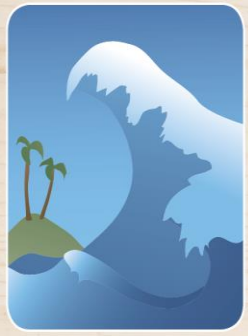
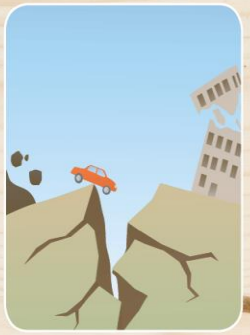
Resilient • Adaptive • Sustainable



TSUNAMIS

HURRICANES



EARTHQUAKES

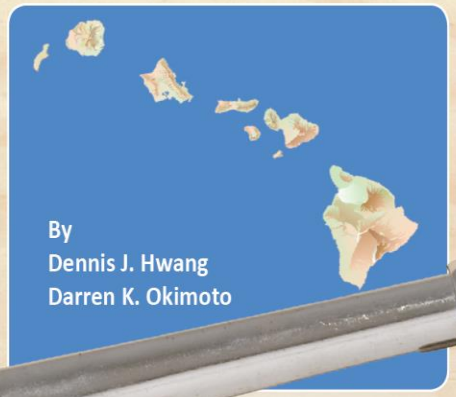
FLOODS

VOLCANO

CLIMATE CHANGE

University of Hawai'i Sea Grant College Program

HOMEOWNER'S HANDBOOK



By
Dennis J. Hwang
Darren K. Okimoto

TO PREPARE FOR NATURAL HAZARDS

Fourth Edition

TYPHOONS

TSUNAMIS

DROUGHT

FLOODING

HOMEOWNER'S HANDBOOK TO PREPARE FOR NATURAL HAZARDS

UH SEA GRANT

HOMEOWNER'S HANDBOOK TO PREPARE FOR NATURAL HAZARDS

REPUBLIC OF THE MARSHALL ISLANDS

By
Don Hess
Dennis Hwang
Karl Fellenius
Ian Robertson
Mark Stege
Ben Chutaro

USAID | PACIFIC ISLANDS

Goals:

1) Prepare families & homes for multiple natural hazards

2) Reduce risk to property and lives

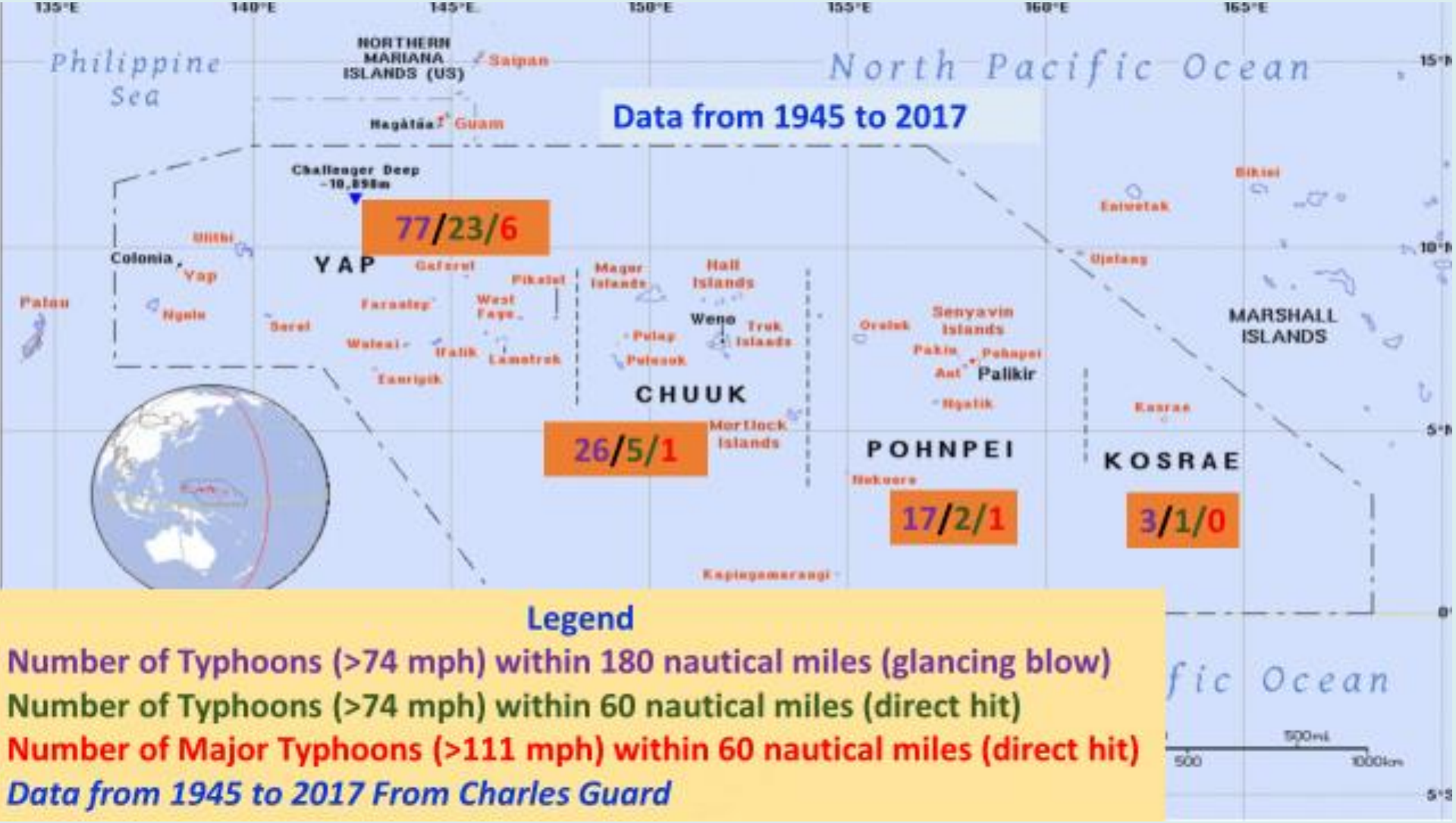
Part 1 – Introduction – Completed, February 2024

Part 2 - Hazard Science – History and Risk - Completed

Part 3 – Emergency Supplies & Evacuation Planning – In Development – Completed after March-April 2023 Field Visit

Part 4 – Hazard Mitigation – Home Strengthening & Retrofit – Completed, December 2023

Typhoon History in FSM



Legend

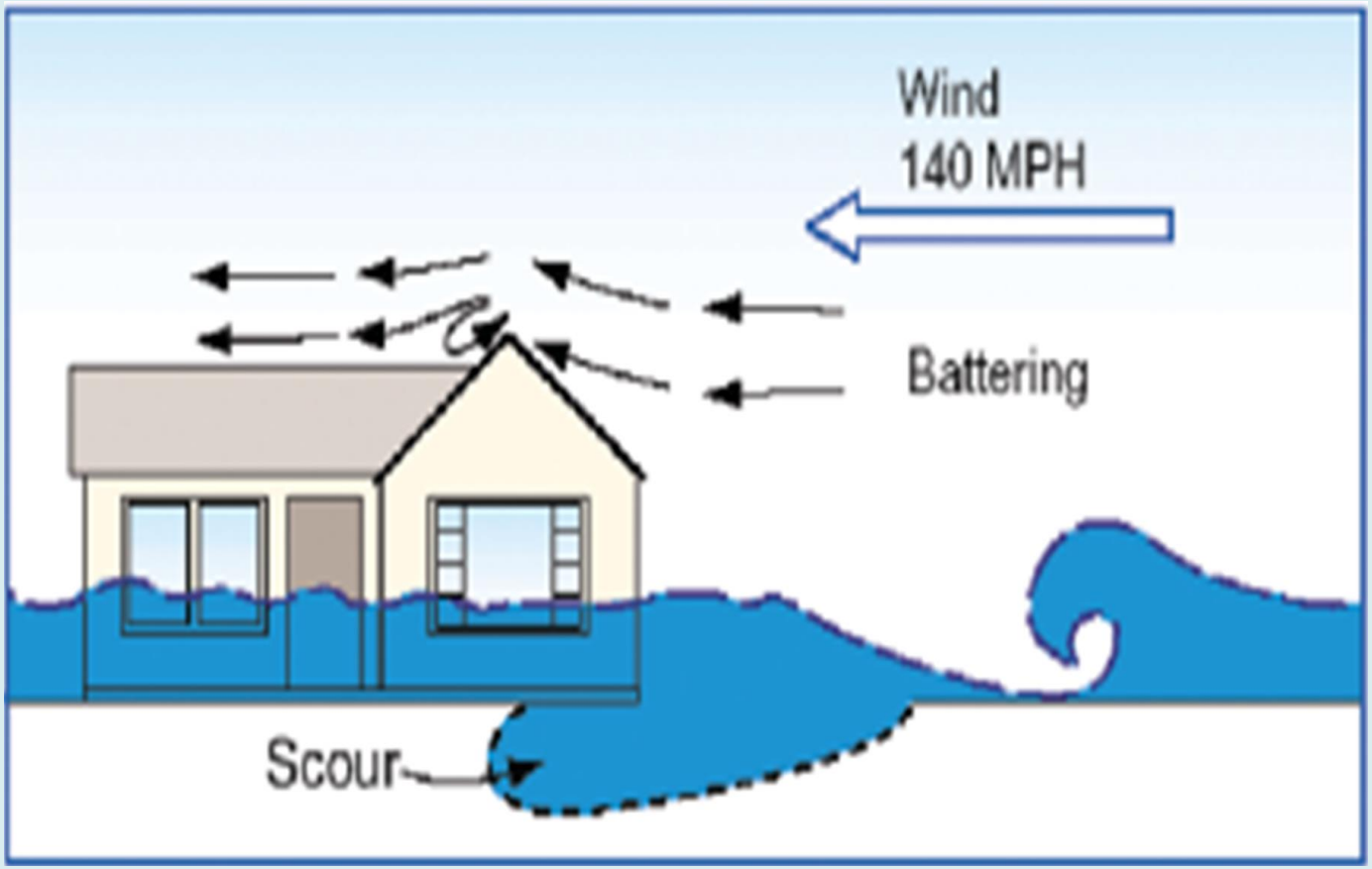
Number of Typhoons (>74 mph) within 180 nautical miles (glancing blow)

Number of Typhoons (>74 mph) within 60 nautical miles (direct hit)

Number of Major Typhoons (>111 mph) within 60 nautical miles (direct hit)

Data from 1945 to 2017 From Charles Guard

Plan for: 1) Erosion/Scour, 2) Storm Surge/Wave Inundation, 3) Flooding and 4) Wind



Important for: A) Emergency/Evacuation Planning, B) Siting, C) Mitigation during Building or Retrofit

Table 3-1. Emergency Supplies Checklist

Item	Picture	Comment	☐
Portable radio with extra-long life batteries		Important to receive emergency instructions from government officials. See information in the table below for applicable emergency radio stations for each State. Carry spare batteries. To prevent corrosion, store batteries in original packaging until ready to be used. Another alternative to batteries is a radio with a built-in wind-up generator.	
Portable flashlight with extra-long life batteries		Flashlights with light emitting diodes (LEDs) use very little energy and thus will last much longer on a set of batteries. To prevent corrosion, store batteries in original packaging until ready to be used.	
First-aid kit		Comes in many different sizes. Antibiotic cream in the first-aid kit is an important accessory.	
List and supply of special medications (prescription and other)		Special medications may not be readily available during and after an emergency. Keep at least a two week supply of prescription medication, that are not expired.	
Fire extinguisher		Flooding of electrical circuits can cause sparks and start a fire. During a drought, fire risk is increased. A multipurpose ABC extinguisher is good for home use. Class A- Wood, Paper; Class B – flammable liquids; and Class C – Electrical.	
Disposable plates, eating and kitchen utensils		Water for cleaning dishes may be in short supply during and after an emergency.	
Sanitation supplies		Toilet paper, buckets, and cleaning materials are needed to prevent transmission of water-borne diseases. Bleach or water treatment tablets can be used to purify water for drinking post-emergency.	
Tarp		During high wind events there is often much roof damage. The tarps are commonly used to cover the roofs that are damaged and provide temporary shelter.	
Supply of nonperishable food		A two-week supply is recommended for families and infants. Also, include food for your pet and a manual can opener.	
Water & storage containers		Two-week supply of water – other than what is in your catchment system. A good estimate is two gallons per person per day for drinking, cooking, and personal hygiene. Storage containers are available at your local hardware store. You can also store water for hygiene use (in bathtubs, coolers, rubbish containers, buckets, and washing machines). Store drinking water in a container with a lid and tap to prevent contamination. Also maintain and secure your water catchment system during a typhoon (see Part 4).	
Portable stove or grill		Household electricity and gas lines may not function during and after an emergency.	
Charcoal, propane, stove fuel, firewood		Also have matches and a lighter. Wood can be fuel and stored under a tarp, ideally elevated. Wood should be precut – not during or after an event when the wood is wet.	
Machete		Can be used to cut firewood, clear brush, or open coconuts for food and drink.	
Chain Saw		A mini or full size chain saw can be used to clear fallen trees and branches in roadways and limbs that have fallen on a house. A gas chainsaw is powerful and cuts more wood, but requires fuel storage. An electric chainsaw is convenient, but the number of cuts is limited by battery power supply.	
Sledge hammer		A sledge hammer can be useful when building materials have collapsed and it is necessary to create emergency access either into or out of a structure.	

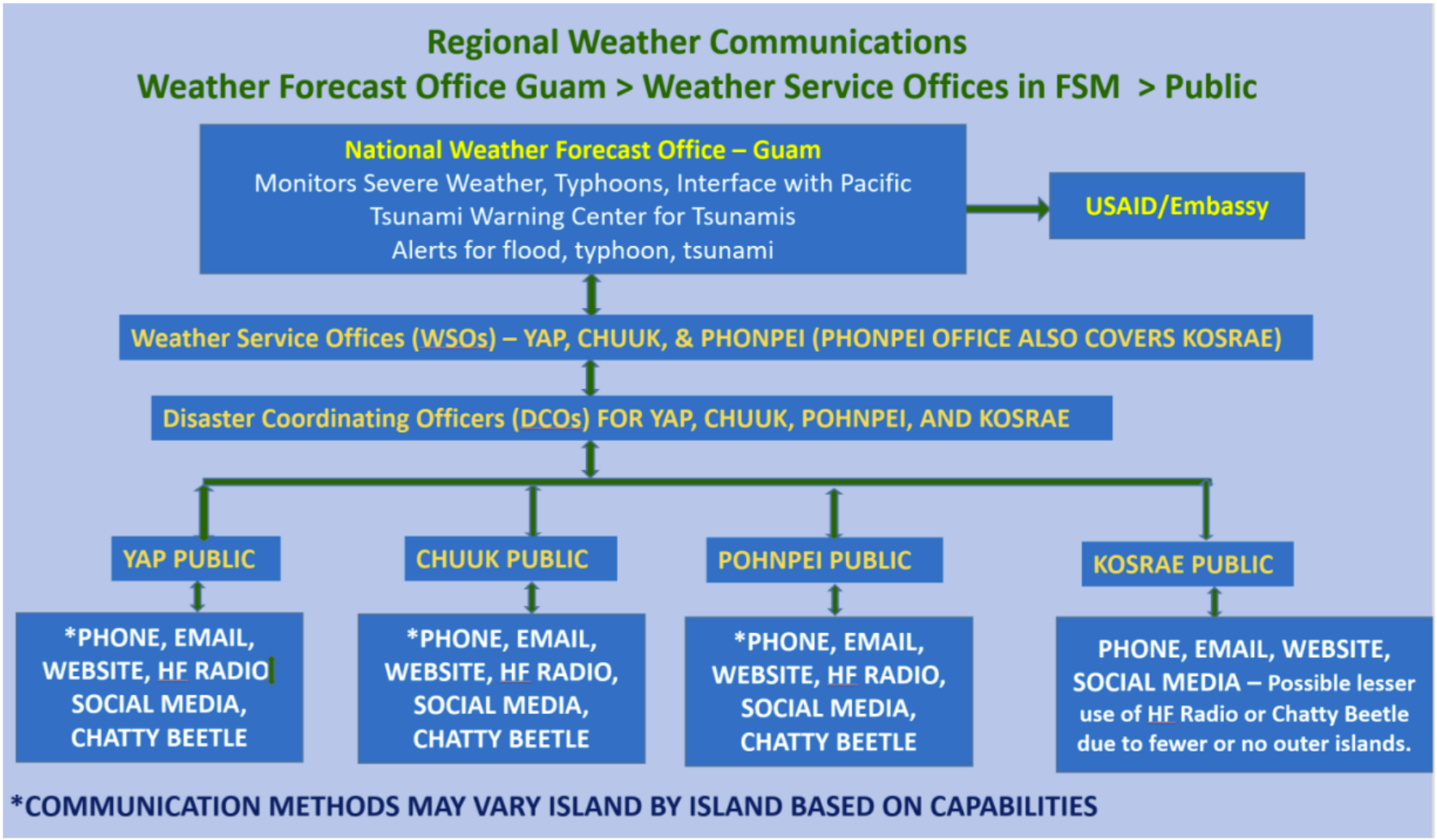
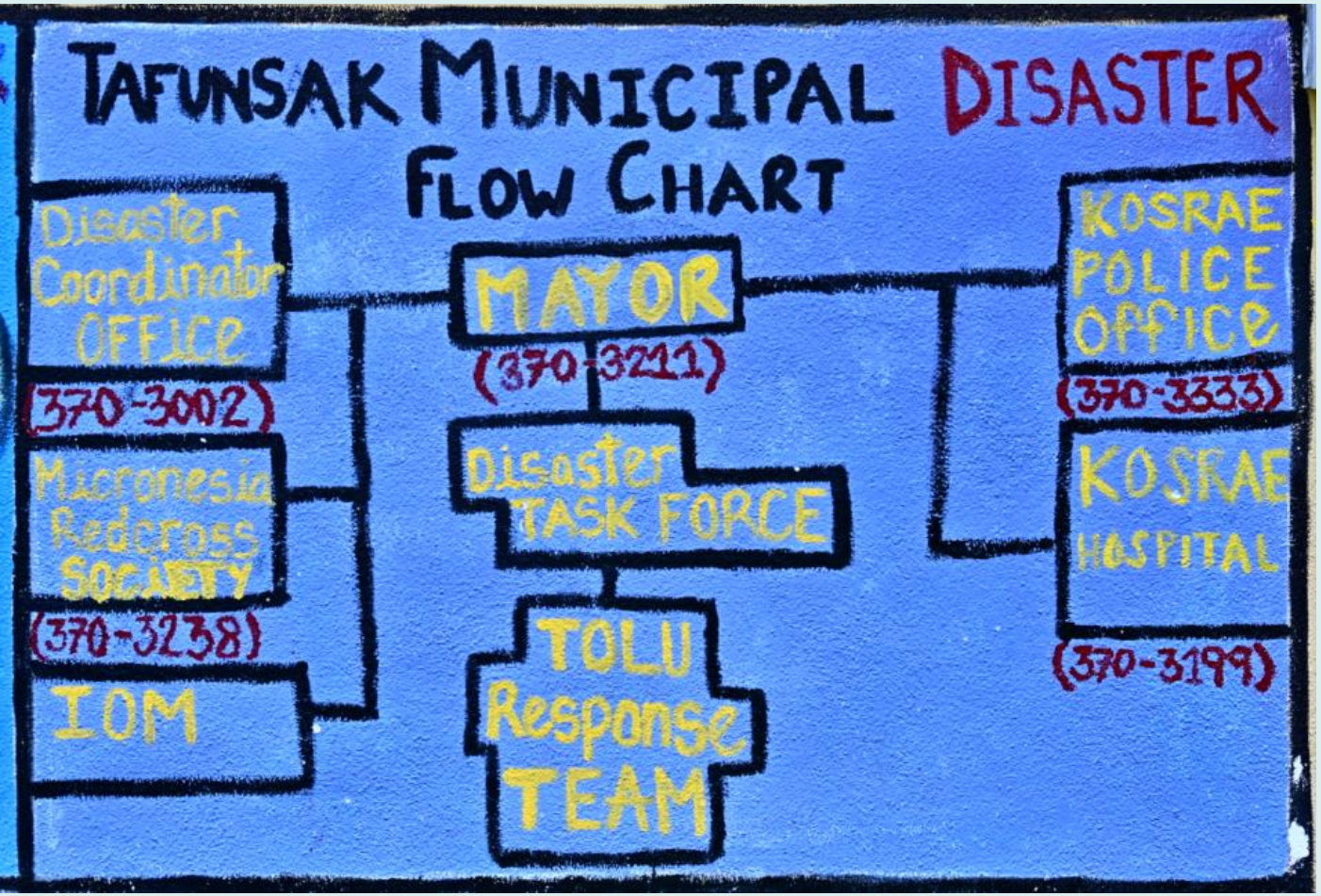


Figure 3-17. During typhoons, tsunamis or other significant weather or water events, the Weather Forecast Office in Guam collects and analyzes data from across the Pacific and communicates with the local Weather Service Offices ("WSOs") for coordination and guidance. WSOs will provide decision support services to the Disaster Coordinating Officers ("DCOs") for each State. The DCOs will consult with their respective State governor and then inform the National Department of the Environment, Climate Change & Emergency Management ("DECEM") and the public through one of the communication methods listed.



The flow of emergency information from the DCO to the Mayor in Tafunsak Municipality, Kosrae. Similar flow of information in Pohnpei and Chuuk

In Yap, each municipality is different and DCO may contact Mayor, Chief, series of Chiefs or other community leader. Communication Plan being worked on for each municipality with DCO, IOM and Catholic Relief Services. Encourage residents to be involved in creating plan.

Table 3-6 – Methods of Communication in FSM & Tips for Residents

Communication Type	How it Works	Where in FSM to Utilize	Tips for Residents
Phone 	Phone coverage in the FSM is through FSM Telecommunications Corporation FSMTC	Almost everywhere including isolated islands in the Mortlocks Region – Ta Island, Satowan Island, Lukunor Island, Oneop Island, Kuttu Island, Ettal Island Moch Island	To ensure coverage, residents should contact FSMTC at: https://www.fsmtc.fm/ **If you have a registered cell phone number with FSM Telecom, you will automatically get emergency text message alerts.** There is no need to register or download an app.
Portable Radio  Communication is one way.	Typical radio sold at the hardware store. This can be part of your emergency kit. There are designated government radio stations at the frequencies to the right.	**Emergency Radio Stations are:** **Kosrae** – 89.7 FM **Pohnpei** – 1449 AM and 88.9 FM **Chuuk** – 1593 AM and 88.5 FM **Yap** – 1494 AM and 89.9 FM	Once residents are alerted of a potential hazard event (e.g., by community leaders, mayors, schools, chiefs), they should turn on the radio to the frequencies listed in column 3 to receive more information. Radio capabilities for some islands is increasing.
Internet i) Website; ii) Social Media (Facebook); iii) email	Internet coverage in FSM is provided by FSM Telecommunications Corporation FSMTC	Weather Forecast Office Guam www.weather.gov/gum and also Facebook US National Weather Service Guam | Facebook Weather Service Offices Chuuk WSO - Facebook Yap WSO - Facebook Pohnpei & Kosrae WSO Facebook Office of President Public Information Office Facebook Department Environment Climate Change & Emergency Management https://fsm-data.sprep.org/group/1	Residents should become familiar and check websites for their individual State: i) WFO – Guam; ii) National Department of Environment, Climate Change & Emergency Management ("DECEM); and iii) websites for individual Weather Service and Public Information Offices
		Kosrae PIO (5) Kosrae-Public Information Office - Posts | Facebook Pohnpei PIO (2) Pohnpei State Public Information, Office of the Governor | Facebook Office of the Governor, State of Chuuk – (2) Facebook Yap Public Information	
High Frequency ("HF") Radio.  Communication is two way. This is also known as Single Side Band radio or SSB radio or Short wave radio.	A specialized radio using high frequencies in the 3-30 megahertz range. This is especially useful for long range communication to link remote regions to the outside world. HF radio is not reliant on conventional communications infrastructure.	HF radios should be pre-positioned with the municipal leader of each island (Mayors, school principal, chief). During normal times, Transmits every 6 hours - (06, 12, 18, 24) hour periods – If incoming hazard event, more often.	Residents should check: 1) if HF Radio is available for their location to receive emergency messages; 2) who are designated persons to receive messages (usually the municipal leader such as the mayor, school principal or chief); and 3) how is message spread through the community ("coconut wireless, walkie talkie, neighborhood communication chain, etc.)
Chatty Beetle from USAID and NOAA 	Portable satellite terminal that permits text-based emergency alerts (weather, tsunami or other) in remote locations where communications are limited. Two-way communication allows incoming alerts & outgoing status - observation reports.	Located in Chuuk – 11 main outer islands - some may not be operational. Also located for some of the outer islands for Pohnpei and Yap.	Residents should confirm: 1) presence of Chatty Beetle, 2) if operational, 3) designated lead person to receive messages (usually the municipal leader such as the mayor, school principal, or chief), and 4) the method of emergency message distribution – (coconut wireless, walkie talkie, community messaging, etc.). Not all locations will have a Chatty Beetle. Where they are located, it is usually just one per island.
Satellite Dish for internet.	For Chuuk and other isolated locations, a private company may be able to set up a satellite dish for individual families. Companies to check include: FSMTECH - https://www.facebook.com/fsmtech.fm/	Islands with Internet Data Signal in the Mortlocks Region - Namoluk Island, Ta Island, Satowan Island, Lukunor Island Oneop Island, Kuttu Island, Ettal Island	Residents should see if they can get internet communication by FSM Telecommunications. If not, a home satellite dish may be possible. As a last resort,
	+691 320 4970 info@fsmtech.fm fsmtech.fm; and Starlink Starlink Micronesia: Satellite Internet Sparks Digital (americantv.com) Starlink The Advent of Starlink in Micronesia: Bridging the Digital Divide (ts2.com.pl)	Moch Island, Losap Island	communication may be by HF radio or Chatty Beetle. Check with your Disaster Coordinating Offices (Table 3-5) before any event. It is important to plan ahead.

At Tufunsak Elementary School

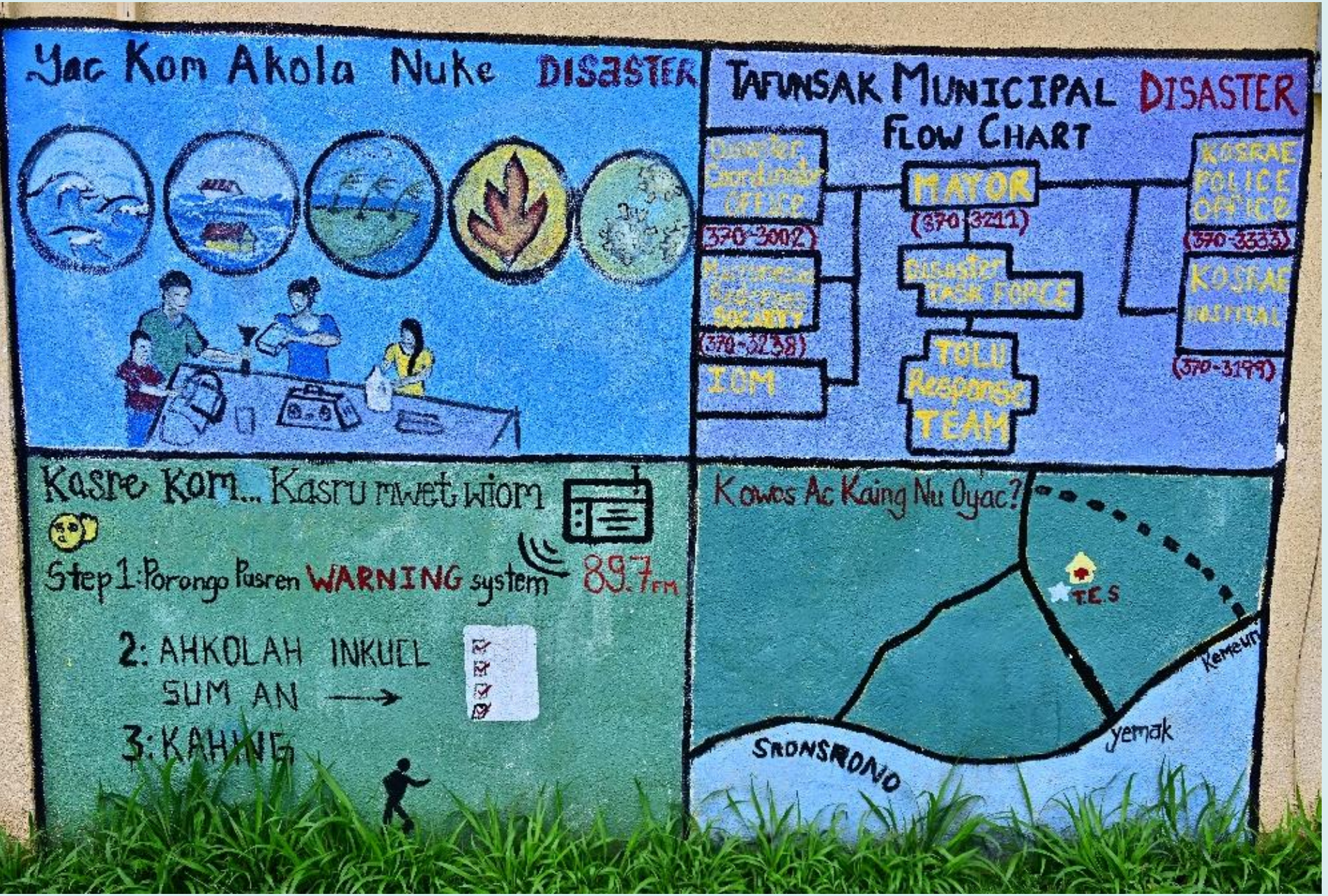


Table 3-2. Important Features for an Ideal Emergency Shelter

Criteria	Comments	
1. Tall building or high elevation	Use the second floor or higher for low lying areas. The taller the building the better if it is in good condition. (Figure 3-2). For buildings on high ground, height is not as important as strength of the building (Figure 3-3).	
2. Reinforced concrete	**Best** – Beam-column moment frame with open lower floor for low-lying areas (Figure 3-4); **Good** – Moment frame with CMU infill on first and second floors (Figure 3-5); **Acceptable** – CMU walls – (solid grouted – concrete and rebar fill the holes) and **under 20 years old** (Figure 3-6).	
3. Tie down roofing	Secure roofing material to the roof (usually plywood over the trusses or rafters) with sufficient number of fasteners and large washers (Figure 3-7).	
4. Roof framing tied down	The trusses should be pre-manufactured and engineered for uniformity and strength (Figure 3-8). Roof trusses must be bolted to the beams, columns or walls to prevent lift-off during high wind events (Figure 3-9). Alternatively, ridge beam, and large sloping rafters should be connected to walls, columns, or beams with steel metal connectors (Figure 3-10).	
5. Window protection	Windows protected from debris impacts. The windows behind screens should be shatterproof or laminated (Figures 3-11 and 3-12). Or use sturdy protective coverings such as aluminum louvers or accordion shutters (Figures 3-13 and 3-14). Design for protecting against wind-borne debris and circulation to keep room cool under normal conditions.	
6. Sturdy doors	The shelter doors should be made of metal or solid wood with quality latches and hinges to prevent their opening in high wind (Figure 3-15).	
7. Strong stairs	Sturdy buildings could have exterior wood stairs to second floor. These can be washed away during inundation events. There should be a back-up exit plan. (Figure 3-16)	
8. Well maintained	Look for newer building (under 20 years for CMU construction), no corrosion of fasteners, and no missing connections (Figure 3-17).	
9. Comfort	In the shelter rooms there should be toilet facilities for men and women (Figure 3-18), with proper hygiene and sanitary guidelines. Typical shelter space requires 10 square feet of space per person, but in an emergency this criterion may be compromised.	
10. 24/7 access	During an emergency – the shelter spaces must be open. There must also be redundancy in case the person who opens the building is not available. There should be redundancy in decision-making and communication since any break in delivering a key message can lead to the loss of life. Plans need to be made for key personnel to run the	

Important Features of an Ideal Emergency Shelter!

Tall Buildings

With Principal Eterny Edwin

Part 4 – Protecting the Home

Concrete - Masonry Walls & Concrete Roof

Concrete- Masonry Walls & Wood Framed Roof & Metal Corrugated Roof

Wood Walls (studs) & Wood Framed Roof - Metal Corrugated Roof

Wood Walls (T1-11), Wood Framed Roof & Metal Corrugated Roof

Concrete – CMU Walls strong - Metal Corrugated Roof damaged by Typhoon Wutip

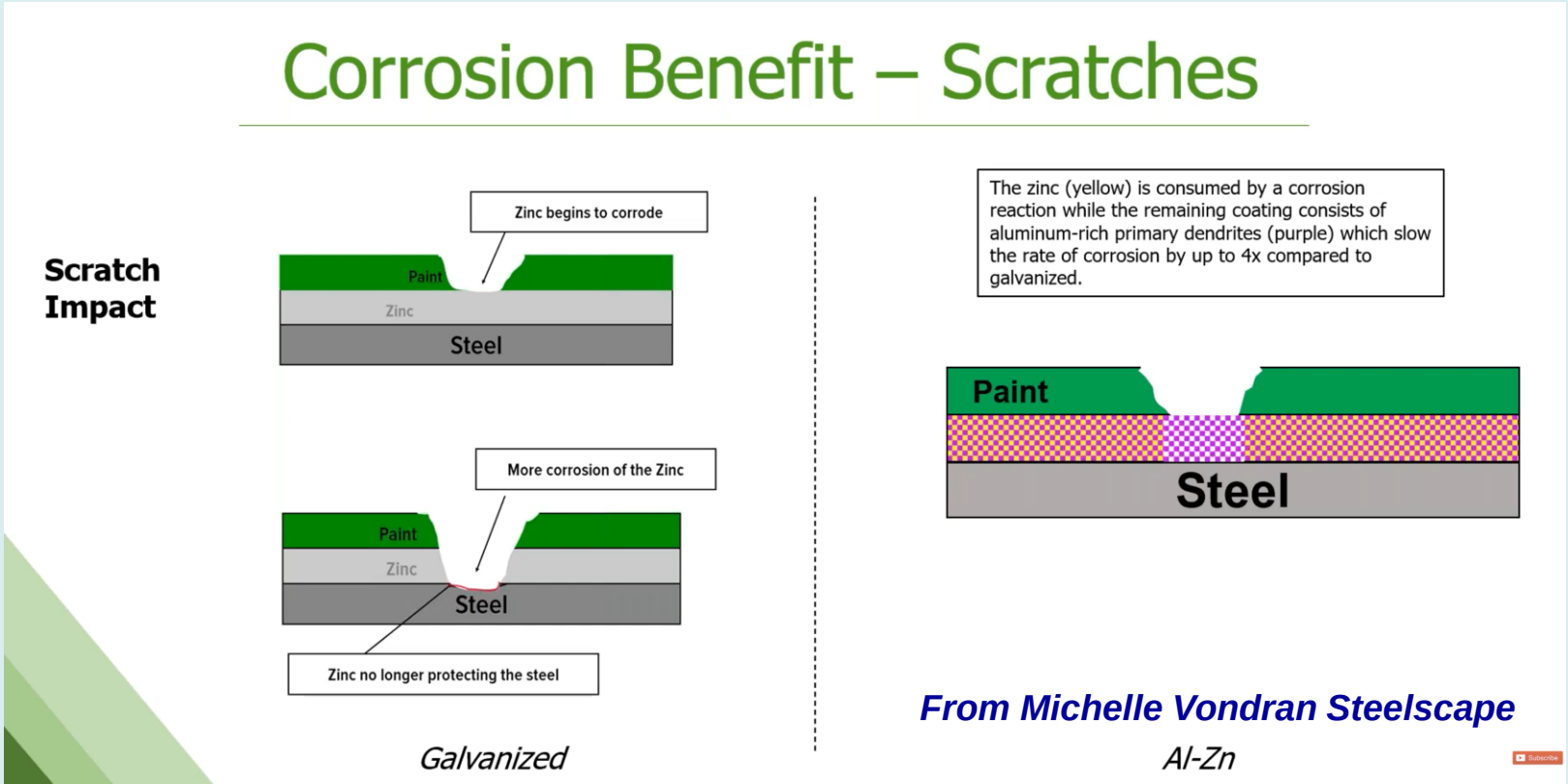
Concrete – CMU Walls strong - Metal Corrugated Roof damaged by Typhoon – Roof weakened by Corrosion

Which is older? Left or Right side??

Galvalume – registered trademark of BIEC
Zincalume – registered trademark of Bluescope Ltd.
Producers need to be licensed.

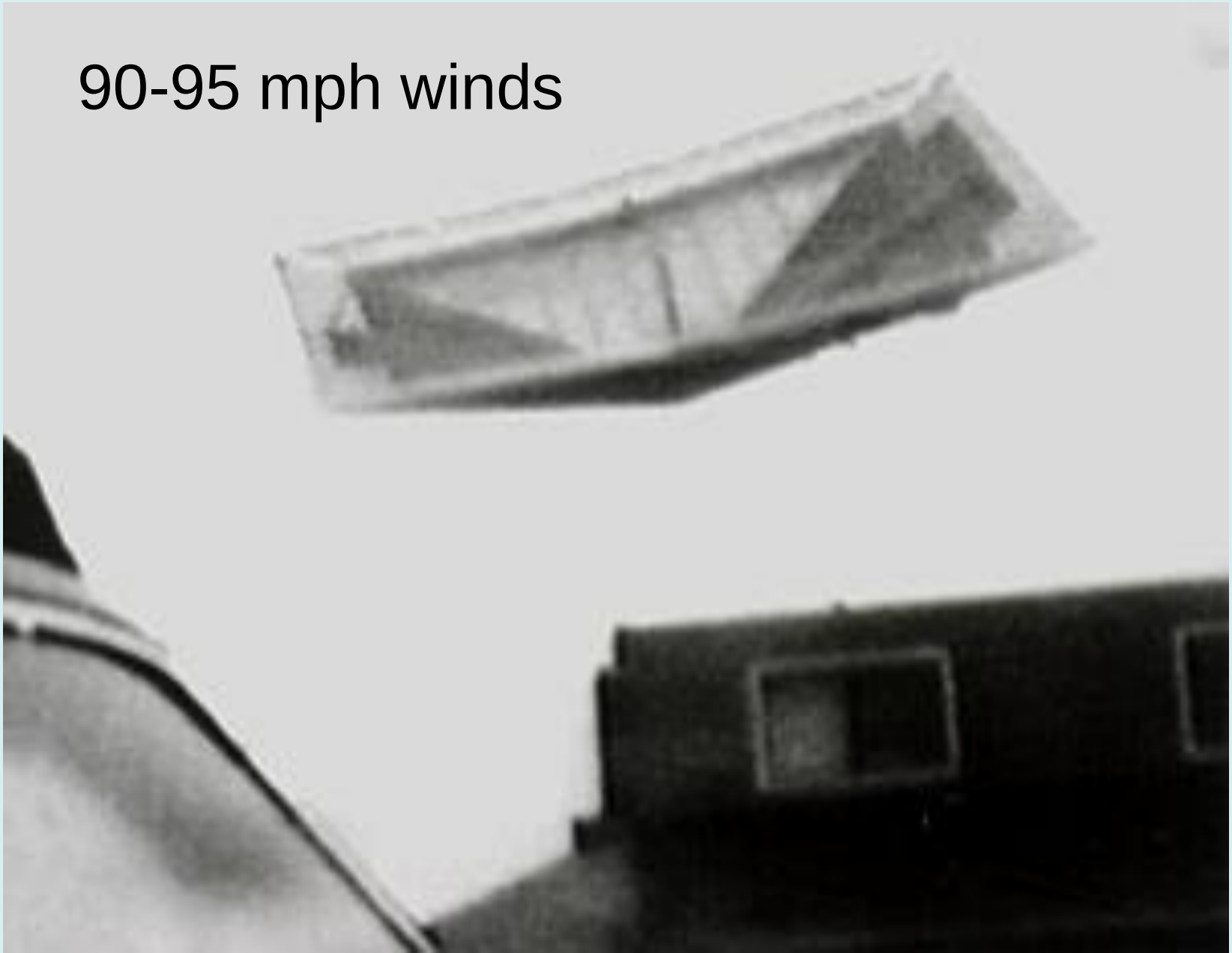
Both have mixture of 55% Aluminum, 43% Zinc and 1.5% Silica which coats the metal roofing

Projected to outlast galvanized sheet by 9X - Some roofs over 50 years. Warranty over 20 years.



From Michelle Vondran Steelscape

Hurricane Iniki-- 1992



When rebuild – do stronger

1. **Trusses or rafters decrease spacing – 2 ft.**
2. **Tie with Simpson MSTM/HSTM strap**
3. **Plywood deck – 5/8?**
4. **Tie roof with umbrella washer screws**

Wood Construction Catalogue 2024-2025 – page 267

MTSM/HTSM

Strong-Tie

Twist Straps

The MTSM and HTSM offer high-strength truss-to-masonry connections.

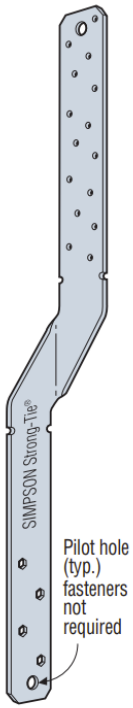
Material: MTSM — 16 gauge; HTSM — 14 gauge

Finish: Galvanized; see Corrosion Information, pp. 12–15

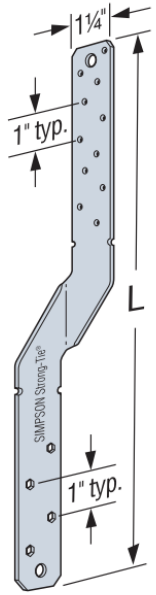
Installation:

- Use all specified fasteners; see General Notes
- Installs with hex-head Titen Turbo™ screws
- Attach to either side of grouted concrete block with a minimum one #5 rebar horizontal
- MTSM and HTSM can be field bent once to a 45° angle
- Products shall be installed such that Titen Turbo screws are not exposed to the exterior environment.

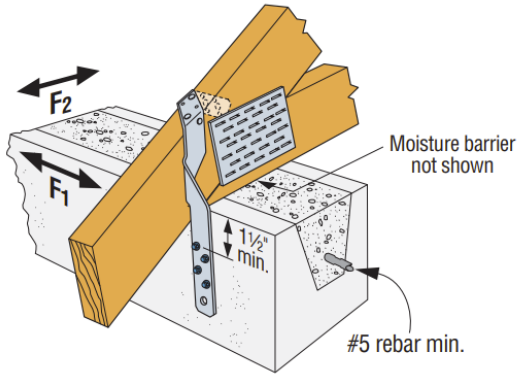
Codes: See p. 11 for Code Reference Key Chart



HTSM20
(MTSM20 similar)



MTSM16
(HTSM16 similar)



Typical MTSM20 Installation
(HTSM20 similar)

Concrete and Masonry Screws

The new Titen Turbo concrete and masonry screw anchor features a patent-pending Torque Reduction Channel that displaces dust where it can't obstruct the thread action, reducing the likelihood of binding in the hole. The Titen Turbo is available in 3⁄16" and ¼" diameter with either a hex head (required for use with connectors) or, for other material installations, a 6-lobe-drive countersunk head. The pointed tip allows for easy attachment of wood to concrete or for wood-to-wood applications. For more information, visit **go.strongtie.com/titenturbo**.

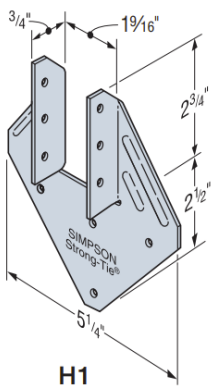
Material: Carbon steel

Coating: Zinc plated with baked-on ceramic coating

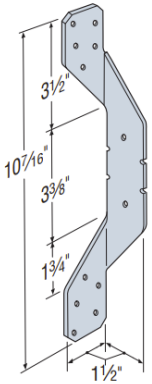
Codes: FL16230, IAPMO UES ER-712 (concrete), IAPMO UES ER-716 (masonry)

For proper installation sequence, see installation requirements in IAPMO UES ER-712 (Concrete) and ER-716 (Masonry).

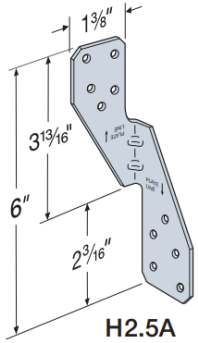
Titen Turbo Hex-Head Screw



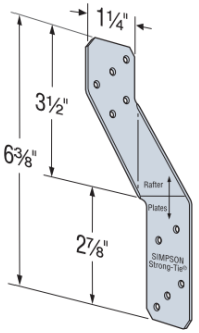
H1
(H1.81Z similar)



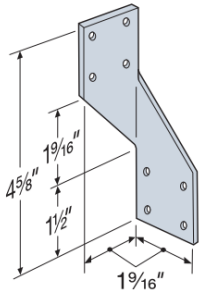
H2A
(H2ASS similar)



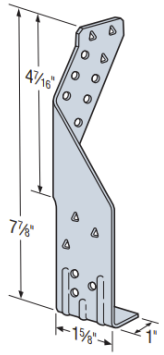
H2.5A
(H2.5ASS similar)



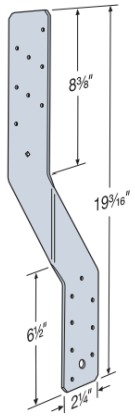
H2.5T



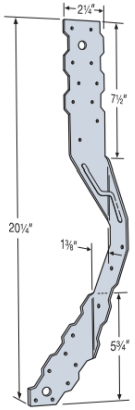
H3
(H3SS similar)



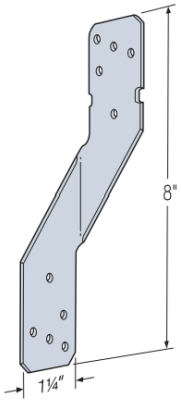
TSP



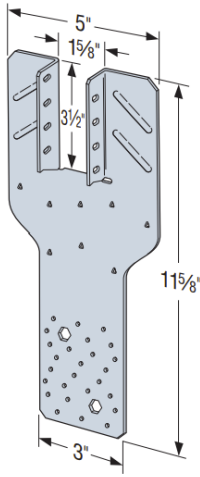
H6



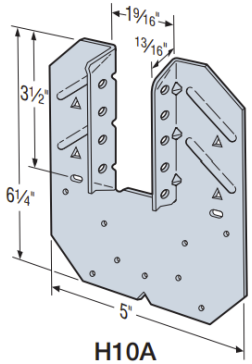
H7Z



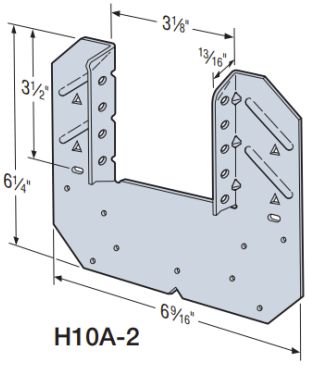
H8
(H8SS similar)



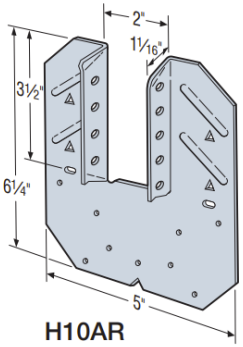
H10S



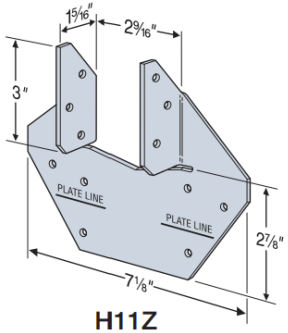
H10A
(H10ASS similar)



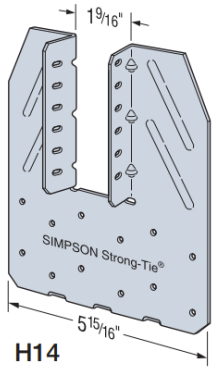
H10A-2



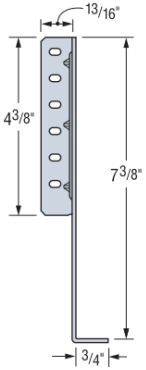
H10AR



H11Z



H14



H14 Profile

Depending on roof to wall configuration, use appropriate tie.


Use Screws and Washers to Tie Roof to Purlins and Rafters
Closer Spacing of Trusses and Rafters
Hurricane Clips
Anchor Top Plate
Structural Bond Beam

FEMA Guidance for Metal Corrugated Roof up to 165 MPH

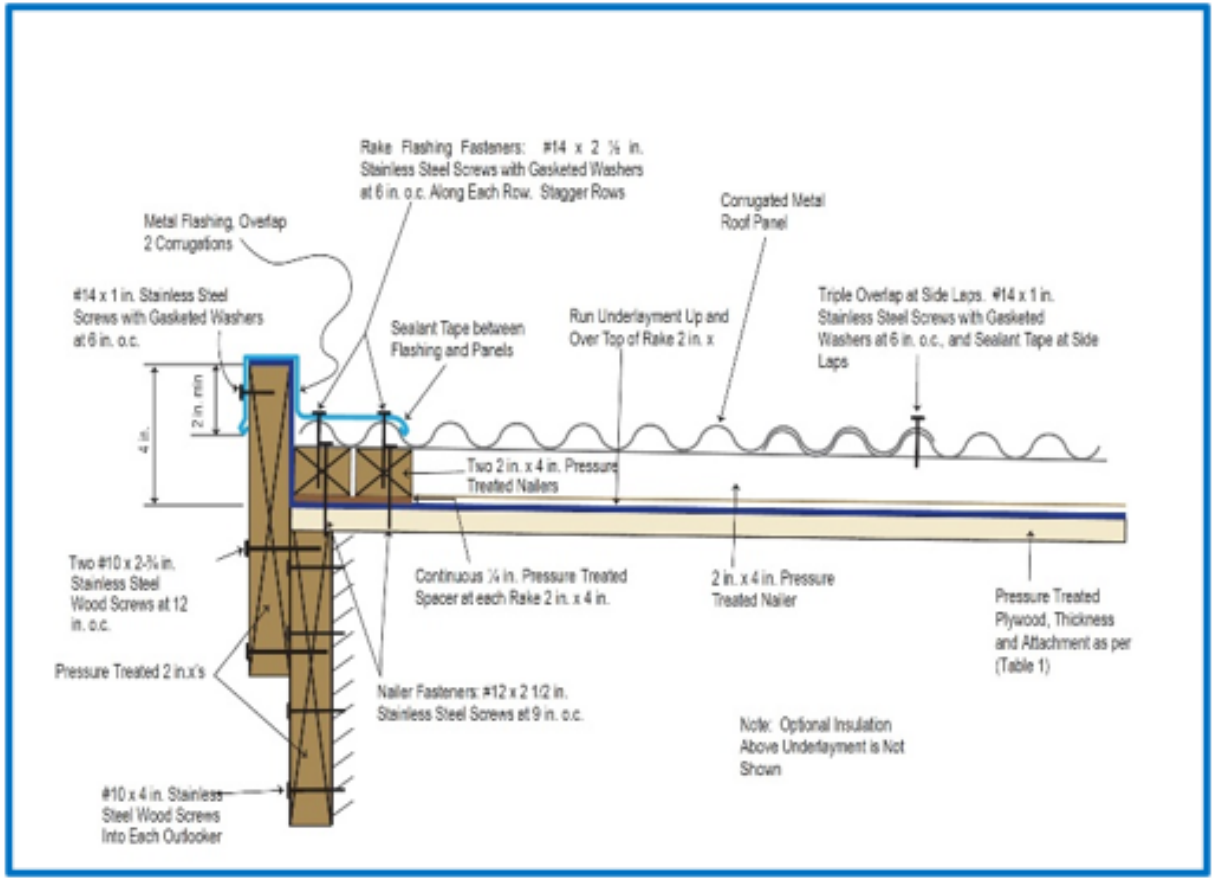
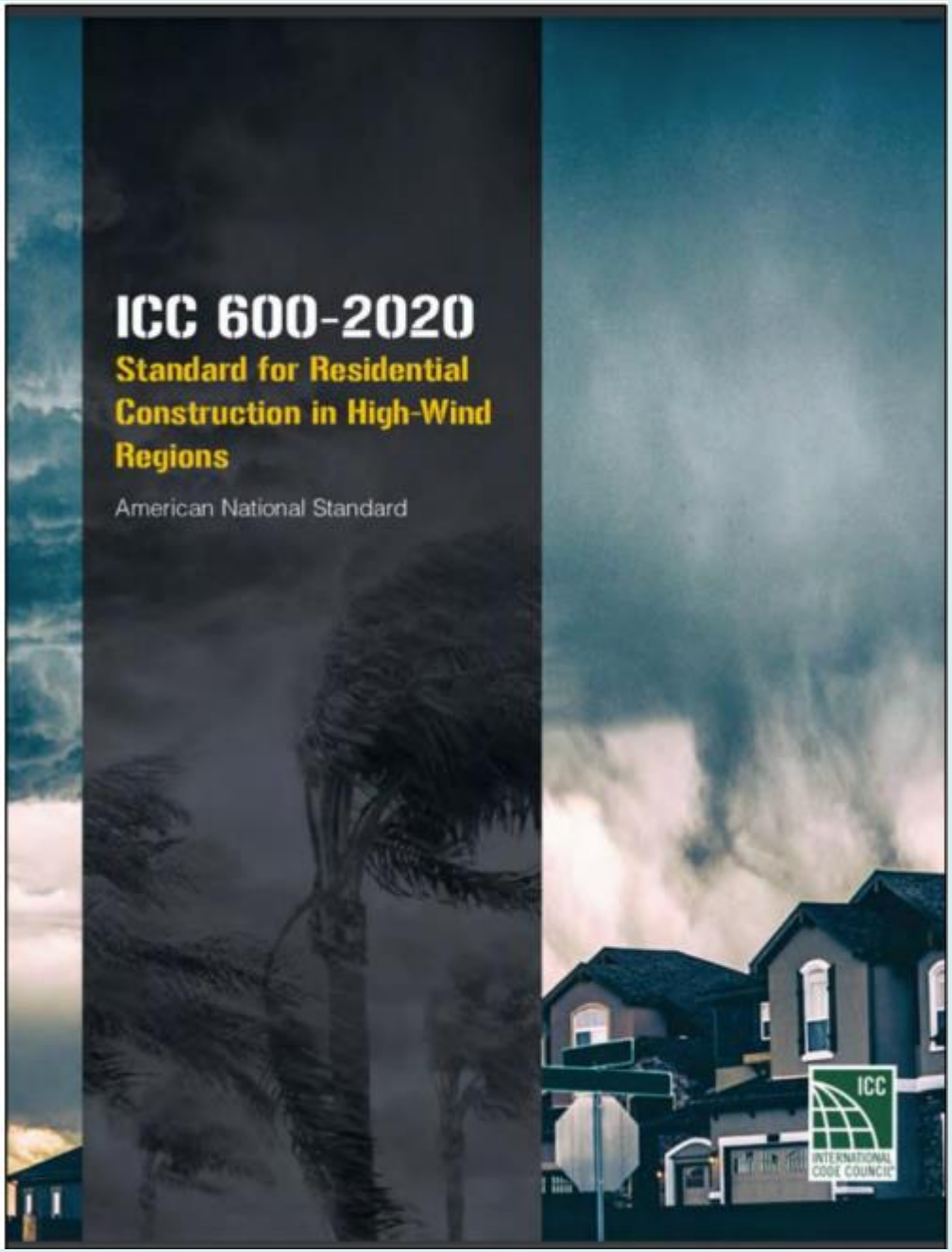


Figure 4-34. Recommendations to build a stronger roof from FEMA include: (i) between the trusses and the metal corrugated roof is plywood sheathing – minimum 5/8 inch thick, (ii) self-adhering bitumen layer underlayment (ASTM D 1970) or bitumen tape along plywood joints to prevent leaks, (iii) purlins or nailers that are 2 feet 3.5 inches apart, (iv) overlap of the metal corrugated roof with three ridges vs. two as in Figure 4-29, (v) trusses that are 2 feet apart and (vi) tighter spacing of the nailers or purlins at the edges and or ridges of the house to account for increased wind pressure there – see Figure 4-31.

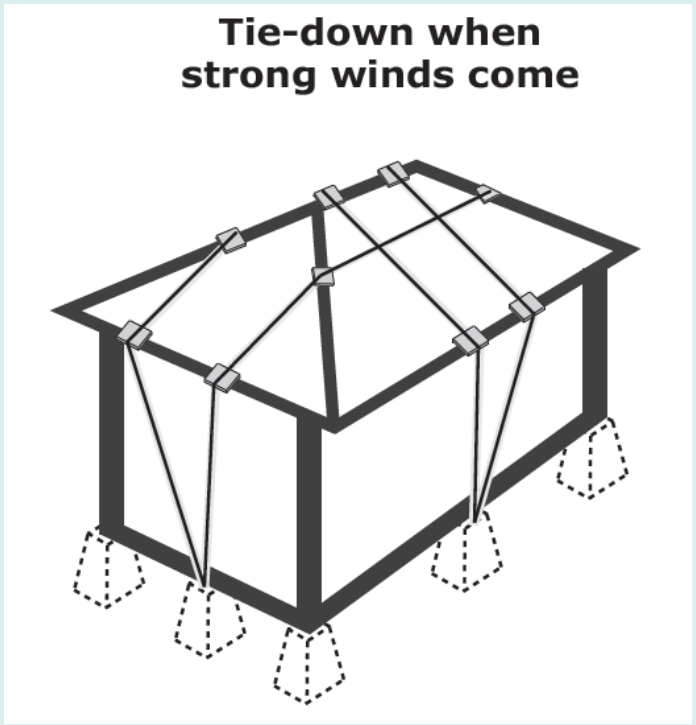


Some of the prescriptive measures could be applicable to new houses in States with greater typhoon risk. Initially as guidance.

E.g., wall thickness equal to or greater than 8 inches, size of bond beam greater than 8" depth, rebar equal to or greater than #5.

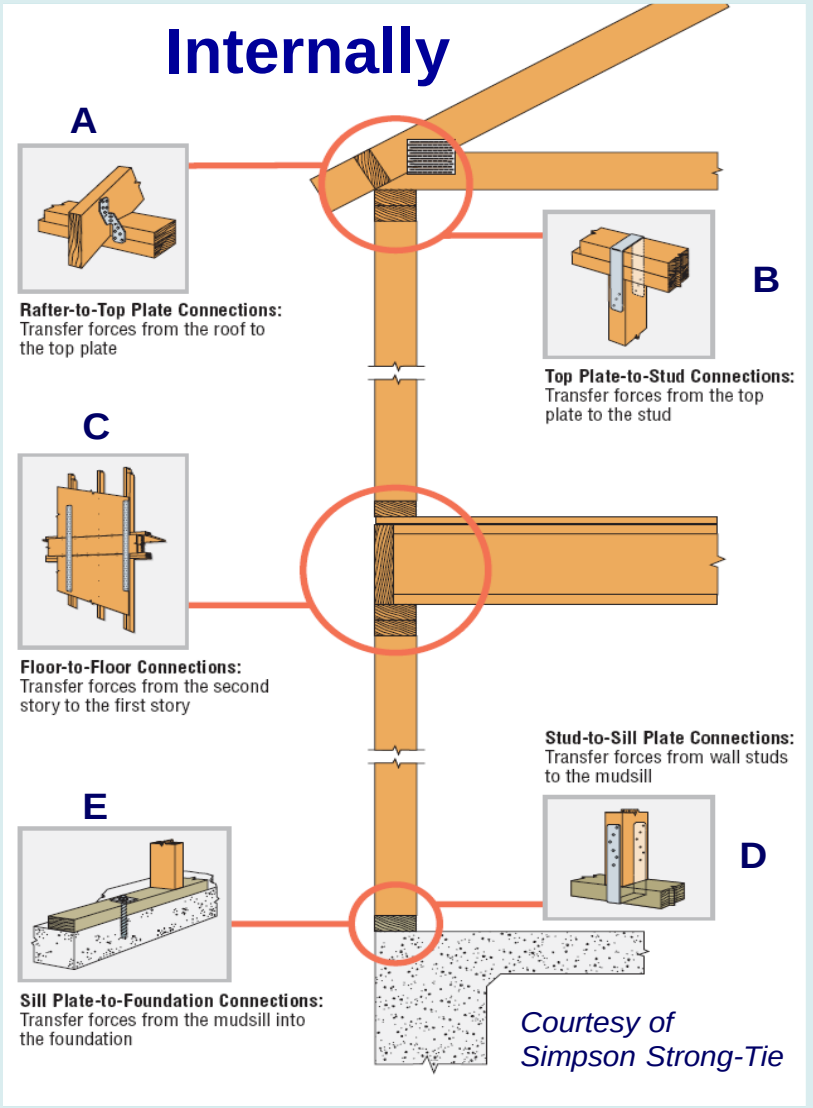
Tie Down The House – Roof to Foundation

Externally

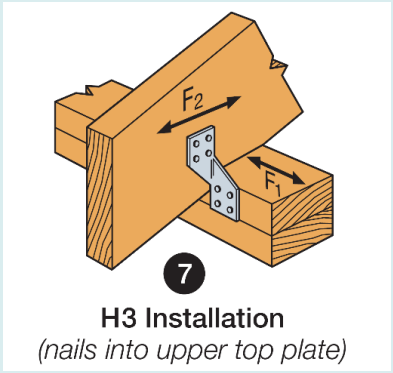


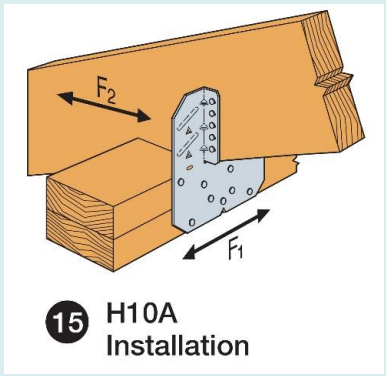
And /Or

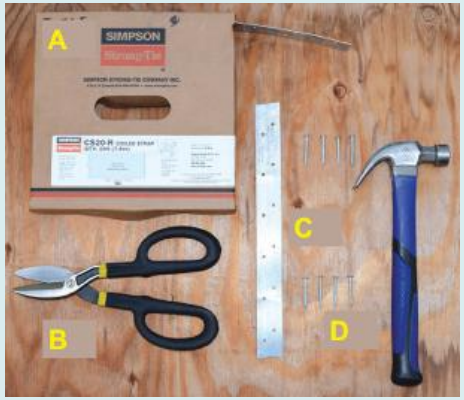
Internally

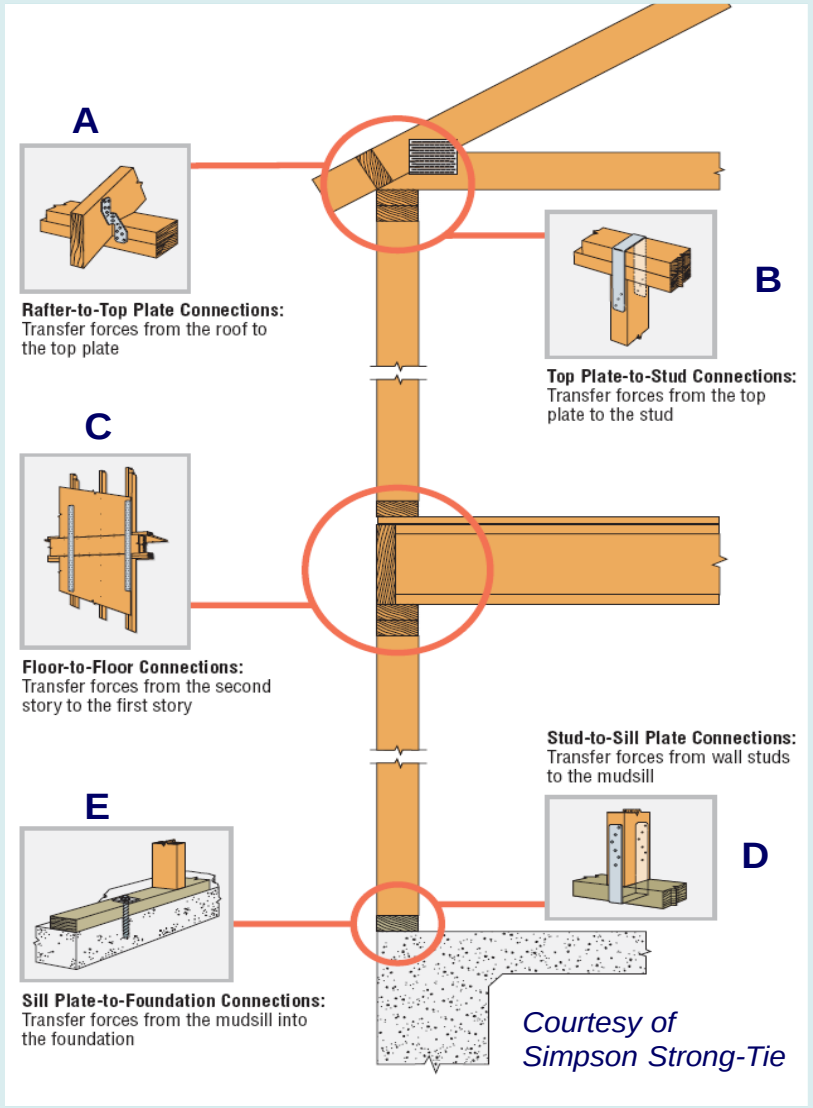


Tie Down The House – Roof to Foundation









Accordion Shutters for Home

Table 3-3 - Ability to Shelter in Place during a Tropical Cyclone[1]

Wall Construction Type – From Figure 4-2 in Part 4 of this Handbook	Tropical Storm (39-73 mph)	Typhoon (74-110 mph)	Major Typhoon (111-150 mph)	Super Typhoon (>150 mph)
Concrete/Masonry Walls & Concrete Roof 	a) opening protection for the windows and doors	a) opening protection for the windows and doors	a) opening protection for the windows and doors	a) opening protection for the windows and doors
Concrete/Masonry Walls, Wood Framed Roof, & Metal Corrugated Roofing 	a) opening protection for the windows and doors; b) tie down of roof to the wall	a) opening protection for the windows and doors; b) tie down of roof to the wall (Section 4.3.2 – Figures 4-18 to 4-21); c) tie all key elements of the roof together (Section 4.3)	a) opening protection for the windows and doors; b) add a new metal corrugated roof following Section 4.3.6; c) tie down the roof to the wall; (Section 4.3.2 – Figures 4-18 to 4-21).	
Wood walls (studs), Wood Framed Roof & Metal Corrugated Roofing 	a) opening protection for the windows and doors	a) opening protection for the windows and doors; b) have a strong continuous load path connection with shear walls (Section 4.2.4); c) tie all key elements of the roof together (Section 4.3)	a) opening protection for the windows and doors; b) have a strong continuous load path with shear walls (Section 4.2.4); c) add a new metal corrugated roof following Section 4.3.6.	
Wood Walls (T1-11) & Wood Framed Roof & Metal Corrugated Roof 	a) opening protection for the windows and doors	a) opening protection for the windows and doors; b) have a strong continuous load path connection with shear walls (Section 4.2.4); c) tie all key elements of the roof together (Section 4.3)		

1 This assumes there is no flood, coastal inundation, or landslide risk. See Part 2 of this Handbook to help determine flood, coastal inundation, and landslide risk in your area. Additional instructions:

a. Consult with a licensed engineer or architect to precisely determine the strength of your structure. This table is a generalization for building types commonly found in the FSM. The features listed in the table and covered in Part 4 play a role in the actual strength of the structure against wind forces. Each house is slightly different.

Green – Can shelter in place provided the house has the features already built in or added as a retrofit. See part 4 of this Handbook for relevant retrofits.
Orange – The structure is stronger with the features already in or added as a retrofit, but there is still risk, especially as the wind strength increases. If in doubt go to a public emergency shelter with the features in Table 3-2.
Red – Do not shelter in place. Go to a public emergency shelter with the features in Table 3-2.

Partners

- Ace Hardware (Kosrae, Phonpei, Chuuk)
- Catholic Relief Services
- Chuuk Disaster and Emergency Operations Center
- EMI Hardware
- FSM – Dept. Environment, Climate Change & Emergency Manag.
- FSM - Telecommunications
- International Office for Migration
- International Tsunami Information Center
- Governor's Office – Disaster Coordinating Officers - All States
- NOAA National Weather Service, Weather Forecast Office Guam
- Weather Service Offices – All States
- Pohnpei State Department of Public Safety
- Pohnpei Hardware
- Shigeto Corporation
- Simpson Strong-Tie
- United States Embassy
- United States Geological Survey
- University of Hawaii - Sea Grant College Program
- USAID
- WAAB Do It Best
- Yap Office of Planning and Budget; Dept. of Education, & EPA
- Yap Cooperative Association

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It is our hope that the information used in this book will be widely used and adopted by the residents of the Federated States of Micronesia to build a more resilient and sustainable community.

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