COX ARCHITECTS: BUSHFIRE RESILIENT BUILDING DESIGN

AUSTRALIA IS NO STRANGER TO BUSHFIRES. HOWEVER, THE SUMMER OF 2019-2020 PROVED TO BE UNPRECEDENTED IN MANY WAYS. BY MID-FEBRUARY 2020, THOUSANDS OF BUSHFIRES ACROSS THE COUNTRY HAD CLAIMED THE LIVES OF OVER 30 PEOPLE AND A BILLION ANIMALS, AND BURNT AROUND 20 MILLION HECTARES OF LAND.

WITH APPROXIMATELY 3,000 HOMES AND SEVERAL THOUSAND OTHER BUILDINGS DESTROYED ACROSS THE COUNTRY, THEIR REBUILDING WILL INEVITABLY REQUIRE CAREFUL AND CONSIDERED BUSHFIRE DESIGN SOLUTIONS, SUCH AS THAT DEVELOPED BY COX ARCHITECTS.

In 2005, Cox Architects commenced work on a research project to create a construction system and building design suitable for bushfire prone areas.

According to David Cox (Director, Cox Architects), "I was really frustrated that Australians kept constructing buildings in fire rated areas, they'd get burnt out, and then simply re-built in exactly the same way again. So, I started the research and development project to do something positive—to lead the industry into doing something to fix the issue."

"Initially, the project was a purely theoretical one. I started by examining buildings under fire to determine where they were failing. We quickly discovered that the standard method for building houses in Australia just won't withstand bushfires. What we need to build to withstand fire is way beyond our typical timber framed, trussed roof houses. The materials are all highly combustible, but it's not just this that is a problem—it's also the way the materials are joined together that causes issues. The typical method of construction just won't work. So, we decided to take a clean sheet of paper and start again."

"When we started, about 98% of all research was focused on getting people out of buildings in the event of a bushfire. There really wasn't any research being done on protecting people within a building by preventing the bushfire from getting into the building. So, we really had to start from square one," said Cox.

"In typical domestic buildings, which are constructed using brick exterior walls on concrete floor slabs, one of the main weak points in the construction method is in the connections: where the eaves and the roof joins, for example. Further, if the whole structure is put together using timber stud frames, this creates an inherent combustibility problem. If fire reaches the timber studs, this also weakens the brickwork veneer walls causing the structure of the building to fail. There only has to be one small opening that allows the fire to get into the building, for the whole building to go up in smoke."

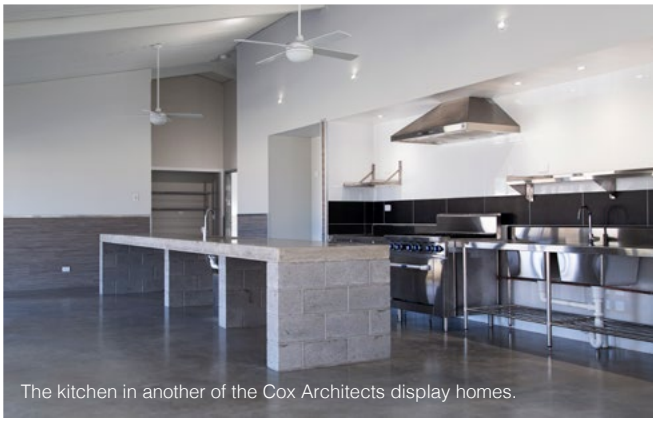
"In comparison, our construction system was developed to prevent fires coming into a building. The external façade had to be water tight, and fire tight, and had to withstand exceedingly high temperatures of a bushfire for a short space of time. This meant that there were a lot of materials we couldn't use. So we designed a building envelope,

> **"We designed a building envelope, with both walls and a roof, that acts as a protection system for the whole building. It is sort of like a hull of ship, placed upside down—instead of a ship going to sea, it's a house surviving fire," said Cox.**

The exterior of the Xanthorrhoea One display home.


David Cox (Director, Cox Architects) stands next to the fire shutters he invented for the Xanthorrhoea One.


The kitchen in the Xanthorrhoea One display home.


The kitchen in another of the Cox Architects display homes.

with both walls and a roof, that acts as a protection system for the whole building. It is sort of like a hull of ship, placed upside down—instead of a ship going to sea, it's a house surviving fire," said Cox.

"Wherever possible, if we could buy products or materials off the shelf, we did. If we couldn't, we invented something, like the shutters. While the shutters look simple, no one had invented such a system. The smart inventions are often the simple ones—more thought often goes into simple solutions."

THE USE OF STEEL IN THE DESIGN

Cox Architects relied on steel as an essential element of the fire resistant design, using cold-formed structural steel sections and steel roofing materials.

"We didn't propose to simply just replace timber with steel. Steel deforms under high temperatures, but if it is protected using composite materials, then it retains its resilience and strength. In addition, if steel is used in the critical elements of the structure, then its advantages can be leveraged," said Cox.

"In a typical residential house, there are thousands of connections. Some are stuck together with glue, others with nails. There are an indeterminate number of connections that you're not certain about because you don't know when the nail will rust, when the glue will break down, or when the timber will rot. With steel, you can greatly reduce the number of connections and you can engineer these connections to a known strength and a specific lifecycle."

DISPLAY BUILDING CONSTRUCTION

Once the design of the theoretical construction system was complete, Cox Architects tested the system with the construction of a full scale building, dubbed the 'Xanthorrhoea One'.

"We completed the first display building in 2011—Xanthorrhoea One—which was a demonstration of our theories," explained Cox. "The display home had two stories for use in civic buildings, but the system could easily be adapted for use in a single storey building," said Cox.

Xanthorrhoea One demonstrated that the construction system is suitable for a range of different small building types, from police and fire stations, through to schools and other civic buildings, as well as residences. The construction system and building design was evaluated by an independent statutory body and found to pass the most stringent requirements for withstanding bushfires in Australia.

"As a result, we lodged patents because there was so much work that went into designing and building the system. The patents also permit some flexibility in terms of how you put the building together and material use" said Cox.

In addition to its very high resistance to bushfires, the Cox Architects construction system offers several other important advantages. It is termite resistant, very low maintenance, highly insulated against heat and cold, ecological, fire resistant from the inside, suitable for remote locations, and highly durable. It also offers high resistance to other natural phenomena such as cyclones and floods.

A NEED FOR INDUSTRY PARTNERS

Cox Architects is seeking industry partners to further implement their long established research.

"I need steel industry operators to collaborate on this project, whether you're a roofing company or a component manufacturer. I know that we can build the system – Xanthorrhoea One proved this. The question now is: how can we produce the system economically? We need to reduce the building costs to create a high performance building that is also economical. If some sections and connections could be bought off the shelf—rather than using individually hand-crafted prototypes—then it would reduce the costs enormously," said Cox.

For more information, visit: https://www.coxarchitects.com.au