Bushfire risk perception: a study of the perceived vulnerability of domestic architecture in bushfire prone areas

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Image from: cover of *Fire Australia*, summer 2008-09

Research Questions

- For residents living in bushfire prone areas, what attributes of domestic architecture and the immediate environs impact on their perception of safety? Do these reflect the risk as assessed by fire authorities and do these perceptions influence behaviour before and during a bushfire attack?
- Can architectural interventions change resident's perception of risk? Do these changed perceptions reflect the risk as assessed by fire authorities and would these changed perceptions influence behaviour before and during a bushfire attack?

Research Outcome

When future occupants of new homes in bushfire prone areas seek shelter from a bushfire attack the part of their home that they intuitively go to is also likely to be the part built to the highest bushfire safety standards.

Bushfire implications for future building design

- Improving building resilience to bushfires in new buildings with the goal of them becoming self defendable. Giving fire agencies a greater chance to defend older existing building stock.
- Creation within new buildings of an inbuilt refuge for occupants to seek shelter in while a fire front passes.
- New homes designed to maximise onsite energy and water collection while reducing exposure in the direction of anticipated future bushfire attacks.
- Merging of a number of natural hazards that affect individual buildings. New building stock will need to include protection from a combination of natural hazard events, such as wildfires, cyclones and earthquakes.
- Redefining of the build form to include new hybrid options, such as earth berming and sections build underground.
- Reduced or no insurance available for homes in bushfire prone areas will considerably change the standard of fire preparedness in future homes.

Small windows with protective overhang placed at the wall and roof junction, on the side facing a bushfire threat, reduces both potential ember entry and earthquake damage while encouraging greater internal air flow. Image from: Walker, P. (2005). *Rammed earth : design and construction guidelines*

Wall facing anticipated bushfire threat direction constructed of non combustible materials with no or limited glazing. Adjoining wall with recessed door and windows and inbuilt bushfire shutters. Architects: Johnston Marklee & Associates

Angled earth covered roof encourages bushfires to move over and away from house. Architects: RB Arkitektur Image from: *http://www.google.com.au/imgres?imgurl=http://www.trendir.com/house-design/underground-home-designs-swiss-mountain-house*

Above Image, Architects : Mark Lee and Sharon Johnston

Curved non combustible walls with recessed windows preferably metal and sliding doors which can be enclosed by protective bushfire shutters. Above Image, Architects : Cracknell & Lonergan

Underground rooms with courtyard access which can be safeguarded by protective sliding shutters built into the wall cavity. Architects: Deca, Image from: *http://dornob.com/underground-living-buried-secrets-of-a-stone-desert-home/?nq=search*

Future Architecture in Bushfire Prone Areas

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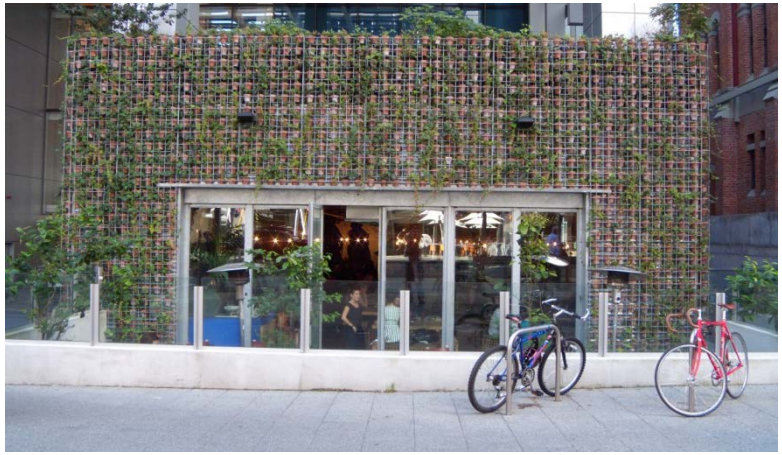
Discipline of Architecture

Architecture engages with a number of others disciplines:

- Engineering
- Psychology
- Sociology
- Planning
- Urban design
- Building industry
- Landscape architecture



AS 3959-2009 the Current Process

(Improves the fire performance of individual building components)

Three scenarios:

- New house build to comply with *AS 3959-2009*
- Existing non compliant house with an extension built to *AS 3959-2009* requirements
- Existing non compliant house with an external bunker constructed to *BCA 2011* guidelines

Limitations of current process

- Does not incorporate design features which could prevent or mitigate building ignition points
- Designed for a bushfire event not the comfort of everyday living
- Does not consider sloping site issues
- Limited response to unknown future requirements

Next 50 years

- World in political, economic, climatic and energy transition
- Limited land supply around cities will place a greater demand on sloping land in bushfire prone areas
- Buildings will need to incorporate design strategies that cater for a range of natural hazards
- Passive design and available on-site energy & water will have greater influence on the design of buildings
- More houses will be factory produced
- Houses may become smaller

Challenges

- Increased cost of energy and water
- Increased insurance premiums for properties in known natural hazard environments or no insurance available for homes in these areas
- Providing a range of building options so that residents can limit their risk through the design of their homes
- Building design options to suitable a variety of budgets

Directions

Develop a range of processes for insuring houses perform to a certain standard in bushfire prone areas by :

- Utilising sloping sites opportunities
- Have increased fire protection for individual sections of a house
- Consider constructing homes in stages
- Provide integration of an external bunker, including above & underground options
- Encourage environmentally sustainable features such as independent energy sources and water harvesting

Developing architectural interventions that prevent

Ember entry through:

- Roof cavity
- Skylights
- Eaves
- Windows and doors
- Vents and weep holes
- Subfloor

Fire and direct flame contact from:

- Guttering
- Re-entrant corners of combustible window and door frames / doors
- Combustible decks and verandas
- Vegetation adjacent to a building
- Combustible fences
- Gas meter flaring
- Car fire adjacent to building
- Spot fires
- Outbuildings
- Building to building ignition

Curved walls reflect embers away from structure

Architects: Mark Lee and Sharon Johnston:
http://www.aud.ucla.edu/news/lecture_mark_lee_and_sharon_johnston_15.html

Angled earth covered roof removes the need for gutters

Architects: RB Arkitektur: http://www.google.com.au/imgres?imgurl=http://www.trendir.com/house-design/underground-home-designs-swiss-mountain-house

Cost effective example of earth covered building with a sloping element linking roof and walls

Architect: Angus Wyman Macdonald, 'Mother Earth News' January/February 1981: http://www.motherearthnews.com/green-homes/earth-sheltered-architecture-zmaz81jfzraw.aspx

Small windows with protective overhang placed at the wall and roof junction reduces both potential ember entry and earthquake damage

Walker, P. (2005), Rammed earth : design and construction guidelines

Part earth sheltered house with adjacent water supply

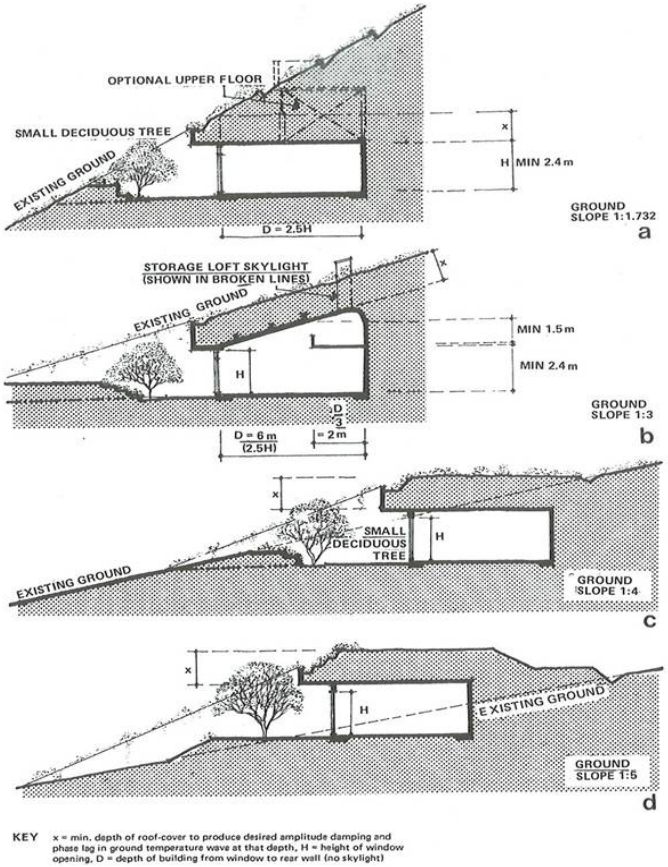
http://www.google.com.au/imgres?imgurl=http://s0.geograph.org.uk/photos/74/27/742754_6cf2e73f.jpg&imgrefurl=http://www.geograph.org.uk/photo/742754&usg=__IvStVLBk1ZHKACeegYL2v_ZljpA=&h=480&w=640&sz=100&hl=en&start=1&zoom=1&tbnid=v-

Earth bermed and covered house with adjacent structure and water supply integrated into building design

Architect: Vetsch Architektur: http://www.lakaskultura.hu/epiteszet/svajci-foldhazak-3878

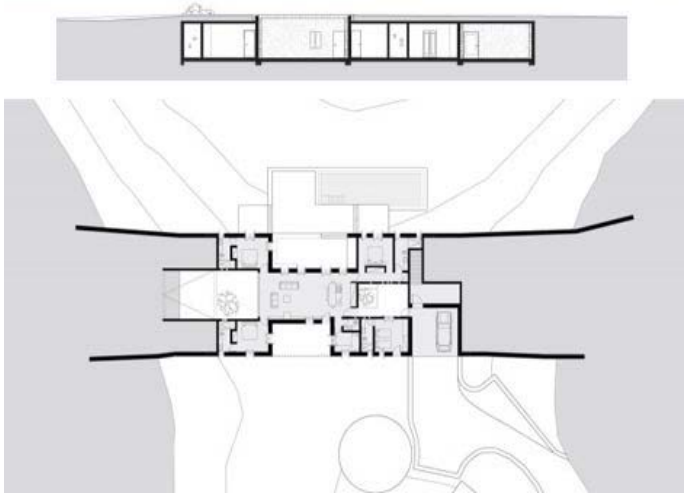
Problematic adaptation to slope elevation

Some sloping architecture options



Baggs, S. (1985), Australian earth-covered building, p56

Part underground house between two hills.
Includes underground room with courtyard access which can be safeguarded by protective sliding shutters built into the wall cavity



Architects: Deca: http://dornob.com/underground-living-buried-secrets-of-a-stone-desert-home/?ref=search

Underground balcony

Architect: Yukiharu Suzuki, http://www.christian-muller.com/CMA_Projects/VJA/vaj001.l.jpg

Contemporary underground interior

Architects: SeARCH and Christian Muller,
http://dornob.com/outside-in-the-ultimate-underground-swiss-mountain-home/?ref=search

Entry through roof

Architect: Antonio Sofan, http://www.trendir.com/house-design/hillside-home-design-with-roof-entrance.html

Imperatives

Work with and advice the insurance industry on the most effective architectural improvements for new and existing building stock (Rather than have them increase premiums unnecessarily)

Continue research on buildings designed specifically for sloping sites in bushfire prone areas

“Shelter, sanctuary, refuge, defence, all aspects of a building within a bushfire prone area need to be considered using the design knowledge of the architecture profession”

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