



GUIDE TO HOUSING
STANDARDS FOR THE

BAHAMAS

BUILD BACK BETTER

August 2020



Foreword

I am especially pleased that my Ministry has participated in the formulation of this Guide to Housing Standards for The Bahamas. This guide serves as a precursor to the fourth edition of The Bahamas Building Code, which will outline the regulatory framework by delineating local and international standards for use within the construction industry.

This guide also seeks to highlight and illustrate construction methods and details which when closely followed in building or rebuilding homes will ensure resilience against the destructive effects of future hurricanes and storm surges. The “Build Back Better” (BBB) theme resonates throughout this booklet by the readable prescriptive methods illustrated therein and in the accompanying texts.

It is our hope that both homeowners and building contractors will adopt and utilize the methodologies outlined in this booklet and integrate them into their building projects so as to develop safer and more resilient buildings throughout our country.

Hon. T. Desmond Bannister, M.P.
Minister of Public Works



Preface

This Guide serves to illustrate the minimum standards details required for residential building construction as set out in the Bahamas Building Code, 3rd Edition and the Construction Manual for Small Buildings within the Commonwealth of The Bahamas, inclusive of BBB principles.

Please note the following:

- All construction projects are to comply with the Buildings Regulation Act, Chapter 200.
- A valid building permit is required for all new construction, inclusive of replacement of entire buildings or additions to existing buildings.
- A building permit is required for all major renovations and reconstructions where the value of said work exceeds 25% of the value of the building under repair.
- Building permit fees may be waived for building permits in areas deemed to be Disaster Areas under the auspices of the Disaster Reconstruction Authority.
- A building application must be submitted to the Local Government Office in the designated Family Island or to the Buildings Control Division in New Providence.
- Mandatory inspections are required during construction for all structural, electrical and plumbing works for new works, renovations and reconstruction throughout the Commonwealth of The Bahamas.
- The standards outlined and illustrated in this booklet are minimum Code standards only, the quality of construction and the materials and methods used may be improved where necessary by the building owner.

Craig G. Delancy, BSc., BArch., RA
Deputy Director of Public Works
(Former Buildings Control Officer)

Ministry of Disaster Preparedness, Management and Reconstruction

Acknowledgement

The contributions of the following are hereby acknowledged, with gratitude:
Cora Bain-Colebrooke - Permanent Secretary, Ministry of Public Works

Contributing authors:

Craig G. Delancy – Deputy Director, Ministry of Public Works

Edwin Yuk Low – Sr. Structural Engineer, Ministry of Public Works

Peer contributors:

Melanie T. Roach – Director of Public Works, Ministry of Public Works

John Michael Clarke – Chairman, Disaster Reconstruction Authority

Valaria Pintard-Flax – Asst. Prof., School of Architecture, University of the Bahamas

David Delgado – Shelter Sector Bahamas Coordinator

Brent C. Ferguson – Actg. Buildings Control Officer, Ministry of Public Works

Students of the School of Architecture, University of the Bahamas:-

Shanea Adderley

Helson Ambrose

Andronekia Clarke

Breanne Grant

Donovan Knowles

Ernal McKenzie

Derek Wong

Scott Sawyer – Area Engineer, Ministry of Public Works

Gerard Turner – Buildings Inspector, Ministry of Public Works

Etoile Pinder – UNDP Bahamas

Entities and Organizations:

Shelter Sector Bahamas

Disaster Reconstruction Authority

United Nations Development Programme

Engineers Without Borders

Introduction

Ministry of Disaster Preparedness, Management and Reconstruction

This Build Back Better Guide for the Commonwealth of The Bahamas is proudly produced by the Ministry of Disaster Preparedness, Management and Reconstruction in conjunction with the Buildings Control Division of the Ministry of Public Works. This Guide could not have been prepared without the assistance of the United Nations Development Programme, Engineers Without Borders, Shelter Sector Bahamas, the National Emergency Management Agency, the Buildings Control Division of the Ministry of Public Works and the University of the Bahamas' School of Architecture.

The impact of Hurricane Dorian on the housing stock of the second and third most populated islands of the Commonwealth of The Bahamas, namely Grand Bahama and Abaco, resulted in damages to residences that is estimated to exceed one hundred million dollars (B\$100,000,000). The Disaster Reconstruction Authority through its home repairs program has registered over four thousand residents for home repairs on the islands of Abaco and Grand Bahama. As of July 1st, 2020, the Grand

Bahama Port Authority estimated that within the two hundred square mile district of the Port Authority, approximately four thousand six hundred thirty-seven (4,637) homes were impacted to varying degrees by the storm. The work of compiling housing repair statistics is on going, as a part of the mandate of the Disaster Reconstruction Authority.

Rapid Assessments were conducted in the aftermath of Hurricane Dorian by teams of local professional architects, engineers, building contractors and Ministry of Public Works technical officers. The site inspections revealed that, as expected, there was extensive damage due to flooding from sea surge. However, for damage not related to sea surge, flooding was largely due to the level of non-compliance with the prescriptive structural requirements of the current Bahamas Building Code.

In an effort to increase building resiliency and to ensure reconstruction, renovations, repairs and new construction to residential buildings adhere to Build Back Better principles, this Build Back Better Guide



serves as an easy reference tool of construction methods and details that comply with the minimum standards of the Bahamas Building Code and local Construction Manual for Small Buildings.

It is therefore our hope that as we seek to rebuild, to mitigate against future hurricanes, home owners, builders and contractors will become familiarized with and adhere to or exceed these minimum standards.

Thank you

Carl Smith

Permanent Secretary

*Ministry of Disaster Preparedness, Management
and Reconstruction*

DYNAMICS OF NATURAL DISASTERS



Natural events such as hurricanes may result in extensive damage to property and loss of life. The official hurricane season spans June 1st to November 30th each calendar year.

HURRICANES

A hurricane is a rotating low pressure tropical system with high power circular winds exceeding 74mph and is usually accompanied by heavy rains, thunder storms and sea surges.

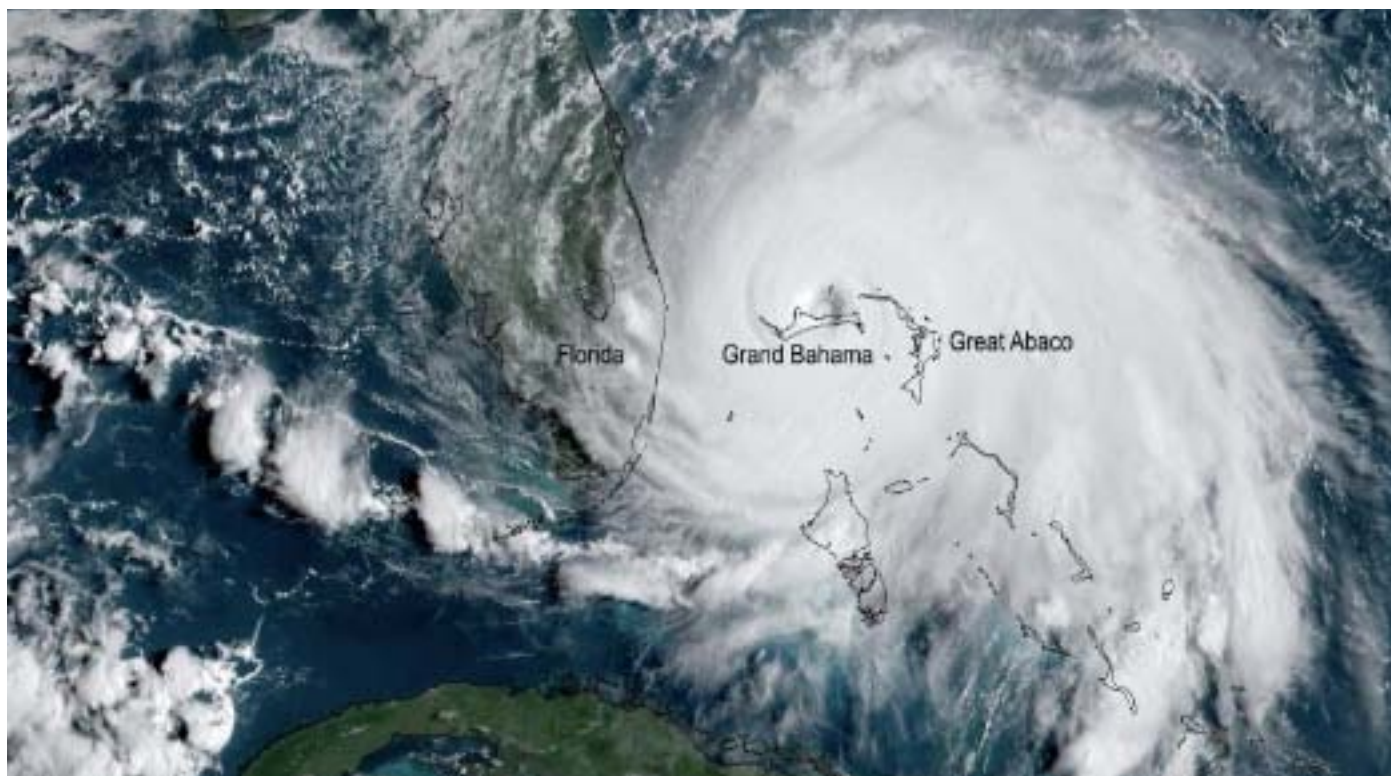


Photo: National Oceanic and Atmospheric Administration

The eye is the calmest part of the hurricane.

The strongest winds are located at the eye wall, which encloses the eye.

After the eye passes, the winds will come again from a different direction.

DESTRUCTION AND CODE COMPLIANCE



Photos 1 and 2 below show the level of destruction after Hurricane Dorian's passage in September 2019, due to non-compliance with the Bahamas Building Code's minimum standards.



Photo 1



Photo 2

Structures shown in photos 3 and 4 below demonstrate how buildings constructed to minimum Code standards may withstand total devastation in the midst of a major category 5 hurricane.

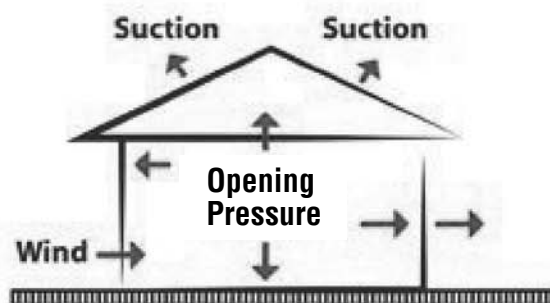


Photo 3

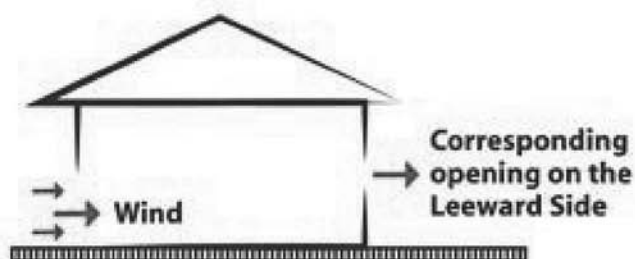


Photo 4

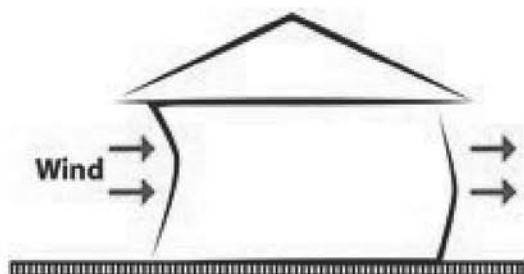
HOW NATURAL FORCES AFFECT THE BUILDING: *HURRICANES*



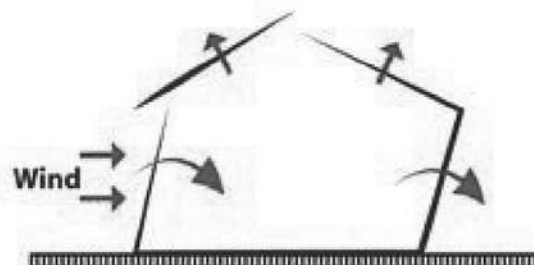
Wind generating an opening on the windward side during a hurricane will increase the pressure of the internal surfaces. This pressure in combination with external suction, may be sufficient to cause the roof to blow off and the walls to explode.



The internal pressure that builds up as a result may be relieved by providing a corresponding opening on the leeward side.

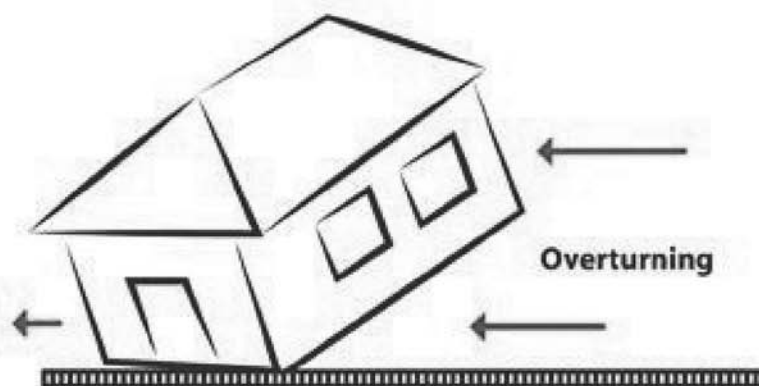


Windward face of the building collapses under pressure of windforce.



RACKING

Collapse starts at the roof with the building leaning in the direction of wind flow.

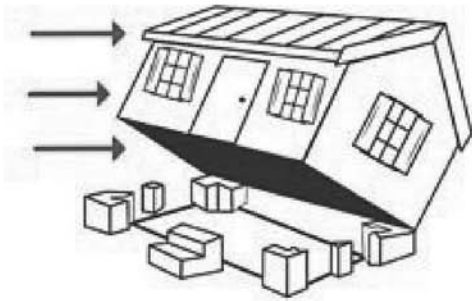


Caused by poor connection to the foundation.

HURRICANE



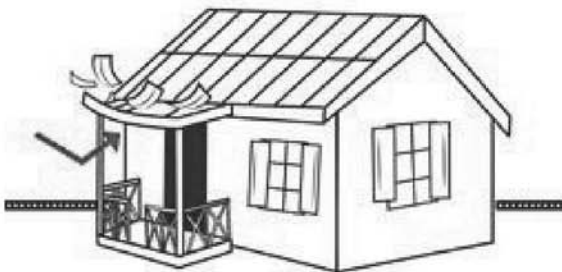
The Enormously Powerful Winds of the Hurricane Can



1. Blow it off its footing;



2. Take off the roof;



3. Remove verandah and garage roofs;



4. Cause flooding because of heavy rains.

SITING



When Choosing a Site for your House, consider the following



A house is best built on a flat, firm site provided it is well drained.

If your lot is on a slope, don't place the house like this unless it is properly anchored. Columns need to be infilled with shear walls and beams.



The wind and water can dislodge the house.

Cut and fill is a common means of levelling a house site.

Avoid building on the fill. Foundation should be on solid ground. This house is safer, cut into the side of the hill.

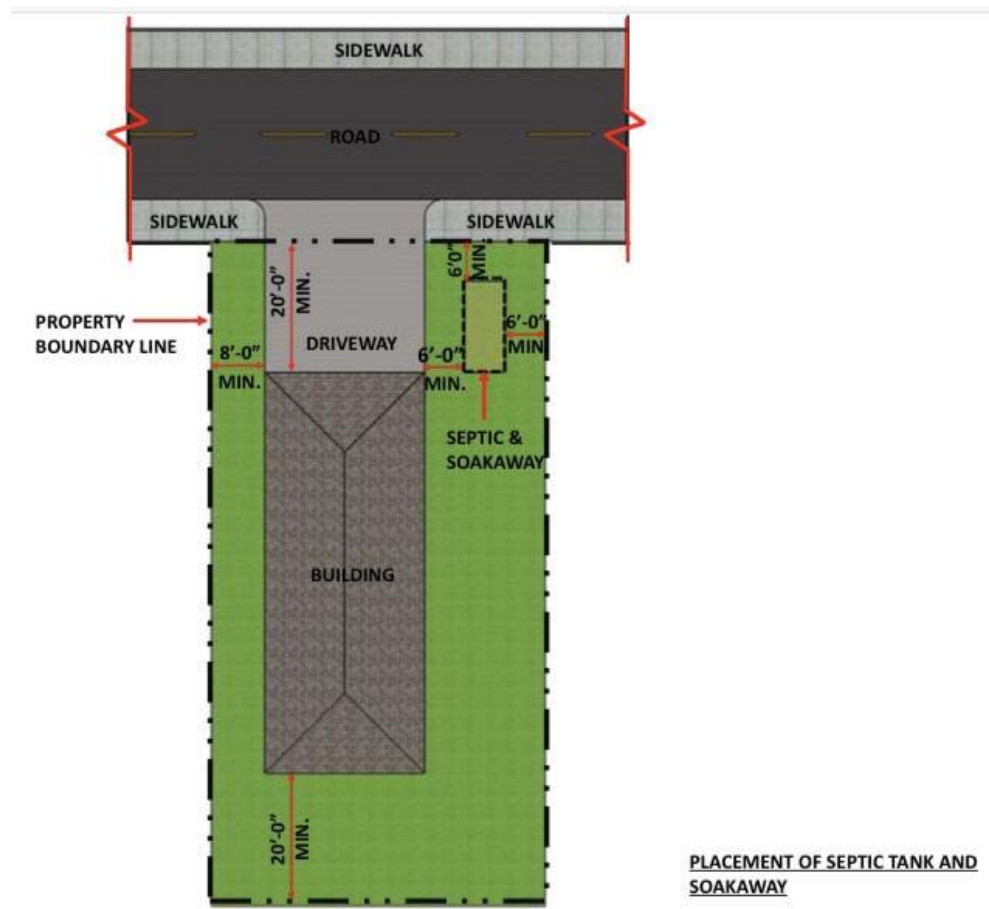


BUILDING SITE DEVELOPMENT



When setting out a building on site, the following should be observed:

- Boundary setbacks are to match those shown on approved plans and any other conditions on approved building permit.
- Verify that setbacks for septic tank and soak-a-way conform to the approved plans.
- Elevate the house wherever possible; at least 12" above the known flood plain or 18" above the crown of adjacent road.





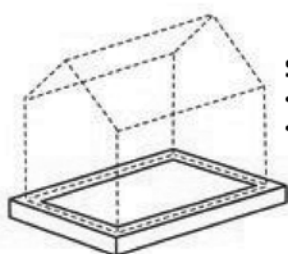
FOUNDATIONS

FOUNDATIONS



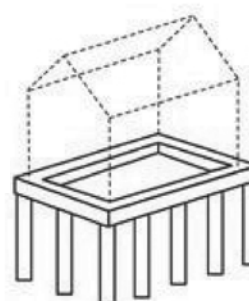
The foundation is the part of the house which transfers the weight of the building to the ground. It is essential to construct a suitable foundation for a house, as the stability of the building depends primarily on its foundation.

THE MAIN TYPES OF FOUNDATIONS ARE:



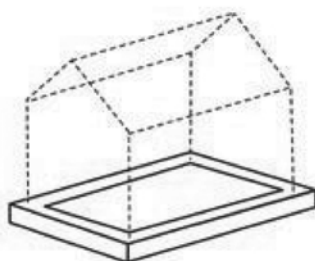
Slab or Raft Foundation

- Used on soft soils
- Spreads the weight over a wider area



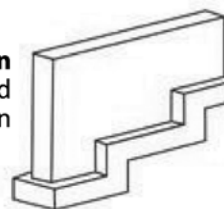
Pile Foundation

- Are deep foundations for heavy buildings
- Not often used in small buildings



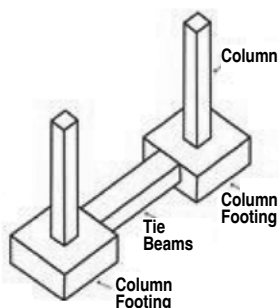
Strip Foundation

- Used for areas where the soil varies
- Most common
- Supports a wall



Stepped Foundation

- Used on sloping ground
- Is a form of strip foundation



Pad Foundation

- Used on firm soil
- Used for columns and poles

NOTE: Tie beams between pads are required



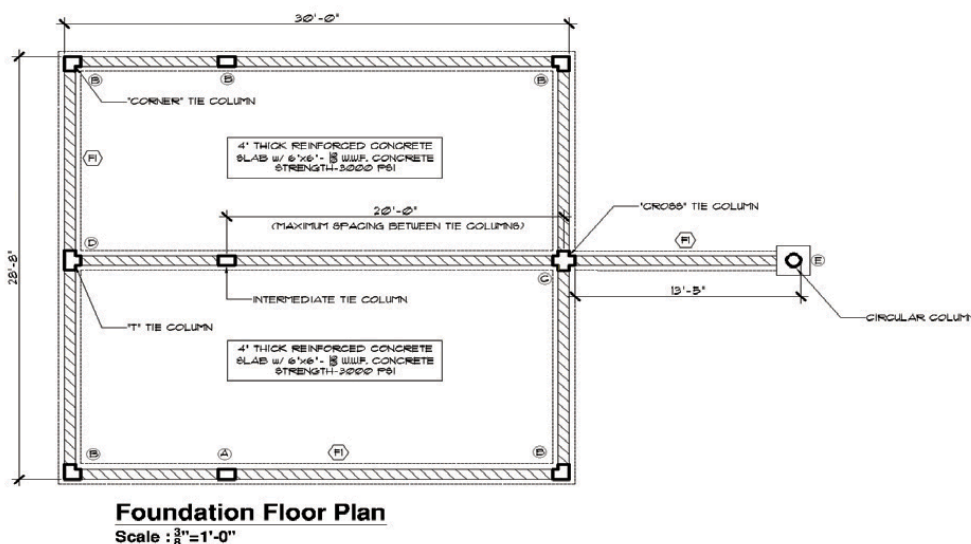
STRIP FOUNDATIONS: *Masonry*

BUILDING FOUNDATION LAYOUT

The functions of the foundations are:

- To securely anchor the house to the ground to prevent wind forces from lifting the entire building or blowing it over.
- To transmit the building loads to the ground. Foundations should be securely connected to the rest of the structure. The foundation cut must adhere to the approved width and depth to take the loads and shall be cut a minimum of 6" into solid rock or otherwise specified for alternate strata.

The foundation for the block wall construction is usually a continuous rectangular reinforced concrete strip footing as demonstrated in the figure below showing a foundation layout with reinforced column locations in a typical blueprint drawing.



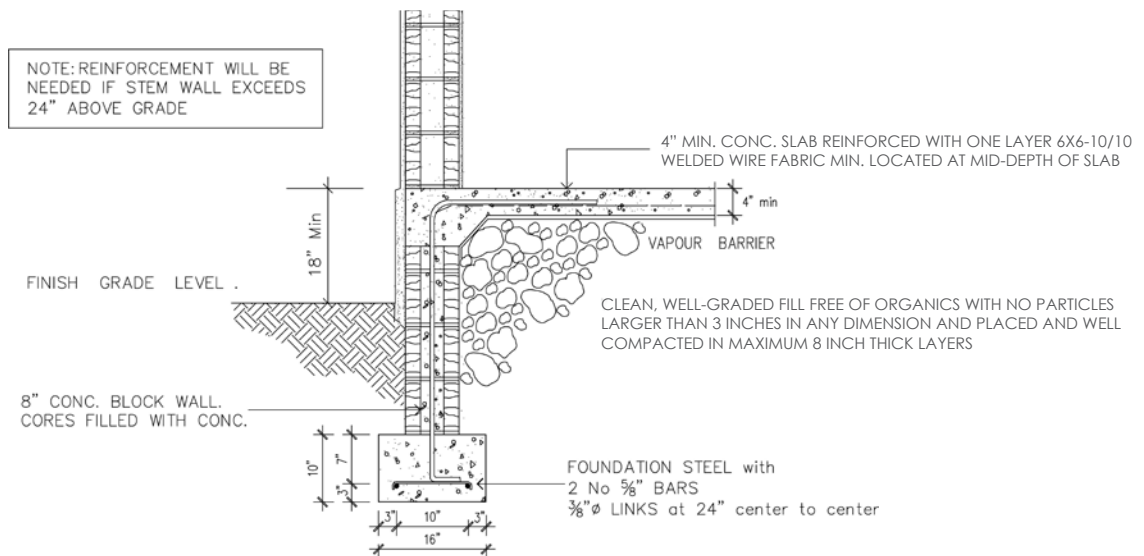
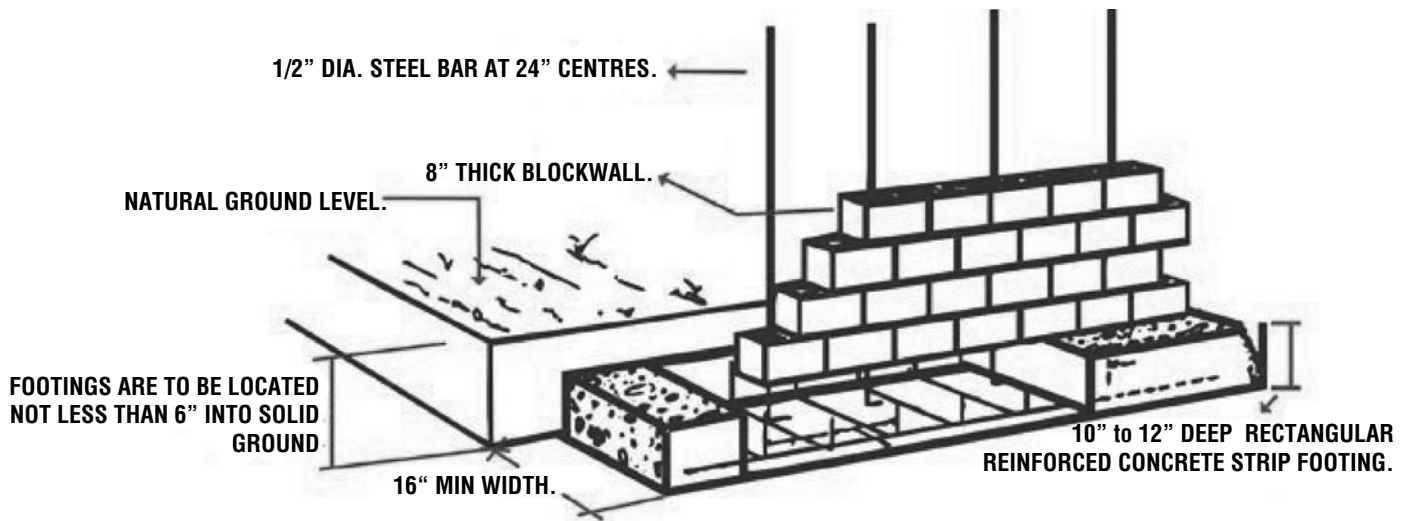
Note: The excavation shall be clean of all rubbish and organic matter. All cavities exposed during excavation shall be filled with rocks and weak concrete mix; or bridged over with extra reinforcement.

Foundation Layout on typical Blueprint drawing

FOUNDATIONS: *Foundation Construction Techniques*



The block walls which are then built up from this footing shall contain vertical reinforcement which is anchored into the footing. Block walls shall be constructed using running bond instead of stacking bond.



REINFORCEMENT TO STRIP FOOTING

TYPICAL CROSS SECTION REINFORCEMENT TO STRIP FOOTING

Foundations constructed on sloping grounds or where the finish floor level is more than 24" above grade require additional vertical reinforcement.

TYPICAL BLOCKWALL FOUNDATION SECTION AND DETAIL

8" block wall

2"X4" Stud wall @ 16" C.C.

4" CONCRETE SLAB REINF'D WITH ONE LAYER 6x6 - W 1.4 x 1.4 W.W.F.

2-#5 Cont.

2 # 5 O.C. w/ # 3 Ties @ 24" C.C.

4" barrier over compacted fill

WELL COMPACTED & CLEAN TERMITE TREATED FILL

CELLS FILLED W/ CONCRETE

ROCK

10"X16" STRIP FOOTING WITH 2 #5 CON. WITH #3 TIES AT 24" O.C. MAX FOOTING TO BE CUT 6" MIN INTO SOLID ROCK

16"

10"

4"

F1

2-#5 cont #3 at 24"



WALLS

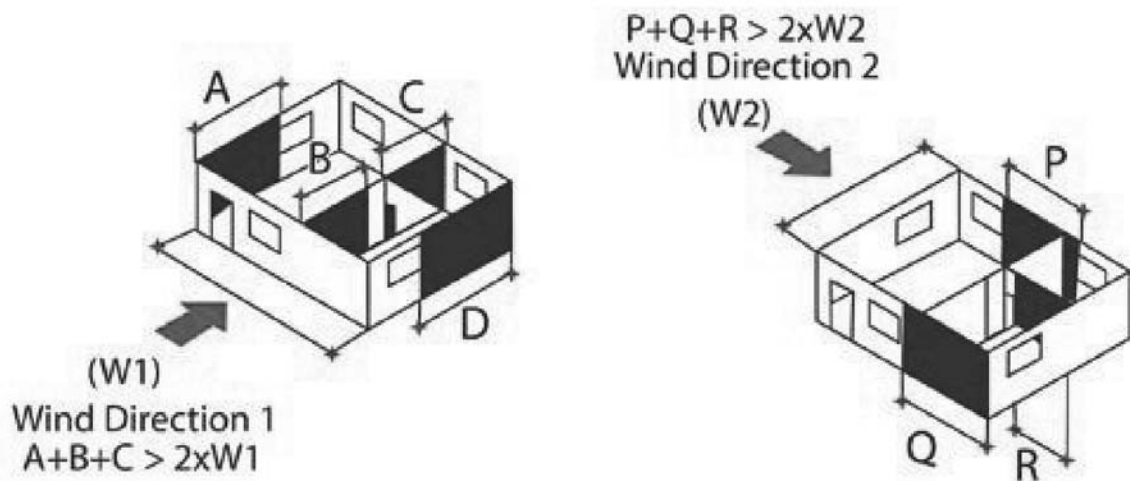
7

WALLS: *Shear Walls*

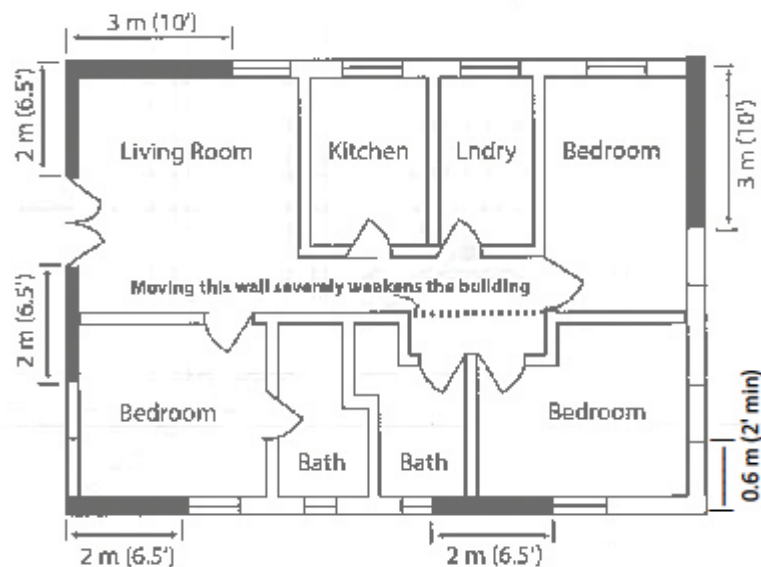


A structural system composed of braced panels to counter/resist the effects of lateral loads (forces acting against the structure). Winds and seismic loads are the most common loads shear walls are designed to carry.

Shear Walls - Timber



Shear Walls - Masonry



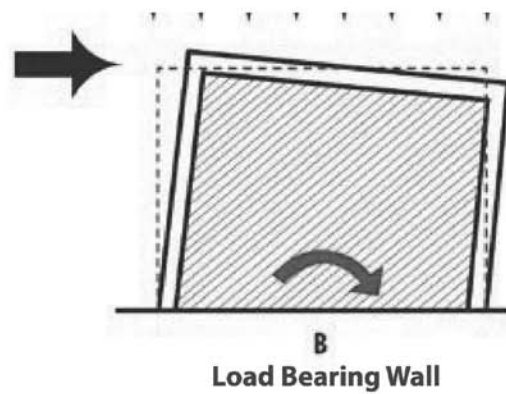
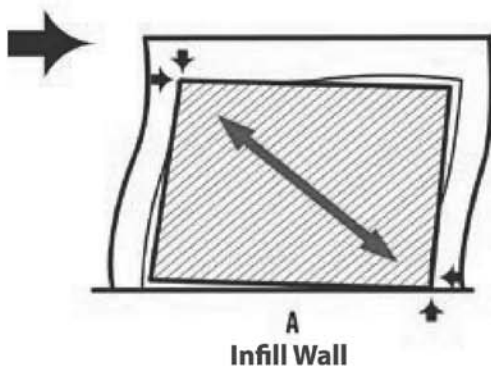
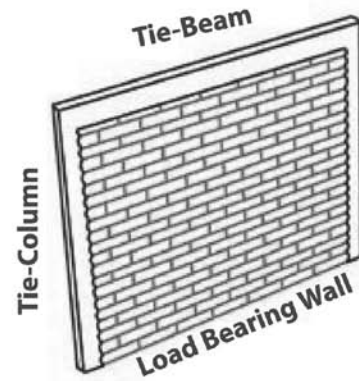
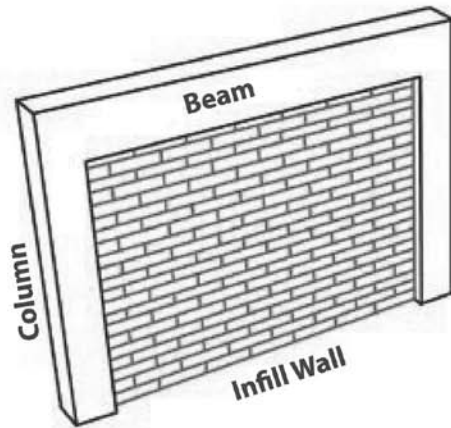
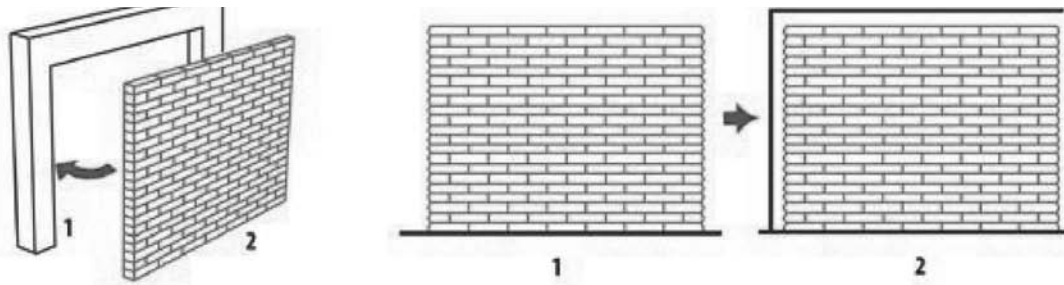
Note: Where outside of tidal surge area, consider rebuilding with internal hurricane/tornado safe room within house—seek a competent engineer to support with design.

WALLS: *Shear Walls*



Shear Walls -Timber framed construction with plywood sheathing panels to counter/resist the effects of lateral loads (forces) acting against the structure.

WALLS: *Masonry*



WALLS: *Masonry*



RC FRAMES WITH MASONRY INFILL WALLS AND CONFINED MASONRY

The appearance of a finished confined masonry construction and a RC (Reinforced Concrete) frame infilled with masonry wall panels may look alike, however these two construction systems are substantially different, as illustrated on page 21 where the figure on the left shows features of RC frames with infills, while the figure on the right shows confined masonry construction.

The main differences are related to:

1. the construction sequence, and
2. the manner in which these structures resist gravity and lateral loads.

The differences related to the construction sequence are as follows:

- In confined masonry construction, masonry walls are constructed first, one storey at a time, followed by the cast-in-place RC tie columns. Finally RC tie-beams are constructed on top of the walls, simultaneously with the floor/roof slab construction.
- In RC frame construction infilled with masonry wall panels, the frame is constructed first, followed by the masonry wall construction.



WALLS: *Masonry*



REINFORCED CONCRETE BLOCK WALLS

Where concrete block structure (CBS) walling is to be used in tidal areas or without reinforced columns:

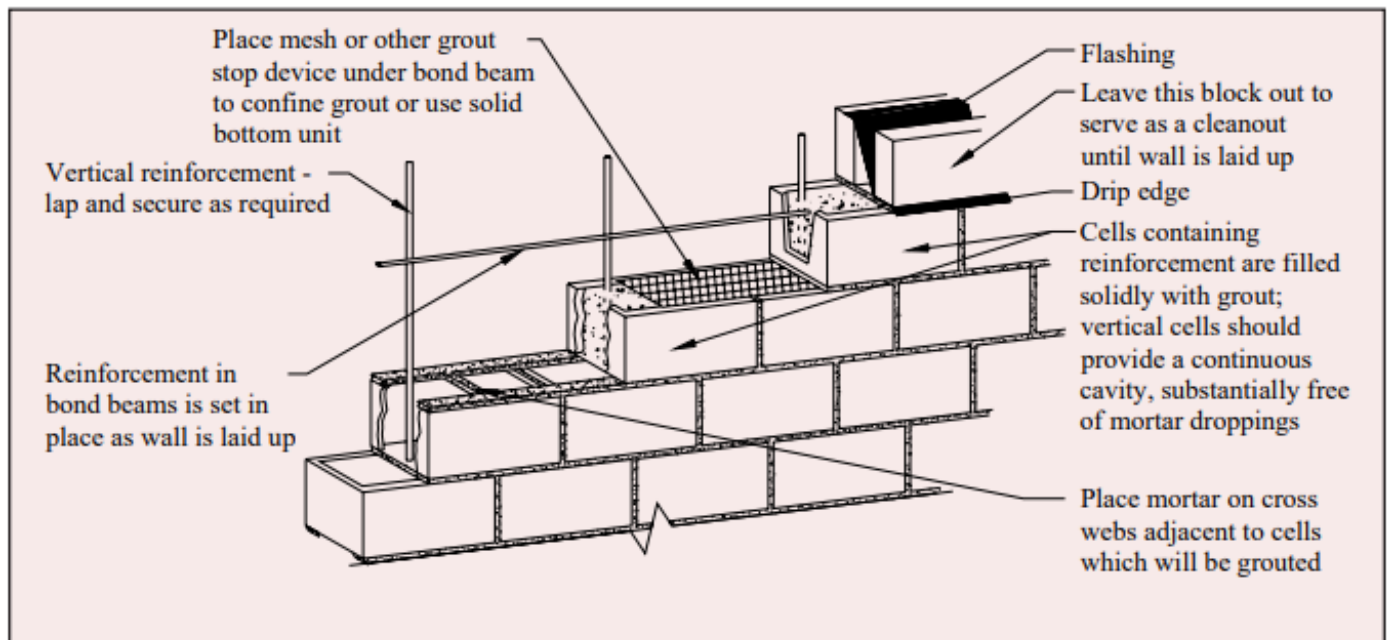
- Starter bars coming out of the foundation will tie the wall to the same.
- Lay blocks so that these starter bars come out through the block pockets. The foundation page calls out vertical $\frac{5}{8}$ " bars at 32" on center, we are also requiring that the reinforcement is continuous from foundation to roof, so this is consistent. This will provide adequate resistance to hurricanes and earthquakes.as more courses are laid one must add more lengths of steel which will overlap at least 18" with starter bars.
- These lengths of steel should go right up through to the top of wall.
- Pockets of block containing reinforcement are to be filled with concrete every 3 courses.
- 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 $\frac{1}{2}$ " to $\frac{5}{8}$ " wide.
- Horizontal reinforcement consisting of two $\frac{3}{8}$ " diameter bars, or Brickforce 16" c/c should be laid every second course. This increases the resistance of the wall to hurricane force winds and to earthquakes.
- Vertical bars are required at all junctions, windows and door openings.



THE WALLS



REINFORCED CONCRETE BLOCK WALLS



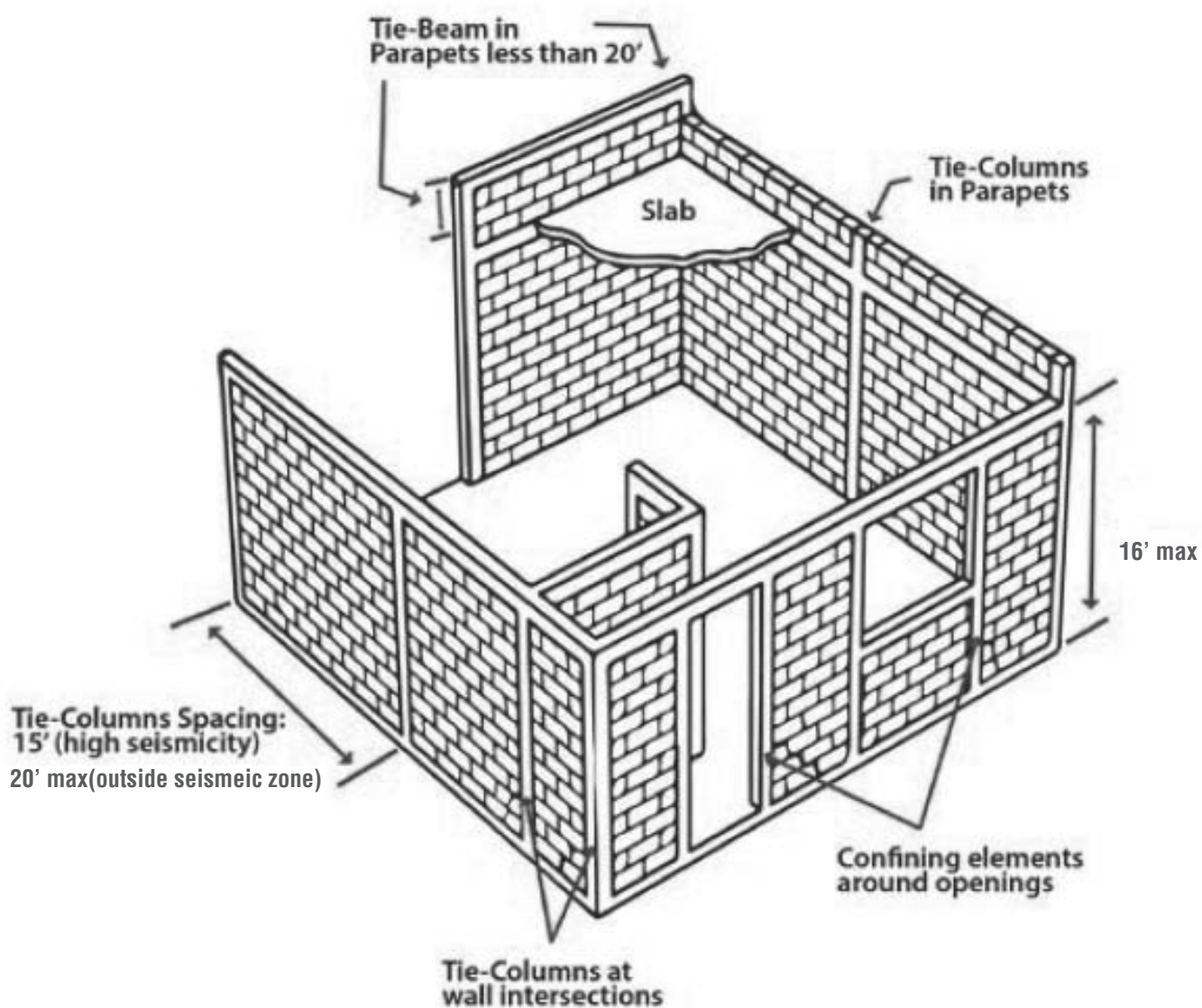
TYPICAL REINFORCED CONCRETE MASONRY WALL SECTION

If concrete block structure **walling is used in tidal areas, every other cell may have vertical reinforcement tied into footing and beam and horizontal mortar reinforcement.** In tidal areas reinforced concrete block structures were found to perform better than unreinforced concrete blockwork between tied columns

THE WALLS: *Masonry*



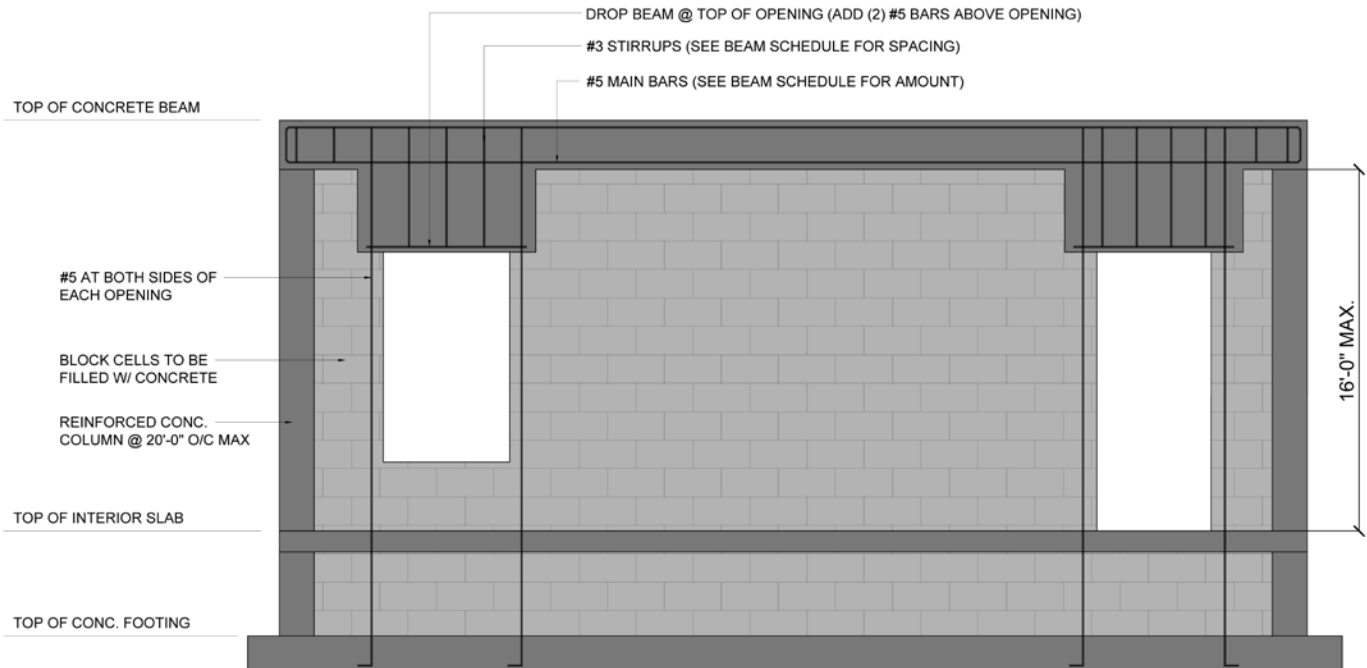
UNREINFORCED CONFINED WALLS



THE WALLS: *Masonry*



UNREINFORCED CONCRETE BLOCK WALLS




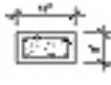


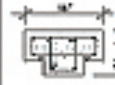

Use of vertical reinforcement in walls continuous from foundation into to tie beam above.

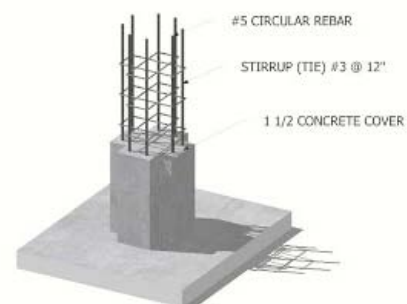
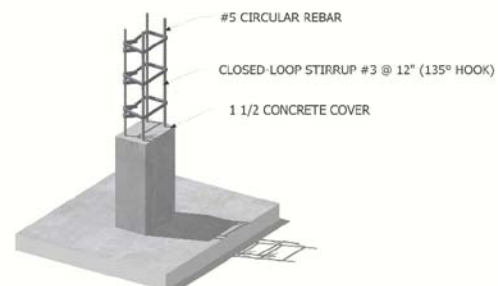
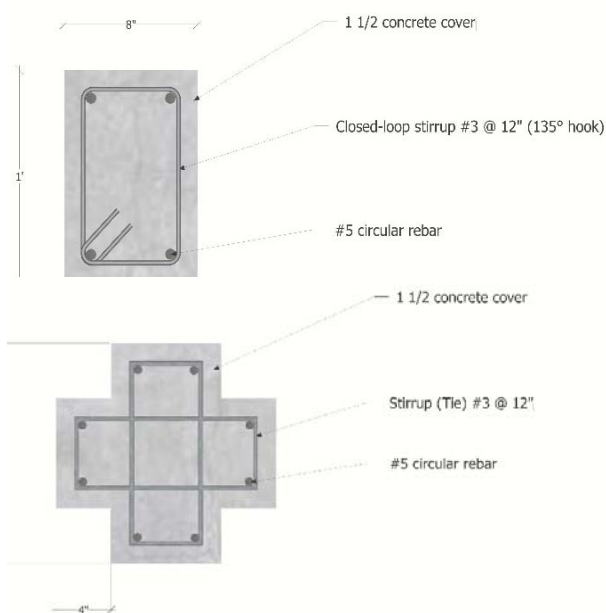
THE WALLS: *Masonry*



VERTICAL REINFORCEMENT

The Column schedule shown in the figure below outlines the typical standard sizes and types of reinforced columns used starting from the foundation level with the use of starter bars embedded within the concrete strip footing.

LEGEND		COLUMN SCHEDULE Minimum cover to 1 1/2"				
The following symbols denote thus:-		TYPE	(A)	(B)	(C)	(D)
	Proposed 8" CMU Wall	SIZE				
	Non-loadbearing partitions	REINF.	4 # 5	5 # 5	8 # 5	6 # 5
(A)	Column Type (see Schedule)	TIES	#3 at 12" c/c	#3 at 12" c/c	#3 at 12" c/c	#3 at 10" c/c
(F)	Footing Type (see Sections)					
GENERAL NOTES:						
1.0 Concrete to have a minimum compressive strength of 3000 p.s.i. at 28 days			4.0 Contractor to notify Engineer a minimum of 48 hours prior to the pouring of the concrete.			
2.0 Reinforcing to conform to ASTM A-615 grade 60.			5.0 Cover to all Columns - 1 1/2"			
3.0 These drawings to be read in conjunction with other relevant contract documents,			Beams - 1 1/2"			
			Foundation - 3"			
			Ground Slab - 2"			
			(over fill)			



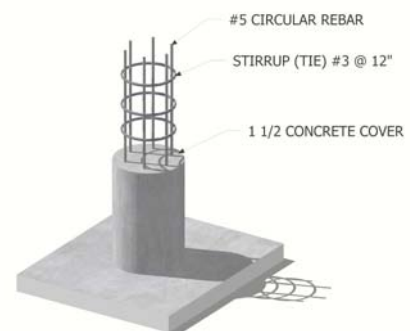
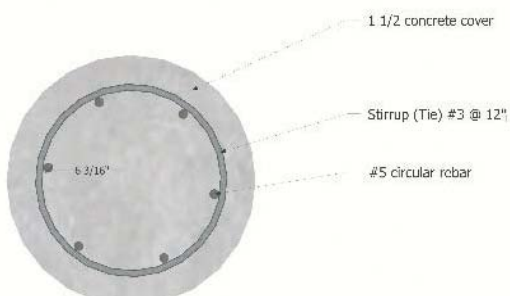
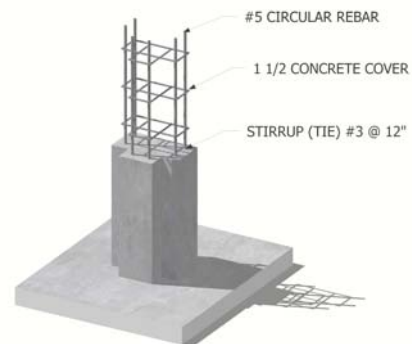
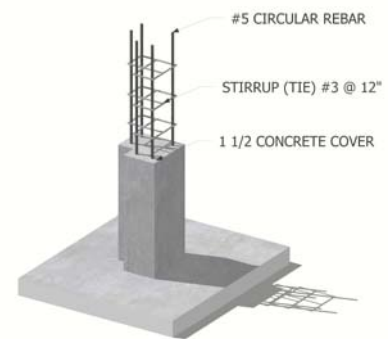
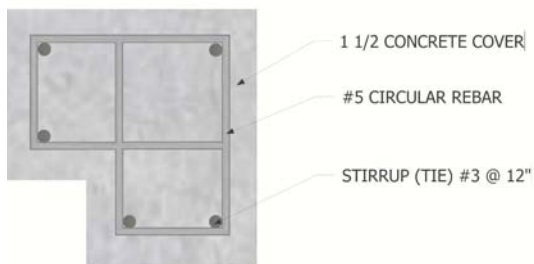
Pictorial view of standard reinforced concrete columns.

THE WALLS: *Masonry*



VERTICAL REINFORCEMENT

Pictorial view of standard reinforced concrete columns (cont'd).



THE WALLS: *Masonry*



CONCRETE WALLS

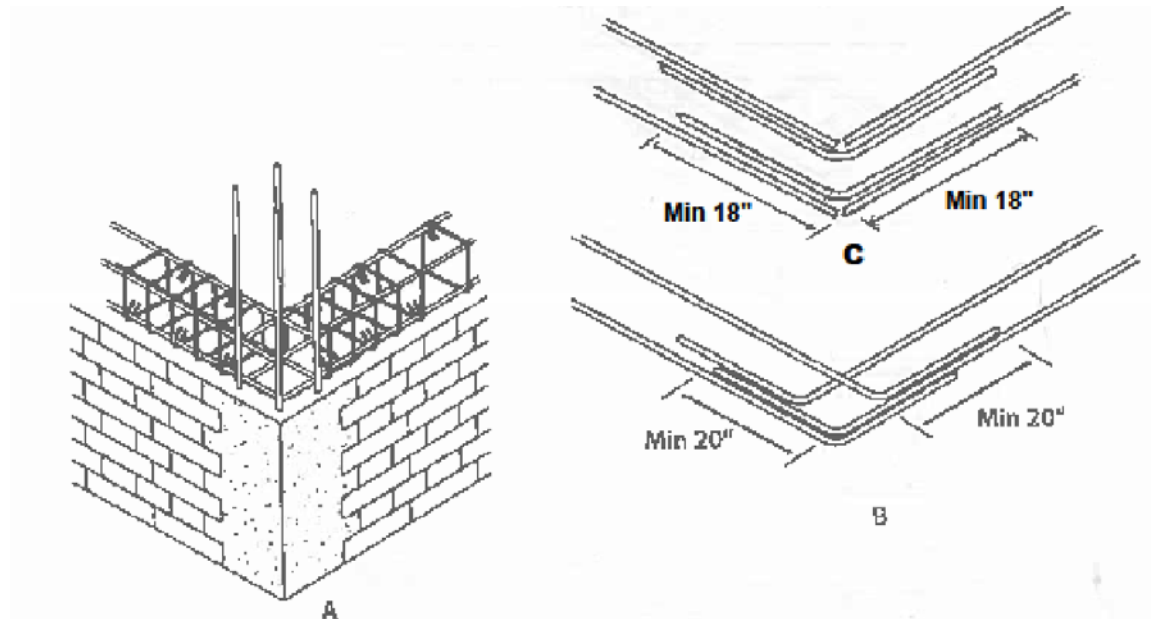
Minimum Dimensions:

- Tie-Column Size (depth x width): 8"x12" min.
- Tie-Beam Size: same as tie-column size

Reinforcement (Tie-Columns):

- Minimum 4 reinforcing bars
- Bar Sizes: -deformed reinforcing bars of minimum #5 bars($\frac{5}{8}$ "diameter).

To ensure the effectiveness of the tie-beams in resisting loads, longitudinal bars should have a 90° hooked anchorage at intersections, as shown below.



Tie-beam construction : a) wall intersections; b) hooked anchorage or c) angle bars for longitudinal reinforcement is required (BBC 2003).

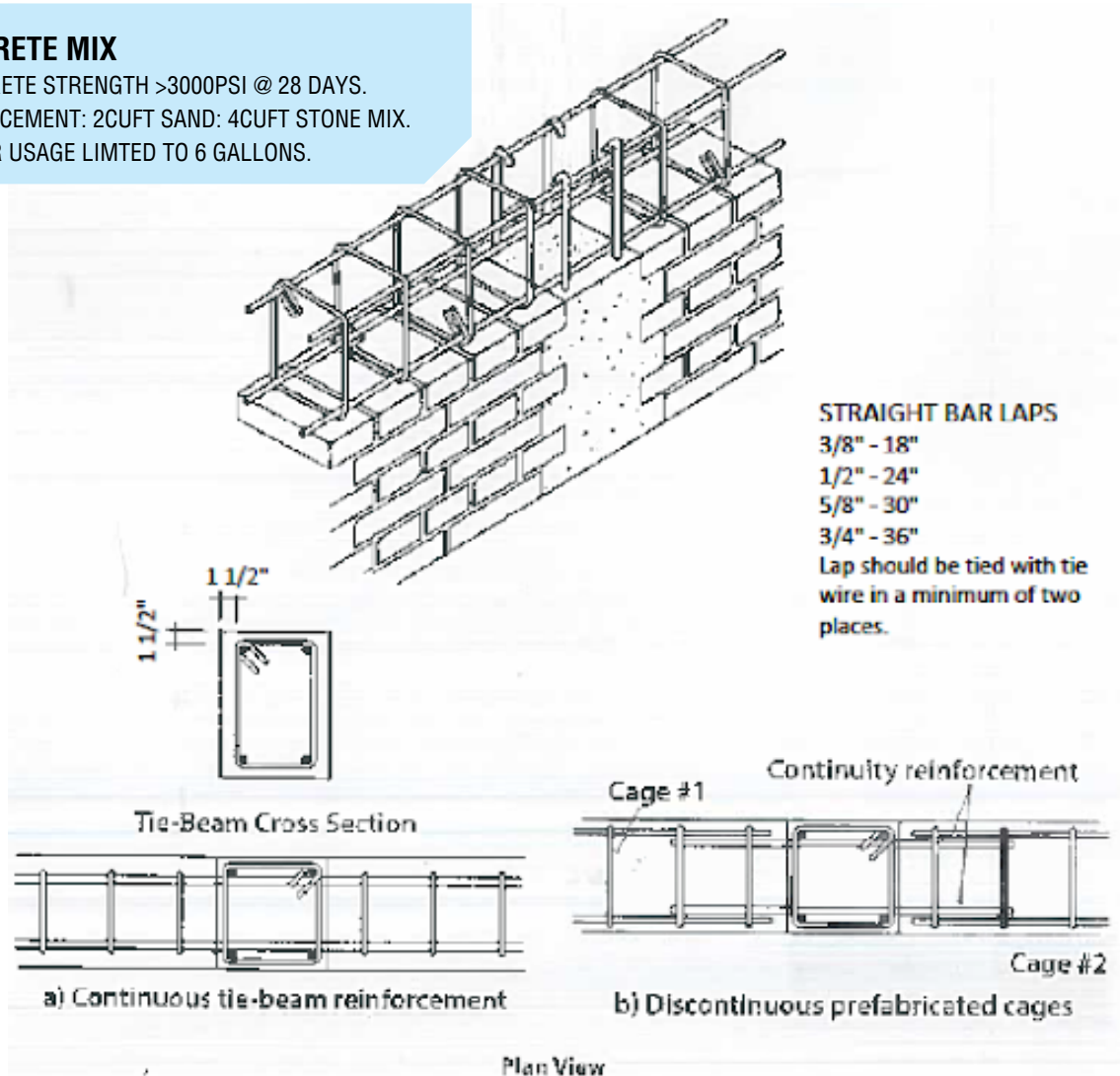
THE WALLS: *Masonry*



CONCRETE BLOCK WALLS

CONCRETE MIX

- CONCRETE STRENGTH >3000PSI @ 28 DAYS.
- 1CUFT CEMENT: 2CUFT SAND: 4CUFT STONE MIX.
- WATER USAGE LIMITED TO 6 GALLONS.



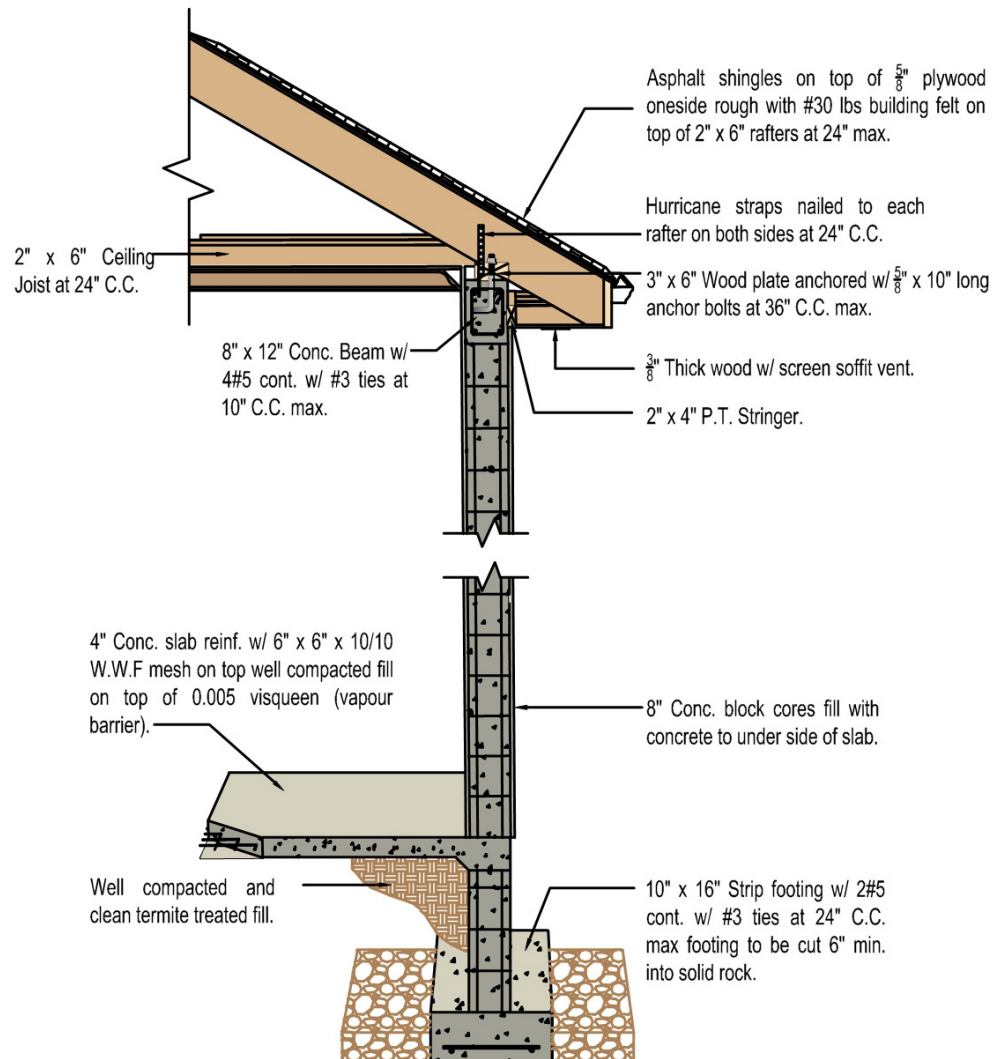
Tie-beam reinforcement details: a) continuous tie-beam reinforcement, and b) discontinuity reinforcement must be added when prefabricated reinforcement cages are used.

Note: Close-loop stirrups with 135° hook, rather than 90° hook.

THE WALLS: *Masonry*



CONCRETE BLOCK WALL SECTION



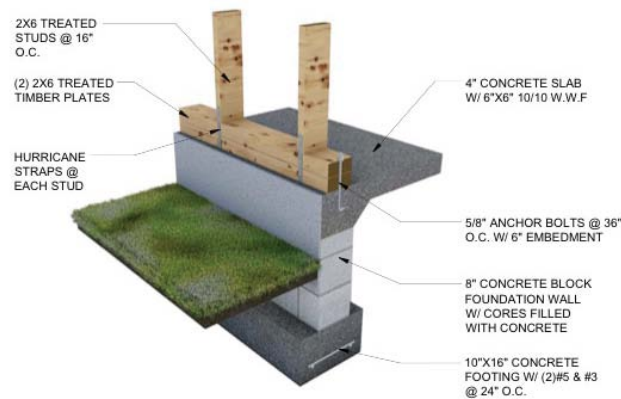
Typical Masonry Wall Section

THE WALLS: *Timber*

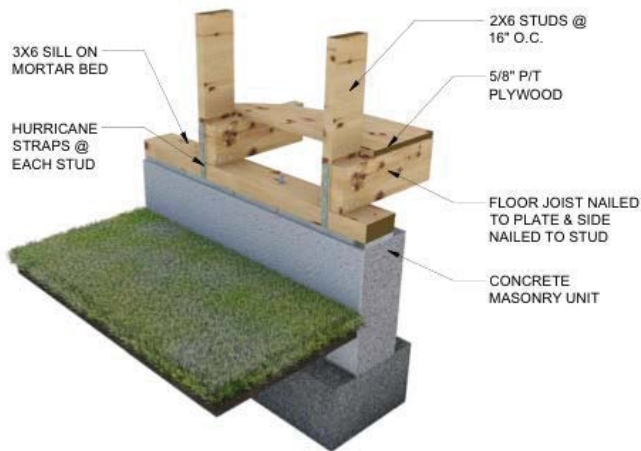


TIMBER WALLS CONNECTIONS

The walls must be securely tied to the foundation with anchor bolts to prevent the wind forces lifting up the entire building or blowing it over.

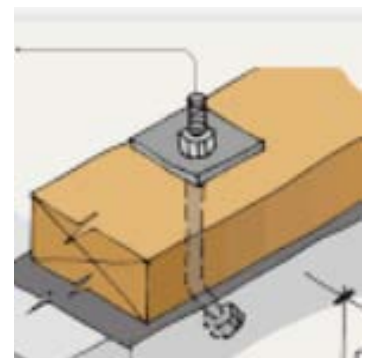


Frame attached to concrete slab



Frame attached with timber floor framing.

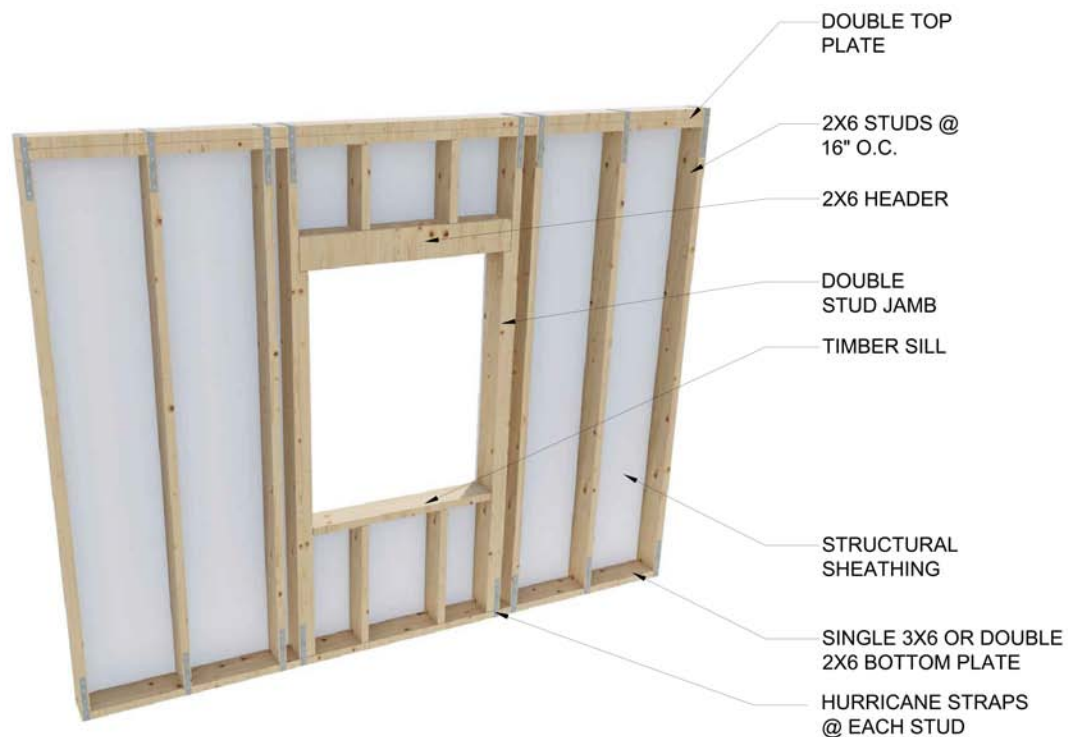
Note: Anchor bolts must have minimum 1/8" thick 1-1/4" diameter washers and nuts with minimum two threads visible above each nut. Drilled holes should be sufficiently small to maximize bearing area for washers.



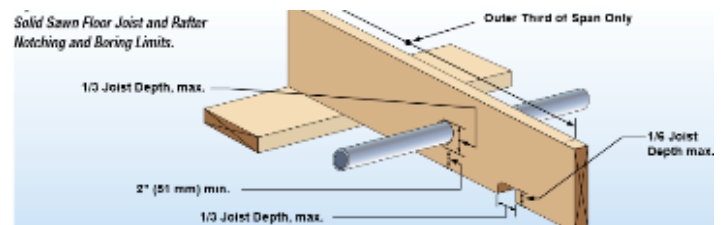
THE WALLS: *Timber*



- The uprights (or studs) of minimum 2" x 6" spaced 16'o/c max. are fixed to the wall sill which is bolted to the foundation walls with 5/8" anchor bolts with spacing max. 36"o/c .
- Using galvanized metal straps fastened per manufacturer's recommendation to each stud improves the hurricane resistance of timber houses. It is a required feature for these types of buildings. Plywood can be used as an alternate to diagonal braces. Plywood (min. 1/2"thick) shall be nailed with 8d nails, 6" o/c at panel edges and 12" at interior supports.



Note: Drill holes if required for wiring and plumbing should be well laid out, with holes being placed in the centre of the member. A maximum drill hole is 2" in a 6" member.

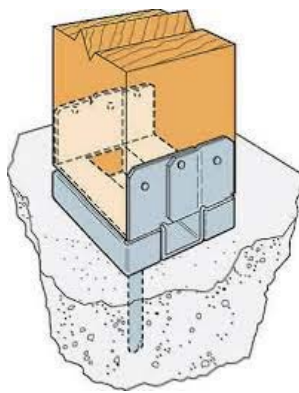


THE WALLS: *Timber*

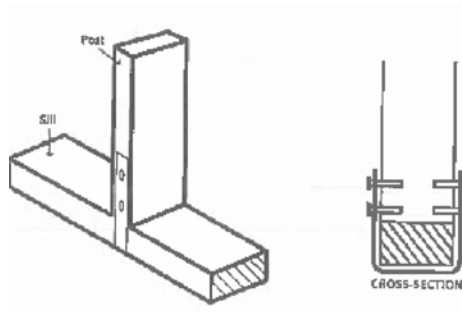
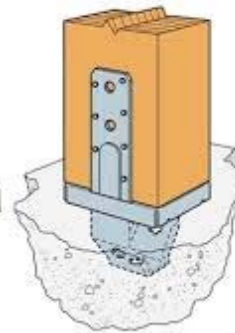


TIMBER FRAME CONNECTORS

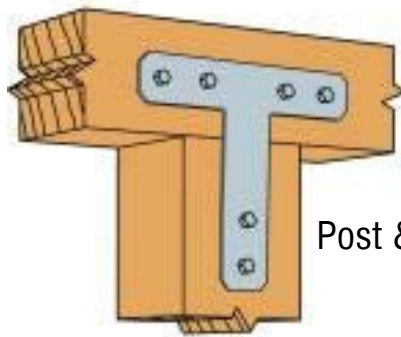
The walls must be securely tied to the foundation with anchor bolts to prevent the wind forces lifting up the entire building or blowing it over.



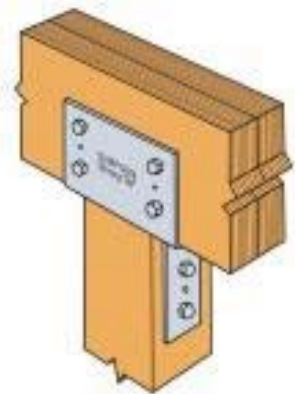
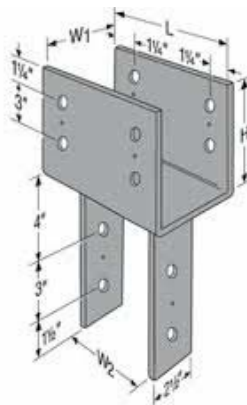
Timber Posts



Stud Walls



Post & Beam

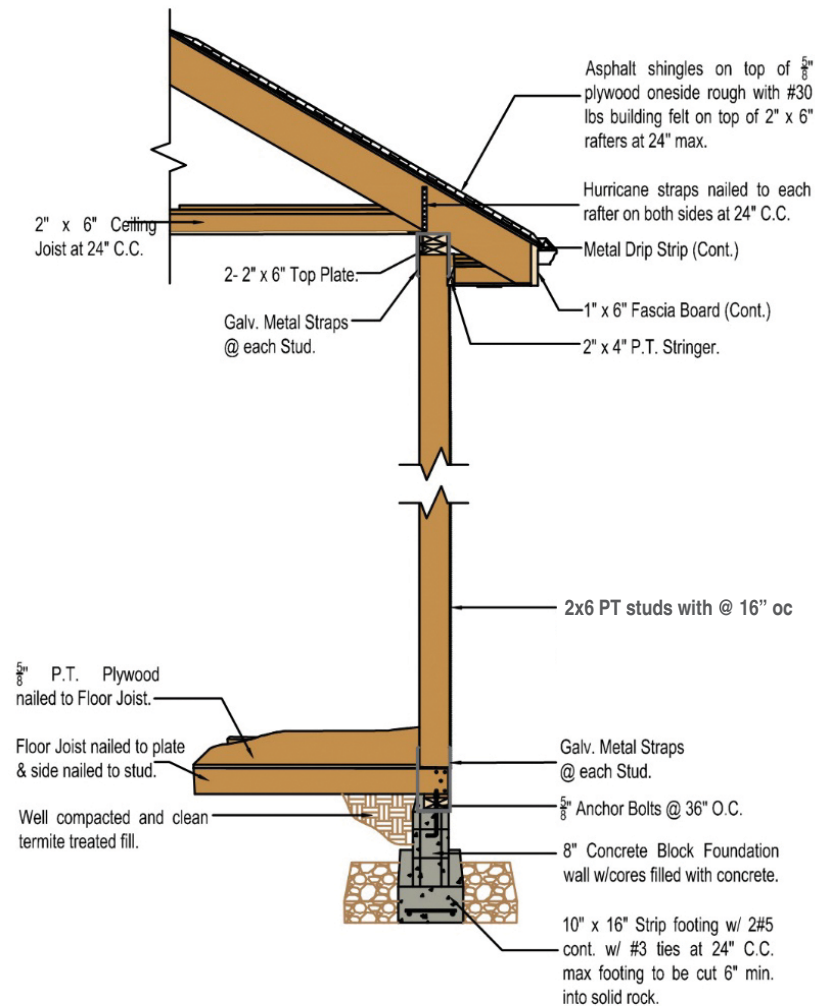


All connector installations to comply with manufacturer's specifications.

THE WALLS: *Timber*



TIMBER FRAME SECTION



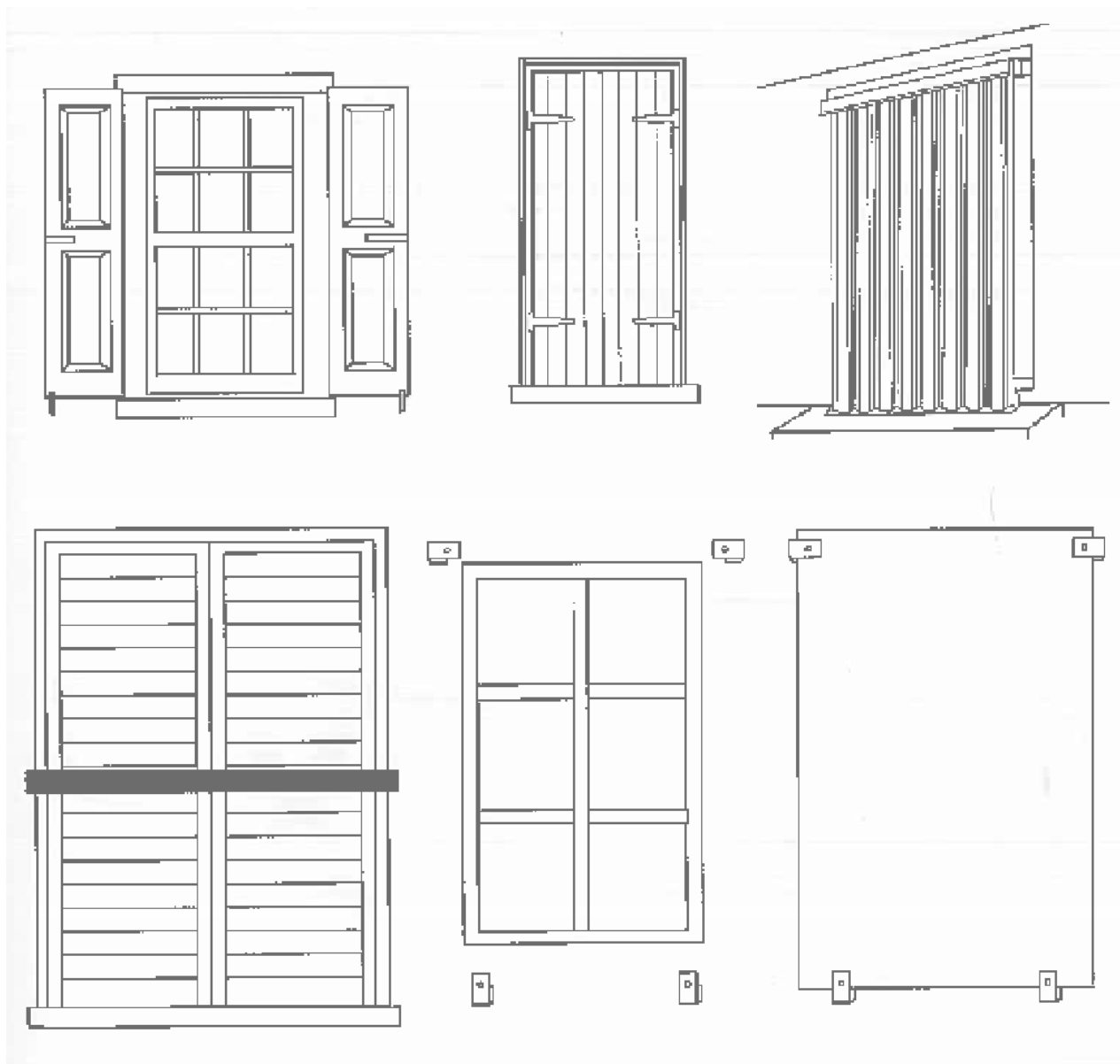
Typical Wood Wall Section

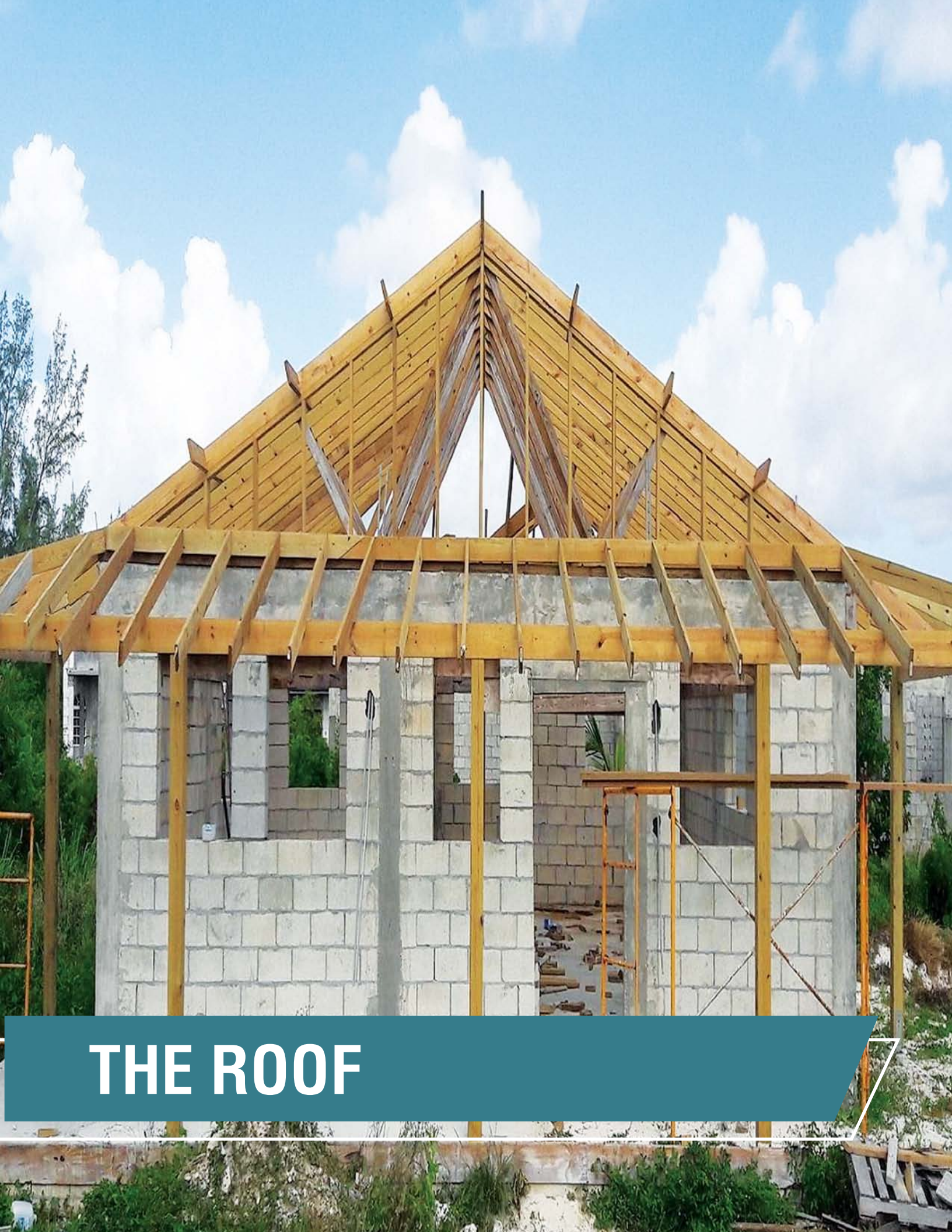
Note: Termites are a significant threat and all timber should be pressure treated lumber. Fixings must be correct for the type of pressure treatment, e.g. hot dipped galvanized or better. Any signs of mold must be remediated before covering back up.

THE WALLS: *Wall Openings*



Avoid openings which cannot be securely closed during a hurricane. Where openings are already in existence, hurricane shutters should be provided or openings constructed with approved structurally designed impact resistant windows and doors in accordance with the BBC. Unless storm shutters are permanently attached to the main structure, they should be neatly stored at all times in a designated and accessible area within the building.





THE ROOF

THE ROOF: *Roof Design*



Lightweight flat roofs are easily blown off in the high winds. In order to lessen the effects of the uplifting forces on the roof, the roof pitch shall not be less than 25° (6:12).

Hip roofs have been found to be more hurricane resistant than gable roofs.

Use a hip or a high pitched gable roof.

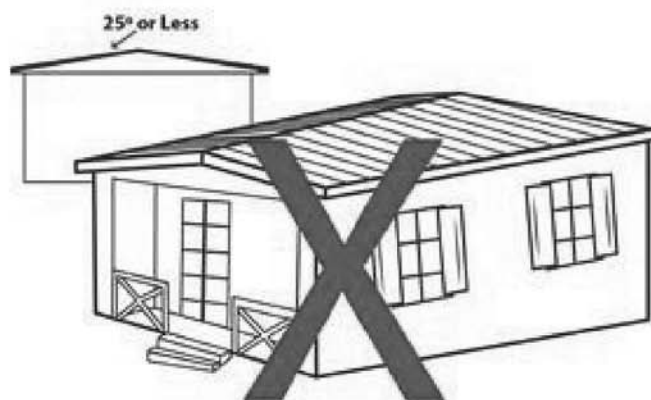
When gable end walls are used, they shall be properly reinforced.



HIP ROOF



GABLE ROOF



FLAT ROOF

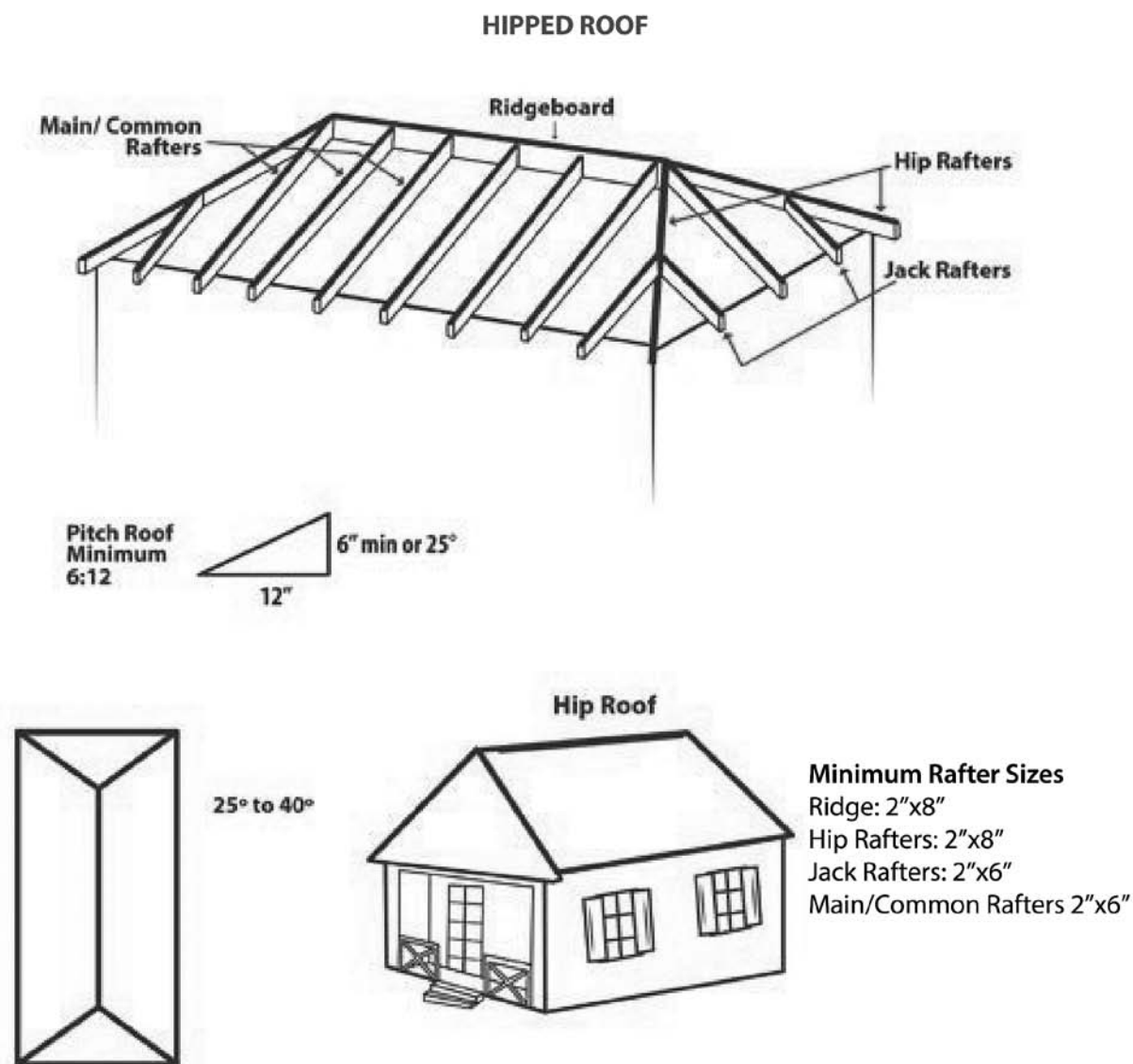
- To stiffen roof, install additional lateral bracing on the roofstructure (in hurricanes sheathing may fail).
- Electrical connection masts where they pass through the roof should be securely fixed to wall of house.

THE ROOF: *Hip Roof Design*



EXPERIENCE AND EXPERIMENT HAVE SHOWN THAT THE HIP ROOF WITH A PITCH BETWEEN 25° – 40° (6:12) HAS THE BEST RECORD OF WIND RESISTANCE.

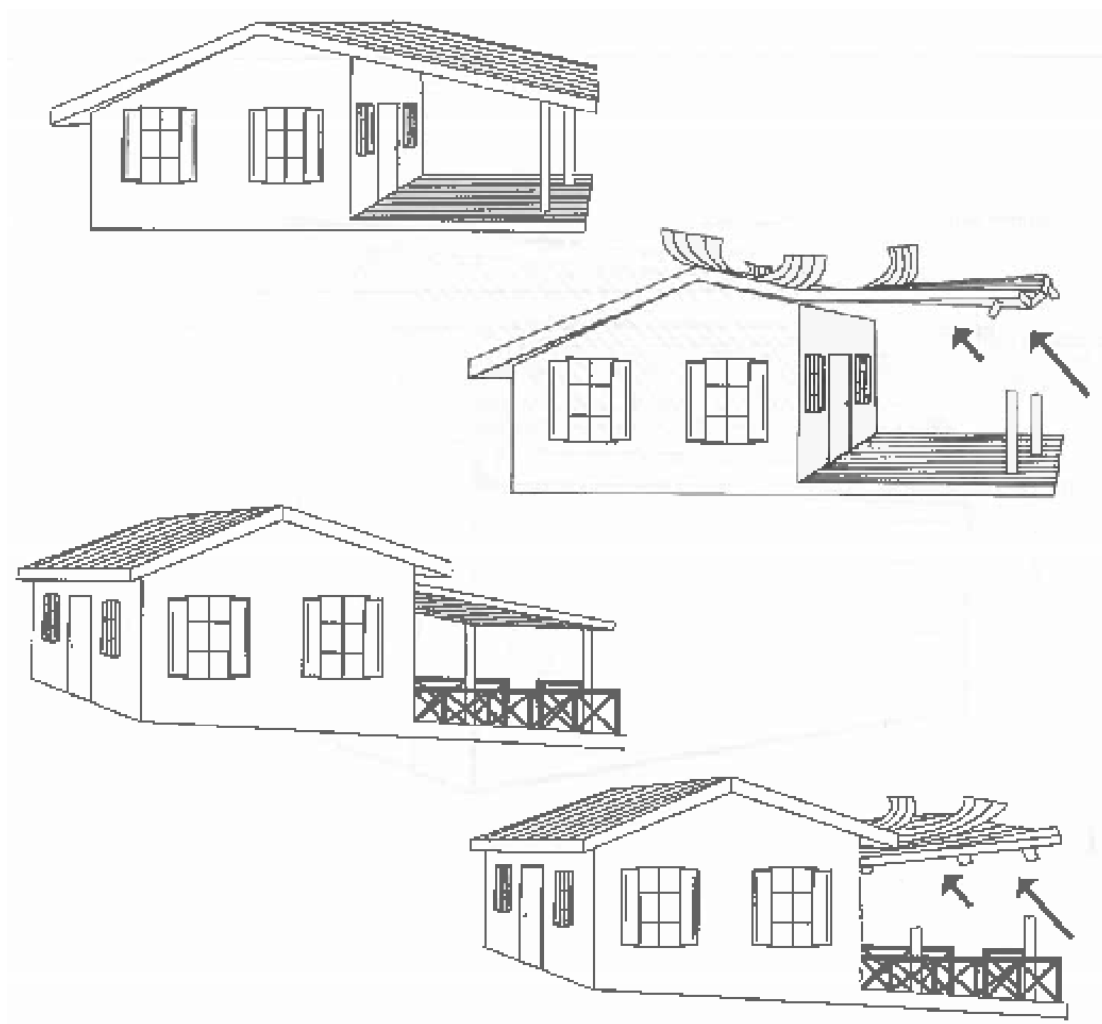
All sides of a hip roof are sloped. There are no gable ends in this roof. Instead, raters (hip rafter) come across diagonally from the corner to meet the ridge board a short distance from the ends of the house. Other shorter rafters going from the wall plate to the hip rafter are known as jack rafters. Once the ridge is firmly in position, the rafters are attached to fit neatly onto the wall plate.



THE ROOF:



Overhangs, patios and verandahs experience high wind pressures and should be kept short, small and separated from the structure.



- Overhangs shall not be more than 24" at the eaves unless specifically engineered.
- Build verandah and patio roofs as separate structures rather than extensions of the main building.

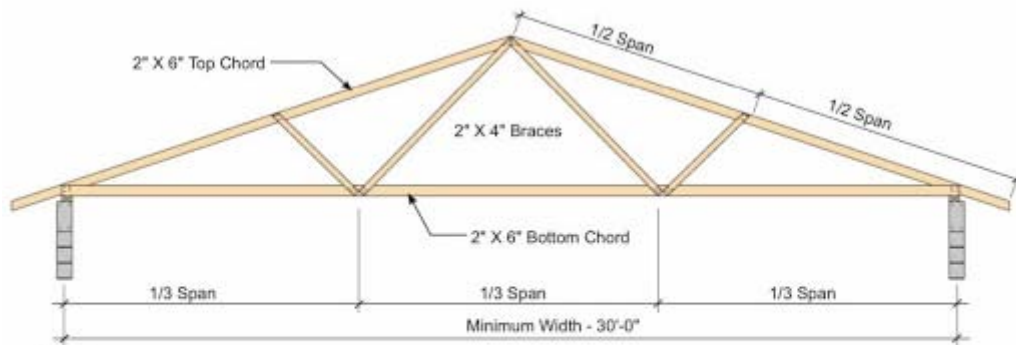
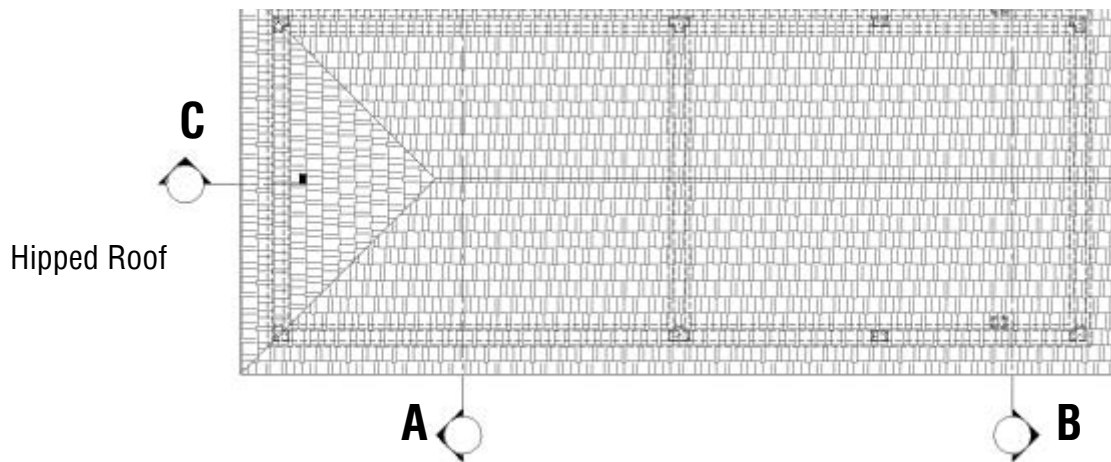
The roofs of all patios/verandas/porches are also required to be designed to resist the wind forces. However, as they are subjected to greater forces, it is recommended that these roofs be constructed independently so that in the case of their failure, it does not compromise the main roof.

THE ROOF: *Typical Roof Framing*



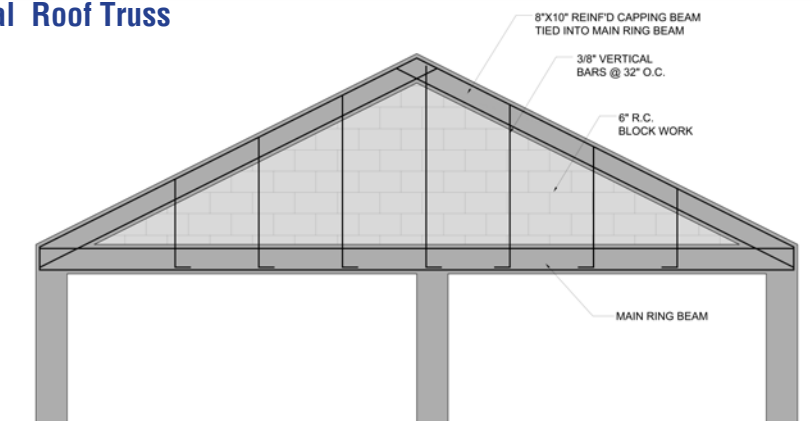
Typical Roof Plan

Gable End



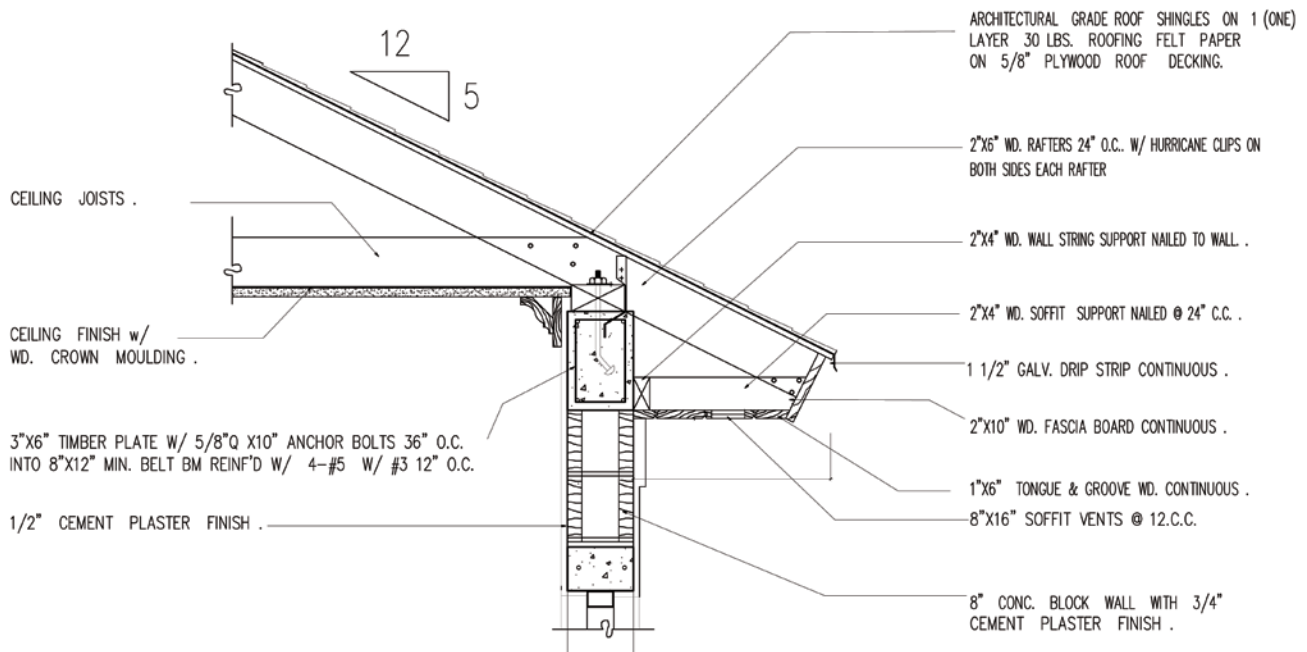
STANDARD FINK/W" TRUSS

SECTION A – Typical Roof Truss



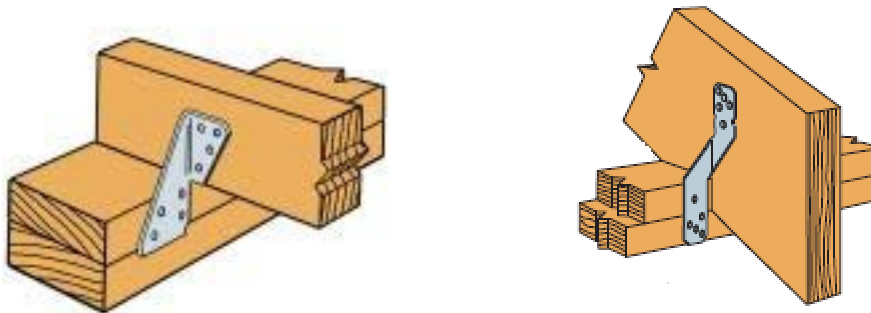
SECTION B – Masonry Gable End Detail

THE ROOF: *Connection to Masonry Walls*



SECTION C – Roof Eave Detail

Timber wall plate when on top of a concrete ring beam to be anchored to beam with $\frac{5}{8}$ " anchor bolts at max. 3' centres. Bolts must have minimum $\frac{1}{8}$ " thick 1- $\frac{1}{4}$ " diameter washers and nuts with minimum two threads visible above each nut. Drilled holes should be sufficiently small to maximize bearing area for washers.



Each hole in the hurricane strap or clip should be filled with a nail, unless the instructions specify less is allowable. Use the specified size of nail requested in the instructions. Take care not to split timber when nailing.

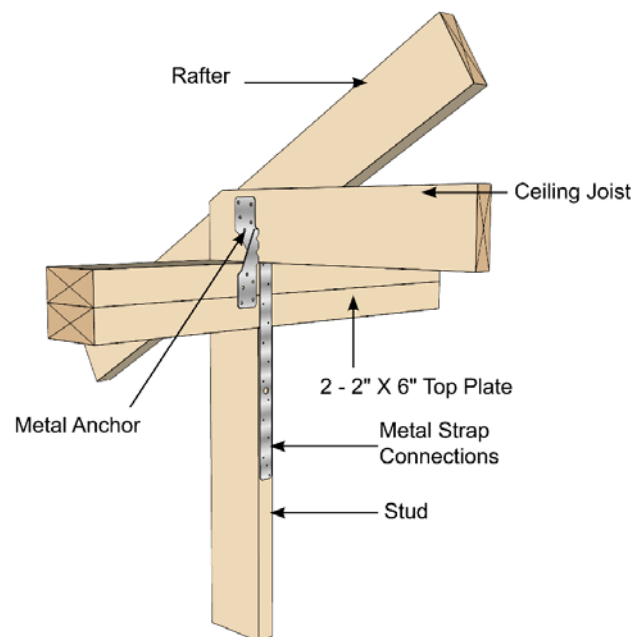
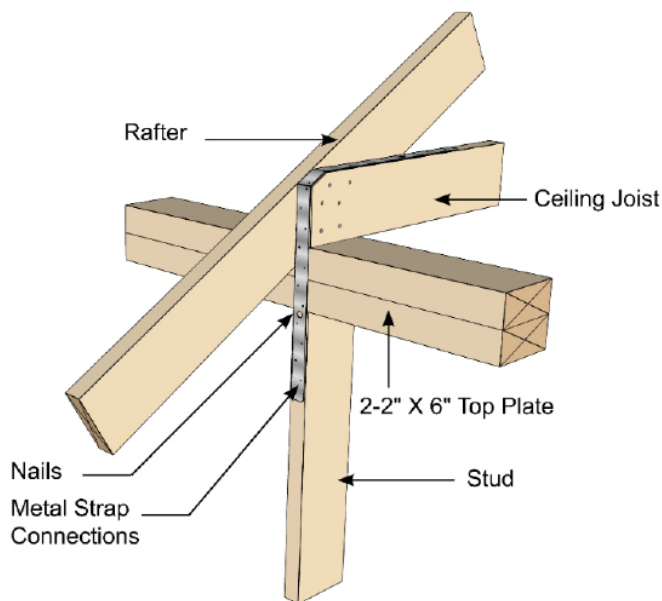
THE ROOF: *Connection to Walls* (Timber)



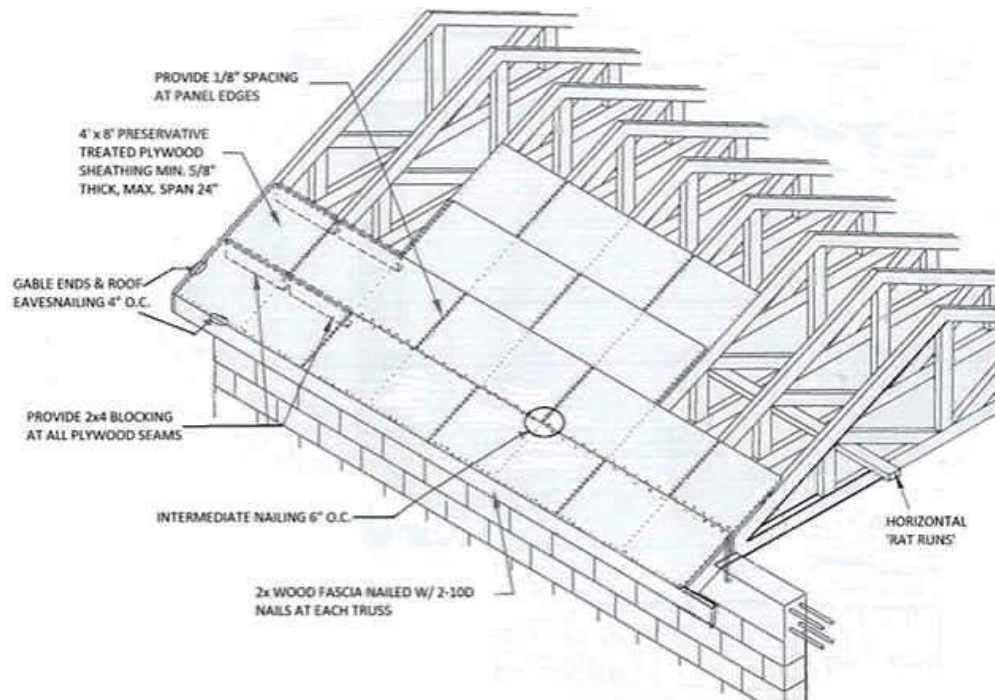
In timber houses, the rafters and trusses are connected to a wall plate which is supported by the vertical posts. Two connections need to be considered:

- The first is the connection between the plate and the uprights with the use of minimum 2"x 6" timber studs and 2-2"x 6" double plate, which should be made using metal straps.
- The second connection is that between the rafter and the plate. It is REQUIRED that hurricane straps and/or clips be used for these connections. Nailing or spiking the rafter to the wall plate is not allowed, as under high suction forces these nails or spikes may pull out.

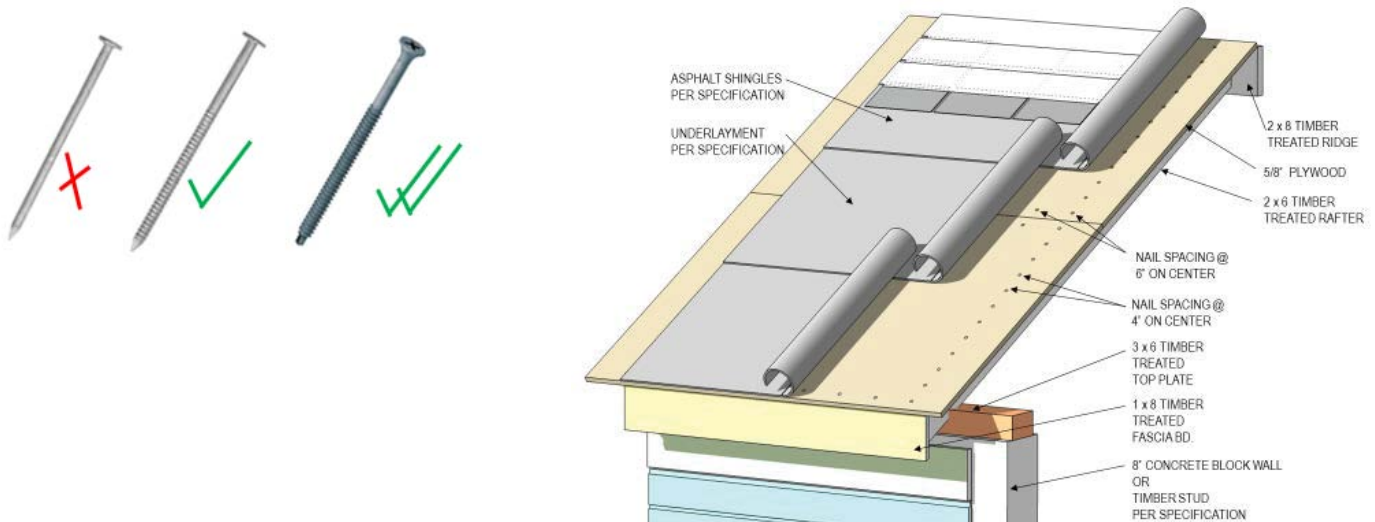
Hurricane straps or metal connectors shall be designed for "High Wind Construction" and have a "High Corrosion" rating.



THE ROOF: *Plywood Sheathing*



PLYWOOD NAILING PATTERN



- Use exterior screws or G-ring shank nails –do not use straight shank smooth nails for roof sheathing.
- Asphalt shingles to be as high quality as can be afforded and each shingle secured at all 4 corners.
- Barrel or Flat Tiles to be fixed through fixing hole not solely with mortar bedding.

BUILDING SAFETY ENHANCEMENTS



SAFE ROOM

Where outside of tidal surge area, consider rebuilding with internal hurricane/tornado safe room within house –seek a competent engineer to support with design, but this can take the form of constructing the bathroom with reinforced concrete block structure (CBS) and tied reinforced concrete ceiling slab, with small hurricane rated window and door.



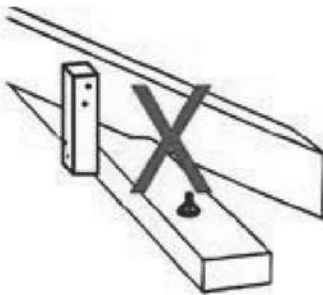
ATTIC ESCAPE

If attic will be used as refuge in future tidal surge ensure attic is easily accessible (with dropdown attic ladders for example), attic includes small attic vent for ventilation and small window for emergency exit.

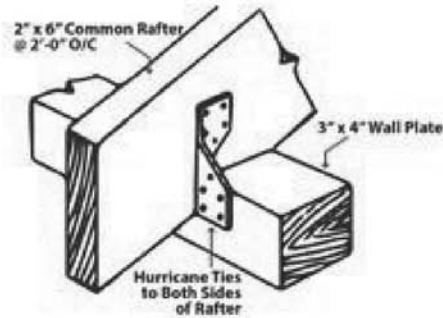
THE RETROFIT:



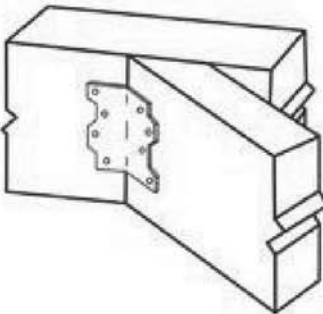
Rafters will lift off wall plates in high winds. Straps must be installed in existing roofs to strengthen them.



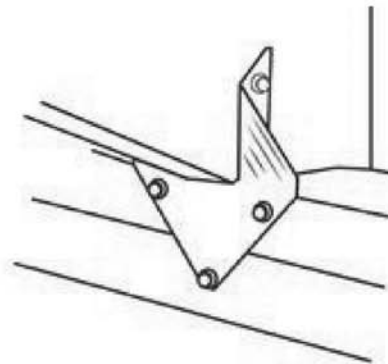
Timber connector may NOT be used as an alternative.



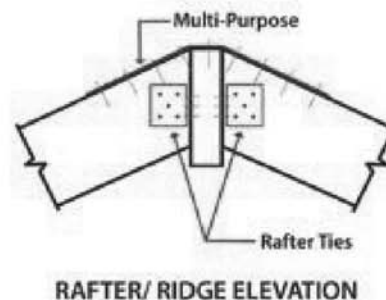
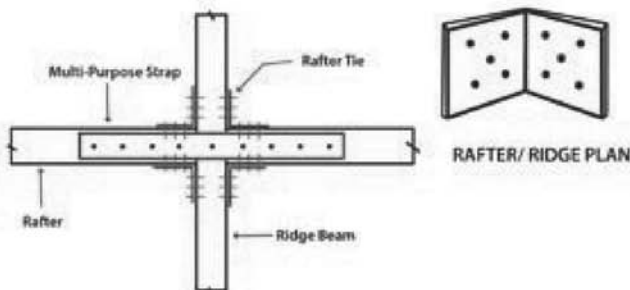
Twisted straps connected per manufacturers specs. Be careful when selecting hurricane straps. Ensure that they can be properly affixed, so that when nailed, they are not too near the edge.



JACK RAFTER/HIP CONNECTION



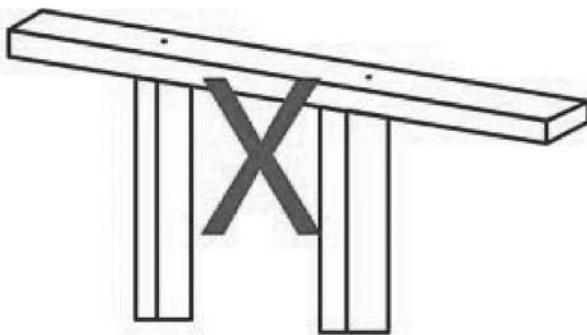
RAFTER/WALL PLATE CONNECTION



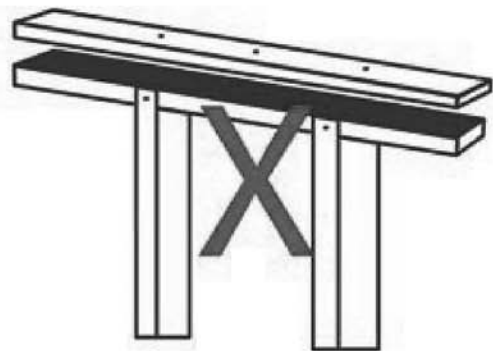
THE RETROFIT:



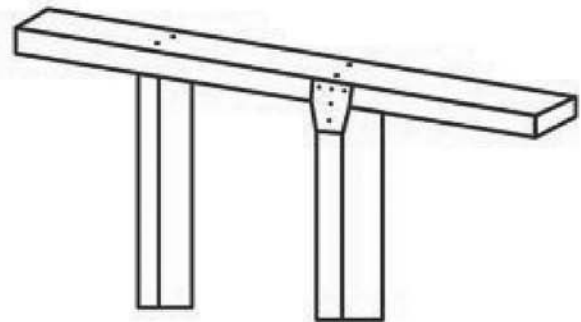
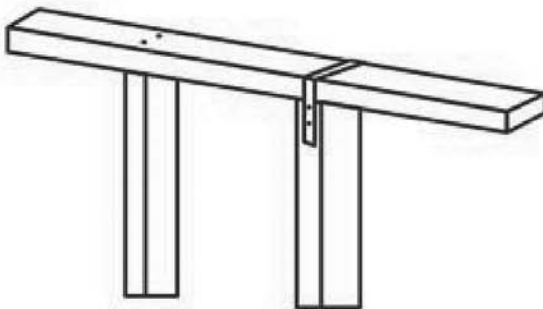
Wall Plates for wooden buildings are critical because they provide stiffness for the building and also serve to hold the roof down.



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



Double plate shall not be used without straps.

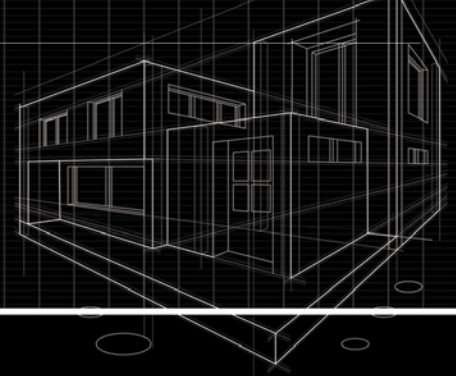


To strengthen use a strap over the top or use a gusset of zinc or plywood.



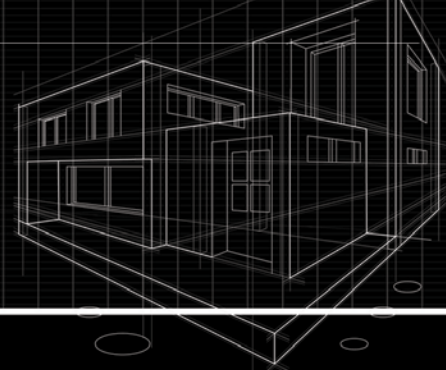
H6 Stud to
Top Plate
Installation

MAINTENANCE:



- Experience and statistics show that lack of maintenance is a significant contributing factor in damages to houses by hurricanes.
- Regular maintenance is necessary in order to ensure that the structure continues to be hurricane resistant. Inspections should be done at least one a year prior to the hurricane season and, or after any significant weather event.
- Check the entire house regularly, inside and out, to see if anything needs repairing or replacing and fix it immediately.
- The most important areas for regular checks are:
 - Roof cladding for damage and fixing for missing screws or bolts;
 - Roof structure; rafters and purlins for soundness, no rot or termites;
 - Joints and connections in timber and masonry construction for structural integrity and durability;
 - Concrete blocks and slabs for cracks.
- For houses on wooden support:
 - check support for rot, especially those below ground level;
 - check for termites and treat when evident. Obtain specialist advice for this problem.

CONCLUSION:



The entire archipelago of The Bahamas lies within the Atlantic Ocean and will be exposed to hurricane force winds and tidal surges annually. It is therefore of vital importance that our buildings are constructed to withstand the increasing intensity of hurricanes. Buildings should be constructed to exceed the minimum Code standards wherever possible. In summary the following minimum standards should be used:

- Roof sheathing shall be a minimum of $\frac{5}{8}$ " plywood C-D grade unless otherwise shown on the approved drawings.
- Metal roof sheeting shall be 24 gauge (0.5mm) minimum.
- Structural wood members shall be grade two (2), pressure treated (APWA UC4A) or better.
- Hurricane ties are required. Hurricane ties shall be galvanized or stainless steel. Clips shall be rated for 'high wind' construction and shall be of "High Corrosion Rating".
- Stainless Steel shall be used within 300' of the ocean:
 - Simpson H3Z or equal for purlin to rafter.
 - Two, Simpson H2.5AZ or equal for rafter to wall plate.

- Plywood sheathing shall be attached by G-ring shank nails:
- Metal sheeting shall be attached by #9 screws with neoprene washer.
- Rafter spacing 24" max, Purlin spacing 24" max.
- Roof spans more than 30" must be designed by a Structural Engineer and approved by the Buildings Control Division; or use of approved pre-manufactured roof trusses.
- Retrofitting from timber roof to concrete requires separate approval by the Buildings Control Division.

Buildings Control Division,
Department of Public Works,
The Ministry of Public Works.

[illegible]

GUIDE TO HOUSING STANDARDS FOR THE BAHAMAS

