWS to the en-suite shower is about 18 m which would contain between 5 and 6 litres of water and experience shows that by the time we have both showered, there is at least 5 litres in the bucket, which means that, were we not putting it on the garden, the showers of this two-person household would be wasting about 1,800 litres of water per year.

The kitchen sink is closer to the HWS, but even so, a little more than 1.5 litres of water needs to run before hot water arrives. Its use three times per day would waste about as much water again as does the shower were we not also collecting it for the garden. The total waste from just these two activities therefore approaches 3,500 litres per year

The problem is caused because like most houses we have a single, large-capacity storage hot water service in a situation where at least one bathroom is remotely located from the HWS and the kitchen sink is not close. Not withstanding the insulation around the hot water pipe, the water in it cools down between showers and sink operations.

This matter is also relevant in the field of energy saving because our approximately 3,500 litres per year of potentially wasted water has been heated to at least 60° C. It is recognised that the authority that supplies the water-heating electricity gives us a benefit by selling it at a reduced cost by doing the water heating over night or at other times of low power demand. It is also recognised that this practice helps them to balance their generating load, but these compensations do not eliminate the waste of energy and the associated CO_2 emissions. A solar HWS would eliminate the use of electricity, but not of the wast of water.

In our city house we abandoned the storage unit in favour of two instantaneous heaters close to the outlets. Hot water for the kitchen sink came virtually instantly from a 15 litre HWS that was located very close to the sink and plugged into an ordinary power point. Water saving at the sink was considerable and I feel sure that the electricity we did not use by the elimination of hot water waste more than compensated for the fact that we paid for it at peak rates. 15 litre units are no longer available and I am advised that this is because they are seen to be the sort of cheap substitute for a proper storage HWS that greedy landlords would otherwise provide for their exploited tenants. Not a correct view on the basis of the above, but one that is widely accepted.

6. Incorporate eco-efficiency principles into new buildings and housing

- How can green construction and refurbishment techniques be integrated into standard building practices?

Response.

Australia's climate. We readily recognise that the climate in this country is markedly warmer than that of the northern parts of Europe and America. However, we seem almost totally unable to avoid a "colonial cringe" that makes it difficult, or even impossible, for us to formally recognise this fact by using methods to control the consequences of this temperature difference that are not the same as those prescribed in the cold northern parts of our globe. This blinkered vision encourages the view that winter heating is the sole problem and thus, the only way to improve thermal performance is to add insulation.

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The effect of insulation on the thermal performance of houses. In a cold climate the insulation properties of the elements enclosing buildings are of paramount importance in maintaining internal comfort with a minimum expenditure of energy. In warmer climates, particularly those where there is usually a significant drop in overnight temperatures, the effects of the thermal inertia properties of heavy building materials such as brickwork and other forms of masonry can be much more relevant. This was apparent from the beginnings of settlement in this country. Cox, Freeland & Stacey, in *Rude Timber Buildings in Australia* explain that by about 1800 ". . . .a unique, sound and most satisfactory way of building was evolved: a sturdy frame of heavy timbers was erected, nogging panels of brickwork or stone were set between the posts in a kind of half-timbering and the outer face of the walls were sheeted horizontally with weatherboards . . . .. The result was a structurally sound, completely weather-tight and *well insulated* building.".

Well insulated cannot be right; AS2627.1 *Thermal insulation of dwellings Part 1: Thermal insulation of roof/ceilings and walls in dwellings* lists the insulating value of the air space in a stud wall as R0.16. If that air space is filled with 110 mm of brickwork and the AS2627.1 listed value of R0.10 is used for that brickwork, the nogging will have reduced the wall's insulating value by R0.06. The fact that brickwork in the middle of the wall was found by our early settlers to be effective in improving the thermal performance of the house cannot therefore be because of improved insulation, it must be because of the thermal inertia effects of the brickwork's mass. I think that Cox, Freeland & Stacey's assumption that improvement came from the insulating properties of brickwork is part of the "colonial cringe' to which reference has already been made: How else could you possibly improve thermal performance?

Brick nogging's slightly negative change to the R Value of the wall means that its presence will have little effect on the heating of pioneer houses, which was not much of a problem anyway because Australia's winters are not very cold, particularly when compared with those of Britain from where Australia's first settlers came and, anyway, firewood was readily available. However, the thermal inertia associated with the bricks would have made a significant difference to summer comfort with Australian temperatures much higher than in the motherland. In those days there were no air-conditioners to reduce the unaccustomed and unwelcome summer heat and the coolness provided by the mass (thermal inertia) of the brick nogging would have been very welcome.

Research studies. The above indicates that heavyweight masonry has played a part in improving thermal comfort in this country from early in the process of European settlement. My interest in this topic began about 25 years ago when, as Director of the Brick Development Research Institute (BDRI), I was involved in the writing of:

(i). Susan Cumming and Tom McNeilly THE LOW-ENERGY FULL-BRICK HOUSE that was published in the Proceedings of the North American Masonry Conference held at the University of Colorado in August 1978.

The paper uses the pioneering thermal performance computer performance program TEMPAL, describes a simple well oriented house and reports its comparative thermal performances when constructed with light and heavyweight walls. Both were insulated to the same levels and an important conclusion is that:

> "...the heavyweight (brick-cavity) construction was found to be superior to the lightweight (brick-veneer or weatherboard) construction, primarily in that an occupant would be highly likely to regard air-conditioning as unnecessary in the former but at least highly desirable in the latter."

It is recognized that good window orientation was a feature of the house studied in this paper and it is also recognized that such a situation is far from universal in Australian house construction. With this in mind I undertook a further and much more recent study: -/4

(ii). Tom McNeilly WALL INSULATION IN BRICK HOUSES IN THE AUSTRALIAN CLIMATE that was published in the Australian Institute of Refrigeration Air-conditioning & Heating (AIRAH) Journal, March 2000, pp 32-35 in which I used the then current VicHERS program to study the performance of a typical poorly oriented house. In lightweight brick veneer construction, insulated to the then current Victoria BCA Appendix [1] Option A, a score of –9 and a three star rating was achieved. By contrast, the same house in full brick with no wall insulation achieved a slightly better score of –8 and the same three star rating.

Taken together these two papers confirm the importance of good orientation, but to regulate for it to be compulsory seems beyond the realms of possibility. However, this second paper provides added evidence of the superior performance of heavyweight construction in our climate, regardless of orientation.

Also relevant, and published in 1982, only a few years later than my first paper described above, is the CSIRO Division of Building Research *Technical Paper (Second Series) No 44*:

(iii). P J Walsh, T A Gurr and E R Ballantyne A comparison of the Thermal Performance of Heavyweight and lightweight Construction in Australian Dwellings
which, using the thermal performance computer program ZSTEP, concluded that:

> "For locations with an essentially temperate or Mediterranean climate, as well as sub-tropical regions such as Brisbane, heavyweight walls and floors are preferred."

Slightly more specific is the statement in the *Abstract*:

> "In general, heavyweight construction or high thermal capacity is advantageous in the milder temperate climates, especially in securing summer comfort."

The above is seen as an important matter because it is clear that, for much of Australia, winter heating does not produce significant problems, it is in the summer when we turn on electrically powered air-conditioner to cool our wrongly designed lightweight houses that electricity black-outs occur. Without some reduction in the occurrence of these black-outs, we will construct more greenhouse gas producing electrical generating plants to drive the cooling devices needed to make even insulated lightweight houses comfortable in the summer. It in not by accident that in those parts of the world where, like much of Australia, hot summer days and cooler nights are normal, heavyweight masonry house construction is usual and air-conditioners are not common. It is clear that this superior construction practice should be vigorously encouraged in this country. Insulation in lightweight houses reduces cooling energy use, but heavyweight construction could eliminate it.

The CSIRO paper also provides evidence that my above reported studies, using Melbourne climate data, are adequately representative of conditions in most of the populated parts of Australia.

While the thermal performance of houses with lightweight walls is greatly improved by the inclusion of insulation, wall insulation is not of paramount importance in producing the superior thermal performance, particularly in summer, in a heavyweight house that is typically constructed with full brick walls and a concrete floor.

6. Incorporate eco-efficiency principles into new buildings and housing (Cont)

- What are the impediments to eco-efficiency principles being taken up across new housing developments and commercial areas?

Response.

House construction methods. In relation to the adoption of heavyweight walls, the impediments are seen as the general public's lack of understanding of the concept of thermal inertia plus and, particularly in Eastern Australia, the house construction industry's familiarity with timber or steel framed walls. Also relevant is the fact that, while building regulations accept the superiority of heavyweight walls, they do nearly nothing to positively encourage their use. -/5

Hot water supply. In relation to wasted hot water, a wrong but well established belief in the superiority and status of a storage HWS plus simple resistance to change is seen as the principal impediment to improvement in these areas of water waste and energy conservation.

6. Incorporate eco-efficiency principles into new buildings and housing (Cont)

- What type of incentives or standards for new developments might be appropriate to encourage more sustainable residential complexes?

Response.

House construction methods. It seems unacceptable to make heavyweight construction mandatory, but a possible method of encouraging this change of construction practice would be to calculate the energy needed to control temperature in a well oriented house with good thermal inertia properties and. in all new houses, to increase the tariff on any that is used above that base amount.

House orientation. The evidence offered in this submission is not needed to establish the importance of orientation; many others have provided much more. To regulate for this seems likely to be too difficult but more encouragement is desirable. Perhaps achieving this objective would be assisted by the just mentioned possibility of a higher tariff for the energy used above what would be needed for a thermally efficient house which must be well oriented to achieve efficiency.

Hot water supply. On the basis of information provided in this submission, it is seen to be appropriate that the maximum distance between a hot water outlet and that water's source be regulated. Such a change seems likely to involve the use of hot water services different from those most commonly in current use. A solar-powered HWS will reduce energy use but will do little to reduce waste water without the inclusion of booster heaters close to the outlets.

6. Incorporate eco-efficiency principles into new buildings and housing (Cont)

- Are existing building standards and product labelling sufficient to enable informed consumer choices and to ensure that the use of eco-efficiency materials and designs are maximised?

Response.

House construction methods. I find it difficult to see how standards or product labelling are relevant to the case being presented. However, more positive official publicity describing the advantages of good orientation and thermal inertia resulting from heavyweight construction, as advocated in this submission, could assist in the broader acceptance of these beneficial practices.

Attention is drawn to the fact that, while the advantages of heavyweight walls are recognised because regulations for the inclusion of wall insulation do not apply to heavyweight walls, publications such as the Victorian Sustainable Energy Authority booklet *Energy Smart Housing Manual*, make no mention of this fact. It feels like a deliberate attempt to not "rock the boat" by emphasising the advisability of a substantial change to currently popular house building techniques.

Hot water supply. Hot water units could have two different star ratings with more stars being allocated only if the unit is located within a stated maximum distance from the outlet.

I commend this submission to the House of Representatives Standing Committee on Environment and Heritage.

Yours sincerely

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