Bushfire Resilience Inc. Webinar 2 2020 Presentation 1

How to harden an existing house

Chair: Malcolm Hackett OAM

Presenter: Dr Justin Leonard

I've spent roughly 26 years delving into the nooks and crannies of how to improve our houses in the wake of bushfires.

In terms of a bushfire itself, we do a unique thing and actually study bushfires from the perspective of the house. So, what is it like to experience a bushfire from the house's perspective? And, I guess once you put that lens on, you start to imagine what experiential processes this house will experience, and what are the mechanisms and processes of how it might respond to those things. And, I guess, as you look into it, it's a far more complex set of actions and processes than simply a fire front turning up and spraying some embers around. There's so many extra nuances around the specific location of the house, and its proximity to other what typically are non bushfire elements that either play roles as barriers or as additional fuel sources in those environments. I'm going to focus on all those processes, and how to harden a house and prepare its surroundings to eliminate the potential negative impacts of those other processes.

Now, if we list these processes out, this is a fairly good profile of what we're up against. Ember attack. Debris accumulation, which happens over the months and years building up to a bushfire. Surface fire, which is the low level surface fuels that are burnt out when fire fronts arrive, and it helps, and ignited and reignited by embers.

Consequential fire might be a new term you haven't heard before, but it's the term we use to describe heavy fuel elements that burn near houses and present an additional heat load might be radiant heat or flame contact or it might challenge someone's ability to leave a burning house. But a consequential fire is all what we call heavy fuels, and that might be a vehicle or a fence, or a retaining wall, or even a wheelie bin. So, consequential fire is a very important aspect of preparing a home, or having a home adequately built to resist.

Radiant heat is what we all come to know and understand. Radiant heat from a fire front some distance away.

The flame front and its ability to contact the house.

Wind action, which is a very important process that's almost ubiquitous in bushfires, where these winds can directly act on the house and weaken them. And, of course, tree strike.

So, I've actually listed them in a deliberate order, from the ones that are most prevalent in causing structural loss through to the ones that are least prevalent. So, this gives us a bit of a guide to move through a list, from the most crucial things to begin and address first, and move further and further down the list to the lesser important ones. But, of course, for all circumstances I'd strongly encourage you to work through the entire list.

So, in terms of the process of trying to unpack, how do we solve each of these actions? It's important to recognize that they're not all created equal in terms of the best way to approach them. And, what I've put up here is a profile of whether a particular attack mechanism is easier to resolve

through house design and upgrade, or modification, or it's more easily addressed through landscaping and removal of it as an action on the house.

Now, if we move through these, it becomes fairly clear ember attack, which is quite a prolific process in the landscape, and embers are spraying everywhere in a bushfire context, it's almost impossible to imagine that we could eliminate ember attack by clearing enough vegetation and enough sources of embers. It's just simply not a practical process to go for elimination from a landscape approach. However, solving it from a house design perspective is relatively straightforward. So, that's why we have an 'X' leaning well over against the house side of the process.

Conversely, if we look at something like tree strike, at the bottom of the list here, you can imagine that designing a house strong enough to withstand tree strike is near impossible. However, managing the trees and providing a sufficient buffer by managing the trees in the landscape side of the process is relatively straightforward. So, this just gives us a nice handy guide and I'll come back to this a few times throughout the presentation.

Now, let's start by also considering that these ember attack processes are obviously very important for house survival, but they are actually absolutely critical for occupant survival. So, not only is a house potentially experiencing all of these processes, but an occupant, if they're forced to leave their house during a fire event because the house may actually ignite and start to burn down will be faced with these very same actions. So, we have to think that we're doing these mitigation processes both for the house's benefit but also to make an improvement in the potential for occupant survival.

And, this graph is one of my favorite graphs to display how, as we move through the categories of fire weather severity, how the potential for life and house loss escalates. So, one of these profiles is life loss and the other one is house loss, ranging from zero to a hundred percent of all the loss that we've studied across the history of Australian fires.

So, we can see that the context of actually planning and preparing our houses for the pointy end of this process, up around the Extreme in Code Red, is particularly important. Therefore, having those types of fire weather severity in mind when we're planning and upgrading our house and modifying our landscape, it really needs to be able to perform and be effective under those categories: when the winds are very severe, the landscapes are very dry and the fires are very aggressive.

The other important context to focus on is that of the people that lost their lives outside. So, not with the benefit of their house, either because the house burnt down and they were forced out to try and survive outside, or they were trying to get back to their house, or they were in the process of defending their house and weren't able to make it back inside. The vast majority, well over 60% of the people that died outside anywhere in Australia, were no more than 100m from their own house. That's not, "any house," it's, "their own house." Which really helps us focus on this idea, that not only the house's survival but the landscape immediately around the house is critical in contributing to your prospects of surviving a fire.

Now, this isn't to negate the idea that we shouldn't be anywhere near a Bushfire Prone Area while one of these fires is active in your landscape, but in the event that those processes and plans didn't unfold the right way, you have the fallback plan of, potentially, a well designed house and a well prepared landscape that you could survive within if you were in the immediate surrounds of your house. This graph also highlights how approximately 80% of all fatalities outside were no

further than 500m from your own home as well. So, quite startling statistics about how important the local landscape around you is in these severe fire events.

So, back to the mechanisms and we're going to address ember attack and debris accumulation first. So, these two processes are predominantly focused around “House”: what we can do with the house. So, we can do a little bit with debris accumulation by removing overhanging trees, but most of our work is trying to prepare a house to be adequate to withstand ember attack, and to be tolerant to some amount of debris accumulation.

So, photos like this show the obvious implications of adjacent and overhanging trees. And, even if they're plants that are well considered, if they are overhanging and can deposit their debris on the structure, the structure accumulates that debris load in obvious places like the gutter lines and in the subfloor areas. But it also builds up in places that you can't see, which is under roof capping, and under tiles, and in roof cavities.

Now, to design against this kind of approach, you would think something like sarking might be might be a possible approach. However, all of our conventional sarking, even the ones specified in our building standards, actually perform similarly to this, where the debris that might accumulate on top of that sarking, and below your ridge line, will simply burn away and allow that debris to drop further into your roof cavity during a fire event. So, sarking isn't really a solution, and the most appropriate way to go is actually to think about removing. In this case, you could remove the capping and place a thin strip of fiberglass insulation batt, and then screw down the ridge capping, which actually seals off while allowing some airflow it, seals off ember access and debris access to that ridge line.

There's also many other ways debris builds up and interacts with other features on our roofs. In this case, we're showing the interaction between a gutter and an overhang which has a polycarbonate roof covering. This scenario here is not of a particular issue, but it just shows you how a small source of fire can interact with such a glazing element. Now, if those glazing elements are actually fiberglass reinforced skylights, they're the ones that have a matte finish and you can see fiber through those coverings they are extremely ignitable and will, in themselves, carry a fire from a gutter line all the way to a house. So, if these are present, or used in your house, they should be removed and replaced by a polycarbonate alternative, which acts in a far more benign way because it doesn't burn in situ and carry a fire across the roofline to your house.

And, in fact, here's an extreme scenario where quite an aggressive fire arrived and exposed this polycarbonate covered patio area. And, in each case, the polycarbonate did not burn in situ, but melted and drooped in position, but did not add any additional fuel load to the house itself. So, while it does melt and droop, the risk that it presents is benign in a bushfire.

And, of course, there's other conventional ways to protect our gutter lines, and one of those is using gutter guards. But, in the event of using a gutter guard, it's very important to firstly select ones that are not made of polymeric materials, because they simply add to the fuel load that's in your gutter. And, when the embers arrive, they will melt and burn through along with any debris that has built up on top of them.

The mesh size for these gutter guards really needs to be 2mm or smaller in aperture size to be effective, because embers will simply pass through larger gaps and access what debris, if any, has built up under them. And, of course, the means of fixing them both to the roof and to the gutter line must be of some type of non-combustible material and flashing, so that it can perform adequately under the combined actions that bushfires bring.

Of course, a house is made up of many gaps, and we need to be really diligent in reviewing where all those gaps may be that embers could enter, including the ones that are quite large, and in some cases are often overlooked, like the overhead gap over a roller door. But, in terms of finding gaps and understanding where they go, it's really a detective process of looking and looking and looking at your house to understand where they are and resolve them through whatever means you can. But it's really an attitude and an approach that you just have to come to terms with and observe very carefully, and look at deliberate vents that may not have small enough apertures. The 2mm rule is absolutely relevant to every gap around your entire house.

Surface fire and surface fuels are a real challenge in a bushfire event because it's not if, but when they will burn out. And when they burn out, they can provide localized flame attack for anything near them, and depending on their thickness of debris load on the ground, they can burn for many hours and provide a really significant heat load for all things at ground level. So, the obvious ways to solve this are not having combustible materials immediately adjacent to the ground, and/or eliminating the surface fuels that come. But in a sense, the complete elimination of surface fuels doesn't completely solve the problem, because there's so much debris active in the air on these windy days, it's fairly common to observe debris build up and re-accumulation against ground elements around your house that ignite and then apply new flames to those events.

The same goes with unprotected gutters. Yes, you can clean your gutters out, but during the fire event itself the debris can build up again, to some extent, in those gutters and apply localized flame attack to the roof elements adjacent. So, the really reliable approach is simply to eliminate ignitable building elements near the ground. And the height you actually need to think about is obviously dependent on the size of the pile of debris that's on the ground, but something like 0.5m of clearance is an effective measure to go by.

The surface fires in ember attack are quite ubiquitous in what they take out near ground level, and in my previous forum I've highlighted the issue of treated pine, which is a common timber used near and in ground contact scenarios that burns out prolifically when surface fires arrive and impact these structures.

Moving away from the ground surface itself, there's many nooks and crannies on the attached elements that surround our house. So, this decking element here actually shows how much debris has packed itself in between the decking boards and the fascia on this deck. And that has obviously provided one of the better locations for an ember to land and take hold in that fine debris, and develop into a decking fire that, if left unsuppressed, would provide such a significant heat load to a house that the house itself could be taken out.

How do you eliminate these? Well, it's simply not viable to have multiple timber elements contacting each other in a complex way, you have to eliminate timber elements by actually using non-combustible supporting elements under decks. And it's possible to use non-combustible supporting elements under decks, and possibly use high durability timber decking boards, or even better than that using deliberately designed wood composite decking that is rated for use in Bushfire Prone Areas. But, the importance of having non-combustible substructures under the decks, and under houses themselves, is absolutely critical.

Of course, the way staircases also present re-entrant corners is ubiquitous and similar to actual decks as well. So, any little nook and cranny or re-entrant corner is a critical way that these can be lost. And, while that looks quite difficult to design a stair system that isn't susceptible to direct ember attack there are quite a few accidental designs that work particularly well. And here's one we observed in the Tathra fires a few years back, where this staircase not only survived the onslaught of radiant heat and ember attack, it actually survived the complete burnout of the house

it was attached to. And that's not because it was all non-combustible. In fact, it had high durability timber treads, but the stair design itself highlights how a bit of isolated timber, not connected intimately with other timber elements, can perform quite effectively because the substructure supporting it has no particular combustibility. So, it can't work off each other and burn down.