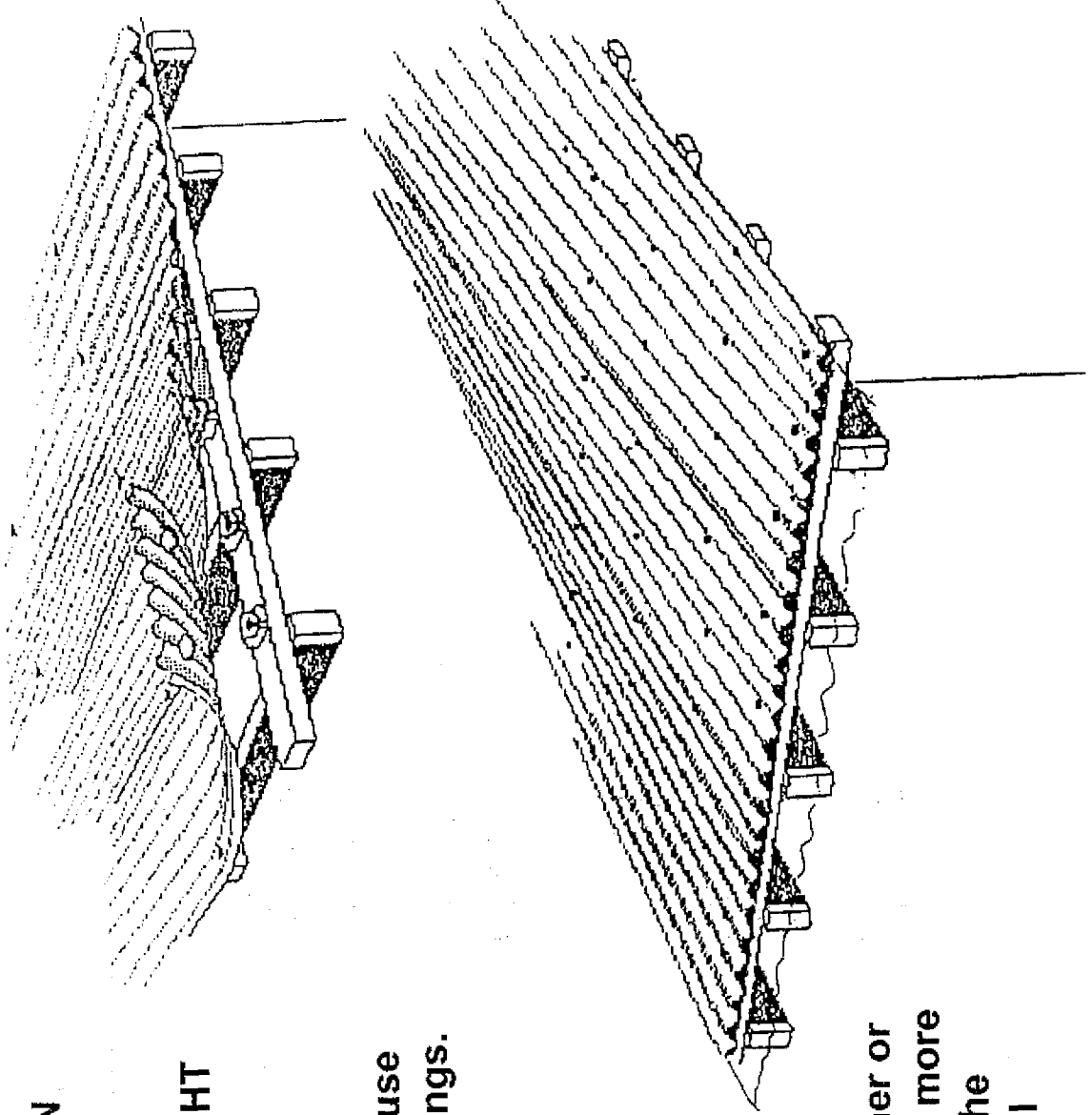


**FAILURE IN ROOFS**

**IF THE SHEETING IS TOO THIN OR THERE ARE TOO FEW FITTINGS, THE NAILS OR SCREWS MAY TEAR THROUGH THE SHEET.**

To prevent this type of failure use more fixings for thinner sheetings.

Use fittings with a broad washer or dome head (zinc nail). To use more fixings for each sheet, put in the laths at closer centres and nail closer together.

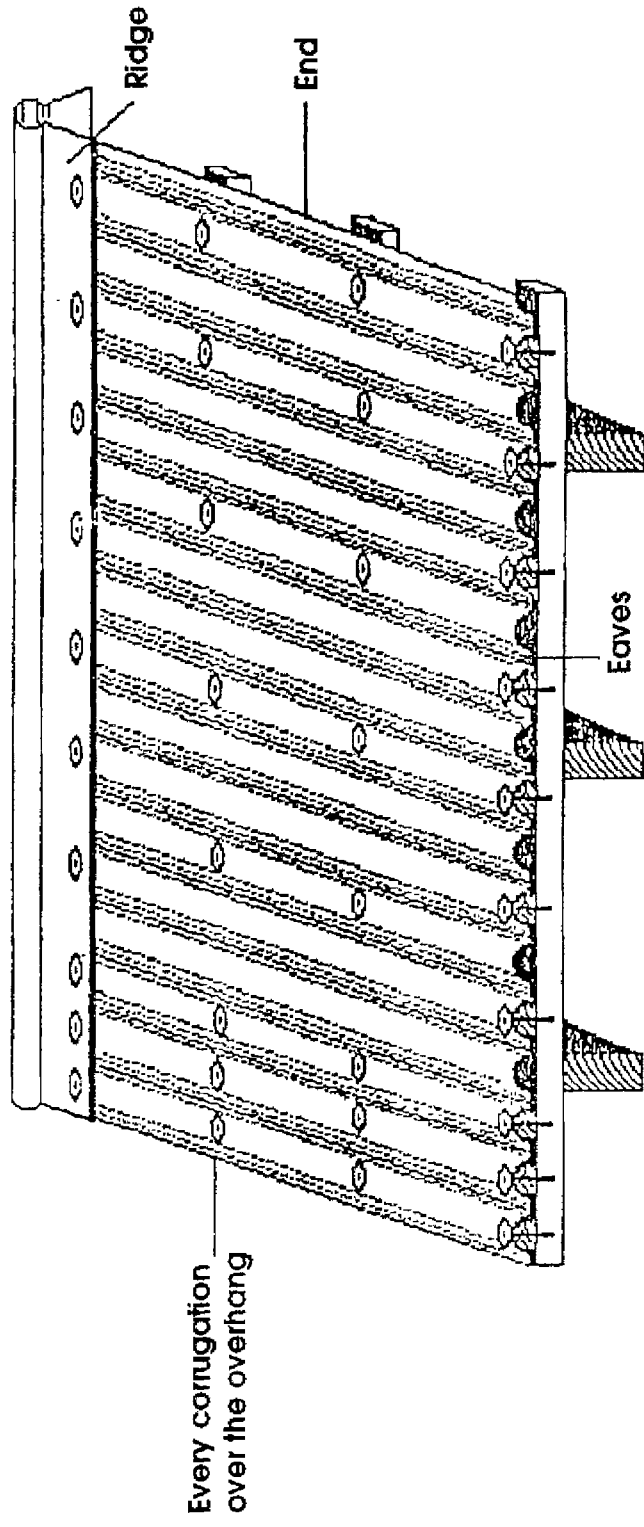


## MAKE THE RIGHT CONNECTIONS

## THE ROOF

### ROOFING MATERIALS GALVANIZED SHEETS

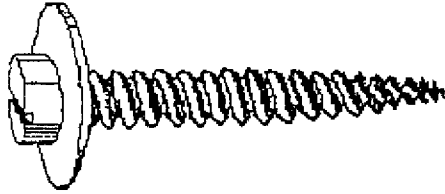
IF GALVANIZED SHEETS ARE USED 24 GAUGE IS RECOMMENDED  
IF YOU MUST USE 26 GAUGE WHICH IS THINNER, THIS IS HOW TO HOLD  
YOUR SHEETING TO THE ROOF STRUCTURE.



At ridges, eaves and overhangs - fixings every two (2) corrugation.  
All other locations, fixings every three (3) corrugation. Maximum spacing.

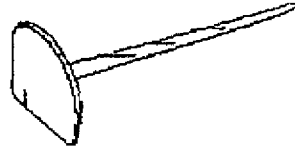
## FIXINGS FOR SHEETINGS

### SCREWS



- USE PROPER DRIVE CREWS FOR CORRUGATED GALVANIZED ROOF SHEETS.
- BE SURE THAT THE SCREWS GO INTO THE PURLINGS AT LEAST TWO (2) INCHES.
- USE LARGE WASHERS UNDER THE SCREW HEADS TO PREVENT THE ROOF SHEETS FROM TEARING WHEN PULEED UPWARD BY HIGH WINDS.
- REMEMBER TO USE SUFFICIENT SCREWS SO THAT THE EHADS WILL NOT TEAR THROUGH.
- NAILS DO NOT HOLD AS WELL AS SCREWS.
- USE NAILS WITH WIDE HEADS AND LONG ENOUGH TO BEND OVER BELOW THE LATH.
- GALVANIZED COATED NAILS ARE BETTER THAN ORDINARY WIRE NAILS.

### NAILS



## LATHS SPACING AND FIXING

- SPACING FOR LATHS AND NUMBER OF FIXINGS WILL VARY WITH THE GAUGE OF SHEETING USED.
- SCREWS HOLD BETTER THAN NAILS SO FEWER SCREWS CAN BE USED. BUT THE SHEETING MUST BE THICK OR THEY WILL TEAR THROUGH.
- LATHS SHOULD BE PLACED CLOSER TOGETHER FOR THIN SHEETS TO PROVIDE SPACE FOR EXTRA FIXINGS.
- A GUIDE TO THE NUMBER OF FIXINGS AND SPACINGS OF LATHS IS SHOWN BELOW.

Gauge of Sheeting	Spacing of Laths
26	18 ins - 2 ft.
25	2 ft. - 2 ft. 6 ins.
24	2 ft. for nails 3 ft. for screws

# THE ROOF

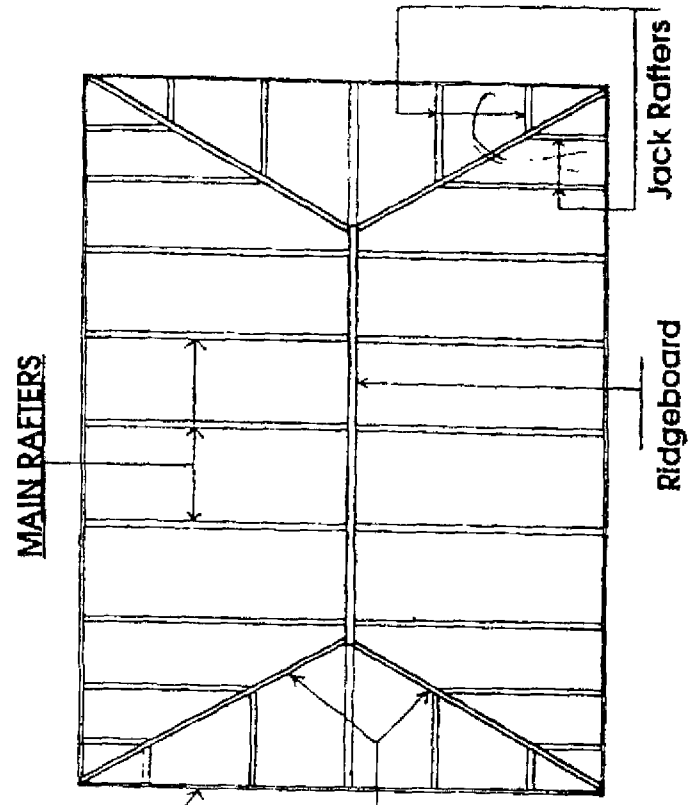
# MAKE THE RIGHT CONNECTIONS

## HIPPED ROOF

This is the strongest type with all sides of the roof sloped. There are no gable ends in this roof. Instead, rafters come across diagonally from the corner and meet the ridge board a short distance from the ends of the house. These are the hip rafters.

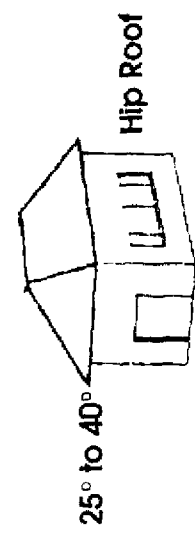
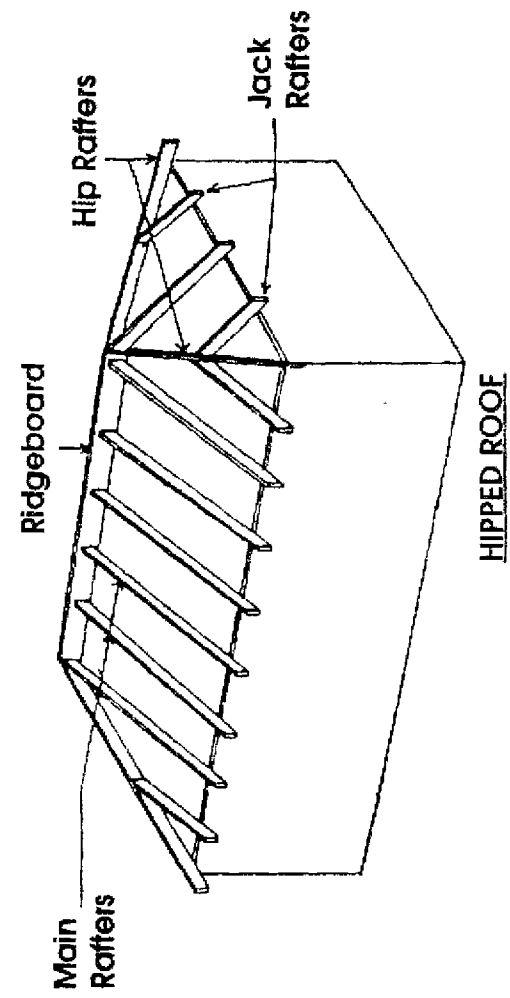
Other shorter rafters go from the wall plate to the hip rafter and are called jack rafters.

After the ridge is firmly in position, the rafters are attached to fit neatly onto the wall plate.



## Fascia Board

## Hip Rafters



Experience and experiment have shown that the hip roof with the pitch in 25° to 40° range has the best record of wind resistance.

## ROOF CLADDING

In addition to the roof structure being fixed to the supporting wall, the cladding must be able to resist and transfer the wind loads to the purlins. Purlins are therefore important structural members of the roof and flat boards should not be used for this purpose. Purlins should be either 2" x 3" or 1" x 4" at no more than 2'0" spacing. Purlins should be fixed to each rafter passed over using hurricane straps or metal cleats.

Corrugated galvanized steel sheeting is the most commonly used form of cladding in the Eastern Caribbean. Sheetting which is too thin and with inadequate numbers of fixings is extremely vulnerable during hurricanes. The minimum thickness of corrugated steel sheeting should be 6mm.

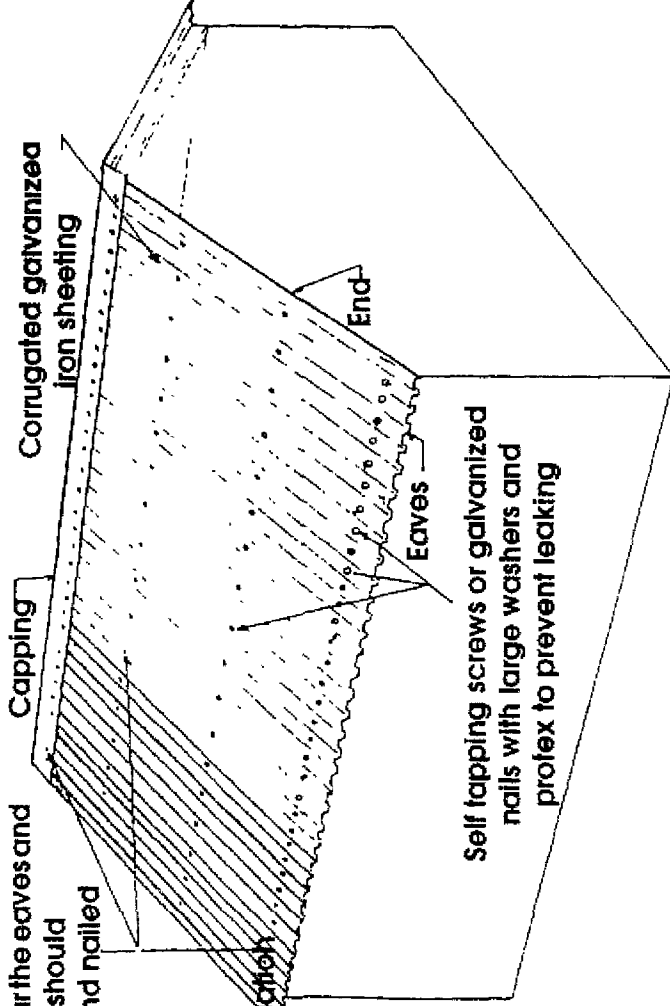
- Sheets should be fixed to the purlins using self-tapping screws or galvanized nails with large washer.
- At the eaves and ridge as well as the gable ends, the fitting should be two corrugations apart, and for the rest of the roof, no more than three corrugations apart.

## CONNECTION OF SHEETING & CAPPING

Every corrugation sheeting near the eaves and ridgeboard should be bolted and nailed to purlins. For rows in between at least every other corrugation

- The corrugated sheeting should be properly overlapped (at least 2 1/2 corrugation) to prevent water from blowing under the seam.
- Roof capping should be made from materials as strong as the sheeting itself, it should be bolted or screwed down to the purlin on either side of ridge or ridgeboard or hip.

- Spaces between the sheeting and the wall plate should be closed up to prevent the wind from getting under the sheeting and lifting it. This can be done by nailing a fascia board to the wall plate and rafters.



**WOODEN WALLS**

The uprights (or posts) are fixed to the wall sill which is bolted to the foundations wall.

Using metal straps with nails improves the hurricane resistance of timber houses.

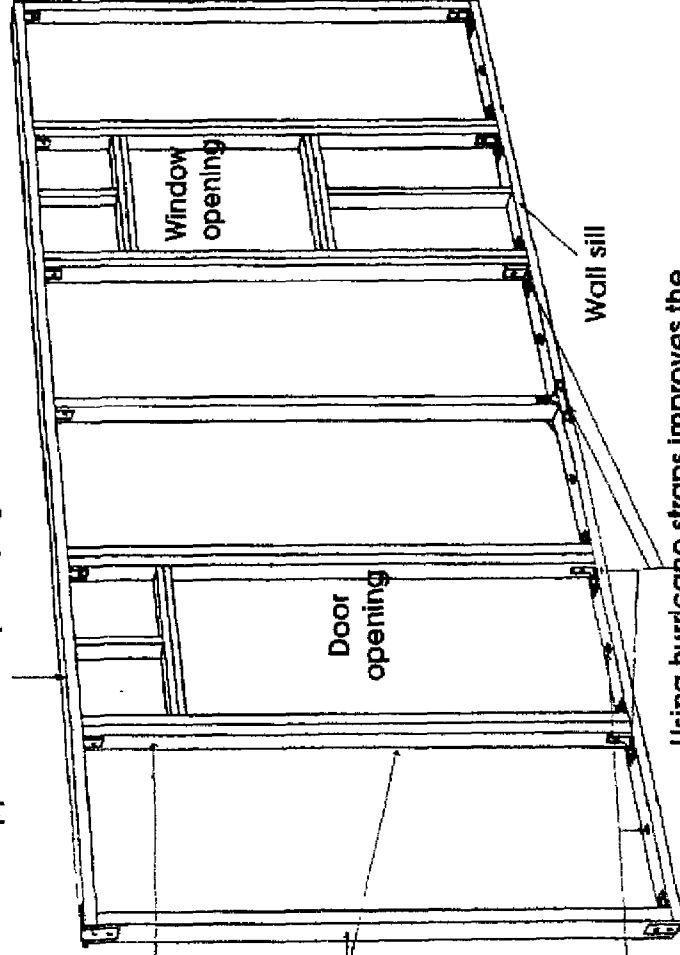
**WOODEN WALL**

Wall plate must be fastened and strapped to the top of uprights

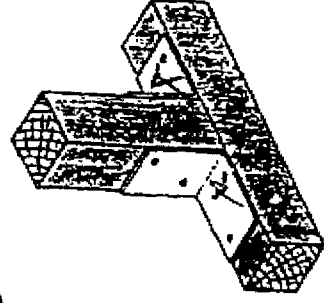
Double uprights at openings

The uprights are fixed to the wall sill

Wall sill is fixed to foundation wall by anchor bolts



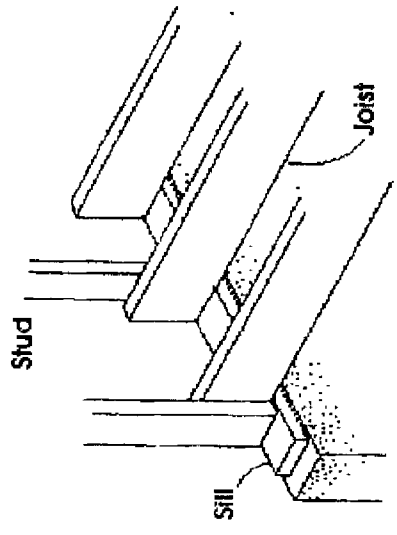
Using hurricane straps improves the resistance against strong winds



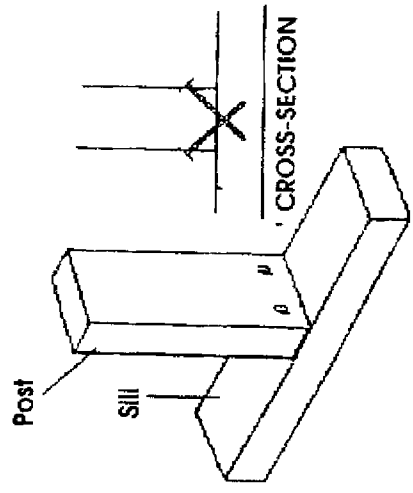
# MAKE THE RIGHT CONNECTIONS

# THE WALLS

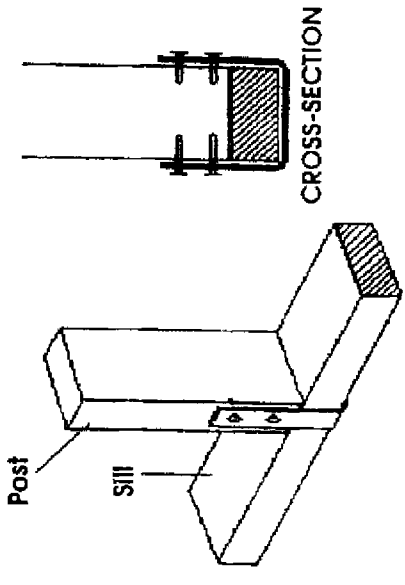
THE WALLS MUST BE SECURELY TIED TO THE FOUNDATION TO PREVENT THE WIND FORCES LIFTING UP THE ENTIRE BUILDING OR BLOWING IT OVER.



CONNECTION FOR TIMBER WALLS



TO NAIL CONNECTION



CONNECTION WITH HURRICANE STRAPS

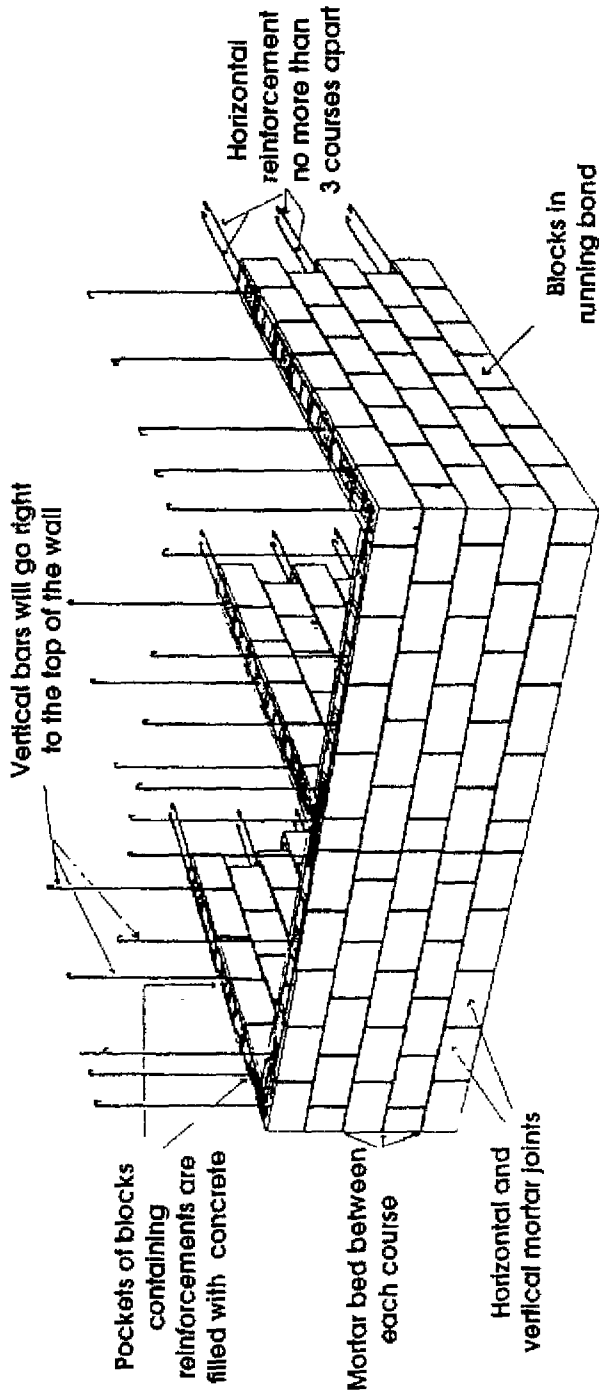
## WALLS

### Concrete Block Walls

- starter bars coming out of the foundation will tie the wall to the foundation.
- Lay blocks so that those starter bars come out through block pockets. For earthquakes the recommended minimum vertical reinforcement is 3/8" diameter bars at 32" centres, this will provide adequate resistance to hurricanes. As more courses are laid you must add more lengths of steel to overlap for at least 12" with starter bars.
- These lengths of steel will go right to the top of the walls.

- pockets of block containing reinforcement are to be filled with concrete
- as each course of blocks is laid, it must be set into a 1:3 mortar bed placed on the last course, mortar is also required on the sides of the blocks to form the vertical joints. Mortar joints should be 1/2" to 5/8" wide.
- Galvanized horizontal reinforcement, Dar-O-Wal or Brickforce, should be laid after every third course. (Two 1/4" diameter bars are often used, but they are likely to rust in the thin mortar joints).
- Horizontal reinforcement increases the resistance of the wall to hurricane force winds (and to earthquakes).
- Vertical bars are required at all junctions and window and door openings.
- Blockwalls should be constructed in running bond rather than stacked bond.

### CONCRETE BLOCK WALL



# MAKE THE RIGHT CONNECTIONS

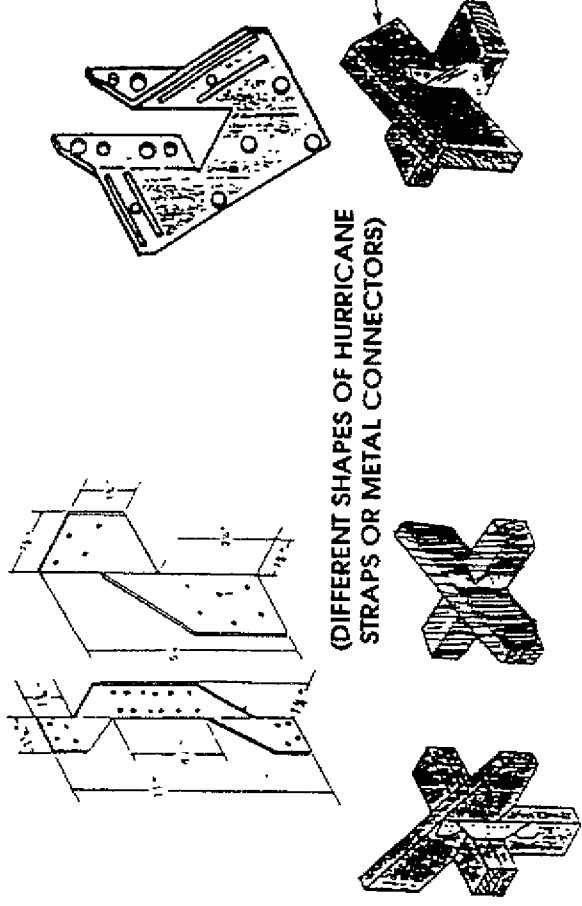
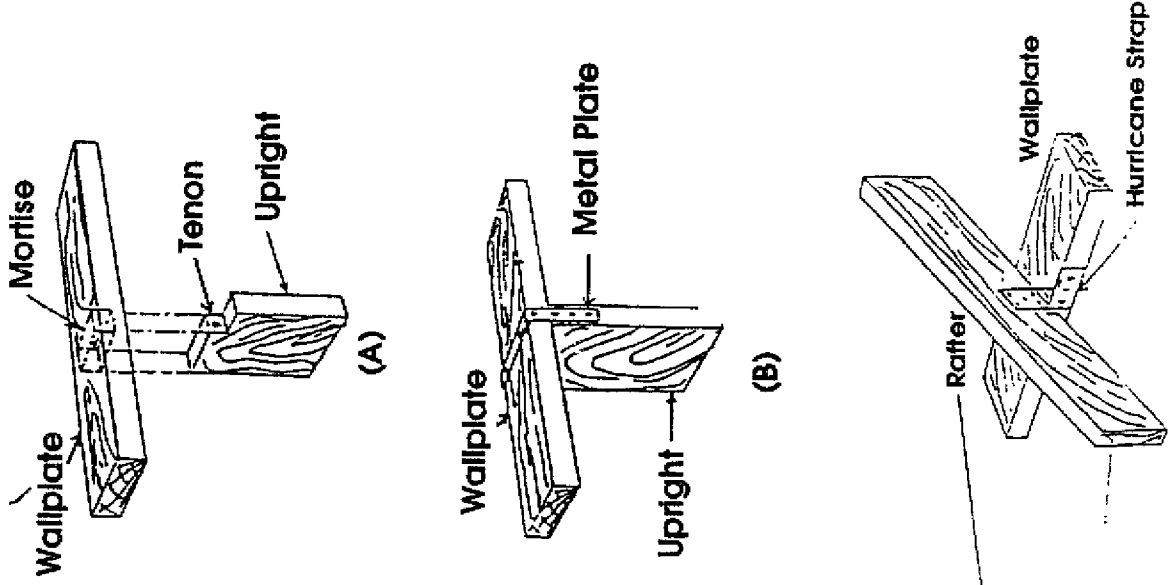
# CONNECTIONS

## TIMBER WALLS

In timber houses the rafters or trusses are connected to a wall plate which is supported by the vertical posts.

Two connections need to be considered.

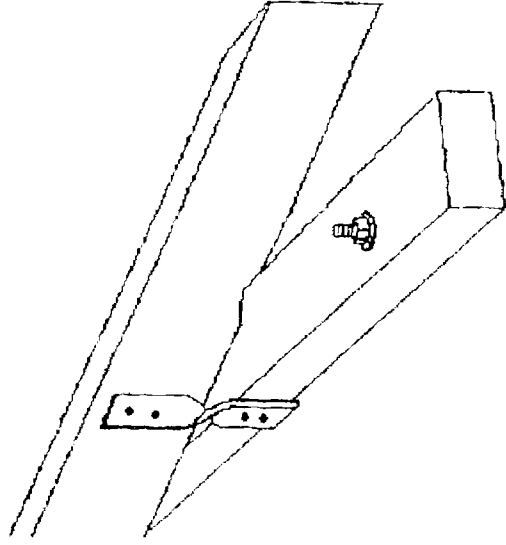
1. The first is the connection between the plate and the uprights which should be made using metal straps. The conventional solution is a mortise and tenon joint (Figure A) using glue and sometimes dowel pins. Suction forces on the roof may cause this joint to fail.
2. The second connection is that between the rafter and the plate. The standard solution is to nail or spike the rafter to the wall plate. Under high suction forces these nails or spikes may pull out. It is strongly recommended that hurricane straps (or metal connectors) be used for these connections. The connectors may either be purchased off the shelf or made up on site using 20 gauge galvanized sheet metal.



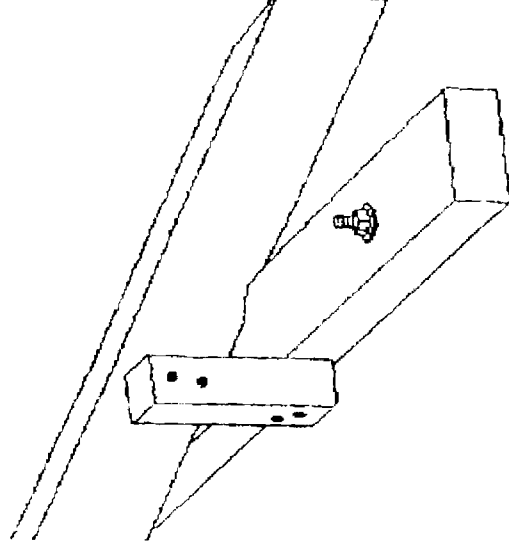
## MAKE THE RIGHT CONNECTIONS

## CONNECTIONS

**RAFTERS WILL LIFT OFF WALL PLATES IN HIGH WINDS. THEY MUST BE HELD DOWN BY MORE THAN NAILS. STRAPS CAN BE INSTALLED IN EXISTING ROOFS TO STRENGTHEN THEM.**



**Twisted straps nailed through rafter with 2 1/2 inch nails. Bend over the ends of nails. Be careful when selecting hurricane straps, ensure that they can be properly affixed so that when nailed, the nail is not too near the edge.**

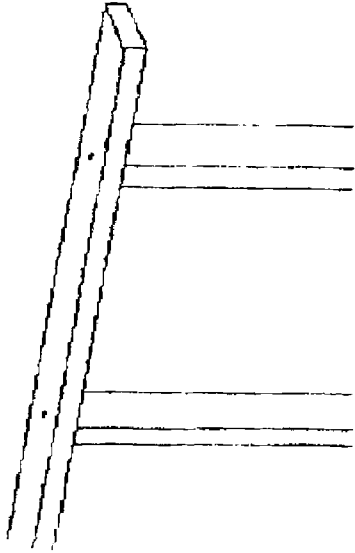


**Timber connector may be used as an alternative. Make sure that the wood is strong.**

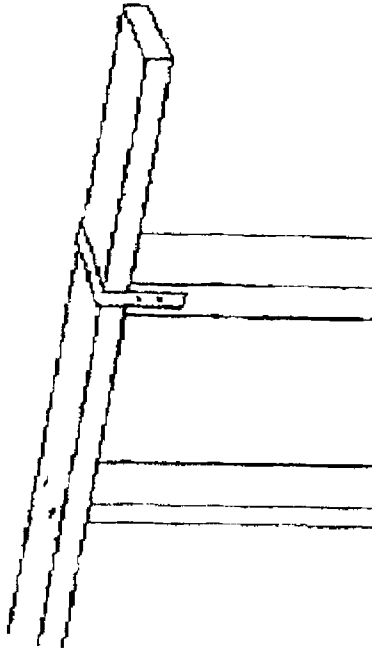
# MAKE THE RIGHT CONNECTIONS

# CONNECTIONS

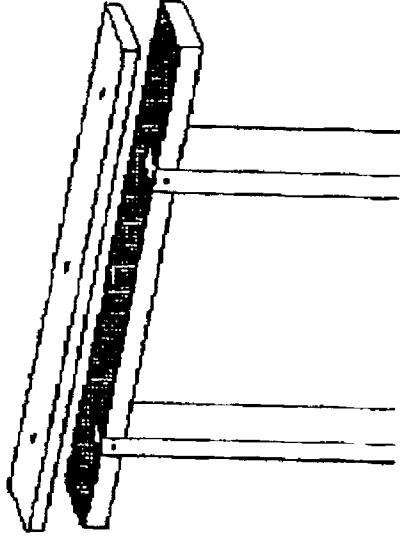
WALL PLATES FOR WOODEN BUILDINGS ARE CRITICAL BECAUSE THEY PROVIDE STIFFNESS FOR THE BUILDING AND ALSO SERVE TO HOLD THE ROOF DOWN.



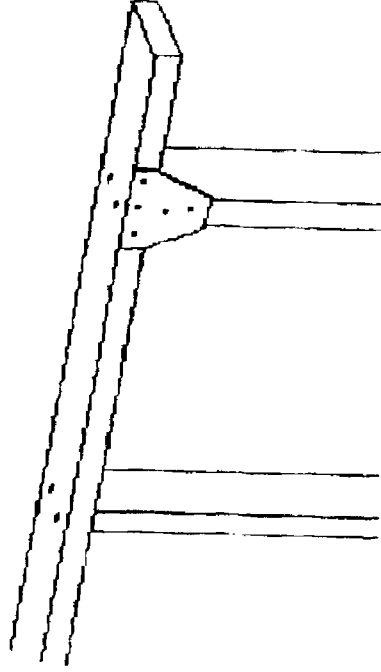
- They are often insecurely held down by nails into the end grain of posts.



- To strengthen use a strap over the top

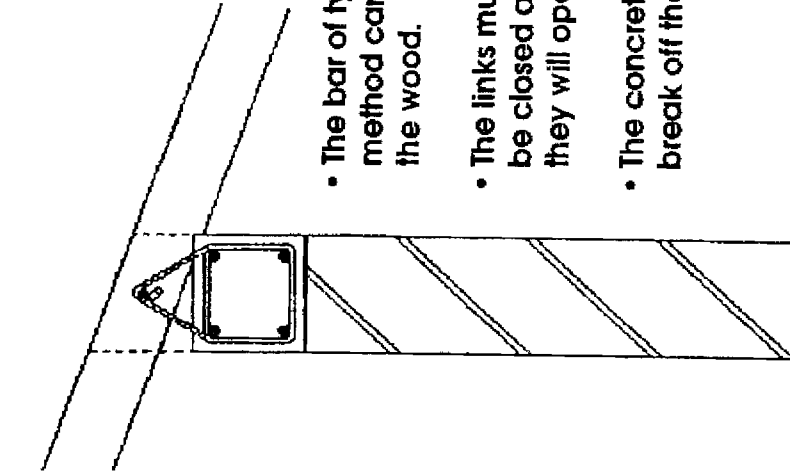


- If a double plate is used, notch and nail the lower one and secure the top one well.

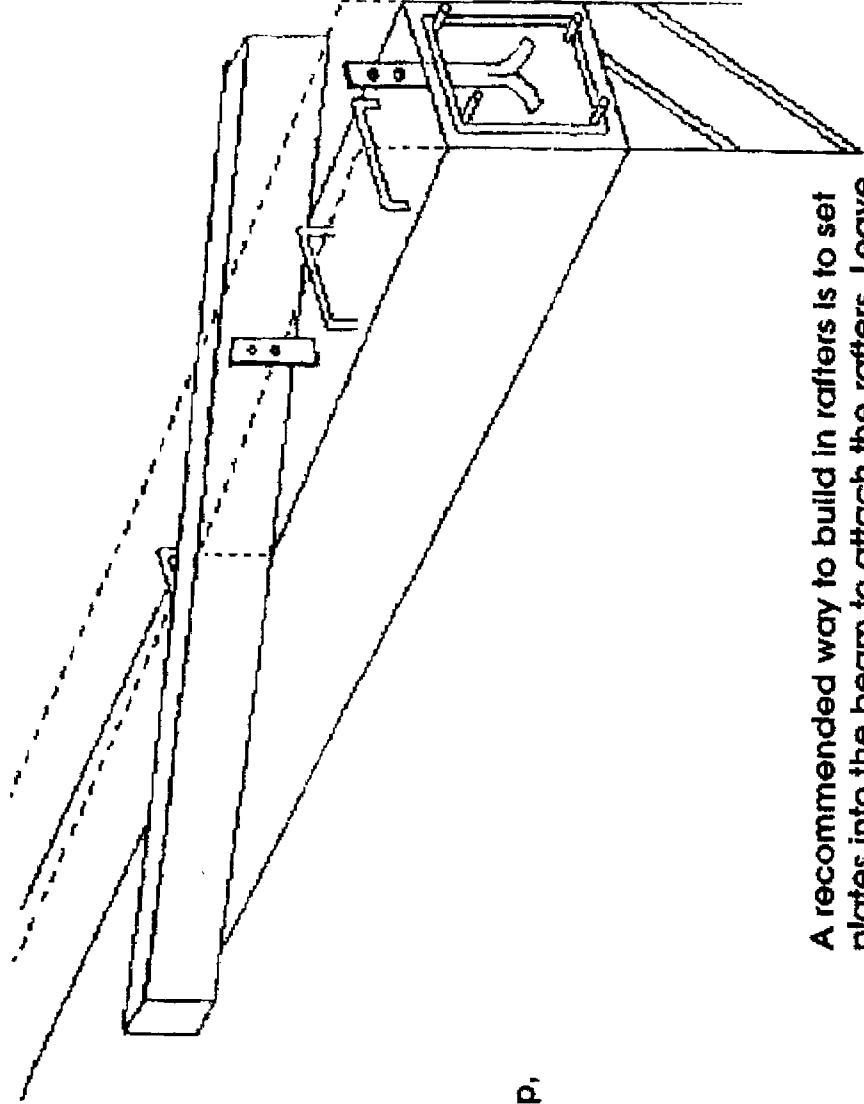


- OR • Use a gusset of zinc or plywood.

**RAFTERS MAY BE BUILT INTO THE BELT BEAM AT THE TOP OF THE WALL. HOWEVER THIS PRACTICE IS DISCOURAGED BECAUSE OF FAILURES OBSERVED AFTER RECENT HURRICANES.**



- The bar of typical method can split the wood.
- The links must not be closed at the top, they will open.
- The concrete will break off the wall.



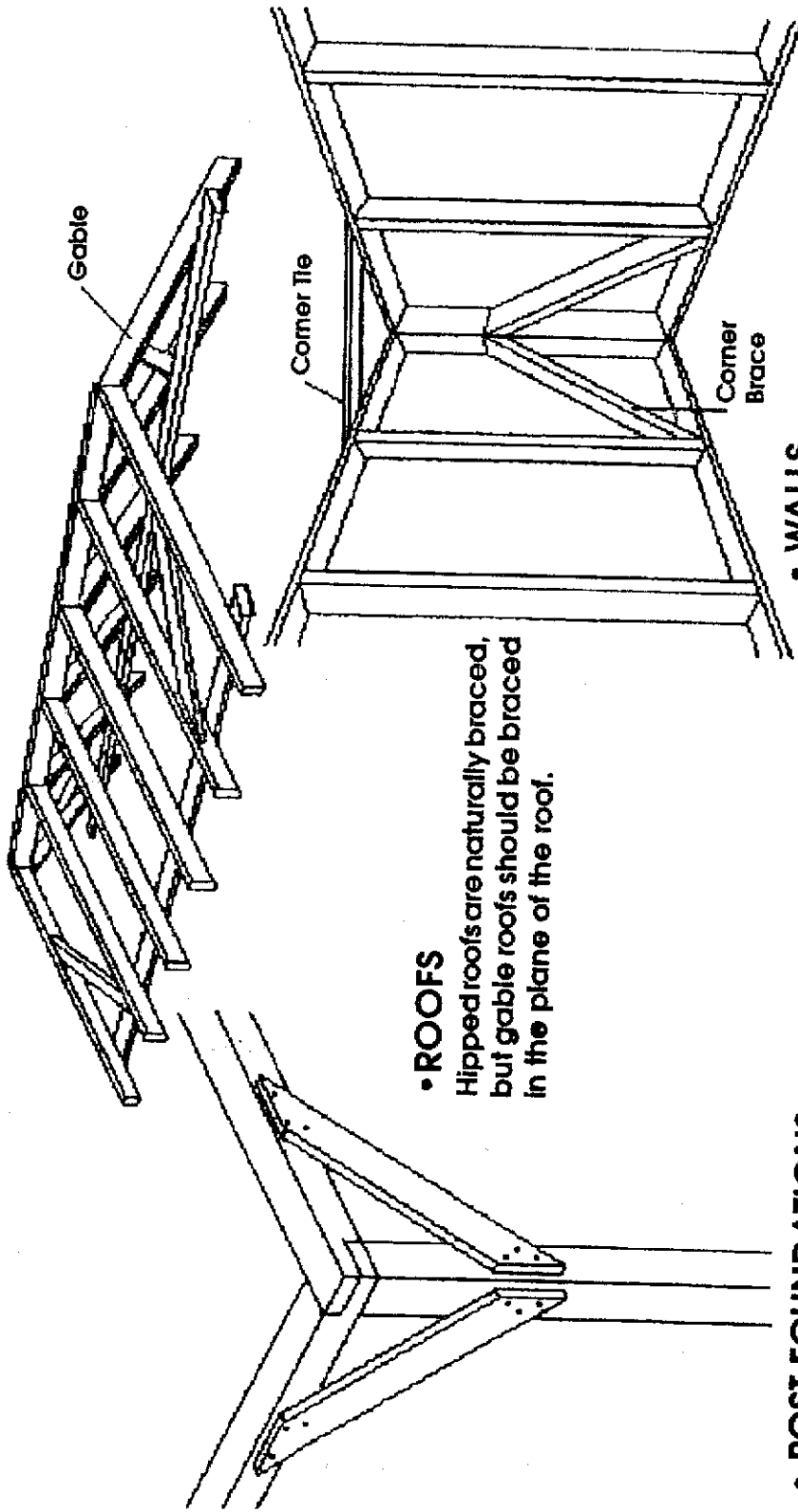
**A recommended way to build in rafters is to set plates into the beam to attach the rafters. Leave some links showing after securing the rafters to the plates, concrete is cast between them up to sarking level.**

**FAILURE MODES  
OF  
TYPICAL METHOD**

# MAKE THE RIGHT CONNECTIONS

# CONNECTIONS

**IN TIMBER BUILDINGS, POST FOUNDATION, ROOFS AND WALLS MUST BE BRACED IN EACH DIRECTION.**



## • ROOFS

Hipped roofs are naturally braced, but gable roofs should be braced in the plane of the roof.

## • POST FOUNDATIONS

Where posts are more than 3ft., brace both ways.

## • WALLS

Walls should be braced across corners at plate level and at both corners of each wall.

**MAINTENANCE**

- 1. Experience and statistics show that the lack of maintenance is a significant contributing factor in damage to houses by hurricanes.**
- 2. Regular maintenance is necessary in order to ensure that a structure continues to be hurricane resistant.**
- 3. Check the entire house regularly inside and outside - to see if anything needs repairing or replacing, and fix it immediately.**
- 4. The most important areas for regular checks are:
  - (a) Roof cladding for damage and fixings for missing screws or bolts.**
  - (b) Roof structure; rafters and purlins for soundness.**
  - (c) Joints and connections in timber and masonry construction for structural integrity and durability.**
  - (d) Concrete blocks and slabs for cracks.**
  - (e) For houses on wooden supports, check supports for rot, especially those below ground level.**
  - (f) Check for termites and treat when evident. Obtain specialist advise for this problem.****

*Material for this Booklet compiled by:  
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Lennard Andre (Architect)*