

4. **Exposed ceilings:** Exposed, open beam ceilings are where the underside of the roof decking can be viewed from below. The owner may wish to maintain the architectural appearance; therefore, roofing nail penetrations of the underside of the decking may not be acceptable. The provides the option of maintaining this appearance.
5. **Ponding water:** The current roof system and/or deck of the building may not drain well and may cause water to pond (accumulate) in low-lying areas of the roof. Ponding can be an indication of structural distress and may require the review of a professional structural engineer. Ponding may shorten the life expectancy and performance of the new roofing system. Ponding conditions may not be evident until the original roofing system is removed. Ponding conditions should be corrected.
6. **Overflow scuppers (wall outlets):** It is required that rainwater flow off so that the roof is not overloaded from a buildup of water. Perimeter/edge walls or other roof extensions may block this discharge if overflow scuppers (wall outlets) are not provided. It may be necessary to install overflow scuppers in accordance with the requirements of Sections R4402, R4403 and R4413.
7. **Ventilation:** Most roof structures should have some ability to vent natural airflow through the interior of the structural assembly (the building itself). The existing amount of attic ventilation shall not be reduced. It may be beneficial to consider additional venting which can result in extending the service life of the roof.

Owner's/Agent's Signature Date Contractor's Signature

**SECTION R4402.14
HIGH-VELOCITY HURRICANE ZONES — UNIFORM PERMIT APPLICATION**

Florida Building Code Edition 2007
High Velocity Hurricane Zone Uniform Permit Application Form.

INSTRUCTION PAGE

**COMPLETE THE NECESSARY SECTIONS OF
THE UNIFORM ROOFING PERMIT
APPLICATION FORM AND ATTACH THE
REQUIRED DOCUMENTS AS NOTED BELOW:**

Roof System	Required Sections of the Permit Application Form	Attachments Required See List Below
Low Slope Application	A,B,C	1,2,3,4,5,6,7
Prescriptive BUR-RAS 150	A,B,C	4,5,6,7
Asphaltic Shingles	A,B,D	1,2,4,5,6,7
Concrete or Clay Tile	A,B,D,E	1.2.3.4.5,6,7
Metal Roofs	A,B,D	1,2,3,4,5,6,7
Wood Shingles and Shakes	A,B,D	1,2,4,5,6,7
Other	As Applicable	1,2,3,4,5,6,7

ATTACHMENTS REQUIRED:

1.	Fire Directory Listing Page
2.	From Product Approval: Front Page Specific System Description Specific System Limitations General Limitations Applicable Detail Drawings
3.	Design Calculations per Section R4403, or If Applicable, RAS 127 or RAS 128
4.	Other Component Product Approvals
5.	Municipal Permit Application
6.	Owners Notification for Roofing Considerations (Reroofing Only)
7.	Any Required Roof Testing/Calculation Documentation

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Section A (General Information)

Master Permit No. _____ Process No. _____
 Contractor's Name _____
 Job Address _____

ROOF CATEGORY

- | | | |
|---|---|---|
| <input type="checkbox"/> Low Slope | <input type="checkbox"/> Mechanically Fastened Tile | <input type="checkbox"/> Mortar/Adhesive Set Tile |
| <input type="checkbox"/> Asphaltic Shingles | <input type="checkbox"/> Metal Panel/Shingles | <input type="checkbox"/> Wood Shingles/Shakes |
| <input type="checkbox"/> Prescriptive BUR-RAS 150 | | |

ROOF TYPE

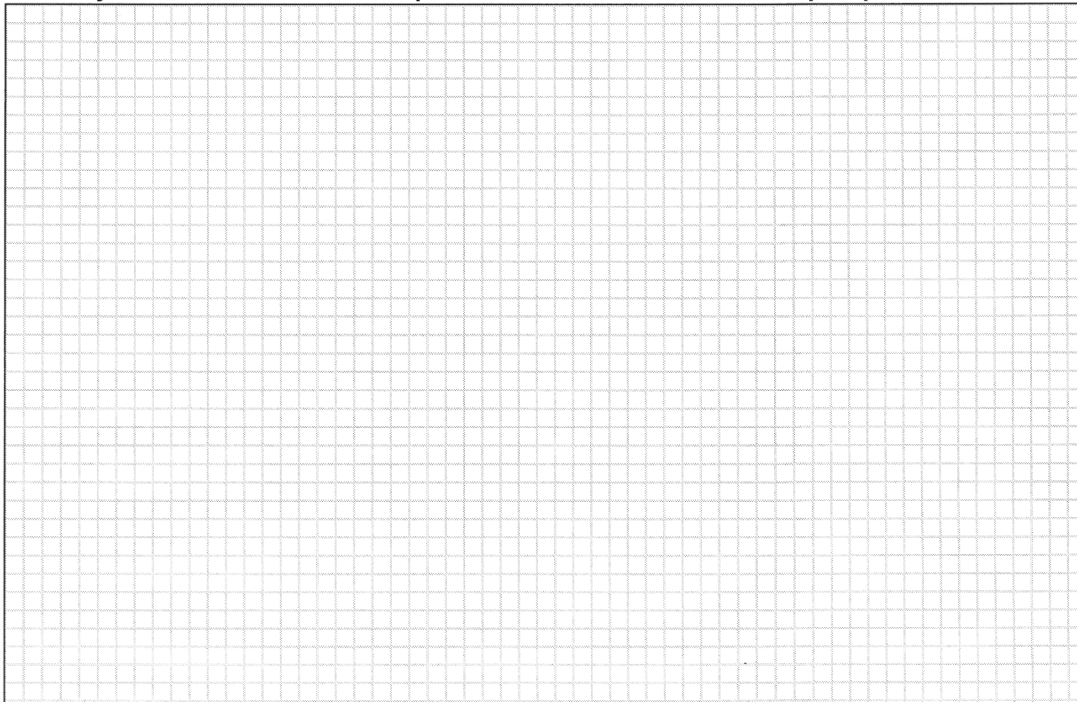
- New Roof Reroofing Recovering Repair Maintenance

ROOF SYSTEM INFORMATION

Low Slope Roof Area (SF) Steep Sloped Roof Area (SF) Total (SF)

Section B (Roof Plan)

Sketch Roof Plan: Illustrate all levels and sections, roof drains, scuppers, overflow scuppers and overflow drains. Include dimensions of sections and levels, clearly identify dimensions of elevated pressure zones and location of parapets.



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Section C (Low Slope Application)

Fill in Specific Roof Assembly Components and Identify Manufacturer

(If a component is not used, identify as "NA")

System Manufacturer: _____

NOA No.: _____

Design Wind Pressures, From RAS 128 or Calculations:

Pmax1: _____ Pmax2: _____ Pmax3: _____

Max. Design Pressure, From the Specific NOA System: _____

Deck:
Type: _____

Gauge/Thickness: _____

Slope: _____

Anchor/Base Sheet & No. of Ply(s): _____

Anchor/Base Sheet Fastener/Bonding Material: _____

Insulation Base Layer: _____

Base Insulation Size and Thickness: _____

Base Insulation Fastener/Bonding Material: _____

Top Insulation Layer: _____

Top Insulation Size and Thickness: _____

Top Insulation Fastener/Bonding Material: _____

Base Sheet(s) & No. of Ply(s): _____

Base Sheet Fastener/Bonding Material: _____

Ply Sheet(s) & No. of Ply(s): _____

Ply Sheet Fastener/Bonding Material: _____

Top Ply: _____

Top Ply Fastener/ Bonding Material: _____

Surfacing: _____

Fastener Spacing for Anchor/Base Sheet Attachment

Field: _____" oc @ Lap, # Rows _____ @ _____" oc

Perimeter: _____" oc @ Lap, # Rows _____ @ _____" oc

Corner: _____" oc @ Lap, # Rows _____ @ _____" oc

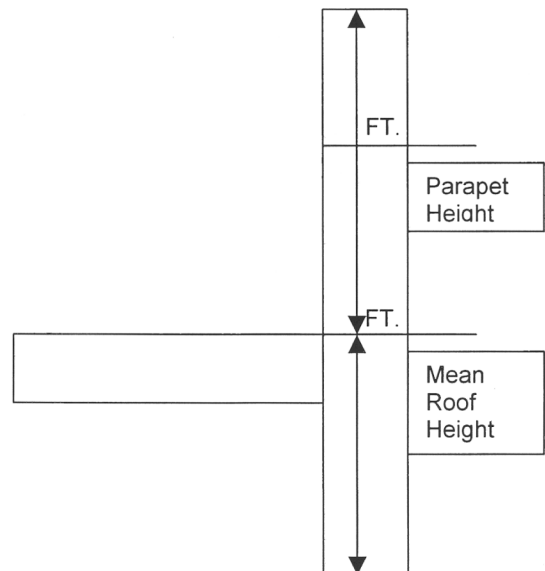
Number of Fasteners Per Insulation Board

Field _____ Perimeter _____ Corner _____

Illustrate Components Noted and Details as Applicable:

Woodblocking, Gutter, Edge Termination, Stripping, Flashing, Continuous Cleat, Cant Strip, Base Flashing, Counter- Flashing, Coping, Etc.

Indicate: Mean Roof Height, Parapet Height, Height of Base Flashing, Component Material, Material Thickness, Fastener Type, Fastener Spacing or Submit Manufacturers Details that Comply with RAS 111 and Chapter 16.



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Section D (Steep Sloped Roof System)

Roof System Manufacturer: _____
Product Approval Number: _____
Minimum Design Wind Pressures, If Applicable (From RAS 127 or Calculations): P1: _____ P2: _____ P3: _____
Maximum Design Pressure Product Approval Specific System: _____
Method of tile attachment: _____

Steep Sloped Roof System Description

Roof Slope:
_____: 12

Deck Type: _____

Type Underlayment: _____

Insulation: _____

Fire Barrier: _____

Fastener Type & Spacing: _____

Adhesive Type: _____

Type Cap Sheet: _____

Roof Covering: _____

Type & Size Drip Edge: _____

Ridge Ventilation?

Mean Roof Height: _____

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Section E (Tile Calculations)

For Moment based tile systems, choose either Method 1 or 2. Compared the values for M_r with the values from M_r . If the M_r values are greater than or equal to the M_r values, for each area of the roof, then the tile attachment method is acceptable.

Method 1 “Moment Based Tile Calculations Per RAS 127”

$(P_1: \underline{\hspace{1cm}} \times \lambda \underline{\hspace{1cm}} = \underline{\hspace{1cm}}) - M_g: \underline{\hspace{1cm}} = M_{r1} \underline{\hspace{1cm}}$ Product Approval $M_r \underline{\hspace{1cm}}$
 $(P_2: \underline{\hspace{1cm}} \times \lambda \underline{\hspace{1cm}} = \underline{\hspace{1cm}}) - M_g: \underline{\hspace{1cm}} = M_{r2} \underline{\hspace{1cm}}$ Product Approval $M_r \underline{\hspace{1cm}}$
 $(P_3: \underline{\hspace{1cm}} \times \lambda \underline{\hspace{1cm}} = \underline{\hspace{1cm}}) - M_g: \underline{\hspace{1cm}} = M_{r3} \underline{\hspace{1cm}}$ Product Approval $M_r \underline{\hspace{1cm}}$

Method 2 “Simplified Tile Calculation Per Table Below”

Required Moment of Resistance (M_r) From Table Below $\underline{\hspace{1cm}}$ Product Approval $M_r \underline{\hspace{1cm}}$

M_r Required Moment Resistance*					
Mean Roof Height Roof Slope \rightarrow	15'	20'	25'	30'	40'
2:12 \downarrow	34.4	36.5	38.2	39.7	42.2
3:12	32.2	34.4	36.0	37.4	39.8
4:12	30.4	32.2	33.8	35.1	37.3
5:12	28.4	30.1	31.6	32.8	34.9
6:12	26.4	28.0	29.4	30.5	32.4
7:12	24.4	25.9	27.1	28.2	30.0

*Must be used in conjunction with a list of moment based tile systems endorsed by the Broward County Board of Rules and Appeals.

For Uplift based tile systems use Method 3. Compared the values for F' with the values for F_r . If the F' values are greater than or equal to the F_r values, for each area of the roof, then the tile attachment method is acceptable.

Method 3 “Uplift Based Tile Calculations Per RAS 127”

$(P_1: \underline{\hspace{1cm}} \times l: \underline{\hspace{1cm}} = \underline{\hspace{1cm}} \times w: \underline{\hspace{1cm}} = \underline{\hspace{1cm}}) - W: \underline{\hspace{1cm}} \times \cos \theta: \underline{\hspace{1cm}} = F_{r1}: \underline{\hspace{1cm}}$ Product Approval $F' \underline{\hspace{1cm}}$
 $(P_2: \underline{\hspace{1cm}} \times l: \underline{\hspace{1cm}} = \underline{\hspace{1cm}} \times w: \underline{\hspace{1cm}} = \underline{\hspace{1cm}}) - W: \underline{\hspace{1cm}} \times \cos \theta: \underline{\hspace{1cm}} = F_{r2}: \underline{\hspace{1cm}}$ Product Approval $F' \underline{\hspace{1cm}}$
 $(P_3: \underline{\hspace{1cm}} \times l: \underline{\hspace{1cm}} = \underline{\hspace{1cm}} \times w: \underline{\hspace{1cm}} = \underline{\hspace{1cm}}) - W: \underline{\hspace{1cm}} \times \cos \theta: \underline{\hspace{1cm}} = F_{r3}: \underline{\hspace{1cm}}$ Product Approval $F' \underline{\hspace{1cm}}$

Where to Obtain Information		
Description	Symbol	Where to find
Design Pressure	P1 or P2 or P3	RAS 127 Table 1 or by an engineering analysis prepared by PE based on ASCE 7
Mean Roof Height	H	Job Site
Roof Slope	θ	Job Site
Aerodynamic Multiplier	λ	ProductApproval
Restoring Moment due to Gravity	M_g	ProductApproval
Attachment Resistance	M_r	ProductApproval
Required Moment Resistance	M_r	Calculated
Minimum Attachment Resistance	F'	ProductApproval
Required Uplift Resistance	F_r	Calculated
Average Tile Weight	W	ProductApproval
Tile Dimensions	l= length w= width	ProductApproval
All calculations must be submitted to the Building Official at the time of permit application.		

SECTION R4403

HIGH-VELOCITY HURRICANE ZONES—GENERAL

R4403.1 General design requirements.

R4403.1.1 Any system, method of design or method of construction shall admit of a rational analysis in accordance with well-established principles of mechanics and sound engineering practices.

R4403.1.2 Buildings, structures and all parts thereof shall be designed and constructed to be of sufficient strength to support the estimated or actual imposed dead, live, wind, and any other loads, both during construction and after completion of the structure, without exceeding the allowable materials stresses specified by this code.

R4403.1.3 No building structure or part thereof shall be designed for live loads less than those specified in this section or ASCE 7 with commentary, except as otherwise noted in this code.

R4403.1.4 The live loads set forth herein shall be assumed to include the ordinary impact but where loading involves unusual impact, provision shall be made by increasing the assumed live load.

R4403.1.5 In the design of floors, not less than the actual live load to be imposed shall be used. Special provisions shall be made for machine or apparatus loads where applicable.

R4403.1.6 Floor and roof systems shall be designed and constructed to transfer horizontal forces to such parts of the structural frame as are designed to carry these forces to the foundation. Where roofs or floors are constructed of individual prefabricated units and the transfer of forces to the building frame and foundation is totally or partially dependent on such units, the units and their attachments shall be capable of resisting applied loads in both vertical and both horizontal directions. Where roofs or floors are constructed of individual prefabricated units and the transfer of forces to the building frame and foundation is wholly independent of such units, the units and their attachments shall be capable of resisting applied loads normal to the surface, in and out.

R4403.2 General design for specific occupancies and structures.

R4403.2.1 Fences. Fences not exceeding 6 feet (1829 mm) in height from grade may be designed for 75 mph (33 m/s) fastest mile wind speed or 90 mph (40 m/s) 3-second gust.

R4403.2.1.1 Wood fences. Wood fence design shall be as specified by Section R4409.15.

**SECTION R4403.2
HIGH-VELOCITY HURRICANE ZONES—
DEFLECTION**

R4403.2.1 Allowable deflections. The deflection of any structural member or component when subjected to live, wind and other superimposed loads set forth herein shall not exceed the following:

1. Roof and ceiling or components supporting plaster L/360

2. Roof members or components not supporting plaster under L/240
3. Floor members or components L/360
4. Vertical members and wall members or components consisting of or supporting material that hardens in place, is brittle or lacks resistance to cracking caused by bending strains L/360
5. Vertical members and wall members or components not required to meet the conditions of Section R4403.2.1, Item 4. L/180
6. Roof and vertical members, wall members and panels of carports, canopies, marquees, patio covers, utility sheds and similar minor structures not to be considered living areas, where the roof projection is greater than 12 feet (3658 mm) in the direction of the span, for free-standing roofs and roofs supported by existing structures. Existing structures supporting such roofs shall be capable of supporting the additional loading L/180
7. For Group R3 occupancies only, roof and vertical members, wall members and panels of carports, canopies, marquees, patio covers, utility sheds and similar minor structures not to be considered living areas, where the roof projection is 12 feet (3638 mm) or less in the direction of the span and for free standing roofs and roofs supported by existing structures L/80
8. Members supporting screens only L/80
9. Storm shutters and fold-down awnings, which in the closed position shall provide a minimum clear separation from the glass of 1 inch (25 mm) but not to exceed 2 inches (51 mm) when the shutter or awning is at its maximum point of permissible deflection L/30
10. Roofs and exterior walls of utility sheds having maximum dimensions of 10 feet length, 10 feet width, and 7 feet height L/80
11. Roofs and exterior walls of storage buildings larger than utility sheds L/180

**SECTION R4403.3
HIGH-VELOCITY HURRICANE ZONES—
VOLUME CHANGES**

R4403.3.1 Volume change. In the design of any building, structure or portion thereof, consideration shall be given to the relief of stresses caused by expansion, contraction and other volume changes.

**SECTION R4403.4
HIGH-VELOCITY HURRICANE ZONES—
MINIMUM LOADS**

R4403.4.1 Live loads. Minimum uniformly distributed live loads shall not be less than as set forth in and Table 4-1 of ASCE 7 with Commentary, except as otherwise noted in this code.

R4403.4.2 Concentrated loads. Minimum concentrated loads shall not be less than as set forth in Table 4-1 of ASCE 7 with commentary, except as otherwise noted.

R4403.4.3 Concentrated loads on trusses. Any single panel point of the lower chord of roof trusses or any point of other primary structural members supporting roofs shall be capable of safely carrying a suspended, concentrated load of not less than 200 pounds (896 N) in addition to dead load.

MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS
See Tables 4-1 of ASCE 7

SECTION R4403.5
HIGH-VELOCITY HURRICANE ZONES —
ROOF LIVE LOADS

R4403.5.1 Minimum roof live loads. Roofs shall be designed for a live load of not less than 30 pounds per square foot (1436 Pa), except as set forth herein.

Exceptions.

1. Glass areas of greenhouse roofs shall be designed for a live load of not less than 15 pounds per square foot (718 Pa).
2. Ordinary pitched and curved roofs, with a slope of 1-1/2:12, or greater, where water is not directed to the interior of the roof, without parapet or other edge of roof drainage obstructions, may be designed for an allowable live load of not less than 20 pounds per square foot (958 Pa).
3. Utility sheds shall be designed for a live load of not less than 15 pounds per square foot (718 Pa).

R4403.5.2 Special purpose roofs. Roofs used for assembly, roof gardens, promenade or walkway purposes shall be designed for a minimum live load of 100 pounds per square foot (4788 Pa). Other special purpose roofs shall be designed for appropriate loads as directed or approved by the building official.

R4403.5.3 Roof decking. Roof decking shall be designed to support the live load set forth in Section R4403.5.1 or a load of 100 pounds per foot (445 N) applied as a 1-foot wide strip perpendicular to, and at the center of, the span of the decking between supports, whichever is more critical.

SECTION R4403.6
HIGH-VELOCITY HURRICANE ZONES —
ROOF DRAINAGE

R4403.6.1 Roof drainage. Where parapets or curbs are constructed above the level of the roof, provision shall be made to prevent rain water from accumulating on the roof in excess of that considered in the design, in the event the rain water drains, conductors or leaders become clogged.

R4403.6.2 Where roofs are not designed in accordance with Section R4403.6.1, overflow drains or scuppers shall be placed to prevent an accumulation of more than 5 inches (927 mm) of water on any portion of the roof. In determining the load that could result should the primary drainage system be blocked, the loads caused by the depth of water (i.e., head) needed to cause the water to flow out the scuppers or secondary drainage system shall be included.

R4403.6.3 Drains or scuppers installed to provide overflow drainage shall be not less in aggregate area than as shown in Figure R4403.6.3, but not less than 4 inches (102 mm) dimension in any direction and shall be placed in parapets not less than 2 inches (51 mm) nor more than 4 inches (102 mm) above the low point of the finished roofing surface and shall be located as close as practical to required vertical leaders, conductors or downspouts. The roof area to be taken in the sizing of the scuppers is the horizontal projection, except that, where a building wall extends above the roof in such a manner as to drain into the area considered, the one-half of the area of the vertical wall shall be added to the horizontal projection.

R4403.6.4 All roofs shall be designed with sufficient slope or camber to assure adequate drainage after the long term deflec-

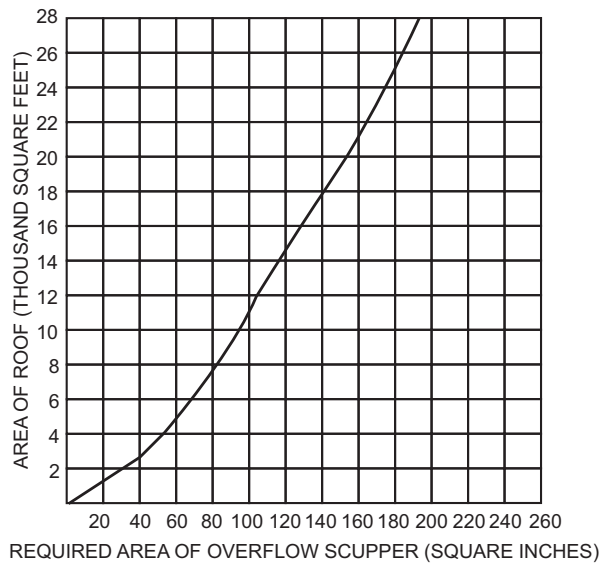


FIGURE R4403.6.3
REQUIRED AREA OF OVERFLOW SCUPPERS

tion from dead load, or shall be designed to support maximum loads including possible ponding of water caused by deflection.

R4403.6.5 Ponding loads. Roofs shall be designed to preclude instability from ponding loads.

R4403.6.6 Each portion of a roof shall be designed to sustain the loads of all rainwater that could accumulate on it if the primary drainage system for that portion is obstructed. Ponding instability shall be considered in this situation. If the overflow drainage provisions contain drain lines, such lines shall be independent of any primary drain lines.

SECTION R4403.7
HIGH-VELOCITY HURRICANE ZONES —
SPECIAL LOAD CONSIDERATIONS

R4403.7.1 Floors. In the design of floors, consideration shall be given to the effect of known or probable concentration of

R4403.12.1.1 The wind loads on screen surfaces shall be per ASCE 7 Table 6-12 based on the ratio of solid to gross area.

R4403.12.1.2 Design shall be based on such loads applied horizontally inward and outward to the walls with a shape factor of 1.3 and applied vertically upward and downward on the roof with a shape factor of 0.7.

SECTION R4403.13 RESERVED

SECTION R4403.14 HIGH-VELOCITY HURRICANE ZONES— FOUNDATION DESIGN

R4403.14.1 Design procedure. The minimum area of a footing or number of piles under a foundation shall be determined in the following manner:

R4403.14.1.1 The total load of the column that has the largest percentage of the live load to the total load shall be divided by the allowable soil pressure or pile capacity.

R4403.14.1.2 The balance soil pressure or pile capacity shall be determined by dividing the total dead load by the area of the footing or the number of piles.

R4403.14.1.3 The minimum number of other footings or number of piles shall be designed on the basis of their respective dead loads only.

R4403.14.1.4 In no case shall the total load of the combined dead, live, wind and any other loads exceed the allowable bearing pressure of the soil for capacity of any pile upon which the foundation is supported.

R4403.14.1.5 The live load used in the above calculations may be the total reduced live load in the member immediately above the foundation.

R4403.14.1.6 The building official may require submittal of design computations employed in foundation design.

SECTION R4403.15 HIGH-VELOCITY HURRICANE ZONES— LOAD TESTS

R4403.15.1 Application. Whenever there is insufficient evidence of compliance with the provisions of this code or evidence that any material or any construction does not conform to the requirements of this code, or in order to substantiate claims for alternate materials or methods of construction, the building official may require testing by an approved agency, at the expense of the owner or his agent, as proof of his compliance. Testing methods shall be as specified by this code for the specific material.

R4403.15.2 Testing method. Such testing shall follow a nationally recognized standard test, or when there is no standard test procedure for the material or assembly in question, the building official shall require that the material or assembly under dead plus live load shall deflect not more than as set forth in Section R4403.2, and that the material or assembly shall sustain dead load plus twice the live load for a period of 24 hours, with a recovery of at least 80 percent or a 100 percent recovery after one-half test load.

R4403.15.3 Alternate test methods. When elements, assemblies or details of structural members are such that their load-carrying capacity, deformation under load, or deflection cannot be calculated by rational analysis, their structural performance shall be established by test in accordance with test procedures as approved by the building official based on consideration of all probable conditions of loading.

R4403.15.4 Fatigue load testing. Where cladding assemblies (including cladding and connections) or roofing framing assemblies (including portions of roof structure and connections) are such that their load-carrying capacity or deformation under load cannot be calculated by rational analysis, the assemblies may be tested to resist the fatigue loading sequence given by Table R4403.15.4

TABLE R4403.15.4
FATIGUE LOADING SEQUENCE

RANGE OF TEST	NUMBER OF CYCLES ¹
0 to 0.5p ²	600
0 to 0.6p	70
0 to 1.3p	1

- Each cycle shall have minimum duration of 1 second and a maximum duration of 3 seconds and must be performed in a continuous manner.
- The design wind load for the height and location, when the assembly will be used. For wall and roof components, shape factors given in ASCE 7 shall be used.

Assemblies shall be tested with no resultant failure or distress and shall have a recovery of at least 90 percent over maximum deflection.

Any cladding assembly not incorporated into the *Florida Building Code, Building* after successfully completing the impact test outlined in Section R4403.16, shall be subject to fatigue loading testing and shall obtain Product Approval by the building official.

SECTION R4403.16 HIGH-VELOCITY HURRICANE ZONES— IMPACT TESTS FOR WIND-BORNE DEBRIS

R4403.16.1 All parts or systems of a building or structure envelope such as, but not limited to, exterior walls, roof, outside doors, skylights, glazing and glass block shall meet impact test criteria or be protected with an external protection device that meets the impact test criteria. Test procedures to determine resistance to wind-borne debris of wall cladding, outside doors, skylights, glazing, glass block, shutters and any other external

protection devices shall be performed in accordance with this section.

Exception: The following structures or portion of structures shall not be required to meet the provisions of this section:

- a. Roof assemblies for screen rooms, porches, canopies, etc., attached to a building that do not breach the exterior wall or building envelope and have no enclosed sides other than screen.
- b. Soffits, soffit vents and ridge vents. Size and location of such vents shall be detailed by the designer and shall not compromise the integrity of the diaphragm boundary.
- c. Vents in a garage with four or fewer cars. Size and location of such vents shall be detailed by the designer and shall not exceed the minimum required area by more than 25 percent.
- d. Exterior wall or roof openings for wall or roof mounted HVAC equipment.
- e. Openings for roof-mounted personnel access roof hatches.
- f. Storage sheds that are not designed for human habitation and that have a floor area of 720 square feet (67 m²) or less are not required to comply with the mandatory windborne debris impact standards of this code.
- g. Louvers as long as they properly considered ASCE 7 in the design of the building.
- h. Buildings and structures for marinas, cabanas, swimming pools and greenhouses.

R4403.16.2 Large missile impact tests.

R4403.16.2.1 This test shall be conducted on three test specimens. This test shall be applicable to the construction units, assemblies and materials to be used up to and including 30 feet (9.1 m) in height in any and all structures.

R4403.16.2.2 The test specimens shall consist of the entire assembled unit, including frame and anchorage as supplied by the manufacturer for installation in the building, or as set forth in a referenced specification, if applicable. Fasteners used in mounting the test specimen shall be identical in size and spacing to what is used in field installations.

R4403.16.2.3 The large missile shall be comprised of a piece of timber having nominal dimensions of 2 inches by 4 inches (51 mm by 102 mm) weighing 9 pounds (4.1 kg).

R4403.16.2.4 The large missile shall impact the surface of each test specimen at a speed of 50 feet per second (15.2 m/s).

R4403.16.2.5 Each test specimen shall receive two impacts except as noted in Sections R4403.16.2.5.1 and R4403.16.2.5.2, the first within a 5-inch (127 mm) radius circle having its center on the midpoint of the test specimen and the second within a 5-inch (127 mm) radius circle in a corner having its center in a location 6 inches (152 mm) away from any supporting members.

R4403.16.2.5.1 For window, glass block, fixed glass and skylight assemblies, both impacts shall be to glass or

other glazing infill. For test specimens with more than one light of glass, a single light closest to the center of the assembly shall be selected and impacted twice in accordance with Section R4403.16.2.5. If a light of glass is sufficiently small to cause the 5-inch (127 mm) radius circle to overlap, two separate lights shall be impacted one time each.

R4403.16.2.5.1.1 For window, fixed glass and skylight assemblies comprised of different glass thickness, types of glass or different types of glazing infill, each separate thickness or type shall be impacted twice in accordance with Section R4403.16.2.5.

R4403.16.2.5.2 For doors, wall cladding and external protection devices, both impacts shall be to the thinnest section through the assembly. For doors, wall cladding and external protection devices with horizontal and/or vertical bracing, both impacts shall be within a single area that is not reinforced and shall be in accordance with Section R4403.16.2.5.

R4403.16.2.5.2.1 For doors with glass, the glass shall be impacted twice and the thinnest section through the assembly that is not glass shall be impacted twice in accordance with Section R4403.16.2.5.

R4403.16.2.6 In the case of glazing, if the three test specimens that comprise a test successfully reject the two missile impacts, they shall then be subjected to the cyclic pressure loading defined in Table R4403.16.

R4403.16.2.6.1 If external protection devices are employed to protect windows, fixed doors or skylights, they must resist the large missile impacts specified in Sections R4403.16.2.3 and R4403.16.2.4 without deformations which result in contact with the windows, fixed glass, glass block and doors or skylights they are intended to protect.

R4403.16.2.6.2 If external protection devices are not designed to be air tight, following the large missile impact test, they must resist an application of force corresponding to those listed in Table R4403.15.4 (fatigue load testing) without detaching from their mountings. The acting pressure cycles shall be simulated with loads applied through a mechanical system attached to the shutter specimen to apply uniformly around the shutter perimeter a force equal to the product of the required pressure and the area of the shutter specimen.

R4403.16.2.7 If air leakage through the test specimen is excessive, tape may be used to cover any cracks and joints through which leakage is occurring. Tape shall not be used when there is a probability that it may significantly restrict differential movement between adjoining members. It is also permissible to cover both sides of the entire specimen and mounting panel with a single thickness of polyethylene film no thicker than 0.050 mm (2 mils). The technique of application is important in order that the full load is transferred to the specimen and that the membrane does not prevent movement or failure of the specimen. Apply the film loosely with extra folds of material at each corner and at all offsets and recesses. When the load is applied, there shall be no fillet caused by tightness of plastic film.

R4404.6.1.10 Closed-top diesel hammers shall be used with a rating instrument and charts to measure the equivalent WH energy per blow of the hammer. The equivalent WH energy as measured by the instrument shall be the ram's weight times the equivalent ram plus an added value obtained from the energy stored in the bounce chamber. The energy per blow shall be the equivalent WH energy for the closed-top diesel.

R4404.6.1.11 Open-top diesel hammers shall be equipped with a ram stroke indicator rod that is striped in increments above the hammer body and fastened to the body of the hammer. The energy per blow for the open top diesel shall be computed as the ram's working stroke times the ram's weight.

R4404.6.1.12 The load-bearing formula applicable for single-acting pile hammers shall be used to compute the bearing capacity of the driven pile.

R4404.6.1.13 Followers shall be used only upon permission of the special inspector or engineer and only where necessary to effect installation of piles. A follower shall be of a size, shape, length, material and weight to permit driving the pile in the desired location and to the required depth and resistance without loss of hammer energy in the follower.

R4404.6.1.14 Splices shall be avoided as far as practicable. Splices shall be constructed to provide and maintain true alignment and position of the component parts of the pile during installation and subsequent thereto. Splices shall develop the required strength of the pile.

R4404.6.1.15 The safe capacity of a group of friction piles in plastic material may be determined by load testing the group to 150 percent of the proposed group load or by the formula given in Section R4404.6.2. When computed by formula, the allowable load for such a group shall be the allowable load for one pile times the number of piles in the group times the efficiency of the pile group determined as follows:

$$E = 1 - O \frac{(N-1)M + (M-1)N}{90MN}$$

where:

E is the efficiency

S the average spacing of the piles, inches

M the number of rows

N the number of piles in one row

D the average diameter of the pile, inches

O arc tan D/S, in degrees

R4404.6.1.16 Types of piles that are not provided for in this section shall conform to the requirements herein for the type that it most nearly approximates, subject to such additional requirements as may be made by the building official.

R4404.6.1.17 Pile driving hammers shall develop a minimum of 1 foot-pound of energy per pound of pile or mandrel, but not less than 7,000 foot-pounds of energy per blow.

R4404.6.1.18 Piles may be driven with drop or gravity hammers provided the hammer shall weigh not less than 3,000

pounds (1362 kg) and the fall of the hammer shall not exceed 6 feet (1829 mm).

R4404.6.1.19 Piles shall be driven with a variation of not more than $\frac{1}{4}$ inch (6.4 mm) per foot from the vertical, or from the batter line indicated, with a maximum variation of the head of the pile from the position shown on the plans of not more than 3 inches (76 mm), subject to the provisions of Section R4404.6.

R4404.6.1.20 The special inspector or engineer supervising the pile driving operations shall be required to keep an accurate record of the material and the principal dimensions of each pile; of the weight and fall of the hammer, if a single-acting hammer or drop hammer; the size and make, operating pressure, length of hose, number of blows per minute and energy per blow, if a double-acting hammer; together with the average penetration of each pile for at least the last five blows, and the grades at tip and cut-off. A copy of these records shall be filed with the building official and kept with the plans.

R4404.6.1.21 Where piling must penetrate strata offering high resistance to driving or where jetting could cause damage, the inspector or supervising engineer may require that the piles be set in predrilled or punched holes. The equipment used for drilling or punching must be approved by the special inspector or engineer, and provided that all piles shall reach their final penetration by driving.

R4404.6.1.22 The maximum load permitted on any driven pile shall not exceed 36 tons unless substantiated by a load test performed at the site, as set forth in Section R4404.13.

R4404.6.1.23 The building official may require tests on any pile where performance is questionable.

R4404.6.1.24 Piles shall be designed and driven to develop not less than 10 tons safe-bearing capacity.

R4404.6.1.25 In soils in which the installation of piles causes previously installed piles to heave, accurate level marks shall be put on all piles immediately after installation and all heaved piles shall be reinstalled to the required resistance.

R4404.6.1.26 Piles shall not be driven closer than 2 feet (610 mm) nor jetted closer than 10 feet (3048 mm) to an existing building or structure unless approved by a special inspector or engineer.

R4404.6.2 Driving formula load. Subject to pile load limitations contained in Sections R4404.7.1.8 and R4404.8.1.2 and in the absence of pile load test data satisfactory to the building official, the load on a pile shall not exceed that computed from the following driving formula:

$$\text{Drop Hammer: } P = \frac{2Wh}{S+1}$$

$$\text{Single Acting Hammers: } P = \frac{2Wh}{S+0.1}$$

$$\text{Double Acting Hammers: } P = \frac{2(W + Ap)h}{S+0.1}$$

Or differential in which:

A = area of piston, square inches
 p = pressure at the hammer, pounds per square inch
 P = allowable total load, pounds
 W = weight of striking part of hammer, pounds
 h = height of fall of striking part of hammer, feet, or stroke, feet
 S = average penetration per blow of not less than the five final blows

**SECTION R4404.7
 HIGH-VELOCITY HURRICANE ZONES —
 WOOD PILES**

R4404.7.1 Woodpiles shall conform to the standard, *Round Timber Piles*, ASTM D 25.

R4404.7.1.1 Untreated wood piles in all cases shall be cut off not higher than mean low water table and shall be capped with concrete.

R4404.7.1.2 Timber piles used to support permanent structures shall be treated in accordance with this section unless it is established that the top of the untreated timber piles will be below lowest ground water level assumed to exist during the life of the structure.

R4404.7.1.3 Preservative and minimum final retention shall be in accordance with AWPAs Use Category Systems Standard U1, Commodity Specification A and E Use Category 4C.

R4404.7.1.4 When timber piles are used in salt water, the treatment shall conform to AWPAs Use Category Systems Standard U1, Commodity Specification G Use Category 5C. Pile cutoffs shall be treated in accordance with AWPAs Standard M-4

R4404.7.1.4.1 All preservative-treated wood piles shall have a metal tag, brand or other preservative treatment identification mark.

R4404.7.1.4.2 Such mark shall identify the producer, and/or the appropriate inspection agency, and treatment specifications or quality mark.

R4404.7.1.5 Wood piles which support a structure over water may project above the water to such height as may be

necessary for structural purposes, provided that such piles used to support structures other than open wharves, boat landings, and other similar light structures shall have been treated in accordance with Section R4404.7.1.2

R4404.7.1.6 Wood piles shall be driven with a protective driving cap or ring when necessary to prevent brooming or splitting of the butt. When brooming or splitting occurs, such piles shall be cut back to solid wood before the final resistance to penetrations is measured.

R4404.7.1.7 If required, when driving through or to hard material or to rock, wood piles shall be fitted with a metal protective driving cap shown satisfactory to the building official.

R4404.7.1.8 The maximum allowable load on a round timber pile shall be determined in accordance with Section R4404.7.1.22, provided the maximum allowable stresses of timber are not exceeded.

R4404.7.1.8.1 The allowable stresses for timber piles shall not exceed the values in Table R4404.7 except as modified by Part 6 of the *National Design Specification for Wood Construction*.

**SECTION R4404.8
 HIGH-VELOCITY HURRICANE ZONES —
 PRECAST CONCRETE PILES**

R4404.8.1 Precast concrete piles shall be cast of concrete having a compressive strength of not less than 3,000 pounds per square inch (psi) (20 685 kPa) at the time of driving, and shall be reinforced with a minimum of four longitudinal steel bars having an area of not less than 1 percent nor more than 4 percent of the gross concrete area. All longitudinal bars shall be of uniform size and shall be tied by not less than #2 hoops spaced 8 inches (203 mm) in the body of the pile and not over 3 inches (76 mm) for the first 18 inches (437 mm) from both the butt and the tip. All reinforcement shall be protected by 2 inches (51 mm) or more of concrete, except that for piles subjected to the action of open water, waves or other severe exposure, a 3-inch (76 mm) protective covering shall be furnished in the zone of such exposure. For point bearing piles, the concrete area of the tip shall be not less than 75 percent of the area of the butt.

TABLE R4404.7

SPECIES	COMPRESSION PARALLEL TO GRADE (psi) ⁴	BENDING (psi) ⁴	SHEAR HORIZ (psi) ⁴	COMP PERP TO GRAIN (psi) ⁴	MODULUS of ELASTICITY
Pacific Coast Douglas Fir ¹	1250	2450	115	230	1,500,000
Southern Pine ²	1200	2400	110	250	1,500,000
Red Oak ³	1100	2450	135	350	1,250,000
Red Pine ⁴	900	1900	85	155	1,280,000

1. Pacific Douglas Coast Fir values apply only to species as defined in ASTM Designation 01760-76, Standard Specification for Pressure Treatment of Timber Products. For faster design, use Douglas Fir-Larch design values.
 2. Southern Pine values apply to Longleaf, Slash, Loblolly and Short Leaf Pines.
 3. Red Oak values apply to Northern and Southern Red Oak.
 4. Red Pine values apply to Red Pine grown in the United States.

R4407.2.4.1 General. Brick shall include masonry units usually 21/4 inches (57 mm) thick, 33/4 inches (95 mm) wide, and 8 inches (203 mm) long, and not less than 75 per cent solid.

R4407.2.4.2 Tests. Tests shall be conducted in accordance with *Standard Methods of Testing Brick*, ASTM C 67.

R4407.2.4.3 Quality.

R4407.2.4.3.1 Burned clay or shale brick shall conform to either the standard *Specification for Building Brick (Solid Masonry Units made from Clay or Shale)*, ASTM C 62, the *Standard Specification for Facing Brick (Solid Masonry Units made from Clay or Shale)*, ASTM C 216 or the *Standard Specification for Hollow Brick (Hollow Masonry Units made from Clay or Shale)*, ASTM C 652.

R4407.2.4.3.2 Sand-lime brick shall conform to the *Standard Specification for Concrete Building Brick*, ASTM C 55.

R4407.2.4.3.3 Concrete brick shall conform to the *Standard Specification for Concrete Building Brick*, ASTM C 55.

R4407.2.5 Stone. Stone for masonry shall be hard and durable.

R4407.2.6 Cast stone. Cast stone shall be made of Portland cement, aggregates and water with or without admixtures. Cast stone for load-bearing masonry or where exposed to the weather shall have an average compressive strength, at 28 days, of at least 3,000 psi (20.7 MPa) and shall have not more than 7 percent water absorption by weight.

R4407.2.7 Concrete blocks.

R4407.2.7.1 General.

R4407.2.7.1.1 Concrete blocks shall be made of Portland cement, water and approved aggregates. The materials shall conform to the requirements for the materials of concrete specified in Section R4405, and the finished units shall meet the requirements of this section.

R4407.2.7.1.2 Concrete blocks used for fire-resistive walls rated 2 hours or more, or used for load-bearing or exterior walls, shall have a minimum face shell thickness of 1 1/4 inches (32 mm), a minimum web thickness of 1 inch (25 mm), and shall have a net cross-sectional area not less than 50 percent of the gross section.

R4407.2.7.1.3 Concrete blocks for other purposes shall have wall and web thickness of not less than 3/4 inch (19 mm).

R4407.2.7.1.4 Where masonry walls are required by this code to be 8 inch (203 mm) thickness, hollow concrete blocks units may be 7 5/8 by 7 5/8 by 15 5/8 inches (195 by 195 by 398 mm) modular dimension with corresponding widths for tie columns and tie beams.

R4407.2.7.2 Quality. Standard units of hollow concrete block shall conform to the *Standard Specification for Hollow Load-Bearing Concrete Masonry Units*, ASTM C 90, except that the maximum moisture content shall not exceed 50 percent of the total absorption.

R4407.2.8 Structural clay tile.

R4407.2.8.1 Limitations. All hollow burned clay wall tile used for fire-resistive walls rated 2 hours or more, load-bearing or exterior walls shall be load-bearing tile.

R4407.2.8.2 Tests. Tests shall be conducted in accordance with the *Standard Methods of Sampling and Testing Structural Clay Tile*, ASTM C 212.

R4407.2.8.3 Quality.

R4407.2.8.3.1 Structural clay load-bearing wall tile shall conform to the *Standard Specification of Structural Clay Load-Bearing Wall Tile*, ASTM C 34.

R4407.2.8.3.2 Structural clay floor tile shall conform to the *Standard Specification for Structural Clay Floor Tile*, ASTM C 57.

R4407.2.8.3.3 Structural clay nonload-bearing tile shall conform to the *Standard Specification for Structural Clay Nonload-Bearing Tile*, ASTM C 56.

R4407.2.9 Gypsum tile.

R4407.2.9.1 Limitations. Precast gypsum shall not be used in load-bearing masonry or in any masonry that will be exposed to the weather.

R4407.2.9.2 Tests. Tests shall be made in accordance with the *Chemical Analysis of Testing Gypsum and Gypsum Products*, ASTM C 471, *Physical Testing of Gypsum Plasters and Gypsum Cement*, ASTM C 472, and *Physical Testing of Gypsum Board Products and Gypsum Partition Tile and Block*, ASTM C 473.

R4407.2.9.3 Quality. Gypsum partition tile or block shall conform to the *Standard Specification for Gypsum Tile or Block*, ASTM C 52, *Chemical Analysis of Testing Gypsum and Gypsum Products*, ASTM C 471, *Physical Testing of Gypsum Plasters and Gypsum Cement*, ASTM C 472, and *Physical Testing of Gypsum Board Products and Partition Tile and Block*, ASTM C 473.

R4407.2.10 Plain concrete. Plain concrete is concrete cast in place and not reinforced, or reinforced only for shrinkage or change of temperature. Plain concrete shall be mixed, placed and cured as specified for concrete in Section R4405. The minimum strength of regular concrete shall be not less than 2,000 psi (13.8 MPa) in 28 days. The minimum strength of lightweight aggregate concrete shall be not less than 500 psi (3.5 MPa) in 28 days.

R4407.2.11 Plain gypsum concrete. Plain gypsum concrete is gypsum concrete cast in place and either unreinforced or reinforced for shrinkage.

R4407.2.12 Mortar.

R4407.2.12.1 General. Except as otherwise set forth herein, all mortars and the materials therein shall conform to the *Standard Specifications for Mortar of Masonry Units*, ASTM C 270.

R4407.2.12.1.1 The gradation of aggregates for masonry mortar shall be such that the fineness modulus is between 1.20 and 2.35 when determined in accordance with the *Standard Specifications for Aggregate for Masonry Mortar*, ASTM C 144.

R4407.2.12.1.2 Aggregates shall be quarried or washed in fresh water and shall contain not more than $1/20$ of 1 percent salt by weight.

MORTAR STRENGTH PROPERTY SPECIFICATIONS		
Type	Minimum Average Strength	
	(psi)	(MPa)
M	2500	(17.2)
S	1800	(12.4)
N	750	(5.2)
O	350	(2.4)

R4407.2.12.1.3 Mortar used to bond unit masonry shall be of Type M, S, N or O and shall comply with either the property specifications set forth hereinafter or the proportion specifications of the standard set forth in R4407.2.12.1.

R4407.2.12.1.4 The type of mortar based on consideration of the location of the unit masonry shall be as follows:

USE OF LOCATION	TYPE OF MORTAR
Below grade foundations and walls	M
Swimming pool walls and retaining walls	M
Fire resistive walls rated 2 hours or more	M or S
Exterior walls and load bearing walls	M or S
Piers less than 32 inches wide	M or S
Partitions	M, S or N
Solid masonry units	One classification less than that above
Mortar or grout under concentrated loads	M
Fences	M, S, N or O
Gypsum	Gypsum

For SI: 1 inch = 25.4 mm.

R4407.2.12.1.5 All solid unit masonry shall be laid in full beds with full end joints. All hollow unit masonry shall be laid with full mortar coverage of the face shells in both horizontal and vertical joints.

**SECTION R4407.3
HIGH-VELOCITY HURRICANE ZONES —
ALLOWABLE UNIT STRESSES IN UNIT MASONRY**

R4407.3.1 Compression.

R4407.3.1.1 Allowable working compressive stresses in masonry walls shall not exceed the limits in pounds per square inch (MPa) of gross area in the following table:

UNIT	TYPE N OR O MORTAR	TYPE M OR S MORTAR
Brick	200 (1.4)	300 (2.1)
Stone	450 (3.1)	600 (4.1)
Rubble Stone	200 (1.4)	300 (2.1)
Concrete Blocks	100 (0.7)	150 (1.0)
Clay Tile	80 (0.55)	100 (0.7)

R4407.3.1.2 The maximum allowable working stress in plain concrete shall be the following percentage of the ultimate strength of the concrete in compression:

Compression $0.20 f'_c$

Shear and diagonal tension $0.02 f'_c$

Where f'_c represents the ultimate compressive strength.

R4407.3.2 The shear in unit masonry shall not exceed 1/10 the allowable compressive stress.

R4407.3.3 Un-reinforced unit masonry shall be assumed to have no value in resisting axial tension (uplift). Flexural tension is allowed in unreinforced masonry per ACI 530.

R4407.3.4 Concentrations. Walls of hollow masonry units shall not directly support concentrated loads.

**SECTION R4407.4
HIGH-VELOCITY HURRICANE ZONES —
CONSTRUCTION DETAILS**

R4407.4.1 General.

R4407.4.1.1 Masonry walls of hollow or solid units or plain concrete shall be constructed as specified in this section.

R4407.4.1.2 Designed reinforced concrete walls, columns and beams shall be as specified in Section R4405, except that such designed columns and beams shall be not less than the equivalent of the minimums herein set forth.

R4407.4.1.3 Reinforced concrete required in this section shall comply with Section R4405, Reinforced concrete.

R4407.4.1.4 Second-hand masonry units shall not be used unless they conform to the requirements of this code, are sound and have been thoroughly cleaned and are approved for use by the building official.

R4407.4.1.5 Bond shall be provided by lapping ends in successive vertical courses.

R4407.4.1.6 Minimum No. 9 gauge horizontal joint reinforcing at every alternate course (16 inches spacing), ladder type for reinforced masonry and truss type for all others shall be provided. This reinforcement shall extend 4 inches (102 mm) into tie columns or be tied to structural columns with approved methods where structural columns replace the tie columns.

R4407.4.2 Exterior walls.

R4407.4.2.1 General.

R4407.4.2.1.1 Exterior walls of unit masonry shall have a minimum thickness of 8 inches (203 mm) except as otherwise set forth in Sections R4407.2.7.1.4 and R4407.4.2.11

R4407.4.2.1.2 No roof or other members shall be placed to develop direct horizontal thrust on walls unless such walls are specifically designed.

R4407.4.2.1.3 The maximum area of wall panels of 8 inch (203 mm) thick unit masonry, as measured between the concrete members which frame the panel such as the beams and tie columns, shall not exceed 240 square feet (22.3 m²), except as set forth in Section R4407.4.2.2.

R4407.4.2.2 Tie columns.

R4407.4.2.2.1 Concrete tie columns shall be required in exterior walls of unit masonry. Concrete tie columns shall be required at all corners, at intervals not to exceed 16 feet (4.9 m) center-to-center of columns, adjacent to any corner opening exceeding 4 feet (1219 mm) in width, and at the ends of free-standing walls exceed 2 feet (610 mm) in length. When openings exceed 8 feet (2.4 m) in width, tie columns shall be provided on each side of all such openings. All gable and shed end corners shall have tie columns.

R4407.4.2.2.2 When openings are between 3 feet and 8 feet (914 mm and 2438 mm) in width, such openings shall have one #5 vertical reinforcing bar at each side. The vertical bars shall be placed in concrete filled cells and shall extend into footings and into tie beams. All such bars shall be continuous from footing to tie beam. All splices, where needed, shall be 30 inches (762 mm) minimum.

R4407.4.2.2.3 Tie columns shall be not less than 12 inches (305 mm) in width. Tie columns having an unbraced height not exceeding 15 feet (4.6 m) shall be not less in thickness than the wall or less than a nominal 8 inches (203 mm), and, where exceeding 15 feet (4.6 m) in unbraced height, shall be not less in thickness than 12 inches (305 mm). The unbraced height shall be taken at the point of positive lateral support in the direction of consideration or the column may be designed to resist applicable lateral loads based on rational analysis.

R4407.4.2.2.4 Tie columns shall be reinforced with not less than four #5 vertical bars for 8 by 12 inch (203 by 305 mm) columns nor less than four #6 vertical bars for 12 by 12 inch (305 by 305 mm) columns nor less reinforcing steel than 0.01 of the cross-sectional area for columns of other dimension nor less than may be required to resist axial loads or bending forces. Vertical reinforcing shall be doweled to the footing and splices shall be lapped 30 bar diameters. Columns shall be tied with #2 hoops spaced not more than 12 inches (305 mm) apart.

R4407.4.2.2.5 The concrete tie columns set forth herein are a minimum to limit masonry panel areas and provide an integrated framework for masonry. The spacing of concrete columns for skeleton frame construction, designed as specified in Section R4405, may exceed the spacing herein set forth provided the masonry panels have an area less than 240 square feet (22.3 m²) and the structural system is designed to transmit horizontal wind loads to the columns.

R4407.4.2.2.6 Concrete tie columns designed to limit masonry panel areas may be offset at tie beams or other horizontal members to avoid openings, but the maximum spacing shall not be exceeded.

R4407.4.2.2.7 Concrete columns in load-bearing walls shall be poured only after masonry units are in place. Where masonry walls of skeleton frame construction are laid up after the frame has been erected, adequate anchorage designed by a professional engineer shall be provided. Where structural steel members are made fire-resistive with masonry units, the panel walls shall be bonded to the fire-resistive materials.

R4407.4.2.2.8 Where the minimum spacing of tie columns, as set forth in Section R4407.4.2.2.1, has been satisfied and where structural columns of skeleton frame construction are spaced as specified in Section R4407.4.2.2.5, provision for resisting the horizontal and vertical loads at the edges of masonry panels abutting door and window openings in masonry walls where openings are not bounded by such reinforced concrete columns shall be considered and, where necessary, transfer the forces through the materials of assembly to the ground.

R4407.4.2.3 Tie beams.

R4407.4.2.3.1 A tie beam of reinforced concrete shall be placed in all walls of unit masonry, at each floor or roof level, and at such intermediate levels as may be required to limit the vertical heights of the masonry units to 16 feet (4.9 m). Well compacted and confined soil below grade may be considered lateral restraint but only above a point 1 foot (305 mm) below the grade where such restraint begins.

R4407.4.2.3.2 Unless otherwise required by design, all tie beams shall have four #3 ties at 12 inches (305 mm) o.c. at corners and at each bend and at 48 inches (1219 mm) o.c. elsewhere. A tie beam shall be not less in dimension or reinforcing than required for the conditions of loading nor less than the following minimums: A tie beam shall have a width of not less than a nominal 8 inches (203 mm), shall have a height of not less than 12 inches (305 mm) and shall be reinforced with not less than four #5 reinforcing bars placed two at the top and two at the bottom of the beam except that a tie beam using "U" type beam block may be used with the following limitations:

1. Limited to one-story Group R3 occupancy.
2. Limited to unsupported spans of 7 feet (2.1 m).
3. Beam block shall be reinforced with one #7 bar in the top and one #7 bar in the bottom of the pour.
4. Beam block shall provide not less than 14 inches (356 mm) vertical dimension or less than 4¹/₂ inches (114 mm) horizontal dimension of poured-in-place beam cross-section.
5. Where beam blocks are used, consideration of resistance to uplift caused by wind forces shall be based on only that portion of the dead load above the topmost mortar joint in the wall.

R4407.4.2.3.3 The tie beam shall be continuous. Continuity of the reinforcing in straight runs shall be provided by lapping splices not less than 30 inches (762 mm). Continuity shall be provided at corners by bending two bars from each direction around the corner 30 inches (762 mm) or by adding two #5 bent bars which extend 30 inches (762 mm) each way from the corner. Continuity at columns shall be provided by continuing horizontal reinforcing through columns or by bending horizontal reinforcing in the columns a distance of 18 inches (457 mm).

R4407.4.2.3.4 A tie beam shall not be required where floor or roof systems provide a rigid diaphragm of reinforced concrete with a minimum thickness of 4 inches (102 mm) or where a floor or roof system has an equivalent stiffness factor of not less than 0.5 cubic inches, as determined by the moment of inertia divided by the length. (Per foot of width, measured normal to the plane of the diaphragm and adequately anchored).

R4407.4.2.3.5 Changes in level of the beams or structural concrete beams (beam) shall be made at tie columns or structural concrete columns and said tie columns or structural concrete columns shall be continuous from beam to beam.

R4407.4.2.3.6 A tie beam may follow the rake of a gable or shed end if the slope does not exceed 3:12 and the requirements of Sections R4407.4.2.1.2 and R4407.4.2.1.3 are met.

R4407.4.2.3.7 The concrete in tie beams shall be placed to bond to the masonry units immediately below and shall not be separated therefrom by wood, felt or any other material which may prevent bond. Felt paper no wider than the width of the cells of the block may be used provided that it is depressed a minimum of 2 inches (51 mm) in one cell of each block.

R4407.4.2.3.8 Tie beams subject to uplift and lateral wind forces shall be sized and designed to resist all such forces. Tie beams over openings shall be sized and designed to resist dead and live loads combined with wind loads, whichever governs.

R4407.4.2.4 Gable end and shed end walls. All masonry structures with gable end and shed end (half gable) walls shall have such end walls constructed of masonry, only in accordance with this section. A horizontal tie beam shall be provided in line with the lower ends of the gables and sheds, except as permitted in Section R4407.4.2.3.6 above, and designed in accordance with Sections R4407.4.2.1.2 and R4407.4.2.1.3, and load requirements as set forth in Section R4403. A concrete coping following the rake of the gable, not less than 64 square inches (413 cm²) in area reinforced with two #5 bars shall be provided. Tie columns at gable and shed ends shall be provided. Any intermediate tie columns required within the gable shall extend to the coping beam. Tie beams resting on masonry which are not subject to uplift and lateral wind forces shall be provided according to Section R4407.4.2.3.2.

R4407.4.2.5 Parapet walls.

R4407.4.2.5.1 Masonry parapet walls shall be not less than 8 inches (203 mm) thick, shall be reinforced with minimum tie columns and shall be coped with a concrete beam not less than 64 square inches (413 cm²) in cross-section, reinforced with two #4 reinforcing bars.

R4407.4.2.5.2 A parapet wall exceeding 5 feet (1524 mm) in height above a tie beam or other point of lateral support shall be specifically designed to resist horizontal wind loads.

R4407.4.2.6 Piers.

R4407.4.2.6.1 In any section of a masonry wall of an enclosed structure where openings are arranged to leave sections of walls less than 16 inches (406 mm), such sections shall be steel or reinforced concrete.

R4407.4.2.6.2 Isolated masonry piers of unenclosed structures shall be so constructed that the height of such piers shall not exceed 10 times the least dimension, that the cells are filled with cement grout and reinforced with not less than two #5 bars anchoring the beam to the foundation.

R4407.4.2.7 Cavity walls.

R4407.4.2.7.1 Cavity walls consisting of two separate walls with an air space of not less than 2 nor more than 6 inches (51 to 152 mm) may be constructed of solid or hollow-unit masonry provided such walls meet the specific requirements for tie columns and beams set forth in this section and are bonded together at intervals not more than 24 inches (610 mm) apart, vertically and horizontally, by masonry ties or by durable, rigid metal ties 0.10 square inch (64.5 mm²) in cross-section.

R4407.4.2.7.2 The minimum thickness of the separate walls of cavity wall construction shall be 4 inches (102 mm), and units shall be laid in full beds of Portland cement mortar with full-end joints.

R4407.4.2.8 Brick and stone walls. Walls of brick and stone shall be laterally supported by tie columns and beams, or the equivalent thereof, as provided in this section and shall meet these additional requirements:

1. In all brick walls at least every sixth course on both sides of the wall shall be a header course or there shall be at least one full header in every 72 square inches (465 cm²) of each wall surface.
2. In walls more than 12 inches (305 mm) thick, the inner joints of header courses shall be covered with another header course that shall break joints with the course below.
3. Solid-unit masonry shall comply with the standard *Building Code Requirements for Masonry*, ANSI A41.1.
4. Rubble stone walls shall be 4 inches (102 mm) thicker than is required for solid brick or concrete walls of the

SECTION R4409
HIGH-VELOCITY HURRICANE ZONES—WOOD

R4409.1 General.

R4409.1.1 Design. Wood members and their fastenings shall be designed to comply with this code by methods based on rational analysis or approved laboratory testing procedures, both performed in accordance with fundamental principles of theoretical and applied mechanics.

R4409.1.2 Workmanship. Wood members shall be framed, anchored, tied and braced to develop the strength and rigidity necessary for the purposes for which they are used and to resist the loads imposed as set forth in this code. Wood construction shall be in conformance with the tolerances, quality and methods of construction as prescribed by the standards in Chapter 43 of this code.

R4409.1.3 Fabrication.

R4409.1.3.1 Preparation, fabrication and installation of wood members and the glues, connectors and mechanical devices for fastening shall conform to good engineering practice.

R4409.1.3.2 Any person desiring to manufacture or fabricate wood truss assemblies shall obtain a certificate of competency from the authority having jurisdiction.

R4409.1.4 The following standards, as set forth in Chapter 43 of this code, are hereby adopted for the design and quality of wood members and their fastenings:

R4409.1.4.1 American Hardboard Products Association
887-B Wilmette Road, Palatine, IL 60067 AHA

1. Basic Hardboard ANSI/AHA A135.4-1982

2. Prefinished Hardboard Paneling ANSI/AHA A135.5-1982
3. Hardboard Siding ANSI/AHA A135.6-1990
4. Cellulosic Fiberboard ANSI/AHA A194.1-1985
5. Recommended Product and Application Specification - Structural Insulating RoofDeck, I.B. Spec. No. 1
6. Recommended Product and Application Specification - 1/2 inch Fiberboard Nail-Base- Sheathing I.B. Spec. No. 2
7. Recommended Product and Application Specification - 1/2 inch Intermediate Fiberboard Sheathing I.B. Spec. No. 3

R4409.1.4.2 American Institute of Timber Construction
333 West Hampden Avenue, Englewood, CO 80110 AITC

1. Typical Construction Details AITC 104
2. Code of Suggested Practices AITC 106
3. Standard for Heavy Timber Construction AITC 108
4. Standard for Preservative Treatment for Structural Glued Laminated Timber AITC 109
5. Standard Appearance Grades for Structural Glued Laminated Timber AITC 110
6. Standard for Tongue and Groove Heavy Timber Roof Decking AITC 112
7. Standard for Dimensions of Glued Laminated Structural Members AITC 113

TABLE R4408.11
CHAIN LINK FENCE MINIMUM REQUIREMENTS

Fence Height (ft)	Terminal Post Dimensions (in inches) (o.d. x wall thickness)	Line Post Dimensions (in inches) (o.d. x wall thickness)	Terminal Post Concrete Foundation Size (diameter x depth) (in inches)	Line Post Concrete Foundation Size (diameter x depth) (in inches)
Up to 4	2 ³ / ₈ × 0.042	1 ⁵ / ₈ × 0.047	10 × 24	8 × 24
Over 4 to 5	2 ³ / ₈ × 0.042	1 ⁷ / ₈ × 0.055	10 × 24	8 × 24
Over 5 to 6	2 ³ / ₈ × 0.042	1 ⁷ / ₈ × 0.065	10 × 24	8 × 24
Over 6 to 8	2 ³ / ₈ × 0.110	2 ³ / ₈ × 0.095	10 × 36	10 × 36
Over 8 to 10	2 ⁷ / ₈ × 0.110	2 ³ / ₈ × 0.130	12 × 40	10 × 40
Over 10 to 12	2 ⁷ / ₈ × 0.160	2 ⁷ / ₈ × 0.120	12 × 42	12 × 42

For SI: 1 inch = 25.4 mm.

Notes:

1. This Table is applicable only to fences with unrestricted airflow.
2. Fabric: 12¹/₂ gauge minimum.
3. Tension Bands: Use one less than the height of the fence in feet evenly spaced.
4. Fabric Ties: Must be minimum the same gauge of the fabric.
5. Fabric Tie Spacing on the Top Rail: Five ties between posts, evenly spaced.
6. Fabric Tie Spacing on Line Posts: One less than height of the fence in feet, evenly spaced.
7. Either top rail or top tension wire shall be used.
8. Braces must be used at Terminal Posts if top tension wire is used instead of Top Rail.
9. Post Spacing: 10 foot (3 m) on center maximum.
10. Posts shall be embedded to within 6 inch (152 mm) from the bottom of the foundation.
11. In order to follow the contour of the land, the bottom of the fence may clear the contour of the ground by up to 5 inch (127 mm) without increasing table values to the next higher limit.

8. Standard Specifications for Structural Glued Laminated Timber of Softwood Species AITC 117
9. Standard Specifications for Hardwood Glued Laminated Timber AITC 119
10. Technical Report No. 7, Calculation of Fire Resistance of Glued Laminated Timber
11. Structural Glued Laminated Timber ANSI/AITC A190.1

R4409.1.4.3 APA The Engineered Wood Association (Formerly APA American Plywood Association) P.O. Box 11700, Tacoma, WA 98411

1. APA Design Construction Guide, Residential and Commercial E30D
2. Plywood Design Specification Y510J
3. Plywood Design Specification-Design and Fabrication of Plywood Beams Supplement No. 1 S811
4. Plywood Design Specification-Design and Fabrication of Plywood Beams Supplement No. 2 S812
5. Plywood Design Specification-Design and Fabrication of Plywood Stressed-Skin Panels Supplement No. 3 U813
6. Plywood Design Specifications-Design and Fabrication of Plywood Sandwich Panels Supplement No. 4 U814
7. Plywood Design Specifications-Design and Fabrication of All-Plywood Beams. Supplement No. 5 H815
8. Plywood Folded Plate, Laboratory Report 21 V910
9. APA Design/Construction Guide Diaphragms L350

10. Performance Standards and Policies for Structural-Use Panels PRP-108
11. 303 Siding Manufacturing Specifications B840

R4409.1.4.4 American Society for Testing Materials 1916 Race Street, Philadelphia, PA 19103-1187 ASTM

1. Standard Test Methods for Mechanical Fasteners in Wood D 1761
2. Accelerated Weathering on Fire-Retardant Treated Wood for Fire Testing D 2898
3. Surface Burning Characteristics of Building Materials E 84
4. Hygroscopic Properties of Fire-Retardant Wood and Wood-Base Products D 3201
5. Standard Specifications for Adhesives for Field-Gluing Plywood to Lumber Framing for Floor Systems D 3498

R4409.1.4.5 American Wood Preservers Association P.O. Box 361784, Birmingham, AL 35236-1784

1. AWWA Use Category Systems Standard U1
2. AWWA Standard M4 Care of Pressure Treated Wood Products

R4409.1.4.6 National Institute for Standards and Technology Standard Development Services Section, Standards Application and Analysis Division, Washington, D.C. 20234 NIST

1. Mat-Formed Particleboard CS236
2. Structural Glued Laminated Timber PS56
3. Construction and Industrial Plywood PS1
4. American Softwood Lumber Standard PS20
5. Performance Standard for Wood Based Structural Use Panels PS2*

*All wood-based structural panels except plywood shall have Product Approval and shall be tested in accordance with High-Velocity Hurricane Zone testing protocols.

R4409.1.4.7 American Forest and Paper Association
1111 19 Street NW, Washington, D.C. 20036

1. ANSI/AF&PA National Design Specification for Wood Construction, 2001
2. ANSI/AF&PA Design Values for Wood Construction, 2001
3. Wood Structural Design Data, 1992
4. Span Tables for Joists and Rafters, 1993
5. Working Stresses for Joists and Rafters, 1993
6. Wood Construction Data No. 1, Details for Conventional Wood Frame Construction, 2001
7. Wood Construction Data No. 4, Plank-and-Beam Framing for Residential Building, 1989
8. Wood Construction Data No. 5, Heavy Timber Construction Details, 1989
9. Wood Construction Data No. 6, Design of Wood Frame Structures for Permanence, 1988
10. Technical Report No. 7, The Permanent Wood Foundation System, 1987
11. ANSI/AF&PA WFCM-2001, Wood Frame Construction Manual for one and Two-Family Dwellings, 2001
12. All-Weather Wood Foundation System, Design, Fabrication, Installation Manual, 1987
13. Technical Report No. 7, All-Weather Wood Foundation System Basic Requirements with Supplements, 1987

R4409.1.4.8 Timber Company, Inc.
2402 Daniels Street, Madison, WI 53704 TECO

Performance Standards and Policies for Structural use Panels. PRP-133

R4409.1.4.9 Truss Plate Institute
218 N. Lee Street, Suite 312, Alexandria, VA 22314

1. National Design Standard for Metal Plate Connected Wood Truss Construction (Excluding Chapter 2).
2. Building Component Safety Information (BCSI 1-03) Guide to Good Practice for Handling, Installing & Bracing of Metal Plate Connected Wood Trusses [A joint publication with the Wood Truss Council of America (WTCA)].

R4409.1.4.10 Underwriters Laboratories, Inc.
333 Pfingsten Road, Northbrook, IL 60062

Test Methods for Fire Resistance of UL-790 Roof Covering Materials

SECTION R4409.2
HIGH-VELOCITY HURRICANE ZONES—QUALITY

R4409.2.1 Identification. All lumber used structurally, including end-jointed lumber, shall be identified by the grade mark of a lumber grading or inspection bureau or agency approved by the Board of Review of the American Lumber Standards Committee or the Canadian Lumber Standards

Administrative Board: except that precut material, rough-sawn lumber and lumber thicker than 2 inches (51 mm) may be covered by a certificate of inspection in lieu of grade marking. The glued joints in end-jointed lumber, when used for load supporting purposes, shall be certified to be in accordance with the appropriate grading rules.

R4409.2.1.1 Structural glued laminated timber shall be manufactured and identified as required in ANSI/AITC 190.1 as adopted in Section R4409.1.4.

R4409.2.1.2 All wood-based structural panels used structurally, including siding, roof sheathing, wall sheathing, floor sheathing, diaphragms and built-up members, shall be identified for grade and exposure level by the grade stamp of an approved testing and grading agency indicating conformance with PS-1, PS-2, APA PRP-108 or TECO PRP-133 as adopted in Section R4409.1.4.

R4409.2.1.3 Wood shingles and/or shakes shall be identified by the grademark of an approved grading or inspection bureau or agency.

R4409.2.1.4 Fiberboard for its various uses shall conform to ANSI/AHA A 194.1.

R4409.2.1.5 Hardboard shall conform to AHA standards as adopted in Section R4409.1.4, and shall be identified as to classification.

R4409.2.1.6 Particleboard shall conform to the mat-formed particleboard standard, NIST CS236, as adopted in Section R4409.1.4.6, and shall be identified by the grade mark or certificate of inspection issued by an approved agency.

R4409.2.1.7 All lumber and wood-based structural panels required to be fire-retardant-treated shall bear permanent identification showing the fire performance rating thereof issued by an approved testing agency having a follow-up service. When exposed to the weather the material shall be permanently identified as suitable for such use in accordance with Section R4409.1.4.4. When exposed to sustained high humidity, the material shall be permanently identified as a low hygroscopic type suitable for interior use. Allowable design values, including connection design values, for lumber, glued laminated timber and wood-based structural panels, pressure treated with fire retardant chemicals shall be obtained from the company providing the treatment and redrying services. Listing of allowable design values shall be submitted and product approved.

R4409.2.1.8 All lumber, sawn timber, wood-based structural panels and poles supporting permanent structures and required by this code to be pressure treated and as described in the AWPAs standards shall bear the quality mark of an approved inspection agency which maintains continued supervision, testing and inspection over the product. Agencies shall be accredited in accordance with the procedures of the *American Lumber Standard* (PS 20) or approved equivalent.

R4409.2.1.9 Pressure-treated poles shall be treated in accordance with AWPAs U1 for sawn timber posts (Commodity Specification A, Use Category 4B) and for round timber posts (Commodity Specification B, Use Category 4B).

R4409.2.1.10 The quality mark shall contain, as a minimum, the following information:

1. The treating company and plant location
2. The AWPA standard to which the product is treated
3. The trademark of an approved inspection agency which maintains continued supervision, testing and inspection over the quality of the product as described in the AWPA standards
4. The preservative used
5. The amount of retention of the chemical per cubic foot of wood
6. If applicable, the method of drying after treatment
7. The purpose for which the wood has been treated: ground contact, above ground or foundation

Exception: When the size of individual pieces, e.g. lumber less than 1 inch (25 mm) in nominal thickness, or lumber less than nominal 1x5 or 2x4, or lumber 36 inches (914 mm) and shorter, except that 5/4x4 shall be quality marked, prevents application of full legible marks, the quality mark shall be applied by stamping the faces of exterior pieces or by end labeling not less than 25 percent of the pieces of a bundled unit.

R4409.2.1.11 All wood-based structural panels, including those made of fiberboard, hardboard and particleboard shall have Product Approval. Product Approval shall be given upon certification by an approved independent testing laboratory that the product:

1. Complies with the applicable standards set forth above
2. The product complies with the manufacturer’s published design properties before and after a wet-dry cycle
3. The product when tested dry maintains a safety factor of 2:1 and when tested after the cycles specified in Section R4409.2.1.11(2) above maintains a safety factor of 1.5:1. Testing shall be as specified in the testing protocol.

R4409.2.2 Wood-based structural panels permanently exposed in outdoor locations shall be rated for exterior use. When used for roof sheathing exposed to the outdoors on the underside or used structurally for wall, floor or roof cladding or for diaphragms, the panels shall be rated for Exposure 1 or exterior use.

R4409.2.3 All lumber 2 inches (51 mm) or less in thickness shall contain not more than 19 percent moisture at the time of permanent incorporation in a building or structure and/or at the time of treatment with a wood preservative.

R4409.2.4 Grade and species.

R4409.2.4.1 All structural wood members not limited by other sections of this section shall be of sufficient size and capacity to carry all loads as required by Section R4403 without exceeding the allowable design stresses specified in the *National Design Specification for Wood Construction* and in compliance with Section R4409.4.

R4409.2.4.2 Lumber boards used for floor and roof sheathing shall be in accordance with Table R4409.2.4.2.

**TABLE R4409.2.4.2
MINIMUM GRADE REQUIREMENTS: BOARD GRADES**

FLOOR OR ROOF SHEATHING	GRADING RULES
Utility	NLGA, WCLIB or WWPA
No. 4 Common or Utility	NLGA, WCLIB, WWPA, NHPMA or NELMA
No. 3	SPIB
Merchantable	RIS

**SECTION R4409.3
Reserved**

**SECTION R4409.4
HIGH-VELOCITY HURRICANE ZONES—
UNIT STRESSES**

R4409.4.1 General.

R4409.4.1.1 Lumber used for joists, rafters, trusses, columns, beams and/or other structural members shall be of no less strength than No. 2 grade of Southern Pine, Douglas Fir-Larch, Hem-Fir or Spruce-Pine-Fir. Joists and rafters shall be sized according to AF&PA Span Tables for Joists and Rafters adopted in Section R4409.1.4.

R4409.4.1.2 Lumber used for studs in exterior walls and interior bearing walls shall be of no less strength than Stud Grade of Southern Pine, Douglas Fir-Larch, Hem-Fir or Spruce-Pine-Fir and capable of resisting all loads determined in accordance with Section R4403. The unbraced height of the wall shall be no more than 8 feet 6 inches (2.6 m) (including top and bottom plates). Heights may be increased where justified by rational analysis prepared by a registered professional engineer or registered architect proficient in structural design.

R4409.4.1.3 Lumber used for studs in interior non-bearing walls shall have a modulus of elasticity of no less than 0.9 by 106 psi (6205 MPa).

R4409.4.1.4 The designer shall specify on the design drawings the size, spacing, species and grade of all load supporting members.

R4409.4.2 Allowable stress design value may be modified for repetitive, duration, etc., factors where design is by a registered professional engineer or registered architect proficient in structural design or where such modified values are reflected in the tables of the standards in Section R4409.1.4.

**SECTION R4409.5
HIGH-VELOCITY HURRICANE ZONES—
VERTICAL FRAMING**

R4409.5.1 Studs in bearing and exterior walls. Studs in walls framing over 8 feet 6 inches (2.6 m) (including top and bottom plates) or supporting floor and roof loads shall be designed by rational analysis prepared by a registered professional engineer or registered architect proficient in structural design.

ness of $1\frac{9}{32}$ inch (15 mm) and shall be applied to studs spaced not more than 16 inches (406 mm) on center. Wall sheathing shall be continuous over three or more supports and shall be nailed to such supports with 8d common nails. Nail spacing shall not exceed 6 inches (152 mm) on center at panel edges and all intermediate supports. Nail spacing shall be 4 inches (102 mm) on center at corner studs, in all cases.

3. When plywood panel, or product approved structural panel, sheathing is used, building paper and diagonal wall bracing can be omitted.
4. When siding such as shingles nailed only to plywood or product approved structural panel sheathing, the panel shall be applied with face grain across studs.

R4409.9.4 Exterior wall cladding.

R4409.9.4.1 Plywood, if protected with stucco, may serve for both sheathing and exterior cladding provided:

1. The panel thickness shall be not less than $1\frac{9}{32}$ inch (15 mm) and Texture 1-11 panels, and the supporting studs shall be spaced not more than 16 inches (406 mm) o.c.
2. All joints shall be backed solidly with 2-inch (51 mm) nominal blocking or studs or the joints shall be lapped horizontally or otherwise watertight.
3. Nailing shall be as set forth in Section 4409.9.3(2).

R4409.9.4.2 Where storm sheathing is provided in accordance with Section R4409.9.3, exterior cladding may be one of the following:

1. Wood siding shall be installed according to its Product Approval.
2. Wood shingles or shakes attached to the storm sheathing, and/or to nailing boards or shingle backer securely attached to the storm sheathing. The minimum thickness of wood shingles or shakes between nailing boards shall be $\frac{3}{8}$ inch (9.5 mm).
3. Hardboard of siding quality for exterior use shall be applied in accordance with the Product Approval.

SECTION R4409.10 HIGH-VELOCITY HURRICANE ZONES — FURRING

R4409.10.1 Where the interior of masonry walls is furred, such furring shall be treated and firestopped as herein required and shall be securely fastened to the masonry with not less than one cut nail in alternate course of block.

SECTION R4409.11 HIGH-VELOCITY HURRICANE ZONES — CONNECTORS

R4409.11.1 The allowable loads on all types of connectors shall be as set forth in the standards listed in Section R4409.1.4 and Table R4409.11.1.

R4409.11.2 Nails, bolts and other metal connectors that are used in locations exposed to the weather shall be galvanized or otherwise corrosion resistant.

R4409.11.3 In general, nails shall penetrate the second member a distance equal to the thickness of the member being nailed thereto. There shall be not less than two nails in any connection.

R4409.11.4 Except for wood-based structural-use panels and other laminated members manufactured under technical control and rigid inspection, gluing shall not be considered an acceptable connector in lieu of the connectors herein specified.

R4409.11.5 Safe loads and design practice for types of connectors not mentioned or fully covered herein shall be determined by the building official before approval.

SECTION R4409.12 HIGH-VELOCITY HURRICANE ZONES — WOOD SUPPORTING MASONRY

R4409.12.1 Wood shall not support masonry or concrete except as permitted in Sections R4409.12.2 and R4409.12.3.

R4409.12.2 Wood foundation piles may be used to support concrete or masonry.

R4409.12.3 Plywood decking and approved wood panels, wood joists and wood studs supporting such wood joists may be used to support reinforced concrete slabs, concrete-base tile and terrazzo floors and lightweight concrete toppings as follows:

1. There shall be an approved moisture vapor barrier between the concrete or other cementitious materials and the wood.
2. Wood members supporting concrete shall be preservative treated in compliance with AWPA Use Category Systems Standard U1, Commodity Specification A Use Category 4B set forth in Sections R4409.1.4 and R4409.13.
3. Approved wood-based structural-use panel decking shall be rated for Exposure 1.
4. Wood rafters may support concrete roof tile.

SECTION R4409.13 HIGH-VELOCITY HURRICANE ZONES — PROTECTION OF WOOD

R4409.13.1 Wood piles shall be treated with preservatives as set forth in Section R4404.7.1.2.

R4409.13.2 Preservative treated or durable species wood.

R4409.13.2.1 All wood used in areas of building or structures where the climatic condition is conducive to deterioration which would affect the structural safety shall be treated in an approved method with an approved preservative or shall be of an approved durable species.

R4409.13.2.2 All wood in contact with or embedded in the ground that supports of permanent structures shall be approved pressure-treated wood suitable for ground contact use.

Exceptions:

1. Naturally durable wood or pressure-treated wood may be used in contact with the ground for support of structures other than buildings and walking surfaces.

2. Untreated wood may be used for supports where entirely below water level and continuously submerged in fresh water.

R4409.13.2.3 Sleepers and sills on concrete slabs in contact with the ground, wood joists and the underside of wood structural floors without joists less than 18 inches (457 mm) above ground; or wood girders less than 12 inches (305 mm) from exposed ground within the crawl space under buildings, shall be treated in an approved method with an approved preservative, or shall be of an approved durable species.

R4409.13.2.4 All wood not separated from and/or in direct contact with concrete masonry, including sills, sleepers, plates, posts, columns, beams, girders and furring; shall be treated in an approved method with an approved preservative, or shall be of an approved durable species.

R4409.13.2.5 The expression “pressure-treated wood” refers to wood meeting the retention, penetration and other requirements applicable to the species, product, treatment and conditions of use in the approved standards of the American Wood Preservers Association (AWPA) and *Quality Control Program for Softwood Lumber, Timber and Plywood Pressure Treated with Water-borne Preservatives for Ground Contact Use in Residential and Light Commercial Foundations* for the American Wood Preservers Bureau.

R4409.13.2.6 The expression “durable wood” refers to the heartwood of the following species with the exception that an occasional piece with corner sapwood may be included if 90 percent or more of the width of each side on which it occurs is heartwood:

Decay resistant: Redwood, Cedars, Black Locust.

Termite Resistant: Redwood, Bald and Eastern Red Cedar.

R4409.13.2.7 Where durable species of wood are used as structural members in buildings and structures, the stress grade shall be not less than that required in Section R4409.4.

R4409.13.2.8 When wood pressure treated with a water-borne preservative is used in enclosed locations where drying in service cannot readily occur, such wood shall have a moisture content of 19 percent or less before being covered with insulation, interior wall finish, floor covering or other material.

R4409.13.2.9 All wood framing less than 8 inches (203 mm) from exposed earth in exterior walls that rest on concrete or masonry foundations shall be approved naturally durable species or pressure-treated wood.

R4409.13.2.10 All posts, poles and columns embedded in concrete which is in contact with ground and supporting permanent structures shall be approved pressure treated wood suitable for ground contact use except naturally durable wood may be used for posts, poles and columns embedded in concrete for structures other than buildings and walking surfaces or in structures where wood is above ground level and not exposed to the weather.

R4409.13.2.11 For conditions not specifically covered, compliance with American Forest & Paper Product Associ-

ation Wood Construction Data #6, *Design of Wood Frame Structures for Permanence*, shall be deemed as compliance with this code.

R4409.13.3 Ventilation.

R4409.13.3.1 Ventilation of crawl spaces. Crawl spaces under buildings without basements shall be ventilated by approved mechanical means or by openings in foundation walls. Ventilation openings shall be covered with a corrosion-resistant wire mesh with openings not greater than $\frac{1}{16}$ inch (1.6 mm).

R4409.13.3.1.1 Where practicable, ventilating openings shall be arranged on three sides.

R4409.13.3.1.2 The minimum total area of ventilating openings shall be 2 square feet (0.19 m²) for each 15 linear feet (4.6 m) or a fraction thereof of exterior wall. Such opening need not be placed in the front of the building. Where mechanical ventilation is used, the ventilation rate shall be at least six air changes per hour.

R4409.13.3.2 Ventilation of attic spaces. Attic space between ceiling joists and roof rafters shall be effectively cross-ventilated by approved mechanical means or with vent openings. The ratio of total net free ventilating area to the area of the ceiling shall be not less than $\frac{1}{150}$.

Exception: The venting ratio may be reduced to $\frac{1}{300}$ where at least 50 percent of the installed ventilating area is provided by a ventilation system located in the upper portion of the space to be ventilated [within 18 inches (457 mm) of ridge]. The balance of the required ventilation shall be provided by eave or cornice vents.

R4409.13.3.2.1 Where practical, ventilating openings shall be arranged on three sides.

R4409.13.3.2.2 Where mechanical ventilation is used, the ventilation rate shall be at least six air changes per hour.

R4409.13.3.2.3 All openings into the attic space of any habitable building shall be covered with screening, hardware cloth or equivalent to prevent the entry of birds, squirrels, rodents, etc. The openings therein shall not exceed $\frac{1}{8}$ inch (3.2 mm).

R4409.13.3.2.4 For existing structures that were built before 1992 without soffit ventilation, and where in the opinion of the building official the soffit ventilation would be impossible or impractical to install, the building official may determine the extent to which the existing structure shall be made to conform to the requirements of this section.

R4409.13.3.2.5 Unvented attic assemblies. Unvented attic assemblies shall be permitted if all the following conditions are met:

1. The unvented attic space is completely contained within the building thermal envelope.
2. No interior vapor retarder is installed on the ceiling side (attic floor) of the unvented attic assembly.