Protecting structures from floodwater

Adapting to the impacts of climate change on flooding

Many climate projections for Australia indicate that, regardless of any mitigation efforts, there is a strong likelihood of increased flood activity in many parts of the country as a result of climate change. It is essential that potentially affected communities and industries, as well as all levels of government, have access to sufficient knowledge to enable them to prepare and adapt effectively to flooding events. Such knowledge can be gained by studying impacts from events such as the 2010/2011 summer floods.

Insured losses reach $2.4 Billion for 2010/2011 flood event

During December 2010 and January 2011 many regions of Australia suffered major flooding. Flood waters affected several of Queensland's coastal cities; a multitude of inland towns in Queensland, NSW, Victoria and Tasmania; and numerous rural farming and mining properties. The massive scale of this flood event has led to the fifth most costly natural disaster affecting Australia since 1967. The worst affected state, Queensland, had 58,600 insurance claims which topped $2.4 billion in insured losses. Many of these costs were due to inadequacies in Australian residential building practices which leave houses vulnerable to damage and possible structural failure when exposed to floodwaters. Proposed changes to these practices recommend new construction follows development controls including floor heights above expected flood levels, and the use of flood-resistant building materials and secure footing systems. However, controls are not retrospective and therefore do not decrease the flood risk to existing buildings or significantly reduce residual community risk.

Flood impacts on buildings

During floods, buildings must resist a range of different pressure forces and damage from floodwater. These flood actions affect each building differently depending on its elevation, structural shape, building materials, water transferability, and surrounding structures and terrain. By identifying a building's specific vulnerabilities to different flood impacts, appropriate measures can be taken to reduce the future likelihood of their occurrence.

FLOODWATER PRESSURE FORCES

» **Still water**
Still floodwaters can push walls inwards and, when above the roof-line, can push the roof down into the building. If external water levels rise quicker than water is allowed into the building, the differential pressure of even a small disparity in water levels inside and outside can cause damage or complete structural failure.

» **Flowing water**
Flowing floodwaters exert dynamic pressure caused by increased water depth and pressure on the upward wall and decreased depth and pressure on the side and leeward walls. This differential can cause gross structural failure and extensive internal damage. When waves break, the impact can cause pressure up to 10 - 20 times the pressure of still water.

» **Buoyancy**
If a lightweight building is water tight, even small depths of floodwater can generate enough force for the building to float. This is a particular issue for elevated weatherboard style homes and older style "Queenslanders" that are not attached to their piers.

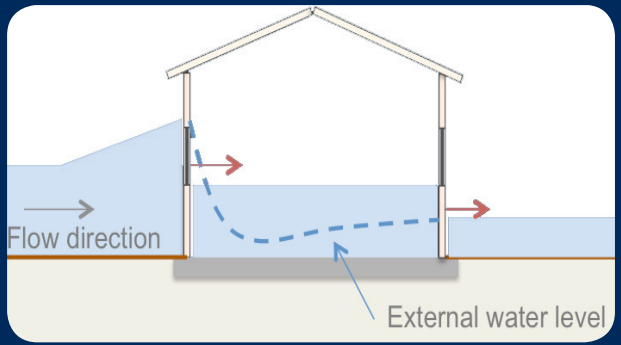
CONCURRENT FLOODWATER DAMAGE

» **Water contact**
Most building materials decay when in contact with water. Floodwaters contaminated by sewage, petrol, industrial and household chemicals or fertilisers can cause chemical deterioration of building material strength and functionality.

» **Debris**
Buildings are damaged when debris is propelled by floodwaters into buildings, deposited inside buildings, accumulated against buildings, and attached to buildings causing increased resistance to flowing water.

» **Soil and rock**
The force of floodwaters can cause erosion, collapse poorly compacted soils, swell or shrink soils, and scour soil around or underneath a foundation.

Flowing water pressure against a wall



Addressing flood risk to new and existing structures

» **New Construction**

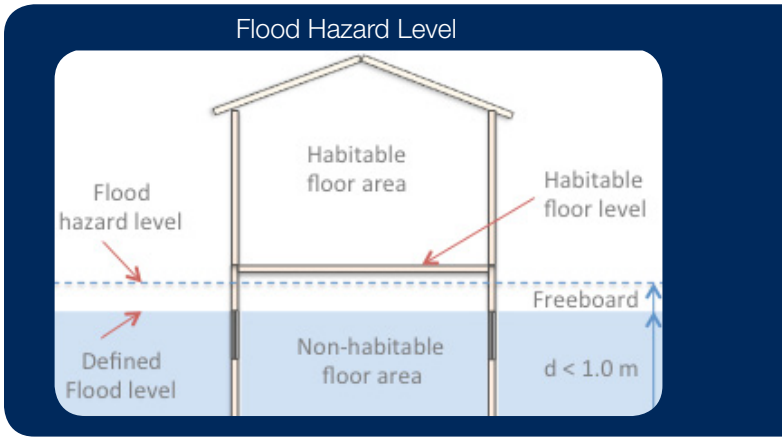
To estimate the long-term costs and benefits of building on a site, flood risk needs to be quantified. Understanding this risk helps an architect or designer choose a suitable floor height to escape expected flood hazards, as well as the size and placement of utilities and supporting structures to cope with inundation.

Any enclosed structures below the flood hazard level must allow floodwaters to enter and exit. Structural attachments must resist floodwater pressure to help the building avoid structural damage. A secure footing system is needed to prevent flotation or displacement of the home off its foundations. It is especially important that building materials resist damage or deterioration from water contact.

» **Existing Structures**

Flood risk can be reduced by rebuilding or retrofitting existing structures to the same standards as new construction. Buildings can be elevated or relocated so floodwaters cannot reach damageable areas. This might involve lifting a structure until the lowest floor level is above the height to which floodwaters have previously risen or are expected to reach.

If this displacement is not feasible, barriers can be constructed to protect the home. These barriers can take the form of freestanding structures, like berms, levees or floodwalls, that are built away from the protected building. Or they can be built as seals on the home itself. The idea behind these systems is to keep water outside a building while having the habitable floor level below the expected flood height.



Existing structures can be modified to allow floodwaters to enter at a rate corresponding to the flow rate outside the building. This 'wet flood proofing' is designed to avoid the detrimental impacts of water pressure loads on the structure. To effectively use this technique, electrical, services equipment and damageable contents must be placed above the expected flood depth or designed for submersion. Where expected flood levels surpass 0.7 - 1.0 m, this wet flood proofing will more than likely be the most cost effective, and safest, option for protecting a home.

Recommendations for structure design

Continue to develop accurate flood maps to identify multiple expected flood levels, and flood characteristics including flood depth, flow velocity, rate of rise, and origin of flooding.

Consider introducing independent flood assessment bodies in all states to assess development proposals with respect to flood risk.

Expand proposed flood resistant design requirements in the Building Code of Australia (BCA) to include commercial and industrial buildings, as well as residential buildings, possibly based on proposed changes to the Queensland Development Code (QDC).

Set minimum freeboard restriction of at least 300 mm to ensure habitable floor levels consider uncertainties in flood depth predictions.

Include storm surge and coastal wave areas in the BCA with specifications similar to flood-resistant design guidelines from the American Society of Civil Engineers.

Require buildings being repaired or raised due to flood events to apply flood resistant design methods similar to those proposed for new construction.

Promote cost-benefit analysis of retrofit methods for flood prone cities and explore funding mechanisms to enable people to retrofit.

Update and maintain prescriptive technical design manuals for flood actions that can be referenced by the BCA for more technical details.

Allow for multiple flood levels in design and construction so a performance- and risk-based engineering approach can be adopted.

This document summarises key findings from the NCCARF report *Analysis of damage to buildings following the 2010-11 Eastern Australia floods*. The project was funded by NCCARF and led by Matthew Mason, Macquarie University. To download the full report go to: www.nccarf.edu.au/publications/building-damage-following-2010-11-floods

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