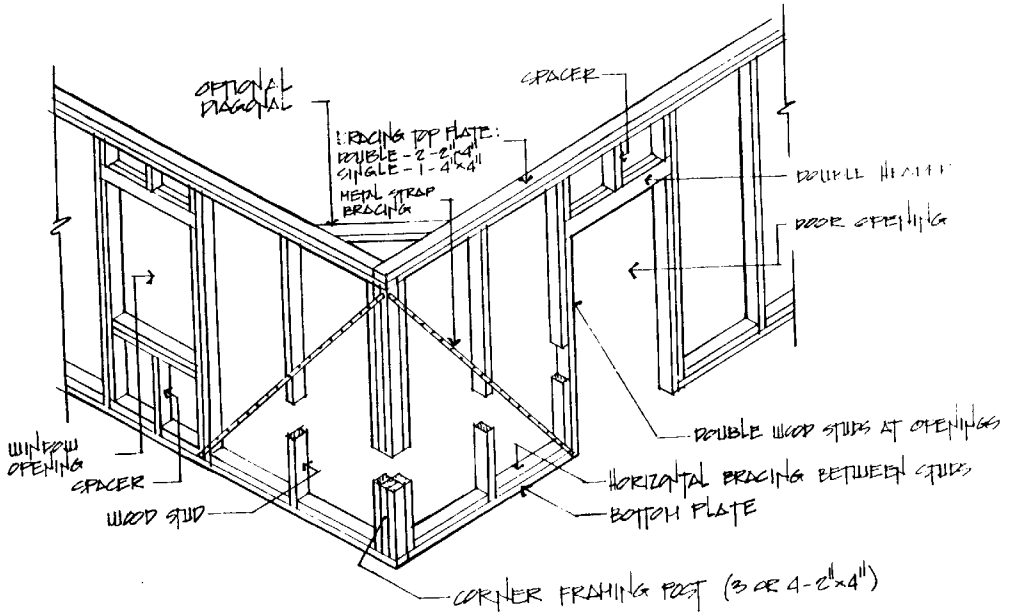
Exterior Wall Framing and Cladding

The walls of the house should withstand the lateral forces produced by hurricane winds. The external walls should also sustain the load of the roof. [Reference: *OECS Building Guidelines,* Section C, clauses (a) to (d).] In timber wall framing, rigidity is critical. Rigidity can be achieved by closer spacing of studs, bracing studs with diagonal bracing and horizontal noggins and cladding the stud wall frame with rigid board materials.



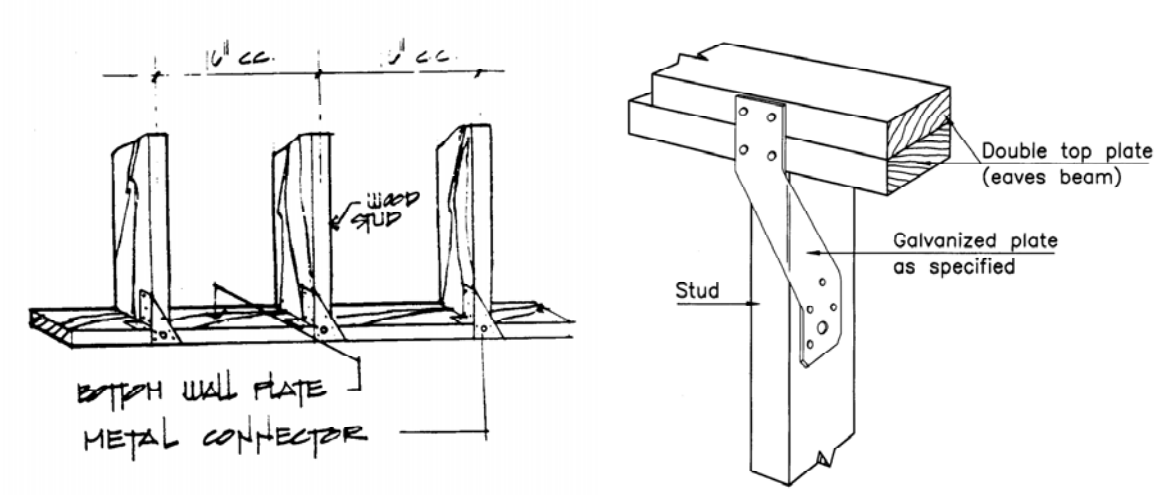


Figure 19 Wall framing

Walls are usually constructed to an average height of eight feet (8 ft), measured from foundation to top plate. They should be built with two by four inch (2" x 4") studs placed at two feet (2 ft) on centres. For increased rigidity and to fit 48" width board cladding, studs may also be placed at 16" centres. Noggins of the same size material should be used to further strengthen the structure. Noggins are short horizontal wooden members in claddings or partitions that are secured in position by nailing through the studs. They

are used to stiffen the studs and to provide extra support. [Reference: *OECS Building Guidelines,* Section A, clauses 2.2(a) to (g).]

Metal straps ('T's) plus corner braces must be added to secure studs at top and bottom plates and at corners of the structure (Figure 19). Metal connectors allow nails/screws to work in shear, which is the most efficient way for them to perform.

Materials used for cladding must possess good strength. For example, 5/8" exterior plywood and shiplap pitch pine boards are appropriate cladding materials.

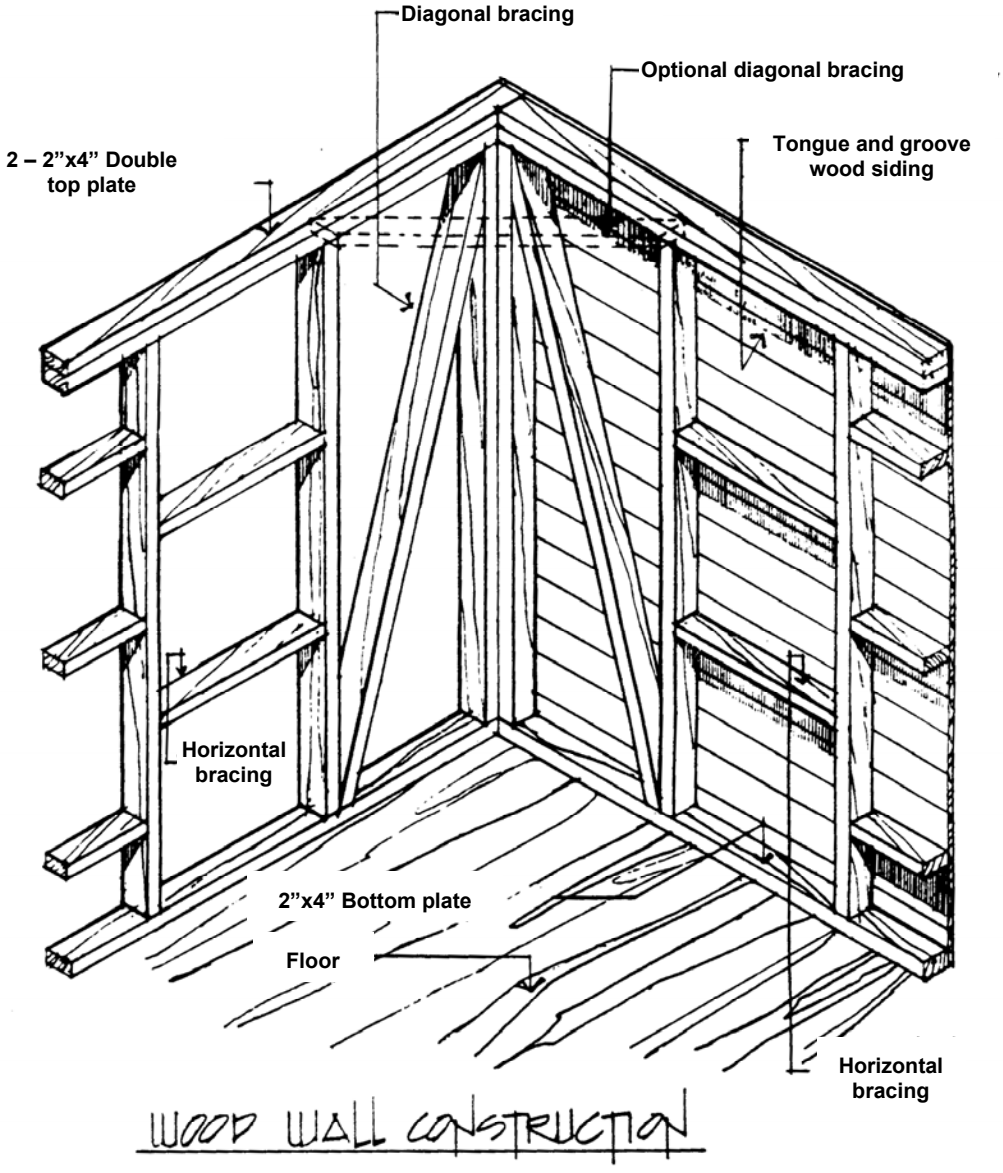


Figure 20 Wood wall construction

Stud spacing should be kept to a maximum of two feet (2 ft) (Figure 20), to ensure that both the centre and edges of the sheet of plywood are supported, which increases wind resistance. The common practice of using very large stud spacing (4'- 0") without noggins should be discontinued. Sound materials, such

as pitch or yellow pine, should be used for studs. Studs must be doubled around all openings (doors and windows), as openings tend to weaken a wooden structure.

External cladding should be so constructed such that no gap is left between the top of the wall plate and the underside of the roof-covering material. Such gaps afford wind intrusion with potentially catastrophic results (Figure 21).

When plywood is used as external cladding, maintenance costs can be quite high, especially when the exterior is left unpainted or guttering is not provided. Lath and plaster is a sound protective method, which can be applied to external walls (especially the weather side) to reduce maintenance costs and preserve the integrity of the building. [Reference: *OECS Building Guidelines,* Section 2-3, clauses (a), (b), (c) and (d).]

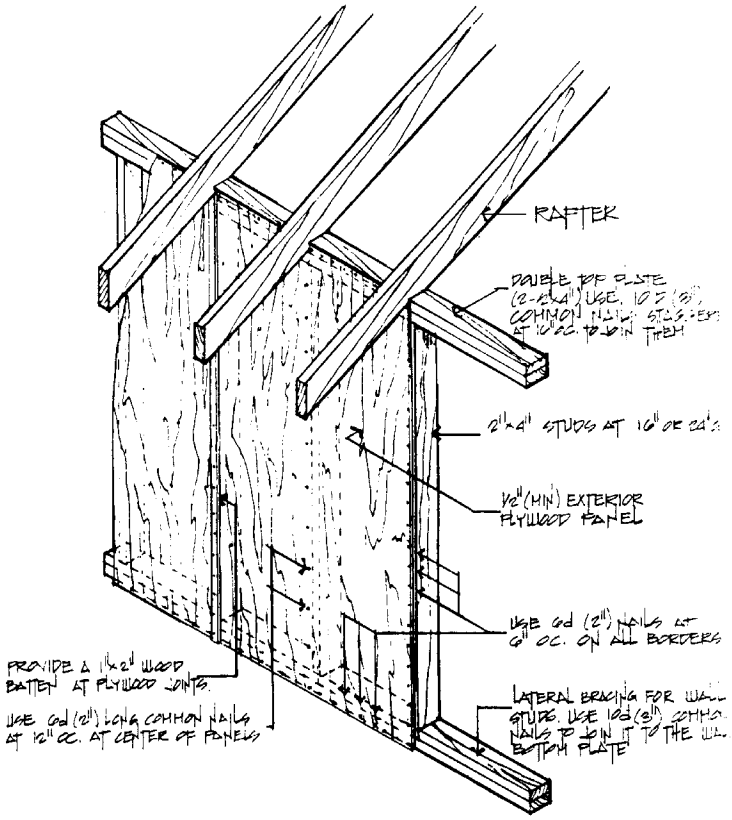


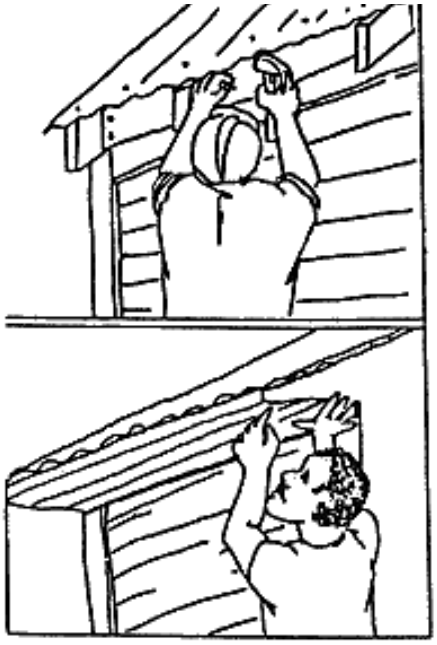
Figure 21 Plywood panel siding installation

In existing houses, a number of options are available for strengthening existing walls. Additional studding and noggins can easily be added, as can additional 'T's and corner bracing. 'T's should be used to connect the studs to the bottom and top plates of the skeletal frame of the building.

Wall plates should be of dimension two by four inch (2''x 4") or two by six inch (2" x 6") and top plates should be of the identical size but doubled. Joints in successive layers of the wall plate should be staggered.

Do not leave too much space between the roof and the walls!

Close up the space and leave smaller spaces to ventilate the roof!



Or, even better, leave ventilation spaces in gable ends!

Recommendations—Framing and Cladding

- Ensure that cladding material used provides sufficient strength and that adequate bracing has been provided to withstand high winds.
- Studs spacing should be 2'-0" on centres.
- Studs are doubled around openings
- Diagonal bracing is provided at corners.
- Metal straps are used to connect components.
- Use lath and plaster on external walls on weather side to protect plywood siding from the elements.

Roofs

Roofs are the most vulnerable part of a building during a hurricane. Therefore, they must be strong and resistant to high winds. Research has proven that, because of their design, hip roofs are most resistant to hurricane strength winds. If the hip roof can be afforded, it should be given priority over the other types (Figure 22). Additionally, steeper roof slopes can significantly decrease the uplift forces imposed upon it. Roofs with slopes of 30° or more are recommended.

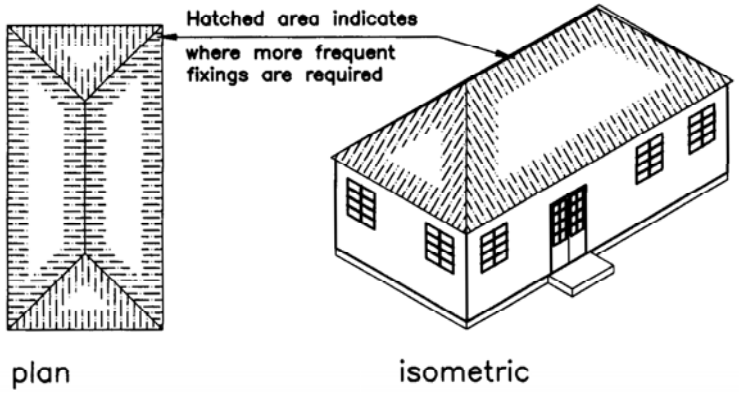


Figure 22 Hip roofs

The gable roof is most frequently used roof type (Figure 23). With gable roofs, it is important to ensure that the roof members are strong. Materials used as rafters should be 2"x 4" (rough lumber) at 24" centres, or 2"x 6" (dressed lumber) also at 24" centres. The use of dressed lumber, which is treated, is preferred over rough lumber, which is not treated. Hurricane clamps should be used to secure the rafters and laths to counter the effects of high winds. [Reference: *St. Lucia Building Code,* Section 4.3, clauses (a), (b) and (c).]

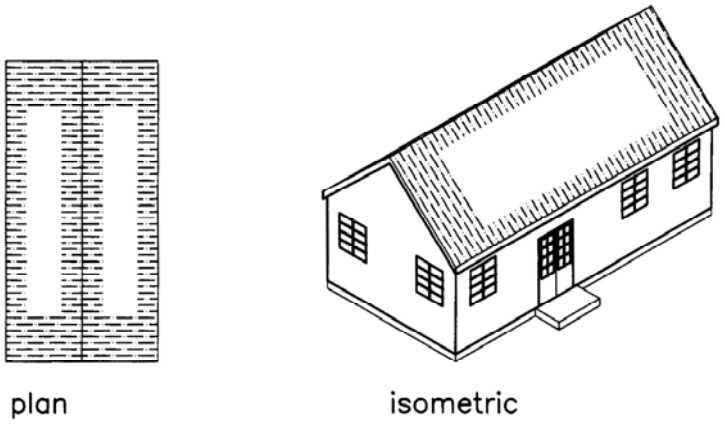


Figure 23 Gable roofs

The connection of the roof covering must be given serious attention. In St Lucia, corrugated galvanized sheet is the most commonly used roof covering. Proper selection and fastening of these roofing materials is critical to maintain the stability of the roof. [Reference: *St. Lucia Building Code,* Section C, clauses 4.1 to 4.5.]

For galvanized roofs, the use of 24 gauge galvanized sheet metal is recommended. 26 gauge galvanized can be used, but extra attention must be paid to proper fastening of edges and overhangs. Gauges thinner than 26 (i.e. 28 and higher) are not acceptable, as they can easily be torn loose by strong winds. The

galvanized sheets are anchored to purlins or laths. Purlins are 2" think wooden strips, which are laid on edge, while laths are up to 1" thick and are laid flat. Purlins should be preferably 2" x 2" or 2" x 3" rough. 1" x 3" purlins are inadequate; their use should be discontinued. Spacing should not be more than 2' - 0" apart (Figure 24).

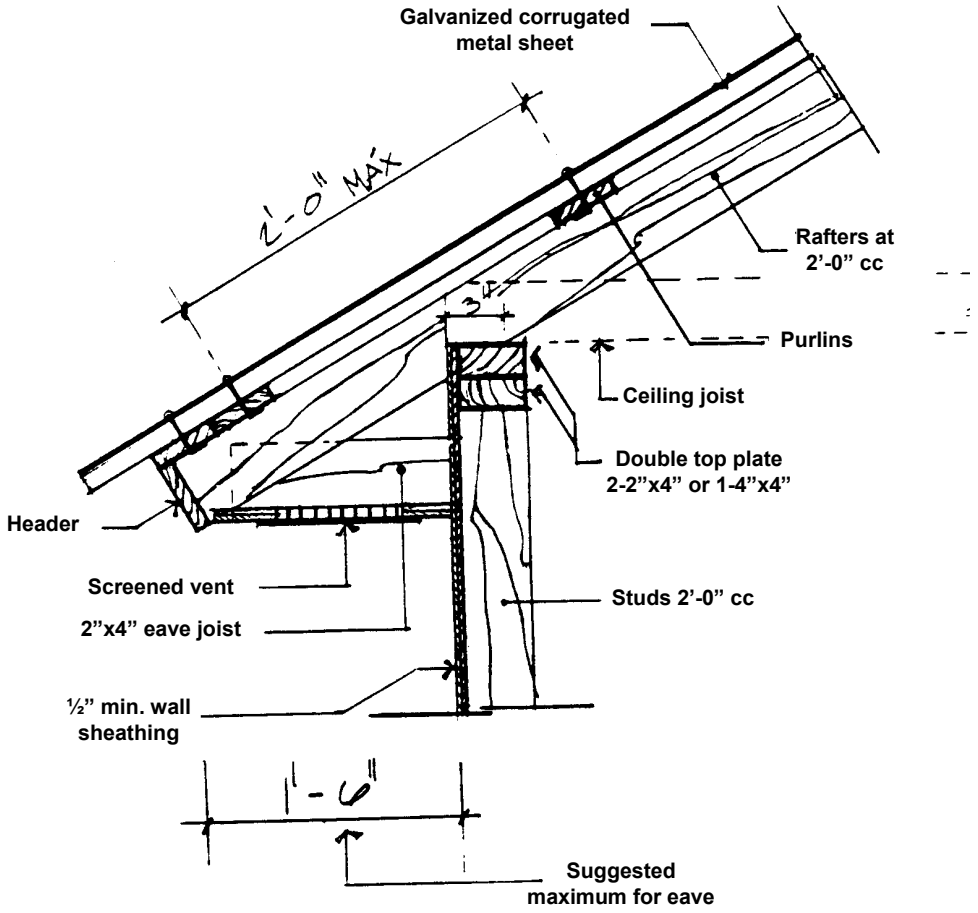


Figure 24 Eave section

Once the laths have been properly placed, it is important to nail each galvanized sheet carefully to the laths. If one of the sheets becomes separated, it could form a chain reaction pulling the others with it, leaving the exterior of the house exposed, thus risking the safety of the occupants and causing damage to personal property (Figure 25).

The following should be adhered to when installing galvanized sheet metal roofing, to minimize the effect of high winds on the roof covering:

1. At the ridge and eaves of the roof, nails should be placed at each corrugation, as the eave are where the lift is greatest and where nails and screws are most likely to tear through the sheets. For the rows in between the ridge and the eaves, one nail should be placed at every other corrugation (Figure 26). Corrugated roof sheeting should always be nailed through the crown of the corrugation, not through the trough (Figure 28).
2. The galvanized sheet and ridge cap should be made to overlap the barge board by about 2" to 2 ½", so that they can be bent over the barge board and secured with 1" nails. This helps prevent the sheet from lifting at that point (Figure 27). Ridge capping must extend at least 4 inches (4") beyond the lower edge of the purlin/lath. Fascia boards must be installed, and whenever possible

the eave should be boxed. Ventilation should be provided to boxed eaves to remove humidity and to equalize the interior and exterior pressures. These vents should be placed in the attic and in overhangs.

3. The length of the eaves must be as short as possible. A shorter eave offers less surface area and hence reduces the upward thrust acting on them by the action of hurricane strength winds. Eaves should be no longer than 8" unboxed or up to 18" when boxed.

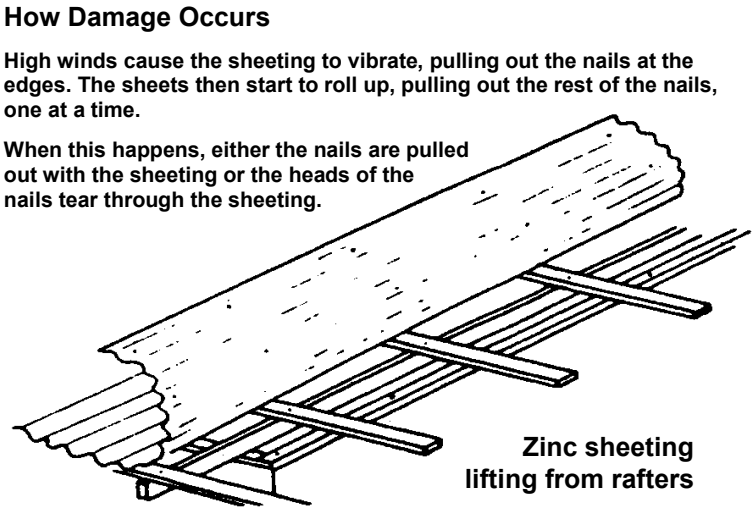


Figure 25 Sheeting lifting from rafters

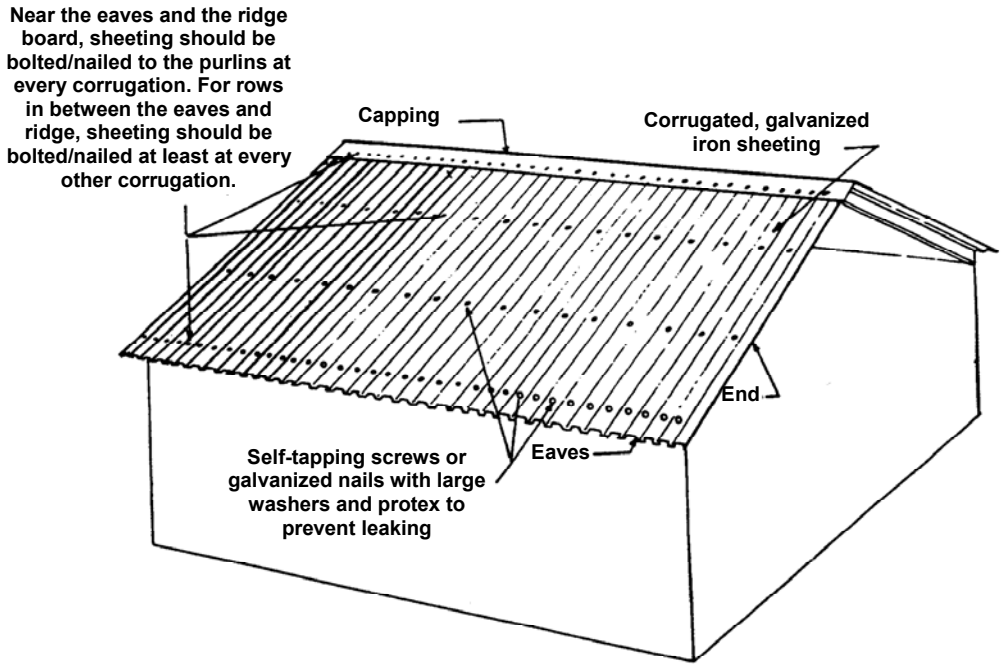


Figure 26 Nailing

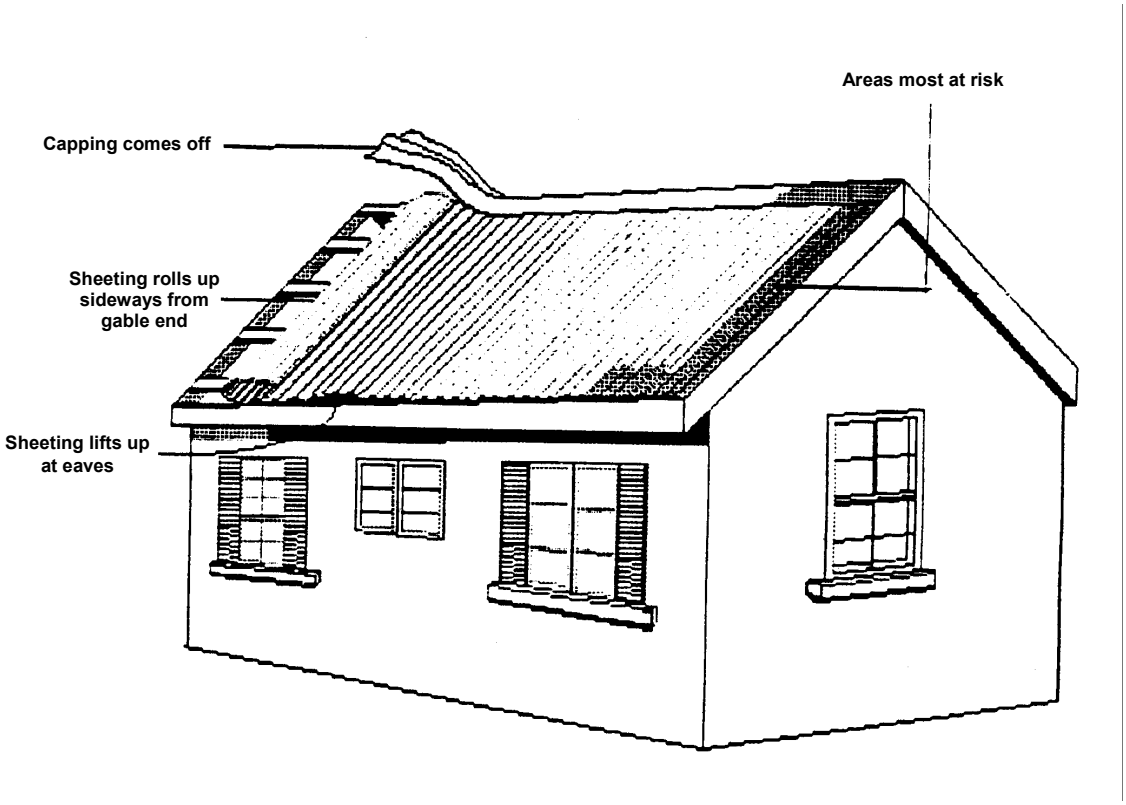


Figure 27 Roof areas most at risk to sheeting loss

There is the tendency to bend the roofing nails into the lath on the underside of the roof, however, this is not good practice. Bending may cause the large head of the nail to become loose, which will cause leaks and release the grip of the nail head on the corrugation of the sheets. Bending of nails can also dent the corrugations, creating a gap between the nail and the roof sheet, which can cause leakage (Figure 28 and Figure 29).

The overlap for ridge caps should be 6" - 8" to prevent leaks caused by driving rain. Roof sheets should preferably extend continuously from the ridge to eaves to eliminate intermediate overlaps. Where overlaps are unavoidable, they should be a minimum of nine inches (9”).

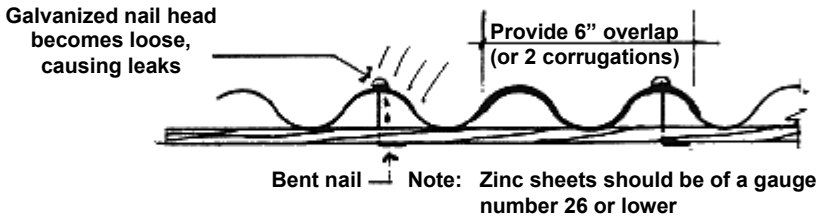


Figure 28 Section detail

Proper connection between rafters and top plate is of paramount importance as uplift created around building fixtures as well as pressure and suction gradients inside and outside the building walls contribute to roofs being blown off during a storm. All rafters must be toe -nailed on both sides of the rafter to ensure that load is transferred vertically into the external walls. If seat cuts are made in the rafters, the depth of the seat cut should not exceed 1/3 of depth of the material used for the rafter. This cut must be accurately executed, as any cut greater than the prescribed depth will seriously weaken the rafter.

It is recommended that each rafter be provided with a pair of hurricane clamps fastened to the side of the rafter and wall plate. It is recommended that screws be used to fasten hurricane clamps It is common practice to use one clamp per rafter, probably because of financial constraints. However, as it has been previously stressed, it makes no economic sense to compromise the quality and structural integrity of any structure.

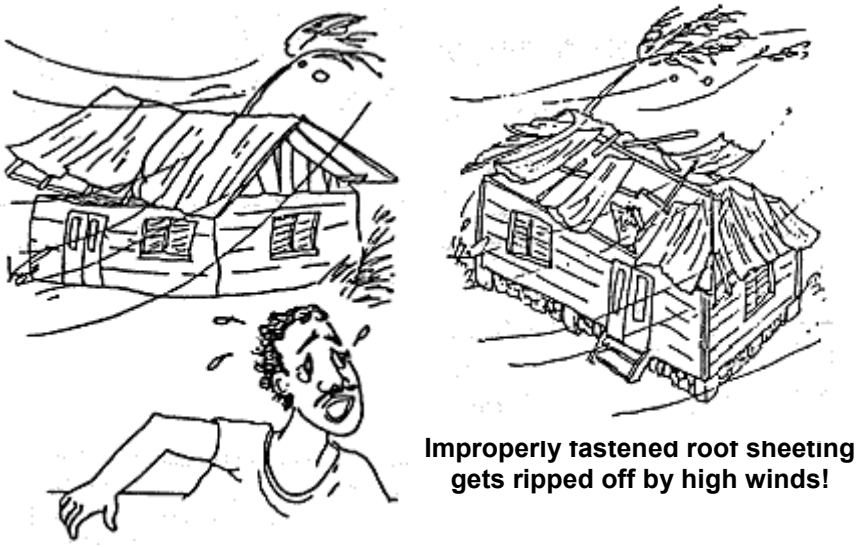
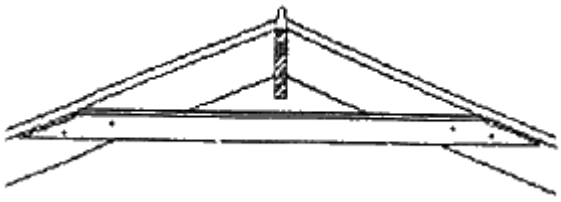


Figure 29 Wind can remove roof sheeting

Before and after a hurricane, roofs should be inspected to ensure that the sheeting is well secured. If they are not, additional nails should be added and damaged sheets should be replaced.

In existing houses, if the recommended nailing patterns have not been employed, additional nails can be installed, as needed. Additionally, clamps can easily be installed to help secure the laths to the rafters.

To further strengthen the roof, collars or ties can be incorporated in the roof structure. Collar ties offer increased rigidity to the roof structure, as they strengthen connections between rafters. Such ties should be nailed to the side of the rafters. Ties nailed to the face of the rafters will pull out more easily.



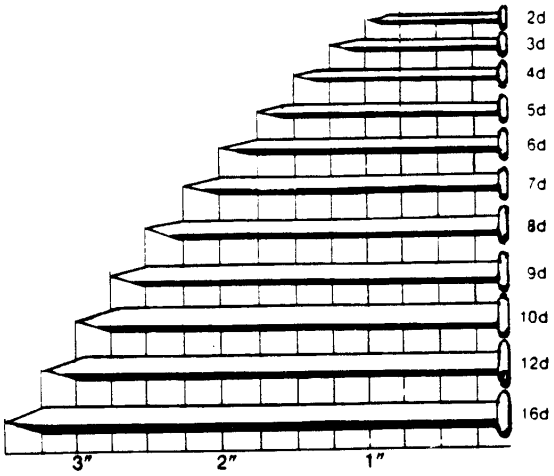
Collar ties: Timbers connecting the rafters. Collar ties must be nailed to the side of the rafters. Ties nailed to the face of the rafters will more likely pull out when stressed.

Figure 30 Collar Ties

Recommendations—Roof

- If galvanized sheets are used, ensure that they are of appropriate gauge (24 gauge) and are properly secured to the laths so as to ensure adequate resistance in high winds.
- Allow sufficient overlaps to ensure that the edges of the sheets can be bent over to prevent lift in high winds
- Roofing nails should be galvanized, with large steel washers at their heads (Figure 31).

Nails

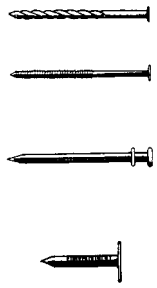


A number of materials are used in to manufacture nails, including steel, aluminum, copper, bronze, zinc, stainless steel and galvanized steel. Heat-treated, high carbon steel nails are used for greater strength in masonry applications. The type of metal used should be checked for compatibility with the materials being secured to avoid corrosion and the loss of holding power and to prevent staining.

The following recommendations should be taken when using nails:

1. Use a nail that is three times (3) longer than the thickness of the board to be nailed. Standard nail lengths range from one to six inches (1”- 6”); the most common lengths are 1”, 1 ½”, 2”, 2 ½”, 3”, 3 ½”, 4”, and 6”.
2. Sharp pointed nails have greater holding strength but may split the wood. Flatten the point with hammer before driving into easily split wood.
3. Thinner nails are used for hardwood or finish work.
4. For roofing, use twisted galvanized nails with a large cap/washer (Figure 31).
5. When nailing corrugated roofing, always nail through a wooden fillet fitted between the crown of the corrugation and the purlin/lath.
6. Gauge: Use gauge of 26 or less.

- **Common Nail:** Used for general construction work.
- **Ring-Shank Nail:** Has more gripping strength than common nails. For plywood of any thickness used in floors and roofs.
- **Double-headed nail:** Most common for scaffold, bracing or any temporary fastening that must be later removed.



Roofing nails. Several types are available to secure specific roofing material.

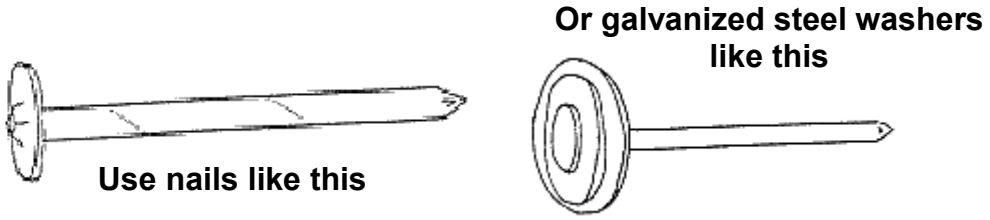


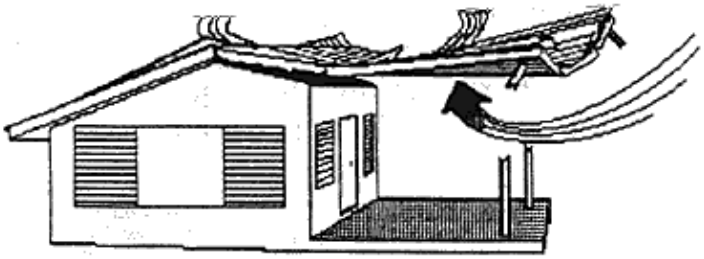
Figure 31 Roofing nails

Porches

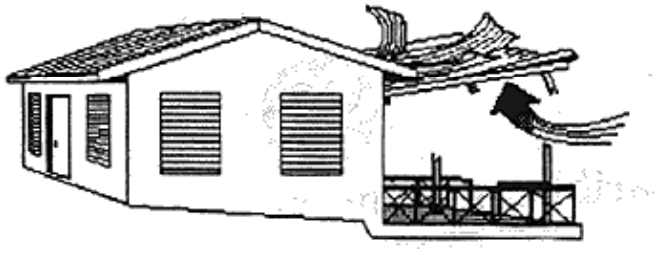
Because of high humidity and intense sun normally experienced during the summer, most persons will include a porch in the design of their homes. If not properly designed, however, porches can prove problematic in a hurricane. Porches and verandas should be kept structurally separate from the main building, but firmly anchored to it.

Half porches should be avoided, because wind trapped underneath an open or half porch will increase uplift on the roof, which may be sufficient to cause failure of the roof structure. If a house has a half porch, a strengthened ceiling should be provided.

The roof of a full porch should be separated from the rest of the house so that, during a hurricane, failure of the exposed porch roof will not endanger the main structure (Figure 32).



Design to Avoid



Recommended Design

Build verandahs and patios as separate structures rather than extensions of the main building, so that, if they are blown away, they will not damage the rest of the structure.

Figure 32 Improperly built verandas jeopardize the entire roof

Shutters, Doors and Windows

Glass doors and windows offer very little resistance to high winds. The loss of a glass door or window will increase the pressure inside of the house and this pressure will cause failure of the roof structure. Permanent or temporary shutters can provide important protection for door and window openings. Due to their vulnerability to breakage from flying objects and pressure and suction forces, glass windows in particular need the reinforcement provided by external protection measures, such as shutters.

While shutters have traditionally been part of housing design in the Caribbean, their use has declined dramatically in recent years. Shutters are now considered to be an unattractive feature by many and are not an apparent priority to homeowners. This is unfortunate, as shutters provide important protection from high winds, particularly in a region where hurricanes are a common occurrence.

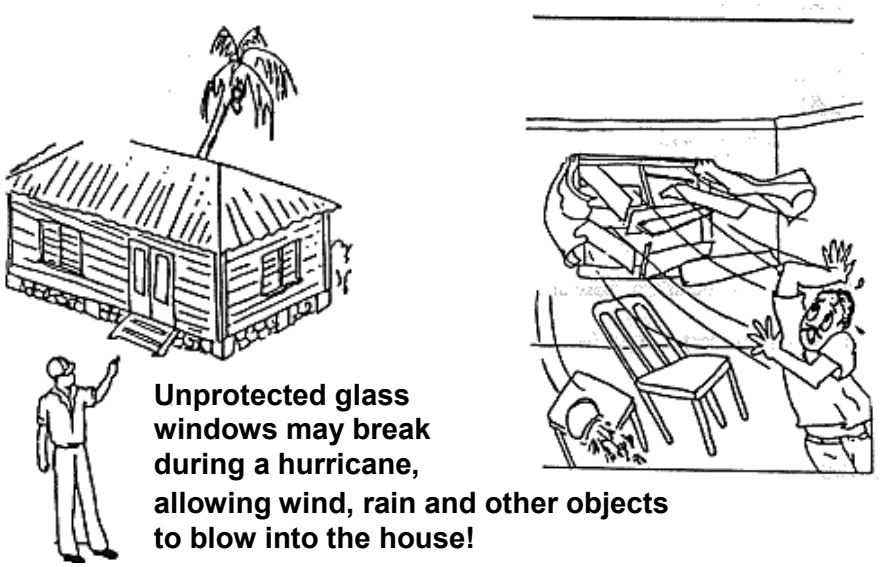


Figure 33 Dangers of unprotected windows

If permanent shutters are not installed, the use of temporary shutters is a viable option (Figure 34 and Figure 35). Temporary shutters, however, can create a storage problem when they are not in use. Bearing this is mind, both new and existing houses should have permanent shutters installed or provision for temporary ones should be made.

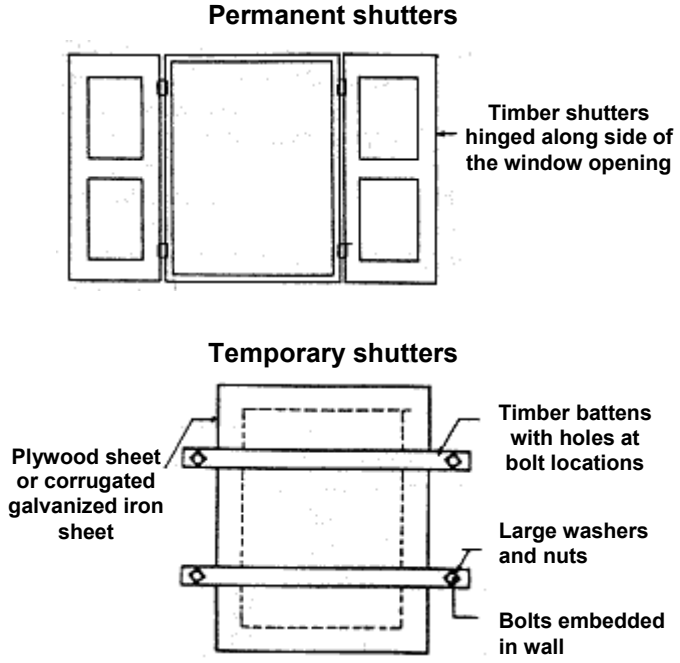


Figure 34 Permanent and removable shutters

Corrugated metal sheets or fitted plywood could be rapidly mounted over door and window openings. Permanent manual and mechanical systems are also available (Figure 35).

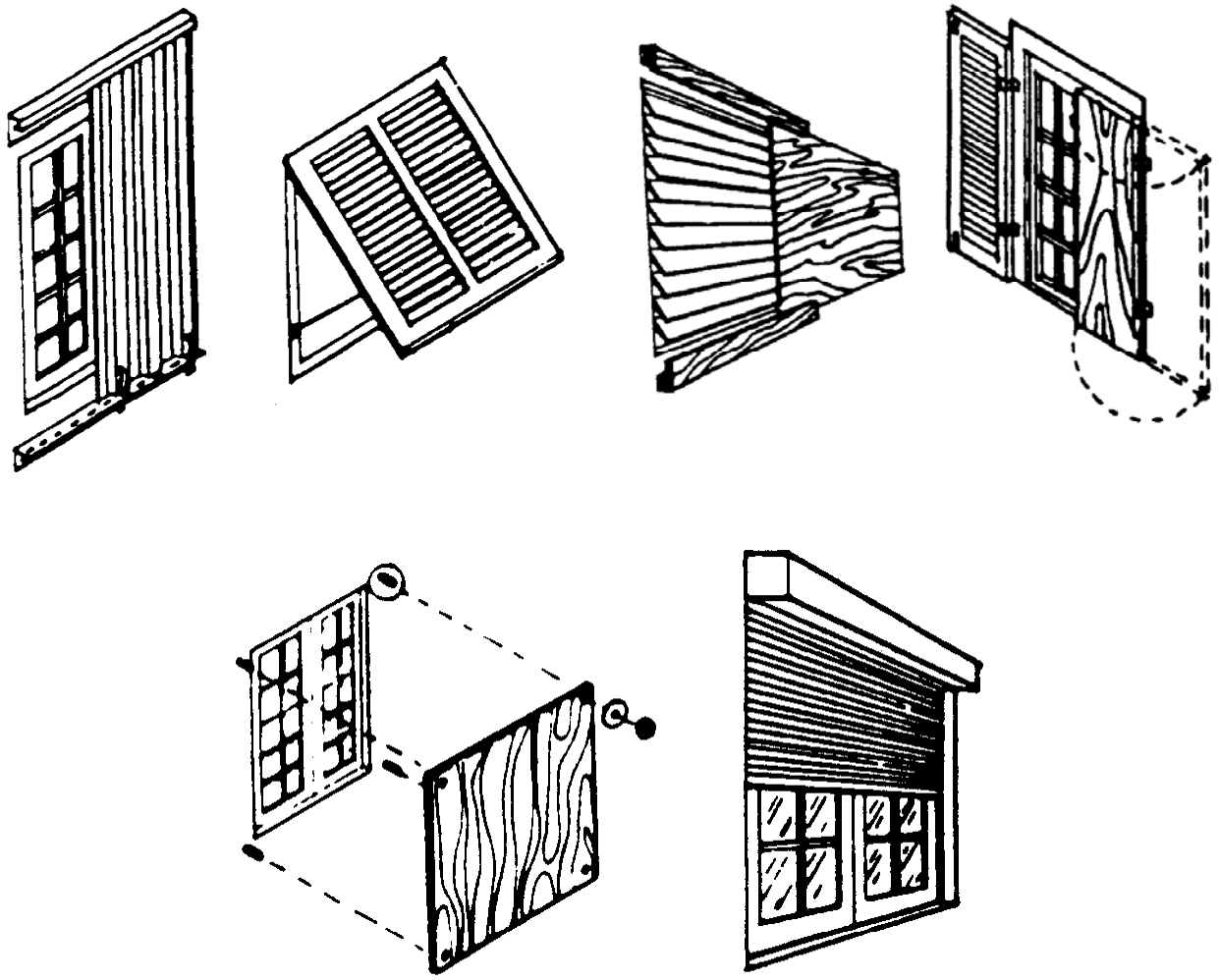


Figure 35 Types of window shutters

A door lock may not be sufficient to hold the pressure of the wind. Bolts should be added as necessary (Figure 36). Bars placed on some types of doors and windows can offer good resistance against the wind and boards can be used on the tracks of sliding doors to keep them from opening.

For windows and doors without temporary or permanent shutters, boards can be nailed over the opening prior to a storm (Figure 37). If it is too late to install protectors you may use tape (duct tape is best) on the glass windows. This will add strength to the glass and, if the glass breaks, the number of projectiles will be minimized. Remember that some prevention is better than no prevention at all.

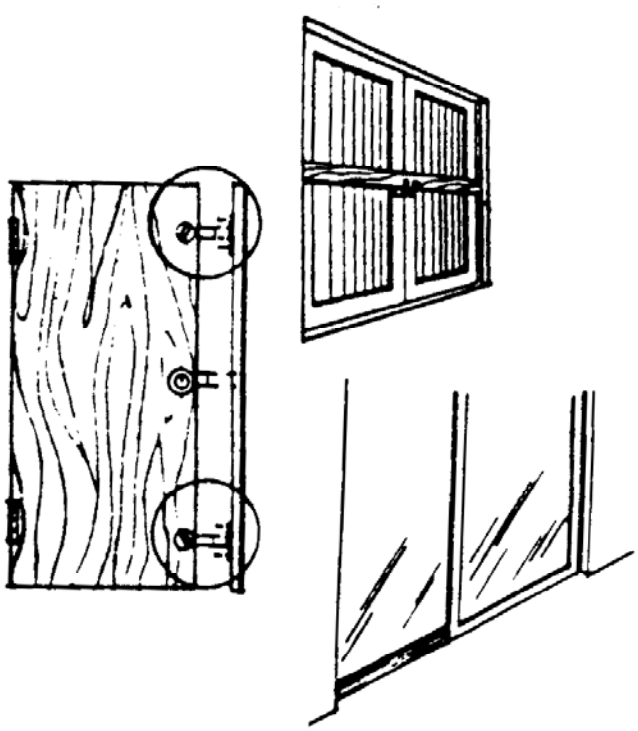


Figure 36 Door protection measures

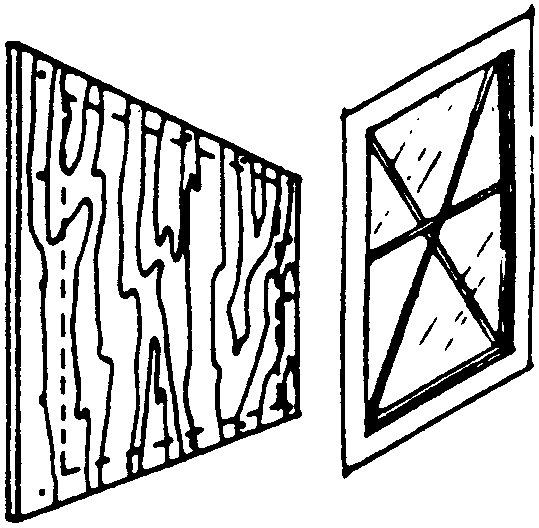


Figure 37 Protection for openings without shutters

Recommendations—Shutters

- Shutters should be provided for all glass openings and any other opening that may require