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SUBMISSION ON

HOUSE OF REPRESENTATIVES
STANDING COMMITTEE ON ENVIRONMENT AND HERITAGE
Discussion Paper
Inquiry into a Sustainability Charter

The Built Environment.

My contribution to this Discussion Paper is restricted to matters within my experience, that is, the design of energy efficient houses that will enable greenhouse gas emissions to be reduced.

It is interesting to observe the Discussion Paper's statement about the environmental objectives of the Swedish Parliament, namely: "....handing over to the next generation a dynamic but sustainable society in which the major environmental problems have been solved". The Paper also speaks of the 1987 report by the World Commission on Environment and Development which states that sustainable development means "....adopting lifestyles within the planet's means" and that "....the current patterns of economic growth could not be sustained without significant changes in attitudes and actions." In relation to these observations I fell the need to observe that:

WE BUILD HOUSES THE WRONG WAY.

Summer Electrical Overload. Clearly one of the ways that we can reduce greenhouse pollution is by making our houses more energy efficient and much Australian effort has recently gone into new building regulations to make that improvement mandatory. However, there is good evidence that we have not yet got things right, mostly because we follow the lead of northern Europe and USA and concentrate on techniques for keeping warm in winter. We take too little note that winter heating does not cause power failures, but black-outs do occur as we run electrically powered air-conditioners to try to keep our unsuitably built and oriented houses cool in summer. Evidence of this power supply problem is given in *Solar Cities: Statement of Challenges and Opportunities* from the Australian Greenhouse Office, 2004. It says: "In South Australia for example the summer peak load (about 2600 MW) is almost double the average demand (about 1500 MW), while demand for electricity on a hot summer's day can exceed demand on a mild summer's day by more than 1000 MW."

We follow the Northern cold-winter lead by primarily regulating for the addition of insulation to our floors, walls and ceilings without giving enough consideration to the fact that all this does is improve the otherwise very poor thermal performance of lightweight timber (or steel) framed brick-veneer, a house-building method that, for thermal efficiency reasons, I argue is intrinsically unsuitable for constructing walls, particularly in relation to our comparatively hot summer climate.

An intuitive understanding of this truth has been with us since early settlement. Cox, Freeland and Stacey, in *Rude Timber Buildings in Australia* state that by about 1800 the practice was common for house walls to be timber framed with weatherboard external sheeting and the space between the studs filled with brickwork for the purpose of improving the wall's insulation. This statement, which follows the almost universal belief that only insulation can improve thermal performance, is not right because the empty air space in an internally lined stud wall has almost exactly the same insulation properties (R Value) as the single leaf of brickwork that the pioneers used to fill it. -/2

The brickwork's near zero change to the insulation value of the wall means that its presence would not have much effect on the winter heating of these pioneer houses. However, the thermal inertia of the dense heavyweight bricks would have made a significant difference to comfort during our hot summer days. Because of their high capacity to adsorb the heat inside the house during those days and release it to the atmosphere during the cool of the night, the bricks would be ready to do the same job when it got hot again on the following morning. They thus provided a continuously available cooling device that used no energy and, in those pioneering days with no air-conditioners to cope with the heat to which the new arrivals were unaccustomed, the coolness provided by the bricks' thermal capacity, not their insulating ability, would have been very welcome.

Years ago my interest in this topic began when I got help to use the pioneering thermal performance computer program TEMPAL to prepare *The Low-energy Full-brick House* by Cumming & McNeilly, published by The Masonry Society in the proceedings of the North American Masonry Conference at the University of Colorado in August 1978. TEMPAL enabled us to compare comfort in a simple well oriented and sun controlled house in full-brick with the same house in both brick-veneer and weatherboard construction. The performances of all three methods with no added insulation were compared with those when insulation was installed to bring all walls up to the same U-Value. TEMPAL uses winter and summer temperatures as recorded for Melbourne in 1968 - very similar to the currently official values - and what follows is selected from that paper's results to compare the performance of uninsulated cavity brick with insulated brick-veneer construction.

Winter (April to October) performances of the two construction types were similar except that with continuous, rather than intermittent heating, uninsulated full-brick slightly out-performed insulated brick-veneer. In summer (November to March) the story was very different: with no insulation the brick-veneer house would experience heat discomfort (temperatures higher than 27^0 C). in the living area on 43 days (nearly two days per week), lasting for an average 7 hours per day. Even with insulation, it would be uncomfortable on 31 days (nearly 1½ days per week), lasting for an average of 5½ hours. Insulation is thus shown to be not very good at dealing with our national problem with hot days.

By contrast, the heavyweight full-brick house with uninsulated walls, would experience discomfort on 10 days (one day every other week) that averaged 4 hours. The addition of insulation to bring the heavyweight brick house up to the same U-Value as the insulated brick-veneer does not bring much benefit. It would reduce discomfort to 8 days, lasting for an average of less than 2½ hours. This demonstrates that in our climate insulation is not as important as thermal capacity.

In these circumstances, the choice of a well-oriented full-brick house would help to save the planet by not needing a greenhouse-gas-generating cooling plant to be installed. By tolerating a few brief periods of heat discomfort they would be saving money as well as energy and would be spared the noise of the air-conditioner. This is much less likely to be the case with the lightweight version, even if it has, as is now compulsory, followed northern hemisphere practice and added insulation to its framed walls and floors to reduce, but far from eliminate, its cooling energy consumption. If there were more well oriented heavyweight houses with no air-conditioning, enough electricity could be saved for those of us with wrongly oriented lightweight houses to be spared the discomfort associated with air-conditioner failures during electrical blackouts. This problem is reduced, but far from eliminated, if our lightweight house is insulated.

It is recognised that the good performance of the heavyweight house reported above was dependant upon the occupier attending to closing the house down at the beginning of a hot day and then opening it up in the cool of the evening. Some are likely to be prepared to carry the cost of air

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conditioning rather than be bothered with personally driving the house, but for them, it would be cheaper to operate automated heat-sensitive electrically powered ventilation devices which would use a minute amount of energy compared with an air-conditioning plant.

Poor Orientation. Many, or even most, Australians insist that a "proper" house must have its front door, garage, formal living room and main bedroom facing the street and will not allow good orientation to control appearance. This submission repeats, with some abbreviation and slight elaboration, parts of the paper *Wall insulation in brick Houses in the Australian Climate* by Tom McNeilly in the March 2000 AIRAH Journal *Australian Refrigeration Air Conditioning & Heating*. That paper reports putting a poorly oriented house through the then current Victorian House Energy Rating Scheme (VicHERS) computer program in various forms of construction. As an ordinary timber floored brick-veneer with no floor, wall or ceiling insulation it achieved an appallingly low Zero Star Rating with a score of minus 112. By contrast, the same house in full-brick construction with a concrete slab-on-ground floor and no floor or wall insulation achieved a 3 Star Rating and a score of minus one. When insulated to the then mandatory Victorian building regulation requirements, the rating of the brick-veneer house went up to 3 Stars and the score to minus nine, showing that the regulatory requirement to insulate lightweight walls to improve thermal performance is justified although it does not produce as good a score as does the heavyweight full-brick house with no wall insulation. The result provides further evidence that insulation is not the only - or even the best - determinant of a house's thermal performance. Even with poor orientation, thermal mass is more effective than insulation in a climate such as ours where our major problem is dealing with hot summers, rather than cold winters.

Unsuitable Construction Methods. All of this shows that, in relation to energy conservation, our most common form of house construction with framed walls is unsuited to our climate. Adding insulation improves performance, but not to a level that would enable most to do without air-conditioning. We should learn from and build as do people with a similar climate to ours - the Mediterranean region - and use heavyweight walls with a solid floor in contact with the ground.

Insulation and Building Regulations. The evidence in this paper adds to that provided by others to show that we place a wrong emphasis on the belief that insulation is the single magic material required to produce thermal efficiency in house construction, but the notion still has currency. Building regulations begin their detailing of deemed-to-comply requirements for improved thermal efficiency by prescribing the amount of insulation that must be included in walls, floors and ceilings but, regardless of the method of construction, go on to give as an alternative the achievement of a specified Star Rating as determined by one of the HERS programs. Lastly and as a third alternative, regulations say that in most Climate Zones of Australia, if the floors and walls have substantial mass, as with slab-on-ground floors, brick internal and cavity-brick external walls, insulation need not be added to them.

The details provided in the foregoing descriptions of my investigations illustrate the intrinsic superiority of heavyweight walls and floors, of which full-brick on a concrete slab is the most common, but not the only form of heavyweight construction. The conclusion is based on Melbourne climate data, but the differences are not great for most of Australia south of somewhere as far north as Gympie or Maryborough in Queensland. Given the compelling evidence of the superior thermal performance of heavyweight construction and the fact that insulation only makes intrinsically unsuitable lightweight construction less inefficient, we should accept the truth of the matter and really help reduce greenhouse gas generation by having building regulations make heavyweight construction compulsory. If that would be too much of a shock to a carpenter dominated house-building industry, regulations should at least list it first as the preferred method, with insulation being required to be added to lightweight construction as the less preferred and poorer performing alternative.

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Cost. An inhibiting fact is that in the eastern states brick-veneer construction is usual and full-brick is more expensive. However, full-brick is normal in Western Australia where I have been advised that it would cost more to build in brick veneer. It would seem from this that, in relation to wall construction methods, what the building industry is accustomed to doing determines price.

It is worth noting that eastern state carpenter-builders now frequently accept thermally superior slab-on-ground floors, rather than the familiar, but less efficient framed and suspended alternative. Perhaps this is caused by public demand, but it is possible that it is because there is still carpentry in the slab-edge formwork and it saves them the non-carpenter task of digging stump-holes.

Orientation. Under virtually any circumstances it is believed to have been shown that uninsulated heavyweight construction out performs insulated lightweight framed walls, but to be most effective those heavyweight buildings also need to have good orientation. Consideration therefore needs to be given to compelling, or at least encouraging, better orientation of our houses to enable us to save energy by taking advantage of the controllable sunlight that is associated with a northerly aspect. By building our houses in these different and superior ways we would substantially reduce summer electrical consumption and greenhouse gas production with its associated climate change problems.

Encouraging Change. If compelling good orientation and heavyweight construction seems beyond the realms of possibility, steps could be taken to encourage their employment. Given that a well oriented heavyweight house will require little or no summer cooling, it would not be unreasonable to legislate for new houses to have separate electrical meters for cooling devices and to impose a substantially higher tariff on that use of electricity. Matters financial are beyond my expertise, but perhaps that higher tariff would provide some compensation to privately owned electricity suppliers for the reduced sales resulting from the energy conserving practices that I am proposing.

Architects and Heavyweight Houses. The current architectural aesthetic, compulsory for acceptance among one's colleagues as a good designer, does not appear to accept the views that awnings should be provided to control sun penetration in well oriented buildings. Nor does it approve of the computer simulation of thermal performance upon which most of my conclusions are based, even though they were developed within the School of Architecture at the University of Melbourne. In many cases lightweight sheet materials, preferably glass, are seen as the proper