FACTSHEET #11

The balanced truth about ABTs

Over the years there had been an on-going stream of Alternative Building systems [ABTs] that claim superior performance over clay brick, lower construction costs and better life time economies. None of these have yet stood up to the challenge of providing comparable quality infrastructure with equal sustainability attributes and equal all round competence.

CLAY BRICK VS ABTS – THE BALANCED TRUTH

The record of clay brick construction in providing sustainable superior quality infrastructure - schools, clinics and houses across South Africa is well evident. This life time cost effectiveness of clay brick infrastructure is underpinned by the proven holistic basket of benefits intrinsic to fired clay and clay brick's unique propensities to function as an enduring structural and decorative walling element at the same time. Clay brick construction cost benefits coupled with enduring performance attributes presents clay brick in buildings as superior, right and proper for South Africa's unique conditions.

Over the years there had been an on-going stream of Agrément SA certificated Alternative Building systems [ABTs] that have claimed superior performance over clay brick construction, lower construction costs, better life time economies and such like. None of these have yet stood up to the challenge of providing comparable quality infrastructure with equal sustainability attributes, equal all round competence, and heart and soul.

The Clay Brick Association of South Africa takes a closer look at three of the more high profile ABTs that claim superior performance over clay brick construction to try to understand whether there is any substance behind their superior performance claims.

LIGHT STEEL FRAME LIGHTWEIGHT WALLED BUILDING (LSF)

This is the system that SASFA claims provides substantially superior thermal performance to clay brick construction in all its forms (Refer Steel Construction Vol 35 No 6, article: "CSIR Research confirms the superior energy efficiency of steel frame building". The claims are based on CSIR thermal modelling research undertaken for SASFA using Ecotect™ V5.6 modelling software. Ecotect™ V5.6 modelling software is neither ASHRAE nor Agrément SA compliant.

The outputs of this Ecotect™ V5.6 modelling software have, on review, been found to be significantly at variance with 8 years of empirical study at the University of Newcastle, Australia - Priority Research Centre for Energy, and a plethora of thermal modelling undertaken both in South Africa and Australia using ASHRAE and Agrément SA compliant modelling software.

The significant Newcastle University research, undertaken in a moderate climatic zone, involved the on-going temperature measurement of four separate, identical building modules differing only by wall construction types. Internal and external temperatures were measured continuously, without heating or cooling. The outputs had a correlation with those attained using ASHRAE compliant thermal modelling software.

In a comparison of different modelling software established that the Ecotect™ V5.6 software produced results 60% at variance with the average score of the outputs of the studies using ASHRAE and Agrément SA compliant modelling software.

Two reviews of Ecotect™ V5.6 software presented below suggest that the comparative outputs of the software are inaccurate.

1. Assistant Professor Juintow Lin in her book "Introduction to Ecotect™ V5.6 modelling software" states:

   "Ecotect™ V5.6 is a tool for architects to test their designs. It is not a validation tool to extract absolute values. It should not be used to determine the amount of energy used i.e. watt per day etc".

   "Ecotect™ V5.6 uses a simpler algorithm Admittance Method for its thermal calculations while the other programmes (namely DOE-2 and Energy Plus) use ASHRAE formulas". (All the studies referenced by the Clay Brick Association of SA and Think Brick Australia used programmes that used ASHRAE formulas)

2. Consulting Engineer Dr. Alec Johannsen's assessment states:

   "The Admittance Method as an application to Ecotect™ V5.6 software is a frequency response method for calculating cyclical response to a periodic pattern of external variations. The outside boundary conditions are assumed to fluctuate in a repeating 24-hour cycle pattern. These methods are simplified by current standards and cannot be expected to get accurate results except in limited range of circumstances'".

   "In reality during an annual energy simulation, the outdoor thermal environment changes continuously on an hourly and daily basis. These variations can be highly irregular, far removed from the sinusoidal pattern assumed in the Admittance Method".

   "Based on the general principals of the Admittance Method, the key assumptions of this method related to heat conducted through the walls are generally not valid during an annual energy simulation".

   In comparison, "Visual DOE-2 and Energy Plus software uses the State Space method for computer calculations. The equations within the State Space method for calculating Conduction Transfer Function (CTF) co-efficients efficiently account for the "unsteady heat conduction through multi-layer walling constructions and annual energy simulations of buildings".

It is reasonable to conclude that the Ecotect™ V5.6 modelling software does not have the requisite equations to take into account the behaviour of thermal mass in walling envelopes i.e. how heat diffuses (slowly) through elements of high thermal mass, how it is slowly absorbed stored and released and in the process provides longer period of thermal comfort in all of South Africa's 6 major climatic zones.

It is a programme that seems rather to emphasise the R-value as the all-important thermal performance property for achieving superior energy efficiency in climates akin to South Africa. Empirical research at the University of Newcastle debunked that notion, as did the thermal modelling of two house floor plans, located in three climatic zones and four orientations done as part of the Energetics full Lifecycle Assessment.

Compared to insulated lightweight walling, un-insulated cavity brick walling envelopes afforded longer periods of thermal comfort and lower heating and cooling energy usage in most situations while insulated cavity brick (R1.3) outperformed the insulated lightweight in all situations.

The superior performance claims made by SASFA in respect of LSF are neither supported by rational deduction or empirical evidence or modelling that has used ASHRAE compliant software.

MIBT

The second ABT reviewed is MIBT promoted as being the "highest certified Agrément SA system". MIBT presents their lightweight concrete panel with fibre cement finishes as having a "better thermal ratings than clay brick" (Refer MIBT advertisement, Housing SA, July 2014). The latter is seemingly done to infer, suggest, or lead the reader to believe, that these wall panels (Mi Panel) will, because of their claimed 'better thermal rating than clay brick', afford occupants greater thermal comfort and generally lower heating and cooling usage than the most basic clay brick house with 230mm external walls.

The Agrément Certificates 2010-376 and 2011-400 pertaining to the thermal performance of these particular wall panels (Mi Panel) contradict this. A reading of the Agrément Certificates confirms that these panels do not provide a house with greater thermal comfort and energy efficiency than a CSIR standard brick house (SBH) comprising 230mm un-insulated double brick walls with no ceiling insulation.

Table 2: Habitability section - Thermal Performance and Energy states that: "the thermal performance of both panel system buildings without insulation in the ceiling is inferior to that of a standard brick house and will perform better when insulated ceilings are installed. The

energy required to heat both panel built system houses un-insulated ceilings will be up to two times that required to heat a standard brick house".

"When fitted with insulated ceilings however heating energy will drop to about half that required to heat a standard brick house". Thus insulation applied in the ceiling of this system house is what provides thermal performance and not the supposed higher thermal rating of the wall panels (Mi Panel) as claimed.

So much then for this Alternative Building System that purports to have the 'highest certifications from Agrément SA'. It begs the question as to just how good then the thermal performance of those walling systems, as applied to all the other 'lesser' certificated ABTs, might be?

KWIKSPACE

The third ABT that was reviewed was Kwikspace, this for no other reason that Kwikspace advertise clay brick as "only useful as a doorstop" [Refer Engineering News March 2014]. This advertisement presents Kwikspace's walling system as unequivocally superior to the very best clay brick construction can offer for sustainable infrastructure. This has to be a first where an ABT lightweight prefabricated building system produced for caravan type accommodation - labour camps, site offices and such like - claims superiority over clay bricks proven competence in construction.

It takes just a day spent in a Kwikspace type school classroom to appreciate just how compromised the learning and teaching environment provided by this type of building technology really is. Clay brick construction quite simply provides a far better infrastructure than that which Kwikspace can ever bring to the table.

These are just three examples of disconnect between the claimed performance of ABTs and reality. The truth of the matter is that clay brick construction in its most basic form - namely 230mm solid walling with a face brick exterior, provides superior lifetime performance at a lower lifetime cost than ABT lightweight walled offerings.

The thermal performance of clay brick buildings with brick walls in their most basic form, proven so effective for moderating internal temperatures for longer during hot summer days, can, as shown in both the empirical and thermal modelling research, be further enhanced.

Retrofitting ceilings with insulation can help reduce heat loss through the roof in winter, while cavity construction and the application of insulation in the cavity in compliance with SANS 204 Energy Standards for masonry buildings [voluntary standard] for the climatic zone, can take the total performance package of clay brick construction way beyond that of ABTs in compliance with SANS 204 Energy Standards.

The full Life Cycle Assessment of clay brick products in Australia well established the "lifetime competence" of double skin clay brick construction in assuring a low total carbon footprint (embodied and operational energy) over the life of buildings while research by WSP Green by Design in South Africa of different wall construction types for low cost housing, found that clay brick construction outperformed LSF to provide a lower total carbon footprint over a 40 year lifecycle (Refer Low Cost House Modelling Project – WSP Green by Design, June 2010 commissioned by Corobrik).

A pointer to where lightweight walled ABTs probably fit in in relation to clay brick walled buildings is in the energy ratings given to the different show houses that were part of the Landcorp Western Australia development in Seville Grove Estate, Perth for different housing manufacturers to demonstrate the environmental compliance of their offerings.

Unfortunately the website that presented the wall specifications and the corresponding BERS thermal ratings of the different house types is no longer available as is the website www.jadeprojects.com.au. None the less the CBA of SA has downloaded copies. Reference of the 8 Star House built of brick can be found at www.righthomes.com.au/jade808.

Of the 7 show houses that were built in steel frame with different lightweight walled composites, the energy rating received was between 5 and 6 Stars. The one and only double skin clay brick house, with insulation applied in the cavity to provide a CR Product comparable to SANS 204 Energy Standards [voluntary] for masonry buildings, received an 8 Star energy rating per the Building Energy Rating System as applied in Australia.

ABTs, notwithstanding their Agrément SA certification, present, under real life scenarios, a compromise to Clay Brick constructions comprehensive basket of sustainability benefits and proven all round performance in South Africa's demanding conditions.

This was clearly evident in a review of the overall performance of schools built with ABTs over the past three years. Their often shoddy build quality, the wide evidence of cracks through wall panels and between wall panels and high associated maintenance costs [one new school in the Eastern Cape has been extensively patched up and repainted no less than twice in three years], the noticeably higher temperatures inside the classrooms that provided for uncomfortable teaching and learning environments, suggests there is just no good economic, social or environmental reason to forgo the fundamental worth that clay brick construction brings to infrastructure buildings – schools, clinics and houses in South Africa. The Governments push for 60% of all future infrastructure to be built in ABTs will surely come with long term economic consequences.

For further information:
The Clay Brick Association of South Africa
Website: www.claybrick.org