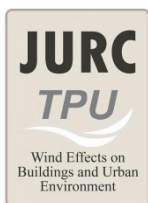


PREPAREDNESS FOR WIND-RELATED HAZARDS



International Strategy for
Disaster Reduction



Wind Effects on
Buildings and Urban
Environment



International Association
for Wind Engineering



The International Strategy for Disaster Reduction (ISDR) system partners are working together at global, regional and national levels to facilitate the implementation of the Hyogo Framework and increase political commitment and concrete actions on disaster risk reduction. Within the ISDR system, there are several thematic groups and platforms focusing on specific disaster risk reduction issues, such as disaster risk reduction and education, environment, capacity development, recovery, early warning etc. The International Group for Wind-Related Disaster Risk Reduction (IG-WRDRR) was established as one of these ISDR thematic groups during the Second Session of the Global Platform for Disaster Risk Reduction in Geneva, June 2009. Tokyo Polytechnic University and IAWE are the leading organizations of this ISDR thematic group on wind-related disaster risk reduction.

International Group for Wind-Related Disaster Risk Reduction (IG-WRDRR)

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General Information

Purpose of Brochure:

- The brochure was prepared to warn people about the possibility of coming wind related hazards as well as to provide them with basic guidelines for mitigation.
- The brochure recommends that local people and authorities have a **“Preparedness Plan”** for wind-related disaster prevention and reduction.

What are wind-related hazards?

- Extreme wind events such as typhoons are often accompanied by heavy rains, floods, landslides, storm surges, lightning, etc.
- They have multi-hazard aspects including serious injuries and fatalities to humans, as well as damage and collapse of houses and properties.

What are typhoons?

- Typhoons are a type of tropical cyclone, which is a generic term for a low pressure system that generally forms in the tropics.
- Typhoons are also accompanied by tornadoes and downbursts.



Strong wind accompanied by heavy rain, storm surge, etc



Saffir-Simpson Hurricane Scale [*FEMA, US*]

Scale Category	Wind Speed (m/s)	Velocity Pressure (N/m ²)	Storm Surge (m)	Damage
1 Minimal	33 - 42	680 - 1100	1.2 - 1.5	Damage mainly to trees, shrubbery and unanchored mobile homes.
2 Moderate	43 - 49	1101 - 1500	1.6 - 2.5	Some trees blown down; major damage to exposed mobile homes; some damage to roofs of buildings.
3 Extensive	50 - 58	1501 - 2100	2.6 - 3.7	Foliage removed from trees; large trees blown down; mobile homes destroyed; some structural damage to small buildings.
4 Extreme	59 - 70	2101 - 3100	3.8 - 5.5	All signs blown down; extensive damage to roofs, windows, doors; complete destruction of mobile homes; flooding inland as far as 10 km; major damage to lower floors of structures near shore.
5 Catastrophic	> 70	> 3100	> 5.5	Severe damage to windows and doors; extensive damage to roofs of homes and industrial buildings; small buildings overturned and blown away; major damage to lower floors of all structures less than 4.5 meter above sea level within 50 meter of shore.

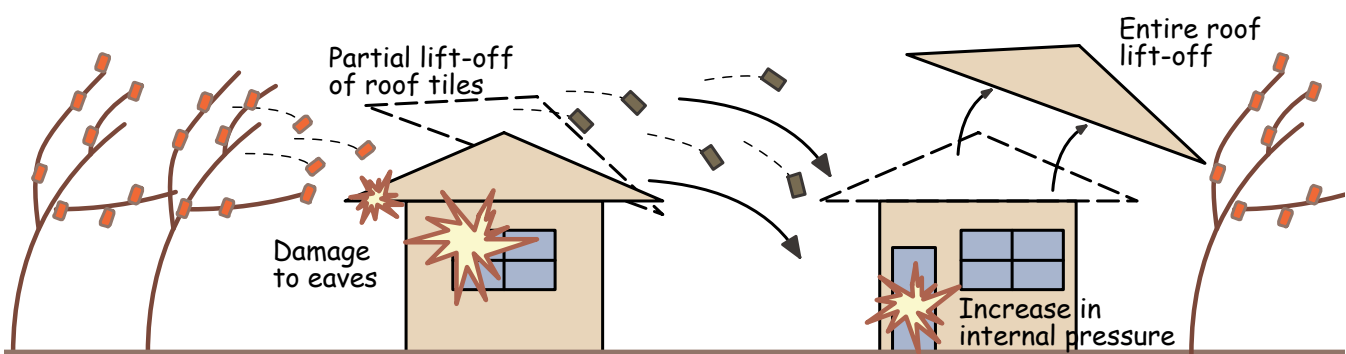
NOTE: The older scale above has been replaced by the new "The Saffir-Simpson Hurricane Wind Scale" which focuses on wind speed rather than other parameters and was newly enacted in February 2010 [*NOAA, US*]

What are the impacts and damage mechanisms of typhoon?

- Extreme wind events such as typhoons often result in floods and storm surges which are deadly and destructive. They may persist for several days or more after the typhoon.
- Excessive rain can trigger landslides and mudslides, especially in mountainous areas.
- Major damage to livestock and crops.

What are common damages to houses?

- Failure of and blown-off roof systems.
- Damage to walls, doors, and windows.
- Damage to cladding/components.
- Windborne debris impact (Damage chain as shown below).



Damage chain due to windborne debris



Typhoons will be more hazardous for damaged and unreconstructed buildings after a preceding hazard.

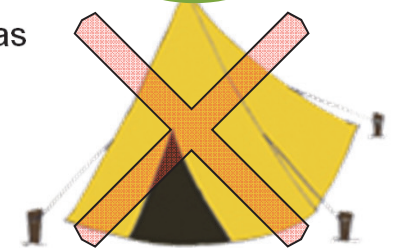
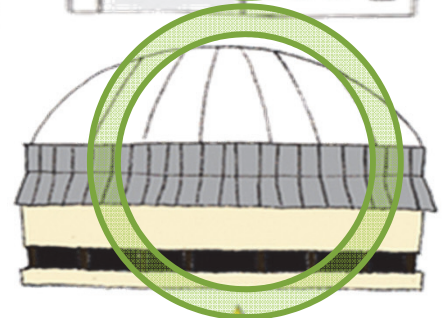
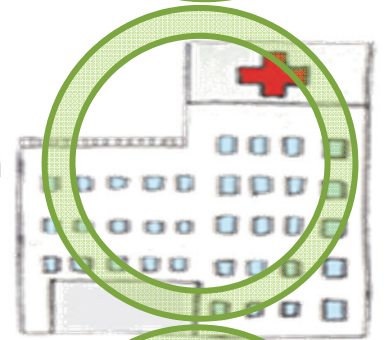
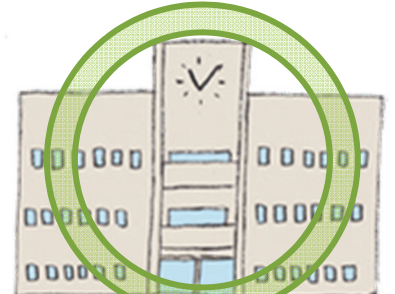


Three important lessons learned for wind-related disaster damage prevention and reduction are: (1) Disaster awareness through an effective communication network, (2) Preparedness and (3) Building performance.

Evacuation & Shelters for Wind-Related Hazards

What are the conditions for evacuation?

- The most important decision is “**Should I Evacuate?**”
- Individuals and groups should evacuate under the following conditions:
 - You are directed by local authorities.
 - You realize you are in danger.
 - You are living in a temporary tent structure.
 - You are living on the coast, near a river, or on an inland waterway.
- If you are still staying at temporary tent camps and unroofed structures after the earthquake, you must evacuate to safe places.
- If you are asked and ordered to evacuate by the authorities, you should do so without any delay or hesitation.
- It is important that you and your family have a “**Preparedness Plan**” that makes yourselves as safe as possible before an actual typhoon threatens your area.



Early evacuation is better.



Protect your head by using a helmet or a hood.



Pay full attention to typhoon forecasts, watches, warnings and guidelines.



It is very dangerous to go outside during strong winds, as windborne debris may hit you.



Don't go up on the roof, if wind speeds are high.

What are the conditions for shelters?

- Shelters are designated public places for people who have no place to go or who are asked to stay during typhoon.
- Local authorities must have their own plan for using shelters for the public during typhoons.
- Shelter volunteers try to make you comfortable, but a shelter is not a comfortable place.
- Necessary supplies may not be available during the first several hours, or there may not be enough for everyone.

Responsibilities of Local Authority:

- Shelters must be safe places to protect people against even extreme typhoons.
- Locations of shelters should be designated so that they are not too far away from residential communities and are easy to access.
- Volunteers in shelters should be trained in advance or at once for coping with emergencies.
- Shelters should be prepared to provide lifetime necessities for people staying there, such as clean water, food, medicine, bedding sets, etc.



The local authorities must have a “Preparedness Plan” ready for coming wind related disaster risks.



Temporary structures are vulnerable to windborne debris.



Shelter/Safe places for typhoon evacuation could be public shelters /buildings, roofed stadiums, schools, and hospitals.



Prepare necessities and emergency kits (water, food, medicine, bedding sets like blankets, sleeping bags, pillows, flashlights, radio, etc.) for yourself before staying in a public shelter.



Follow announcements and instructions of local authorities and shelter volunteers about shelter opening schedules and locations of shelters.

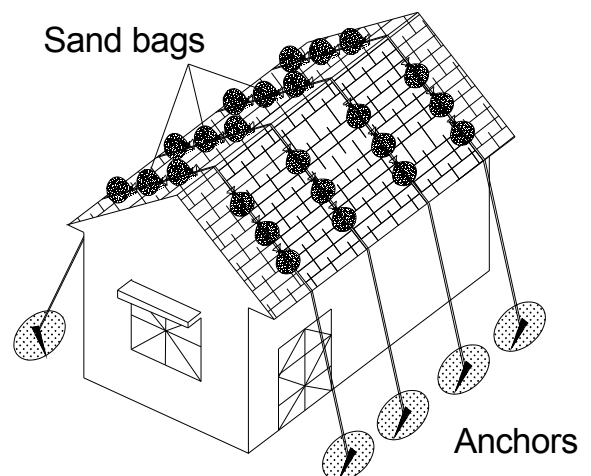
Reinforcement of Houses for Wind-Related Hazards

Why reinforce houses?

- High winds can cause local damage or even total collapse of houses. It is especially dangerous for temporary structures and unrecovered houses used after the earthquake.
- Typical damages are to the framed structures, roof systems, exterior walls, doors and windows. Thus, reinforcements of these components should be required.

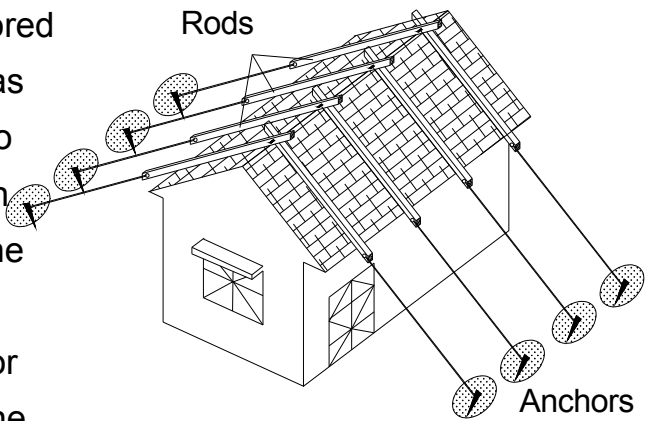
How to reinforce houses?

- Tighten connections of the roof system to the main frames and main frames to the foundation.
- Inspect metal connectors for possible corrosion.
- Strengthen wall corners by adding suitable bars.
- Roof trusses must be anchored to the bond beam.
- Composite sheets, plywood, rods, sand, rope, nails as well as fishermen nets can be used to reinforce houses.
- Use on-site available materials such as steel sheets or aluminum sheets.
- Reinforce the foundation.
- Reinforce support columns.
- Reinforcement of roof system:
 - Type 1: Using sand bags (10 - 20kg/bag) linked by ropes, anchored into ground as shown in the figure.



Type 1: Sand bags and ropes

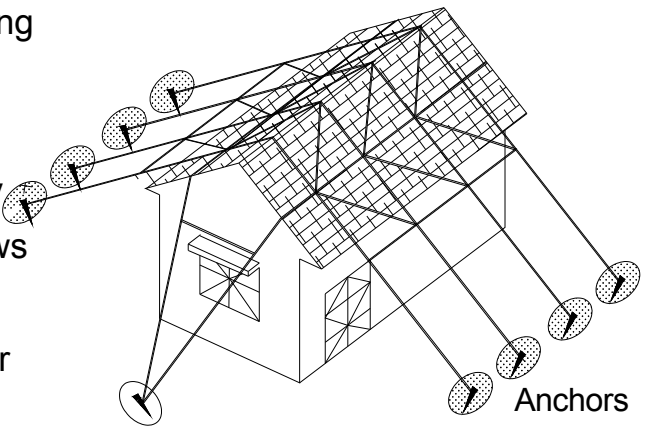
- Type 2: Using linked rods anchored into the ground by using ropes as shown in the figure. It is better to have a gap of 1.2-1.5m between two rods and the rod linked to the roof by screws or metal strings.
- Type 3: Using linked rope nets or fishermen nets, anchored into the ground as shown in the figure.



Type 2: Guyed rope, rods, anchors
[IBST, Vietnam]

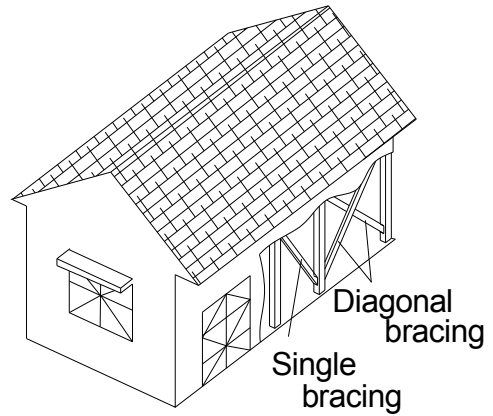
- Reinforcement of wooden frames: Using wooden rods and nails.
- Reinforcement of joint connections between the roof system and masonry walls and wooden frames are as follows (also shown in the figures):

- Reinforce joints with nails and/or rods.
- Reinforce joints with steel / FRP hurricane clips and/or straps.

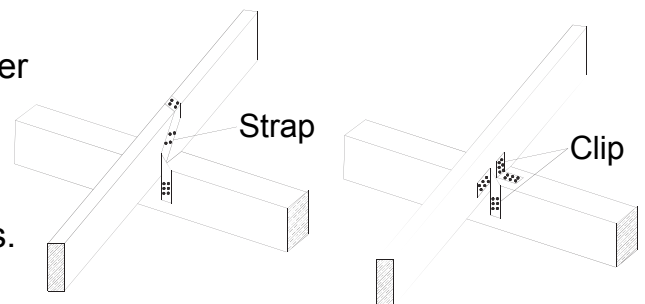


Type 3: Net ropes and anchors

- Reinforcement of doors and glass windows:
 - Close all doors and windows.
 - Put tape or paste paper on doors and windows.
 - Cover doors and glass windows with plywood or aluminum sheets.
 - Fix doors and windows with rods.
 - Reinforce walls with plywood sheets, rods, nails and tape.
 - Install temporary shutters to cover window glass using plywood, steel or aluminum sheets to protect against windborne debris.



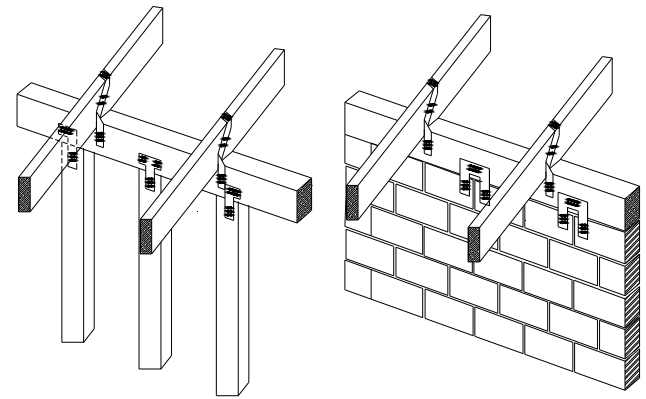
Reinforcement by wooden bracing



Reinforcement of wooden joists by strap and clip [IBHS, US]

How to reinforce damaged houses?

- Houses damaged by the earthquake can be reused during a typhoon's passage, if the house is heavy.
- Materials and elements similar to the original ones should be used for repairs.
- Severe damage and repair measures must be inspected / checked by professionals.



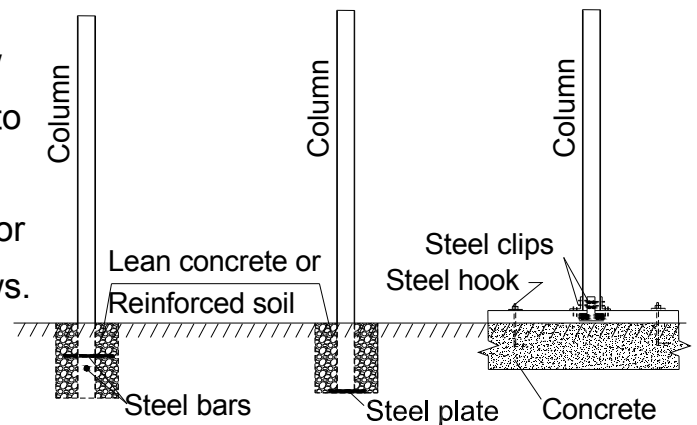
Wooden wall

Masonry wall

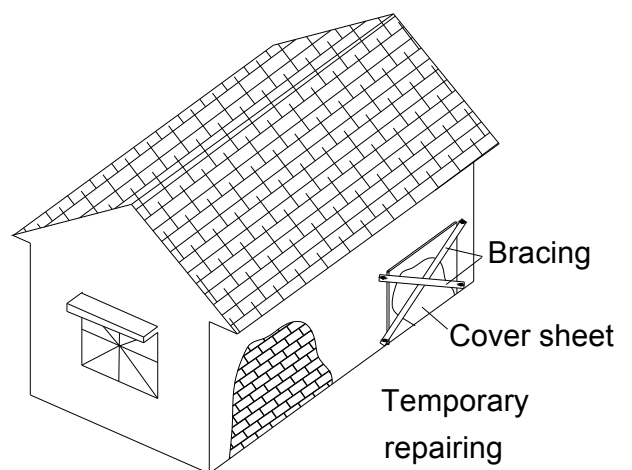
Reinforcement of wooden walls and masonry walls [IBHS, US]

How to secure houses?

- Close and lock doors and windows.
- Put tape and paste paper on window glass to prevent broken glass injury to occupants.
- Install temporary shutters, plywood, or wooden rods over doors and windows.
- Protect house from floods and storm surges by waterproofing lower components and exterior walls.
- Protect your valuable properties and documents, clean water storage systems, water wells, gas storage systems, electrical systems, electric appliances, etc.
- Reinforcement of damaged house
- Protect your house from windborne debris by removing possible windborne missiles like rods, sheets and stones, and anchor exterior components like tanks and boats.



Reinforcement of column

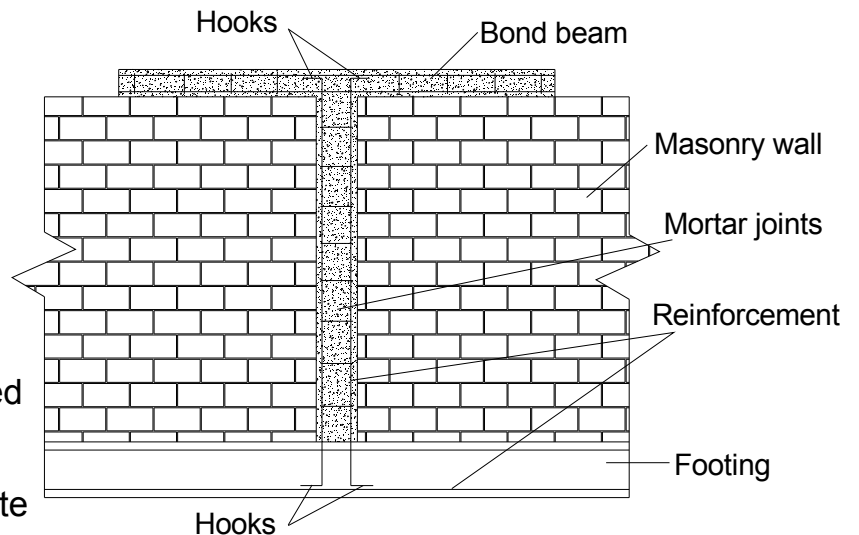
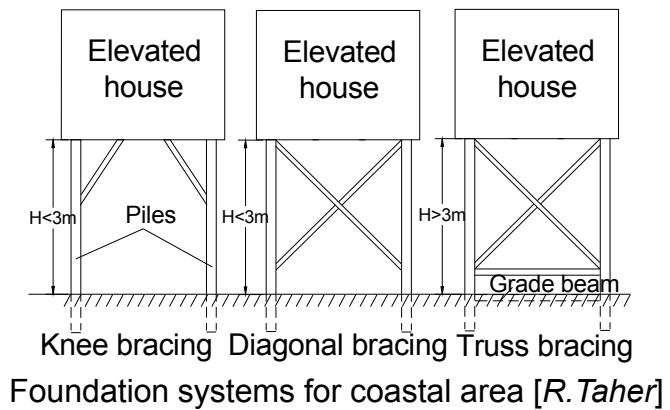


Reinforcement of damaged house

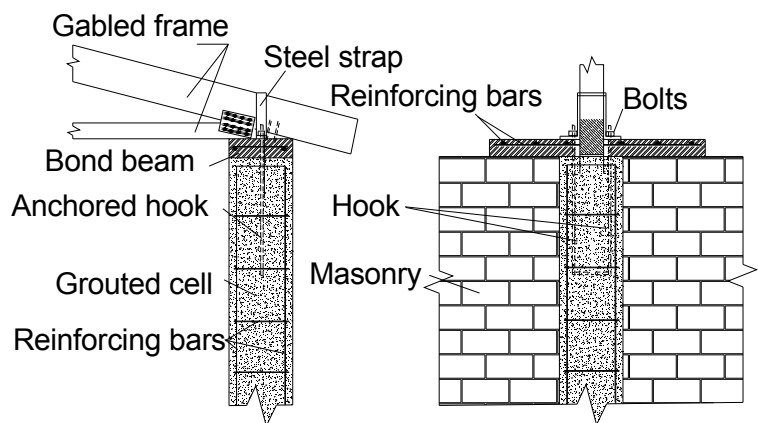
How to build new houses?

- New construction of houses in typhoon areas must utilize typhoon and high wind resistant designs as shown in the figures.
- The following documents are good references for new construction:

- Coastal Construction Manual by Federal Emergency Management Agency (FEMA).
- Is your home protected from typhoon disasters? - By Institute for Business and Home Safety (IBHS).



Bond beam and masonry reinforcement [R. Taher]



Vertical reinforcement and roof truss anchor [R. Taher]



New house construction in the coastal typhoon areas should refer to available documents.



If you are staying in temporary camps or unroofed structures, you must evacuate to safe places. Reinforcement will not be enough during a typhoon.

Before Wind-Related Hazards: Actions

What should local authorities do?

- Make community emergency plan or evacuation plan.
- Organize disaster rescue teams based on conditions and needs of specific regions.
- The team should collect all information about evacuation, shelter location and guide, food supply, medical support, etc.
- Promote training, practice drills and exercises, and circulate information for disaster prevention to raise awareness and preparedness.



What should individuals/families do?

- Make family emergency plan or evacuation plan.
- Inspect your home for potential hazards (items that can move, fall, break, or catch fire) and correct them.
- Listen to announcements and guidelines given by the TV, radio, newspaper, community supervisor/rescue teams for disaster prevention during typhoon season.
- Be aware of disaster risks such as high winds, floods, storm surges or landslides.
- Recognize public shelters or safe places nearby as well as access routes.
- Prepare “Emergency Kits” including non-perishable food, water, first aid kit, radios, flashlights, batteries, blankets, pillows, and toiletries.



Preparation for typhoon

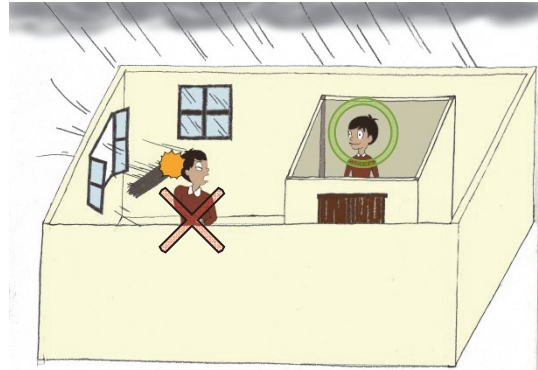
During Wind-Related Hazards: Actions

What should local authorities do?

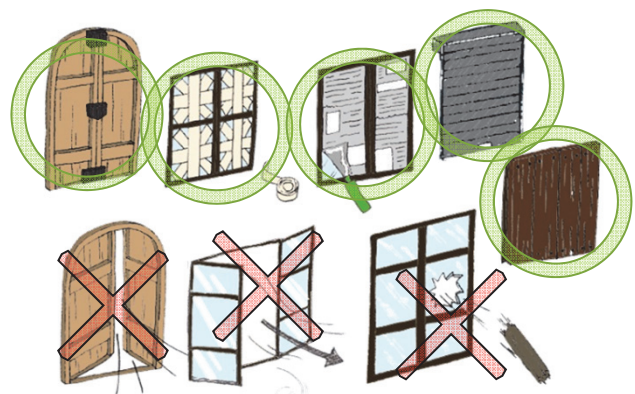
- Local authorities and rescue teams should frequently update weather information and announcements for local people.
- Rescue equipment should be ready for immediate management for local people.

What should individuals/families do?

- Listen to the TV or radio for information and follow instructions from local authorities.
- Don't go outside, it can be dangerous or even fatal, due to windborne debris in strong winds.
- Don't open doors and windows.
- Keep away from glass windows.
- Hide in the safest places in your house.
- Turn off gas, electricity, water supplies and household utilities if they are not really needed or if announced.
- In very severe situations, it is better to stay inside a small room surrounded by many columns/walls such as a bathroom and lie on the floor, under table, or other sturdy object.
- If staying in a public shelter, follow announcements and guidelines from shelter volunteers.
- Stay inside the shelter until a safe announcement is declared.
- If flood water enters your house, move to an upper level.
- Don't use the phone, except for emergency.



Stay in safe place



Window protection



Go to upper level, if flooding

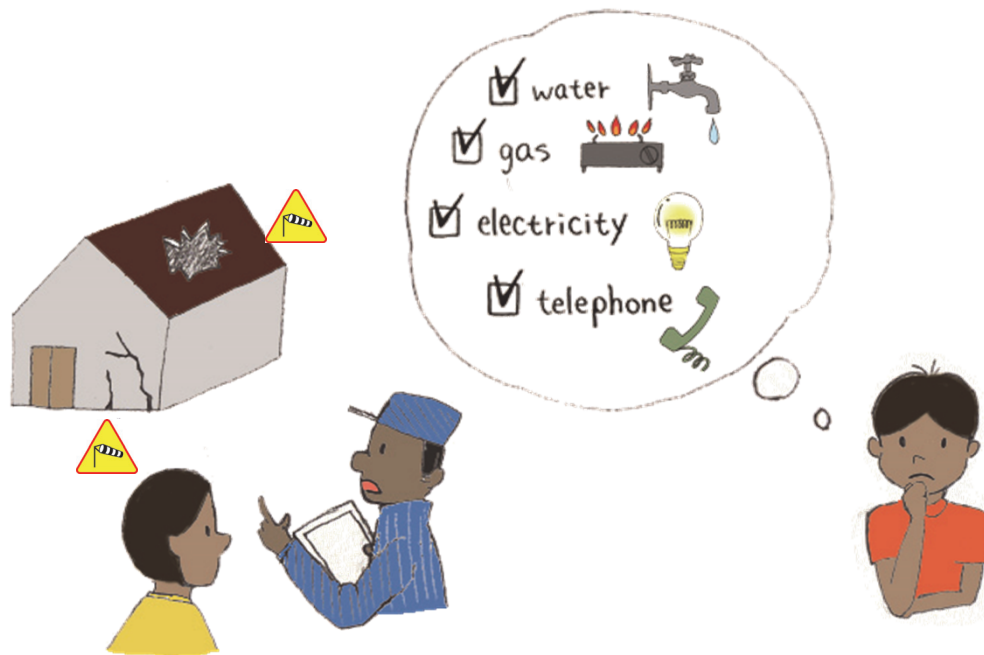
After Wind-Related Hazards: Actions

What should local authorities do?

- Update people about exact damages and future recovery plans.
- Provide food, water, medical aid and temporary homes for local people, who have lost their homes.
- Organize rescue teams for people who are isolated by flood water, landslides, etc.
- Open medical centers and arrange medical teams for the treatment of injured people according to their requirements.
- Collaboration of local authorities with higher authorities and local people with the intention to recover from disaster damages.



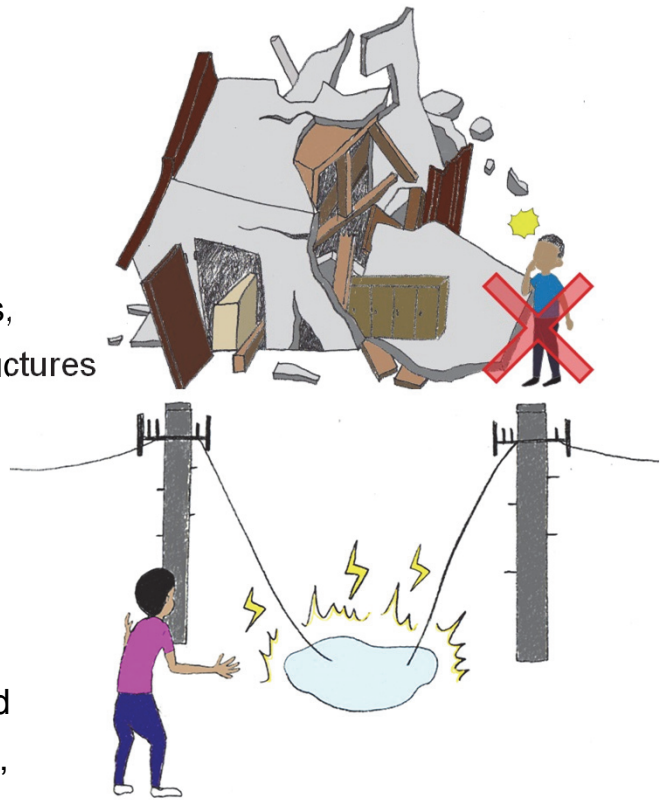
Cooperation



Inspection of damaged houses

What should individuals / families do?

- Listen to announcements from local authorities.
- Assist and help each other in the disaster rescue and recovery.
- Keep away from fallen electrical wires, damaged houses, and weakened structures on streets.
- Inspect damaged house carefully to ensure that it is safe to go inside.
- If you have any doubt about safety, your house must be inspected by a qualified engineer before going inside.
- Check carefully broken electrical, gas, water and sewer lines before going inside.
- Check that all electrical appliances are free from water before use.
- Repair the house by accepting help from rescue teams and local authority.
- Don't use the phone, except in emergencies for human rescue and life threatening circumstances.
- Accept treatment from medical centers.
- Be careful about waterborne diseases such as diarrhea, typhoid, skin disease, etc.



Be careful about broken electrical wires



Remove stone, rod, tin, broken tree, etc.