

6.3.10 storms

The term 'storm' includes a wide variety of phenomena:

- wind, including tropical cyclones, tornadoes, downbursts, and extreme wind speeds
- precipitation, including intense rain, driving rain, snow, sleet, ice, and hail
- lightning
- sand and dust storms
- extreme temperatures, involving heat, cold or humidity (6.4).

settlements The orientation, siting, and layout of settlements influence the ways in which they are affected by wind, precipitation, sand, dust, and other storm phenomena. Local topography can also have a big impact, and can create intense local variations in the storm climate. For example:

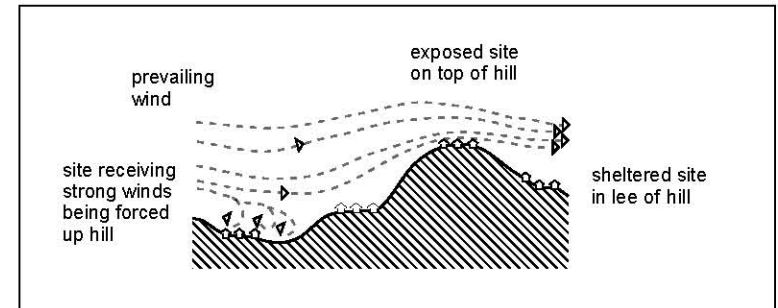
- Gaps in hills or mountain ranges can funnel wind, as can valleys.
- Complex topography can cause complex wind patterns.
- Peaks are a major barrier to moisture-holding air. Sites a few kilometres apart may experience widely varying patterns and intensities of rainfall.

Wind has both desirable and undesirable characteristics: it can clear snow and sand, and provide cooling in the summer; but it can also cause snow and sand to drift and can create chilling draughts. When locating and designing settlement sites, try to incorporate the favourable factors while reducing the negative influences of the wind.

Wind barriers, the shape and layout of a building, and the surrounding landscape and vegetation are all factors that can control the flow of air around a settlement.

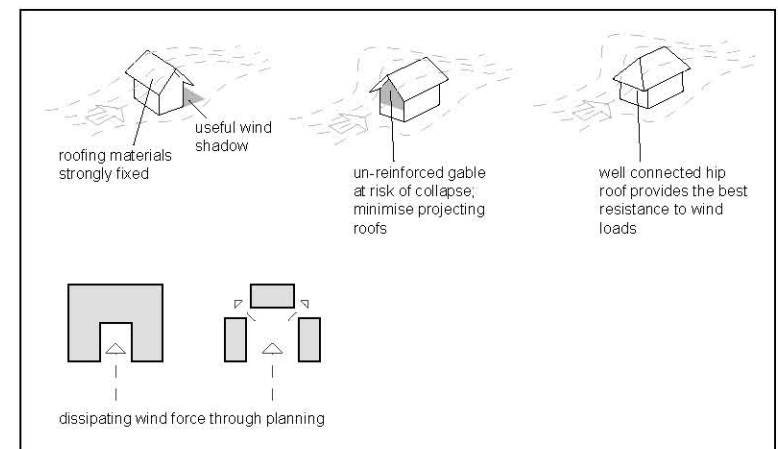
Proper grouping of buildings can create a protected microclimate within the community, by buffering dwellings from winds and controlling the accumulation of sand or dust.

figure 6.3(g): storm risk to settlement



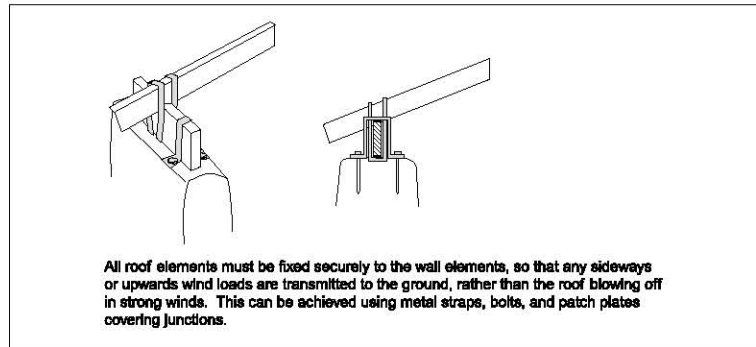
buildings The orientation, materials, and surroundings of a building affect its vulnerability to extreme storms, including the wind, rain, snow, or dust that might accompany the storm. A building can be made more resistant to wind by designing it to resist the force as an entire structure, not as an assembly of bits and pieces. Some solutions also pose risks. For example, orienting a building to increase wind resistance might expose a larger surface area to driving rain, abrasive sand, or missiles. Note also that although trees generally act as buffers against wind, in extreme events they could be blown over on to buildings or uprooted; or branches could be torn off, thereby striking buildings as missiles. Consider using a buffer of vegetation without thick branches or trunks, such as bushes. Expert judgement and local conditions will determine the most appropriate solution in each case.

figure 6.3(h): reducing wind damage



One of the primary mechanisms by which wind causes damage is 'uplift'. The roof should be tied down on to the walls, and these upward loads should then be transmitted all the way through to adequate anchorage in the foundations. It is important to ensure that the roof stays down when subject to the wind-uplift loads. Roof trusses need to be bolted to the load-bearing columns through incuts or straps. (See figure 6.3(i).)

figure 6.3(i): fixing roof trusses



A well-anchored roof will prevent water entering during rain storms or tropical cyclones. If roof shingles (wooden tiles) are used, a simple preventative measure is to use eight nails per shingle, rather than four.

Iron sheeting should not be nailed straight into supports, because it will be lifted straight out in strong winds. Connections, brackets, anchors, or tie-straps should transmit wind-uplift loads adequately to the foundation.

Hipped roofs are less vulnerable than gable roofs, because they are braced in all four directions. Good design and connections between the roof and the walls can overcome the weaknesses inherent in gable roofs. Low roofs create increased uplift, and steep roofs create increased lateral loads, so both should be avoided. Check what the local people do, because they have probably learned how to live with the hazard.

Ensure that objects that can easily be picked up by a strong wind are not left lying around. Keep flammable, explosive, and combustible materials away from buildings, and keep them well secured. If a

storm is coming, especially a tropical cyclone, cover openings, especially windows, with sheets of wood or plastic.

Structures with fewer storeys are less vulnerable to wind and the impact of missiles. Metal ties, screws, and nails may corrode in humid environments, or in areas near the sea, because of the salt in the air.

Figure 6.3(j) shows how steeply pitched roofs receive a high wind loading and may blow in as a result.

figure 6.3(j): roofs and wind loads (1)

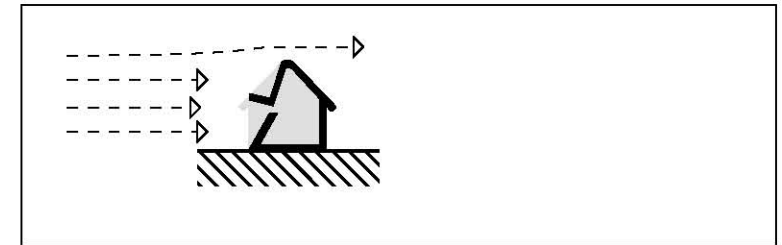


Figure 6.3(k) shows how low-pitched roofs receive a high suction and are likely to blow off as a result.

figure 6.3(k): roofs and wind loads (2)

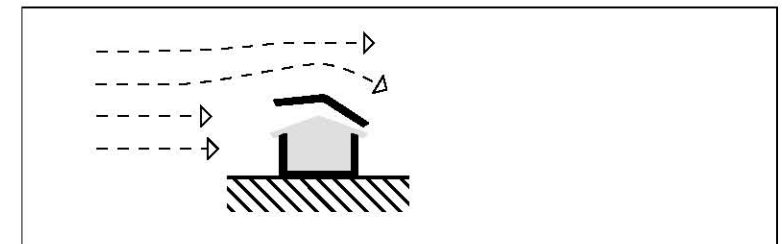


Figure 6.3(l) shows that a roof angled at 20°–30° receives the least wind stress.

figure 6.3(l): roofs and wind loads (3)

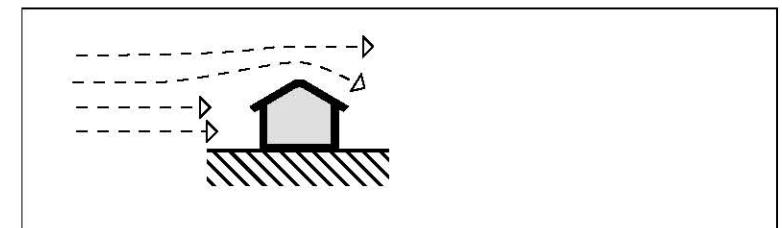


Figure 6.3(m) shows how buildings which are not properly anchored to their foundations may overturn.

figure 6.3(m): roofs and wind loads (4)

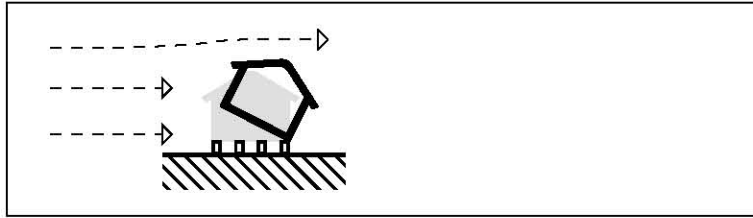


Figure 6.3(n) shows that the frame of buildings without appropriately connected and stiffened joints may distort as a result of a strong wind.

figure 6.3(n): roofs and wind loads (5)

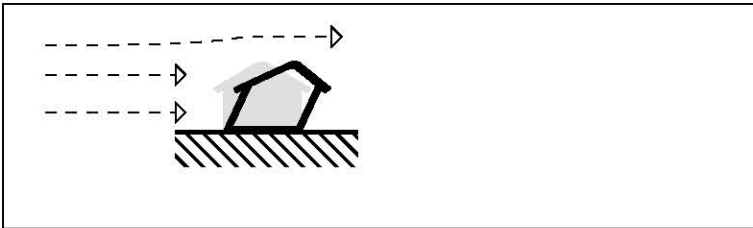
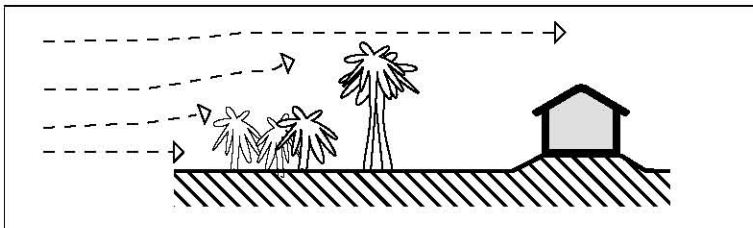


Figure 6.3(o) shows that a building that is shielded from wind, located at a safe distance to avoid trees falling on it, and built on a plinth, is well protected against winds and floods.

figure 6.3(o): roofs and wind loads (6)



6.3.11 floods

'Floods' is a general term which includes flash floods occurring after sudden rainfall or snowmelt, or when rivers break their banks or spread out over the floodplain; surges in sea levels caused by low atmospheric pressure and severe wind; and rises in ground water due to a sudden influx of water upstream. In addition to the dangers of damage and drowning from the water, saturated ground allows mosquitoes and other insects to breed (6.3.5); food and fresh water become contaminated; and debris or waves can cause structural damage or injuries.

Contact with flood water should always be avoided, because it is usually contaminated with oil and sewage, which can compromise health and safety. Floods may also disrupt animals' normal locations and behaviour patterns, bringing poisonous snakes or crocodiles into the area.

Settlements should not be built in areas that are frequently flooded. Floodplains are usually simple to identify, although flash-flood areas are less easy to note. Specialist assistance should be sought. If building in floodable areas is absolutely necessary and completely unavoidable, seek local advice and follow local practice.

Note, however, that many populations live permanently in flooded areas, and flooding is a constant and natural feature of their lives. Some of these people adapt to the conditions by living in boats, or in structures on raised platforms, or on stilts above the water. Flooding, if poorly prepared for or unexpected, can be catastrophic and highly dangerous; but when livelihoods depend on seasonal or near-permanent flooding, water can be used to improve transport and to support livelihoods, such as fishing or rice farming.

Always ask local people for advice about flooding, and look at a site for evidence of seasonal flooding, such as cracks in the earth, deep footprints in dried earth, and marsh grasses.