NEWS ARTICLE

Achieving Thermal Comfort

& Low Energy Cost Outcomes

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www.claybrick.org

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Achieving Thermal Comfort and Low Energy Cost Outcomes

To achieve thermal comfort without mechanical heating and cooling and thus a more energy efficient house in South Africa's different climatic zones begins with understanding the local climate in which the house is to be situated, and the fundamentals in how building materials and combinations of materials perform.

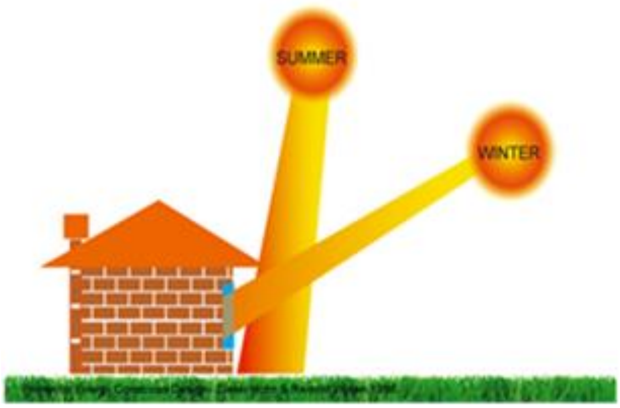
SANS 10400 XA Building Regulations recognizes the general energy efficiency of double-skin brick walls and SANS 204 "Deemed to Satisfy" Energy Efficiency Standards for masonry building provides the combinations of thermal capacity "C" (derived from thermal mass) and thermal resistance "R" for achieving the South Africa's energy efficiency goal.

Typical CR-Values	
Wall Type *Double-Skin Brick*	**CR Product** *Hours*
2 x 106mm with no air cavity	40
2 x 106mm with 50mm air cavity	60
above with *R*=0,5 cavity insulation	90
above with *R*=1 cavity insulation	130

Table 4 of SANS 204 & SANS 10400 XA : CR Product Table for Masonry Walls
An online CR-value Calculator is available for download at : www.claybrick.org

The combination of thermal mass and thermal resistance is part and parcel of a "rationally designed" building incorporating also the effective application of Passive Solar Design principals relevant to the climate and micro climate of the site. Through that process opportunity is provided for achieving superior thermal comfort outcomes cost effectively, mitigating mechanical heating and cooling and hence the least use of heating and cooling energy.

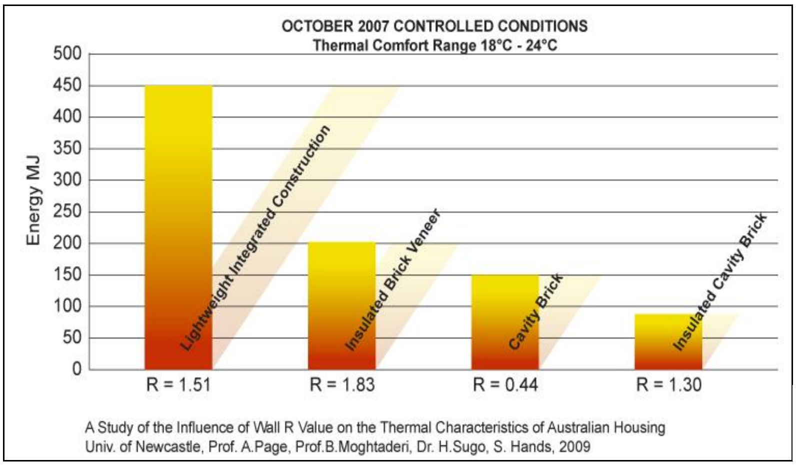
Achieving this energy efficiency at a low cost begins with the designer having a good understanding of Passive Solar Design principles where building orientation and shading are factored in to take best advantage of the sun's free energy for winter warmth and ventilation to capture prevailing breezes to keep the house cool in summer - is fundamental to an effective solution.



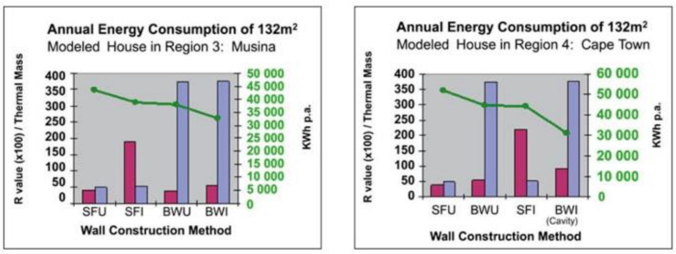
With regard to best building material choices for achieving such energy outcomes, understanding the fundamentals of how building materials perform as part of composite systems is also key. This understanding provides for those different combinations of materials best able to do the job with best pay-back over the lifecycle.

In the case of walling material combinations appropriate for the job, research provides some important insights. This research dispels the myth that the wall thermal resistance or R-value is the sole determinant of energy efficiency and elevates the value of thermal mass in the building envelope and combinations of thermal mass and resistance for specific climatic zones.

It demonstrates how Alternate Building lightweight walling systems (ABT) that rely mainly or solely on thermal resistance (R-value) for energy efficiency have shortcomings relative to higher mass alternates.



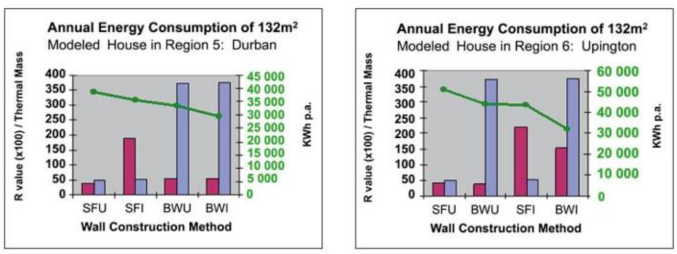
The energy efficiency of high mass walling constructions on the other hand, this a result of the thermal diffusivity of the masonry component (a property which is the combination of the density, specific heat and the thermal conductivity of a material), is found, with the appropriate use of insulation to provide greater comfort alleviating mechanical heating and cooling interventions.



		R-Value (m²K/W)	Thermal Mass (kJ/m³K)
SFU	steel frame dry wall uninsulated	0.4	50
SFI	steel frame dry wall insulated	1.9 / 2.2	51.5
BWU	brick wall uninsulated	0.38 / 0.54	374
BWI	brick wall insulated	0.54 / 0.9 / 1.54	375

R Value
Thermal Mass
KWh p.a.

Thermal modeling by Structatherm (Howard Harris), March 2009, using VisualDOE and the DME / CSIR approved 132m2 house with insulation to SANS 204 Part 2 DTS levels.



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This shows that Clay Brick masonry adds considerably more to thermal efficiency than previously thought. The 8 years of empirical study at the University of Newcastle in Australia into the thermal performance of different wall construction types of Australian houses under "real world" conditions, finding:

- Lightweight building (high thermal resistance, R-value, with no thermal mass in the walls) was the worst performer in all seasons.
- Brick veneer (thermal mass provided by adding one skin of brickwork to the external walls perform better than lightweight).
- Insulated cavity brick performed the best.
- Using Clay Brick for internal partition walls adds further thermal comfort no matter the external wall construction type. In the case of building modules with lightweight external walling, internal brick partition walls enhanced energy efficiency by 20 percent.

  (Reference: www.thinkbrick.com.au - Energy Efficiency and the Environment, The case for Clay Brick, Edition 4)

This research adds further credence to Clay Bricks pre-eminent status over lightweight building technologies such as Light Steel Frame Building (LSFB) for energy efficient house construction in South Africa.

Some rule of thumb pointers for achieving superior thermal comfort and lower energy usage through passive design interventions and the use of clay brick include:

- The home should be appropriately insulated for the climate zone. SANS 204 standards provide a route to greater energy efficiency through the application of the CR-value as per Tables 3 (below) and 4 (above).

Table 3 as per SANS 204

Minimum Thermal Capacity & Resistance (CR-Value) in Hours, for External Walling						
Occupancy Group	**Climatic Zone**					
	1	**2**	**3**	**4**	**5**	**6**
Residential E1-3,H1-5	100	80	80	100	60	90
Office & Institutional A1-4,C1-2,B1-3,G1	80	80	100	100	80	80
Retail D1-4, F1-3, J1-3	80	80	120	80	60	100
Unclassified A5, J4	NR	NR	NR	NR	NR	NR
Note: NR = No Requirement						

- It is recognised that different levels of insulation are important to the building envelope and that roofs should receive the major portion of this insulation. Greatest energy efficiency is achieved in mild climates if thermal mass is incorporated into the floors and walls to absorb daytime heat, keeping the interior cooler during the hottest part of the day.

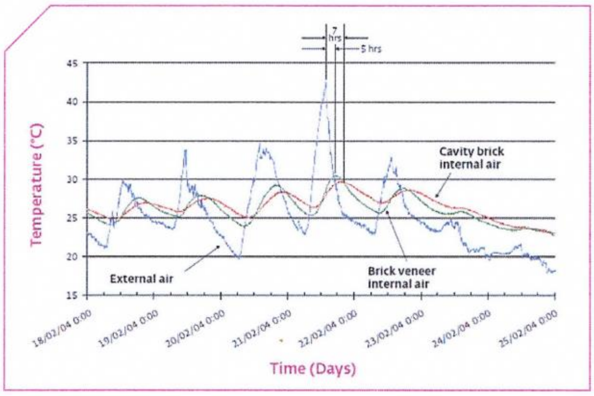

Figure 12 External and internal air temperatures for cavity brick and brick veneer buildings, February 2004

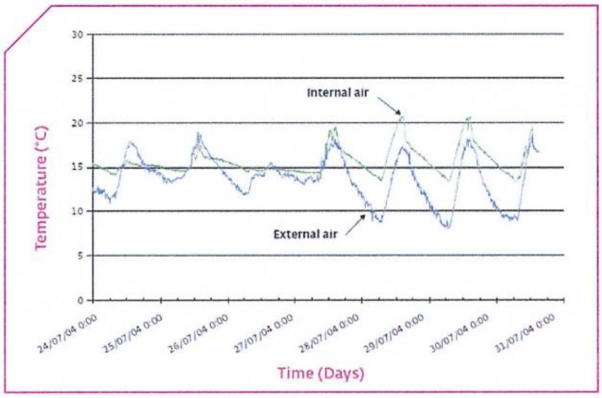

Figure 16 Internal and external air temperatures for the cavity brick building with north facing window in winter

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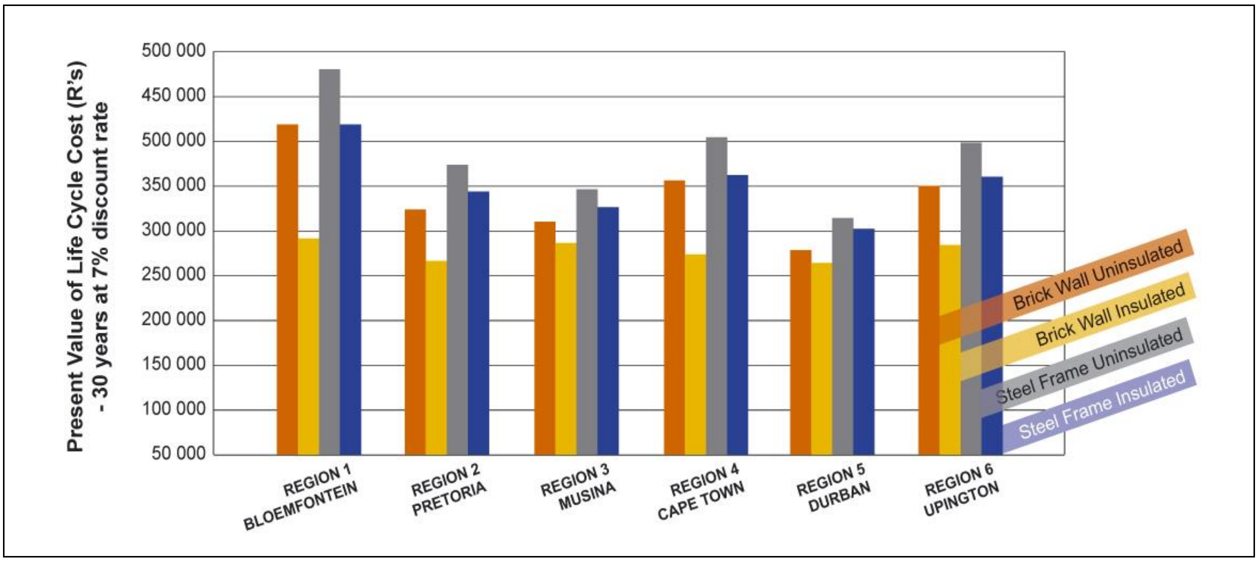
By contrast insulated lightweight walls, as associated with LSFB, have been found through both empirical and modeling research to lack propensity to “self-regulate” in South Africa’s hot summer conditions leading to “hot box” conditions. .



Thermal Modeling by Structatherm (Howard Harris), March 2009, using Visual DOE
& DME/CSIR approved 132m² house with insulation to SANS 204 Part 2 DTS levels

The above research coupled with modeling undertaken by WSP Green-by-Design, shows that insulated lightweight walls associated with frame building techniques result in “sub-optimal” energy outcomes.

- In the cooler months, good insulation in the roof and, to a lesser extent in the walls, together with thermal mass has been proven to help stabilise house temperatures inside and offset heating required at night time. Insulation in the ceiling is a significant contributor to thermal comfort during winter.

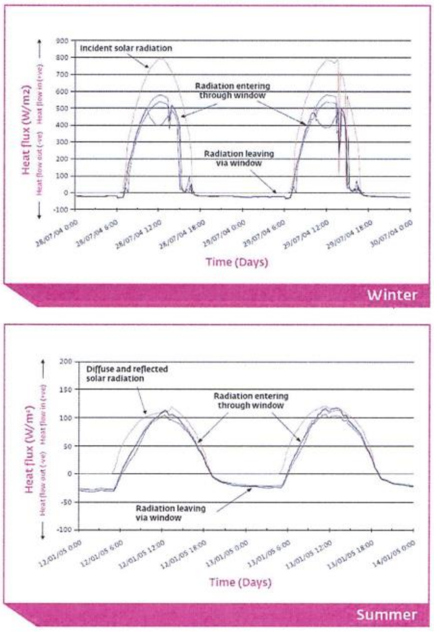


Figure 17 Heat exchange via the window for cavity brick building with north facing window

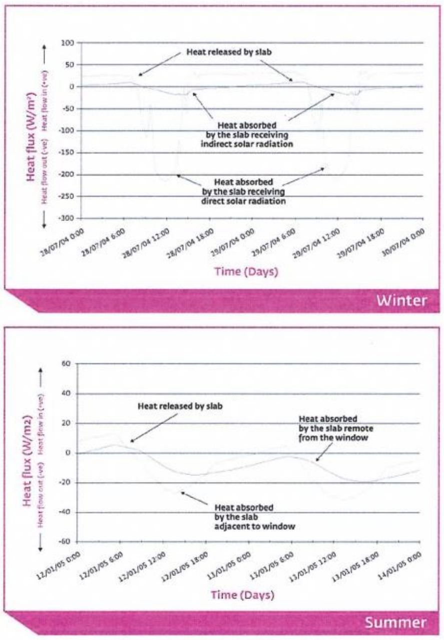


Figure 18 Heat exchange via the slab for cavity brick building with north facing window

Illustration from Think Brick Australia that shows heat loss without insulation and with insulation

- The orientation of the home together with the positioning of high thermal mass elements should maximise the benefit of the sun in winter and windows should be placed to capture the prevailing breezes in summer. North facing living areas will allow winter sun to penetrate the high thermal mass elements inside the house (such as double Clay Brick walls and/or concrete floors) to gain and store warmth for release during cold nights, providing "free" heating for the house and thus reducing energy consumption.

- Openings (doors/windows) on those elevations where the breezes most impact can cool the home through good cross ventilation in summer.

- Ideally shading should be provided over the openings in summer to avoid unnecessary heating. South Africa's mainly sub-tropical positioning requires that good shading is provided on North, East and West windows. Shading of the North facing fenestrations is however only required in the summer months and hence retractable shading devices should be considered for providing this shading.

The bottom line is that double-skin Clay Brick construction with appropriate insulation for a particular climatic zone affords greater energy efficiency than comparable lightweight building in all climatic zones of South Africa, and affords the best opportunity to eliminate mechanical heating and cooling. This thermal performance of Clay Brick construction together with the cost-effectiveness of such construction in South Africa, the solidity and structural integrity of brick construction to endure extreme weather events and its reputation for preserving investment value, makes Clay Brick construction the sensible way to provide energy efficient housing in South Africa.

Ends.