Preliminary Ambae considerations for heavy ashfall, roof cleaning, and roof collapse potential - Version 2

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These have been designed for rapid use, compiled by Assoc. Prof Tom Wilson at the University of Canterbury, with input from Esline Bule and Sandrine Cevuard of VMGD; Nico Fournier, Graham Leonard, and Natalia Deligne at GNS Science; Carol Stewart of Joint Centre for Disaster Research; Assistant Professor Susanna Jenkins from Earth Observatory of Singapore; Emeritus Professor Russell of Macquarie University and Emeritus Professor Robin Spence of University of Cambridge. As further information on volcanic impacts comes in, further analyses are made, or further impacts occur, these considerations may be updated.

See the version number and date in the top right and the latest version of these considerations can be downloaded from: http://www.vmgd.gov.vu/vmgd/index.php/geohazards/volcano/volcano-info/resources

General considerations

- It is a challenging to provide definitive advice mitigating ash load structural damage/roof collapse for residential buildings because of conflicting experiences around the world.
- Most injuries associated with (light, moderate, and heavy) ashfalls occur during ashfall cleaning activities. However, most deaths associated with very heavy ashfalls are due to the collapse of roofs/buildings in occupied buildings – although this has only been recorded in a limited number of cases and seems to be much rarer than cleaning injuries.
- If people are worried about their house collapsing under the weight of ash (especially natangura (traditional thatch) houses, which are more vulnerable, then head to a concrete or wooden framed and metal roof building.
- It is important to consider: ash characteristics (fine ash is usually heavier), moisture content of ash (wetter is heavier), building design, building materials, ability to safely clean the ash from the roof, environmental factors, etc.
- Continually monitoring what is happening in affected areas and what response actions are working is essential.

Roof collapse threshold

- There is high uncertainty as to what thickness/weight causes roof collapse or other structure damage to houses. Additionally, thickness is not the most useful measure – what causes the damage is the mass loading (weight), which is influence by things such as rainfall and grainsize distribution.
- 5cm (five centimetres) of fine ash is a good general guide for estimating when light non-engineered timber structures may collapse, but it could be lower if there is fine and wet ash (which will be denser). It depends on construction type, building condition, building materials, so the threshold could also be higher for a particular building.
- Long span roofs are more vulnerable to ash loading than others, and older buildings are usually more vulnerable as well. A good idea is to use observations of impacts from previous ashfalls in an area with similar structures as a starting point.
- Shelter in the strongest buildings, ideally those with metal roofs. These often have concrete/block walls or heavy timber framing.
- Propping roofs from below during ashfall can increase the load that the roof can take before failing. This can be done by placing a plank below the main roof joists, and then using timber (or better steel) props below, resting on a plank on the ground/floor. But it depends on having materials available.

Cleaning ash off roofs

Most injuries during ashfalls seem to be related to unsafe cleaning activities, such as falling from roofs. It is a physically difficult activity, as surfaces are slippery and it's dusty so is hard to breath and see (and may irritate skin and eyes). **However, the collapse of roofs/buildings of inhabited houses/buildings in very heavy ashfalls is the highest cause of death during ashfalls.**

- Given this balance, the key issue tends to be '***What should be the ashfall thickness threshold that triggers cleaning during an ashfall for inhabited structures?***' Engineers, architects and scientists who have studied ash induced roof collapse recommend:
  - If caught in a building that has very thick ashfall on it, the safest option is to evacuate the building(s). However, this can be difficult if there are no other shelter options or there has been little warning e.g. the rate of ash accumulation suddenly become much higher (due to wind direction or the volcano itself).
  - For buildings that need to be inhabited, observe the building to see if there is any deformation of load bearing elements of the building when under ash load. Look for sagging or bending of beams and columns of the building, even the sheet metal) and once observed, use that as a trigger to start cleaning – if safe and practical.
  - If people feel unsafe, evacuate.
- For cases where there is a risk of roof collapse due to ash loading, the best results for cleaning ash seem to be when ash accumulates to 2-3cm depth, then sweep or rake off. . Use your best judgement, as each ash may behave a differently.
- Note roof cleaning is very difficult to do during an ash fall. If possible, wait for a break in ashfall deposition.
- As with any outdoor activity in an ashy environment, wear long sleeves and pants, cover your mouth, nose and eyes and wear a hat. Wash afterwards. Clean up can remobilise ash, ensure children and vulnerable people (elderly, pregnant women) are elsewhere to avoid exposure.
- Cleaning should focus on areas on the roof where there is a reduced change in slope, as ash will collect there and it creates uneven load on the roof supports/frame.
- Removing ash from gutters (if installed) is critical as they can catch the ash and prevent further ash from shedding/sliding from the roof. It is particularly important to keep the gutters intact as they are used to collect drinking water on Ambae.
- If a roof is too weak for a person to stand on it normally, it will not be safe for someone to stand on it to clean the roof.
- Avoid climbing onto the roof, if possible. It will be slippery, ash is heavy so it is hard to remain balanced when cleaning, and more weight is being added to the roof (at least initially before any ash can be removed). If unavoidable: set up ladders or a crawl board onto the roof, and (ideally) work platforms (e.g. scaffolding) prior to ashfall – although this is rarely practical in reality. If set up poorly all of these additional structures can simply add to the risk of injury.

Disposal of ash and covering ash

Any way to reduce remobilisation of the deposit is important to reduce, but it is time consuming and labour intensive. It may help to cover accumulated piles of ash with large leaves (e.g., coconut trees, banana plants) and weight them down with rocks (or, better, soil). If you intend to move the ash later you can put ash in plastic bags and tie them closed. Do not put more than a few litres of ash in a bag, as the ash is quite heavy, and so many cause back injuries when moved later.