TESTING OF RENDERED STRAW BALE WALLS TO COMPLY WITH AS3959

Bohdan Dorniak - South Australia

Background
The Australian Standard AS 3959-1999 “Construction of Buildings in Bushfire Prone Areas” was introduced in November 1999 superceding AS3959-1991. This Standard was then referenced into the Building Code of Australia (BCA) in Amendment No. 6 in January 2000 and is able to be enacted into all States/Territories. A further amendment was made to the Standard in June 2001.

Planning Regulations and Designation of Bushfire Prone Areas
In South Australia, certain areas within Local Government (council) areas have been designated as Bushfire Prone – and any residential development requires referral to the Country Fire Service (CFS). Councils may or may not take cognizance of CFS recommendations (for approval or refusal) of any residential development within these Bushfire Prone areas.

The First Stumble
We were engaged in January 2000 by clients to design a Strawbale house in the Adelaide Hills. It was in a designated Bush fire prone area. There were some trees on site, the land had a fall somewhere in the order of 1 in 10, what we would consider as a low Bushfire Attack area. To our surprise the site was assessed as being of a Medium Busgfire Attack Category, and was also rejected by the CFS as there is no mention of rendered strawbale walls under Section 3.5 “External Walls” of the Standard.

A copy of the SHB AGRA Inc Engineering and Environmental Services Group (New Mexico, USA) Fire Test on Stucco Coated Strawbale Wall Panels completed in 1993 and the accompanying video was dispatched to the CFS’s Assessment Unit. After several weeks and phone calls these documents were returned and the project was not approved.

The comments from both CFS and the Council rejected any use of strawbale walls in any designated Bushfire Prone Areas. We realised that this ecologically sound material was no longer an option for walling.

Two options were available to us:

1. Constructing a veneer onto a strawbale wall of a known framed material with a cladding such as metal, cement sheet or other light weight claddings.

Or

2. Fixing a sarking material directly to the strawbale wall and then rendering the wall only allowed for a medium fire attack category

Both these methods were trialled and planning and building approvals were granted but both found to be unsatisfactory and particularly not aesthetically pleasing nor technically adequate.
The Beginnings
Rather than losing out to a technical hitch in the Standard, discussions were held with the main objector the CFS and the council it became obvious that a test as prescribed in the Standard would be necessary.

The Process
A recognised testing authority in Australia for materials testing was the Building Construction and Engineering Division of the CSIRO at North Ryde, NSW. This group was approached for a quote to test three different render types on standard wheat strawbales. A quote was received.

The South Australian Government was approached for a grant through an “Energy Research Grant”. This was successful and the South Australian State Energy Research Advisory Committee (as part of the Department of Primary and Resources SA PIRSA) granted 50% of the required monies. The preparation of the registration was assisted by Lance Kairl.

The results of receiving the grant was posted on the Earthgarden website and soon there were volunteers in NSW to construct the samples they were Mark and Irena Spry (currently Irena is the Vice President of AUSBALE) and Frank Thomas a strawbale builder and a past NSW member of AUSBALE.

The rendering of three different renders on strawbales is no easy task, and it took over three months to finalise the samples to reach a high level of finish

The Sample Bales.
It was decided that the most popular renders used in our experience would be tested for the CSIRO tests;

Earth Render
The mixes that were used were:
Scratch Coat Soil
Other Coats 3 Sand : 1 Soil
Final Coat 4 Sand : 1 Soil
The soil had a clay content of 43%
The thickness of this render was minimum 40mm and maximum 59mm as measured by CSIRO

Lime Putty
The mixes that were used were:
Scratch Coat 3 Sand : 1 Lime
Other Coats 3 1/2 Sand : 1 Lime
Final Coat 4 Sand : 1 Lime
The lime used was slaked lime putty.

Lime/Cement
The mixes that were used were:
Scratch Coat 5 Sand : 1 Cement : 1 Lime
Other Coats 6 Sand : 1 Cement : 1 Lime
Materials used Portland Cement, Hydrated Lime.
The nominal size of the rendered bales being approximately 950mm X 450mm X 570mm and because of the testing procedure it was decided to render the bales on all six sides.

**TESTING PROTOCOL**

The testing protocol was based on CSIRO research on the radiant flux emitted by various categories of Bushfire attack. The Bushfire Authorities Council (AFAC) have prepared a draft document that recommended that materials would be exposed up to 29 kW/m2 for a period of ten minutes. And consequently a simulated fire test was designed. This was the basis for the testing procedure.

The heat source used was a gas fired panel that emitted the required 29kW/m2 and as an added test a pilot flame was to be passed over the exposed surface to detect any ignition of surfaces materials.

**TEST DAY**

On the 25th July 2002, some eighteen months after the introduction of the Standard, the first building material to be tested by this method was rendered Straw Bale. The first sample bale to be tested was the earth rendered bale followed by the lime/sand and cement/lime/sand rendered bales. All passed the test without ignition, cracking or other visible deformation.

Other rendered bales after the standard testing underwent more stringent testing - holes were drilled through the rendered surfaces and exposed to longer periods of heat flux. There were no visible deformation.

These tests were observed by myself, Lance Kairl, House of Bales who helped with the collection of donations, Frank Thomas who built, rendered, transported and supplied materials for the rendered bales and for a short time Mark Sprey who donated time and the building site for the bales. Another interested party who witnessed the testing was Brian Menadue (from the Country Fire Service, South Australai) who travelled from Adelaide.

All present at the testing site were relieved that all the rendered bales passed with flying colours and the remainder of the report writing, etc., was left to the experts, namely Dr. V. Apte, Brad Paroz, Glenn Whittaker and Justin Leonard of CSIRO. The final report after amendments was received in November 2002.

**AS 3959 EXPLAINED**

The Standard sets out requirements for the construction of buildings in designated bushfire prone areas.

Each site within a bushfire prone area will require an individual site assessment to determine the category of bushfire attack: either low, medium, high or extreme. If the bushfire attack category is classified as Low then no protection is required under the standard. If the category is classed as Medium, High or Extreme then protection in accordance with AS3959 is required. I am aware that each state has variations to the standard. The testing of the rendered strawbales has established that they are not flammable and withstand the prescribed 29kW/m2.
The following is a synopsis of the sections and contents of the Standard:

SECTION 1 “SCOPE AND GENERAL
This section describes the objectives, referenced documents and definitions.

SECTION 2 “SITE BUSHFIRE ATTACK ASSESSMENT”
This section describes the procedure for determining the bushfire attack category and the level of construction that is required.

There are three parts to assess:

1. **Identification of the predominant vegetation class** within 350 metres of the house site. There are 28 classes of vegetation- from “Tall Closed Forest” to “Sparse Open Herbfield”.

2. **Determine the distance from the predominant vegetation.** (That is from the edge of the foliage to the site).

3. **Determine the average slope of the land.** This is the slope between the site and the predominant foliage. A surveyor’s levels can help in this section, particularly if the site is close to the 10 degrees (a slope of 1 in 5.7).

SECTION 3 “BUILDING CONSTRUCTION”
This section sets out the requirements for the construction details for various building elements.

For Medium Bushfire Attack LEVEL 1 Construction is required
For High Bushfire Attack LEVEL 2 Construction is required
For Extreme Bushfire Attack LEVEL 3 Construction is required

The building elements that are covered include:
1. Flooring Systems
2. Supporting Posts, columns, stumps, piers and poles
3. External walls, windows, doors, vents and weepholes
4. Roofs including rooflights, eaves, fascias, gutters
5. Verandahs and decks
6. Service pipes (water and gas)

APPENDIX B
Describes the variances for the different states including Victoria, NSW, SA and QLD.

In South Australia we assess the site for bushfire attack and submit with our design drawings lodged for Planning approval. These are forwarded to Council who in turn forward to the Country Fire Service for their assessment. The planning approval process for projects in bushfire prone areas has been extended from a non complying use of 8 weeks to 12 weeks so that CFS can comment on the bushfire attack category.

Our practice has worked together with Councils and the CFS for acceptance of rendered strawbale walls in all council districts.
I would like to thank all who made donations and gave encouragement. I will be available during this conference to discuss the results and the report.