CHAPTER 44
HIGH-VELOCITY HURRICANE ZONES

SECTION R4401
HIGH-VELOCITY HURRICANE ZONES — EXTERIOR WALL COVERING

R4401.1 Wood.

R4401.1.1 Wood and wood products used for wall claddings shall comply with Section R4409.

R4401.1.2 Wood and wood-products used for wall cladding as non-structural exterior trim, fascia and soffits on buildings of Type I and Type IV construction may be applied to the outside of exterior walls, cornices, architectural appendages, eaves overhangs and similar projections. Where an exterior wall is required to be fire resistive, such material shall be separated from the interior of the building by the vertical extension of the exterior wall.

R4401.2 Asphalt shingles. Asphalt shingles shall be applied only to solid wood sheathing and shall be in tin-capped and spot-stuck, as set forth in Section R4402.

R4401.3 Roll slate or felt. Roll slate or felt shall be applied only to solid wood sheathing and shall be secured by nailing, as set forth in Section R4402.

R4401.4 Metal shingles. Metal shingles shall be applied only to solid wood sheathing and shall be secured as set forth in Section Section R4402.

R4401.5 Steel shingles. Steel siding shall be designed and applied as set forth in Section R4408.

R4401.6 Aluminum siding. Aluminum siding shall be designed and applied as set forth in Section R4406.

R4401.7 Veneers. Masonry veneers shall be applied as set forth in Section R4407.

R4401.8 Combustible materials. Combustible materials and fire resistive characteristics of all materials shall comply with the requirements for the group of occupancy or type of construction, and the required interior finish rating.

R4401.9 Other materials. Any cladding materials or assembly not addressed in this code shall be classified by the building official as the one it most nearly resembles, and shall comply with the requirements for loading and fire resistance herein required for such materials and assemblies.

SECTION R4402
HIGH-VELOCITY HURRICANE ZONES — ROOF ASSEMBLIES AND ROOFTOP STRUCTURES

R4402.1. General.

R4402.1.1 Scope. The provisions of this section shall set forth minimum requirements for the installation of roofing components, roofing systems, roofing assemblies and the waterproofing thereof.

R4402.1.2 Application. These High-velocity Hurricane Zone roofing requirements with associated roofing application standards (RAS) and testing application standards (TAS) are solely to be implemented in areas of high basic wind speeds, and where the jurisdiction having authority has adopted their use.

R4402.1.2.1 All roofing components, roofing systems and roofing assemblies for construction regulated by this code shall comply with this chapter. All roofing components, roofing systems and roofing assemblies shall have a valid and current, referred to as product approval hereinafter. In the event that the manufacturers published literature or instructions are in conflict with those of the product approval, the product approval shall prevail. Where items specifically and expressly addressed in this section are in conflict with the product approval, the provisions of this section shall prevail.

R4402.1.2.2 Innovative products and/or systems outside those currently recognized under this chapter may have a product approval issued based on performance testing; in such case(s) the conditions set in the product approval shall prevail.

R4402.1.2.3 For roofing systems to be installed on a specific building or structure, where an existing product approval may not be applied, such roofing system may be granted a one time approval by the authority having jurisdiction, provided the applicant demonstrates, by testing and/or rational analysis that such roofing system complies with the provision of this code.

R4402.1.2.4 Where a product approval does not address a detail for a specific job condition, the permit applicant may propose to the building official an alternate detail to address the specific need of the job. The building official may accept such proposal if it can be demonstrated that the provisions of this code will be met.

R4402.1.2.5 Workmanship standards. All roofing work shall be performed by a qualified contractor licensed to perform roofing, in compliance with the tolerances, quality and methods of construction established herein or set forth in the standards adopted by these high-velocity hurricane zone requirements. Roofing assemblies detailed in product approvals shall be installed in strict compliance with the method of application set forth in such product approval or, if not part of the product approval, in compliance with manufacturer's published application instructions, or as approved by the building official. (Aesthetic issues not affecting the performance of the roof are not part of this section.)

R4402.1.2.5.1 Appearance. If the architectural appearance is to be preserved from below, an alternate method of attachment complying with the wind load requirements of Section R4403 may be proposed unless otherwise addressed in Section R4402. The alternative attachment shall be prepared, signed and

sealed by a Florida-registered architect or a Florida-registered engineer, which architect or engineer shall be proficient in structural design.

R4402.1.3 Permits outside these High-Velocity Hurricane Zone requirements shall comply with Section 105 of the *Florida Building Code, Building*. Permits within high wind areas shall be required for all work in connection with the application, repair or maintenance of any roofing component or any roofing assembly and/or any of its components except as otherwise permitted in Section 105 of the *Florida Building Code, Building*.

R4402.1.3.1 All new roofing construction, including recovering and reroofing, repair and maintenance shall have a uniform roofing permit application, as established by the authority having jurisdiction, completed and executed by a licensed contractor.

R4402.1.3.2 The uniform roofing permit shall include calculations per Section R4403 of this code, unless the roofing assembly is less than the height/pressure threshold allowed in the applicable protocols herein.

4402.1.3.3 Reserved.

R4402.1.3.4 Attachments to the uniform roofing permit application shall include two copies of each of the following documents: properly executed OWNERS NOTIFICATION FOR ROOFING CONSIDERATIONS herein; the fire directory listing pages product approval cover sheet, product approval specific system description, product approval specific system limitation, product approval general limitations, and applicable detail drawings; the municipal permit application; other components approvals; and any other additional data reasonably required by the authority having jurisdiction needed to determine the integrity of the roofing system.

R4402.1.3.5 In new construction, a licensed roofing contractor may dry-in the wood deck (no mopping) on a specific structure, prior to the roofing permit being issued provided:

R4402.1.3.5.1 The master building permit for that specific structure has been obtained;

R4402.1.3.5.2 The sheathing inspection has been made and approved by the building official; and

R4402.1.3.5.3 The required roofing permit application is submitted to the building official within 10 days after dry-in work is started and the slope of the roof deck is 2:12 or greater.

R4402.1.4 Inspections performed outside these High-Velocity Hurricane Zone requirements shall comply with Section R109 .

R4402.1.4.1 All roofing work for which a permit is required shall be inspected by the building official. One or more inspections may be performed at the same time at the request of the roofing contractor or when feasible. Lack of roofing contractor's personnel at the job site, in and of itself, shall not be cause to fail the inspection. Certain roofing inspections shall be performed during specific phases of the applications as noted below:

R4402.1.4.2 For discontinuous roofing systems (as defined herein or Chapter 2):

R4402.1.4.2.1 During or after application of the base sheet, anchor sheet or underlayment of any roofing system.

R4402.1.4.2.2 During the installation of the cap sheet.

R4402.1.4.2.3 During the installation of any prepared roof covering, such as shingles, tiles, slates, shakes, and similar.

R4402.1.4.2.4 Upon completion of all adhesive-set and mortar-set tile systems, and prior to the final inspection, a field verification and static uplift test, in compliance with TAS 106 shall be required to confirm tile adhesion. This test may be required by the building official for mechanically attached tile systems. All results of this test shall be submitted to the building official.

R4402.1.4.3 For continuous roofing systems (as defined in herein or Chapter 2):

R4402.1.4.3.1 During application of any roofing system prior to the full concealment of the adhesion/attachment process to the roof deck or to the existing roofing assembly.

R4402.1.4.3.2 In cases where a roof area is less than 1,500 square feet (139 m^2), and when the building official is not able to perform any of the above requested inspection in a timely manner, the building official may authorize to continue with the work and may require that satisfactory evidence be provided to show that the covered work was performed in compliance with this code.

R4402.1.4.3.3 After all roofing work has been completed; a final inspection shall be performed by the building official.

SECTION R4402.2
HIGH-VELOCITY HURRICANE ZONES — DEFINITIONS

R4402.2.1 Definitions. For definitions outside Section R4402 and accompanied RAS and TAS, see Chapter 2. For the purposes of Section R4402, accompanying RAS, TAS and roofing products product approval, roofing terms shall be defined in compliance with ASTM D 1079, unless otherwise defined below. The definitions listed below shall take preference. Other terms used herein shall be defined as set forth in Chapter 2 of this code.

AIR PERMEABLE ROOFING SYSTEM. A roofing system consisting of a prepared roof covering over an approved underlayment on a sloped roof. The components within the prepared roof covering are discontinuously laid and small, with unsealed side and head laps. Air permeable roofing systems shall be applied over sheathed decks with either mechanical attachment or a mortar/adhesive bond. Any roofing system with sealed

side or head laps shall not be defined as an air permeable roofing system. The authority having jurisdiction may require testing in compliance with TAS 116, to determine whether a roofing system is air permeable.

ANCHOR SHEET. A roofing felt mechanically attached to a nailable deck with approved fasteners to which insulation is then installed in a solid mopping of asphalt. The roofing membrane is then installed to the insulation in the usual manner.

ARCHITECTURAL METAL PANEL. Water shedding (hydrokinetic) roof panel fastened to a roof deck.

ASTM (ASTM International). A scientific and technical organization that is responsible for the development of standards on characteristics and performance of materials, products, systems, as adopted for the high-velocity hurricane zone.

BASE SHEET. The bottom or first ply of a roofing assembly over which subsequent roofing plies are applied. A base sheet may be designed for mechanical attachment, full or partial adhesion to the substrate.

BUILDING INTEGRATED PHOTOVOLTAIC ROOFING. A roofing product consisting of an electricity generating photovoltaic component integrated into a roof covering.

CLASS A ROOFING ASSEMBLY. A roofing assembly that, in combination with the roof slope, has been classified by an approved testing agency, with a listing and follow-up service, as "Class A" in compliance with ASTM E 108 or UL 790.

CLASS B ROOFING ASSEMBLY. A roofing assembly that, in combination with the roof slope, has been classified by an approved testing agency, with a listing and follow-up service, as "Class B" in compliance with ASTM E 108 or UL 790.

CLASS C ROOFING ASSEMBLY. A roofing assembly that, in combination with the roof slope, has been classified by an approved testing agency, with a listing and follow-up service, as "Class C" in compliance with ASTM E 108 or UL 790.

CONTINUOUS ROOFING SYSTEM. An impervious roof covering, composed from a single or multiple layers, forming a homogenous membrane over the entire roof surface, applied to either a flat or pitched roof surfaces.

CORROSION RESISTANT. Any component that passes appendix of FMRC's Test Standard 4470, as modified, and set forth in TAS 114.

COUNTER BATTENS. Vertical wood strips installed on sloped roofs over which horizontal battens are secured. The primary roof covering is attached or secured to these horizontal battens.

COUNTERFLASHING. Formed metal or elastomeric sheeting secured on or into a wall, curb, pipe, roof-top unit or other surface to cover and protect the upper edge of a base flashing and its associated fasteners.

DISCONTINUOUS ROOFING SYSTEM. A roofing system with unsealed overlapping components, where the combined roofing system has openings at the point of overlap, applied to a sloped surface with a pitch of 2:12, or greater. Discontinuous roofing systems include asphalt shingles; concrete, clay or metal tile; wood shingles or shakes; and cement fiber roofing systems.

DRY-IN. The process of applying the first layer of felt in a roofing system.

FM APPROVALS. A research and testing organization that is responsible for examination and testing of construction and other products.

FASTENER WITHDRAWAL RESISTANCE TEST. A static pullout test of mechanical fasteners, which are used to anchor any roofing component, to determine the force required to withdraw a fastener from the substrate. Testing shall be in compliance with the test procedure detailed in TAS 105.

FIRE-RESISTANT ROOF COVERING. Any Class A, Class B or Class C roofing system applied to the appropriate deck type within the specified slope of the listed classification.

FLASHING. The roofing component used to seal roofing systems, where the system is interrupted or terminated.

LAP. See *NRCA Manual* fourth edition.

METAL PROFILE. Including but not limited to eave and gable drip, gravel stop, raised edge systems and fascia systems. All composite and nonmetallic flashing materials shall have a Product Approval.

METAL ROOF PANEL. An interlocking metal sheet having an installed weather exposure equal or greater than three square feet per sheet.

METAL ROOF SHINGLE. An interlocking metal sheet having an installed weather exposure less than three square feet per sheet.

MINIMUM CHARACTERISTIC RESISTANCE FORCE. A force or pressure which is representative of data from withdrawal resistance testing; static uplift testing; and/or wind uplift testing after the data has been statistically analyzed to a 95 percent level of precision.

MOMENT. A quantity that represents the affect of a force applied at a particular point in relation to a specific point or axis.

NET FREE VENTILATING AREA (NFVA). The gross area of the smallest plane area of the ventilating device reduced by the percentage of physical obstruction to the plane area.

NRCA. The *NRCA Roofing and Waterproofing Manual*, fifth edition, as published by the National Roofing Contractors Association.

PREPARED ROOF COVERING. Any manufactured or processed roof covering designed for use as the top layer of a discontinuous roofing system applied to a sloped roof.

RAS. Roofing Application Standards.

RECOVERING. The process of covering an existing roofing assembly with a new roofing system or a prepared roofing system.

REPAIR. The work of corrective procedures by replacing or altering an existing roofing component or system to eliminate water intrusion

REROOFING. The process of recovering or replacing an existing roofing system, either in its entirety or in existing sections.

RIDGE VENT. A ventilator located within 18 inches (457 mm) of the ridge that allows the escape of warm and/or moist air from the attic area or rafter cavity.

ROOF COVERING. An assembly of multiple field-applied components or a single component designed to weatherproof a building's top surface. A roof covering may be a roofing assembly or form a portion thereof.

ROOF DECK. Solid or spaced sheathing to which the roofing or waterproofing system is applied.

ROOF SECTION. A separation or division of a roof area by existing expansion joints, parapet walls, flashing (excluding valleys), difference of elevation (excluding hips and ridges), roof type or legal description; not including the roof area required for a proper tie-off with an existing system.

ROOF TILE PROFILE, FLAT. Those tiles with less than $^1/_2$-inch (12.7 mm) rise.

ROOF TILE PROFILE, HIGH. Those tiles having a rise-to-width ratio greater than 0.20

ROOF TILE PROFILE, LOW. Those tiles having a rise-to-width ratio less or equal than 0.20; except those tiles meeting the flat profile definition.

ROOFING ACCESSORY. A type of roofing product as described in Section R4402.6.6 of this code.

ROOFING ASSEMBLY. An assembly of interacting roofing components [includes the roof deck, vapor retarder (if present), insulation, and roof covering].

ROOFING COATINGS, ADHESIVES AND MASTICS. Any and all liquid materials applied to the roofing membrane layer to enhance ultraviolet light resistance; increase resistance to fire; increase reflectivity of the roofing assembly; or, in some way, enhance the performance of the roofing assembly. Roofing coatings, adhesives or mastics shall not contain asbestos materials.

ROOFING COMPONENT. A roofing product that is incorporated into various roofing assemblies.

ROOFING MAINTENANCE. Is the work of extending the longevity of a roofing system through preventative care, such as refilling pitch pans, applying coatings, regraveling, resurfacing and recaulking.

ROOFING SYSTEM. A system of interacting roofing components, generally consisting of membrane or primary roof covering and insulation (not including the roof deck) designed to weatherproof, and sometimes to improve, the building's thermal resistance.

STRUCTURAL METAL PANEL. Roof covering intended to be self supporting between structural members (see Sections R4406.1.8.2 and R4408.9.4).

TAS. Testing Application Standard.

UNDERLAYMENT. One or more water shedding layers applied to a sloped roof prior to the application of a prepared roof covering. The primary purpose of an underlayment is defined as a water shedding layer to function in combination with a prepared roof covering.

WOOD SHAKES. Tapered or straight pieces of red cedar, or other wood types, of widths ranging from 3 inches to 14 inches (76 mm to 356 mm) ranging in lengths from 18 inches to 32 inches (437 mm to 819 mm) applied to a sloped roof, in conjunction with an approved underlayment, forming a discontinuous prepared roof system.

WOOD SHINGLES. Tapered pieces of red cedar, or other wood types, sawn on both faces, of widths ranging from 3 inches to 14 inches (76 mm to 356 mm) and lengths of 16 inches, 18 inches, and 24 inches (406 mm to 610 mm) applied to a sloped roof forming a discontinuous prepared roof system.

SECTION R4402.3
HIGH-VELOCITY HURRICANE ZONES — WEATHER PROTECTION

R4402.3.1 General. Roof decks shall be covered with roof coverings secured to the building or structure in accordance with the provisions of this section. Roof coverings shall be designed, installed and maintained in accordance with this code and the manufacturer's installation instructions such that the roof covering shall serve to protect the building or structure. All roof coverings, roof systems and roof assemblies shall be designed and installed to resist the wind load requirements of Section R4403 of this code.

R4402.3.2 Flashings. Flashings shall be installed in such a manner as to prevent moisture entering the wall through the joints in the coping, through moisture permeable materials, at intersections with the roof plane or at parapet wall penetrations. All roof flashing and terminations shall be designed and installed to resist the wind load requirements of Section R4403 of this code, and shall be in compliance with the provisions set forth in RAS 111.

R4402.3.2.1 Locations. Flashings shall be installed at (1) wall and roof intersections (2) at gutters, (3) wherever there is a change in roof slope or direction this requirement does not apply to hip and ridge junctions, and (4) around roof openings. Where flashing is of metal, the metal shall conform to the provisions of RAS 111.

R4402.3.2.2 Membrane flashings. All membrane flashing shall be installed according to the roof assembly manufacturer's published literature and in accordance with the provisions set forth in RAS 111.

R4402.3.2.3 Metal flashings and terminations. Metal flashing and terminations shall be of the material and thickness described in Section R4402.6.6 and RAS 111 of this code, and shall be designed and installed in accordance with RAS 111. Metal flashing shall be installed after the roofing felts have been laid and turned up the vertical surfaces, in compliance with the roofing assembly Product Approval.

R4402.3.2.3.1 Such felts shall be embedded in hot bitumen or an approved adhesive.

R4402.3.2.3.2 Metal surfaces shall be primed with an ASTM D 41 or ASTM D 43 primer, as appropriate and allowed to dry prior to receiving hot bitumen or cold adhesive.

R4402.3.2.4 Metal counterflashing. Metal counterflashing shall be of the material and thickness described in Sections R4402.6.6 and RAS 111 of this code, and shall be installed in accordance with RAS 111.

R4402.3.2.4.1 Metal counterflashing shall be built into walls, set in reglets or applied as stucco type and shall be turned down over base flashing not less than 3 inches (76 mm).

R4402.3.2.4.2 Metal counterflashing shall be side lapped a minimum of 4 inches (102 mm).

R4402.3.2.4.3 Metal counterflashing, where set in reglets or surface-mounted, shall be waterproofed, in accordance with applicable application standards.

R4402.3.2.4.4 Where metal counterflashing is used as the means of sealing (such as a vented system) it shall be set in an approved sealant, sealed with an approved adhesive on the top flange and all joints shall be sealed with an approved sealant and lapped a minimum of 4 inches (102 mm).

R4402.3.2.5 Roof penetration flashing.

R4402.3.2.5.1 All pipes shall be flashed with approved lead sleeve-type, pitch pans or other approved methods detailed in the roofing system assembly product approval. Lead flashing shall not be less than 2.5 pound per square foot (12.2 kg/m^2). Flanges shall be a minimum of 4 inches (102 mm).

R4402.3.2.5.2 Other roof penetrations shall be suitably flashed with curbs, collars, pitch pans, in compliance with RAS 111 or an approved method, in compliance with the roofing system assembly Product Approval.

R4402.3.2.5.3 No roof penetration shall be located in roof valleys.

R4402.3.3 Coping. Where required, parapet walls shall be properly coped with noncombustible, weatherproof materials of a width no less than the thickness of the parapet wall. Copings shall be designed and installed to resist the wind load requirements of Section R4403 of this code, and shall be in accordance with the provisions set forth in RAS 111.

R4402.3.4 Roof drainage. Unless roofs are sloped to drain over roof edges, roof drains shall be installed at each low point of the roof. Where required for roof drainage, scuppers shall be placed level with the roof surface in a wall or parapet. The scupper shall be located as determined by the roof slope and contributing roof area. Scuppers shall be sized in accordance with the provisions contained in ASCE 7, Section 8 with commentary and shall comply with Section R4403.6.

R4402.3.4.1 Gutters. Gutters and leaders placed on the outside of buildings, other than one- or two-family dwellings, private garages and buildings of Type V construction, shall be of noncombustible material or a minimum of Schedule 40 plastic pipe.

R4402.3.4.1.1 Gutters and leaders shall be constructed of metal or approved plastic for outdoor exposure with lapped, soldered or caulked joints and shall be securely fastened to the building with a corrosion resistant fastening device of similar or compatible material to the gutters and downspouts. Gutters shall be in compliance with RAS 111.

R4402.3.4.2 Overflow drains and scuppers. Where roof drains are required, overflow drains or overflow scuppers sized in accordance with *Florida Building Code, Plumbing* shall be installed with the inlet flow line located not less than 2 inches (51 mm) or more than 4 inches (102 mm) above the low point of the finished roofing surface, excluding sumps. Overflow scuppers shall be a minimum of 4 inches (102 mm) in any dimension and shall be placed in walls or parapets and shall be located as close as practical to required vertical leaders, conductors or downspouts. Overflow drains and scuppers shall also comply with the *Florida Building Code, Plumbing*, and Section R4403.6 of this code.

R4402.3.4.2.1 When overflow scuppers and roof drains are installed, they shall be lined with approved metal or other approved materials set forth in the roofing system assembly Product Approval.

R4402.3.4.2.2 When recovering, reroofing or repairing an existing roof, the existing number of scuppers and/or roof drains shall not be reduced, unless a new drainage system is designed by an architect or engineer, in compliance with the provisions of this code.

R4402.3.4.3 Sizing and discharge. Roof drains, gutters, conductors and leaders shall be sized and discharge in accordance with the *Florida Building Code, Plumbing*.

SECTION R4402.4
HIGH-VELOCITY HURRICANE ZONES — PERFORMANCE REQUIREMENTS

R4402.4.1 General. All roof assemblies, roof coverings and roof systems shall have Product Approval, and shall meet the following minimum requirements.

R4402.4.1.1 All continuous roofing assemblies shall be tested in compliance with FMRC Test Standards 4470 and/or 4471 (for metal roofing), as modified for the purposes of this code and set forth in TAS 114. Only those

components listed within the roofing assembly Product Approval shall be approved for use with the roof covering. Roofing assemblies shall be acceptable for use in this code's jurisdiction providing they are in compliance with the fire classification required for the structure to which the roofing assembly is to be installed.

R4402.4.1.2 All fastening devices and fastening assemblies used for insulation, anchor sheet or roof coverings shall be tested in compliance with Section R4402.12 of this code.

R4402.4.1.3 All roofing assemblies shall be tested by a testing laboratory certified.

R4402.4.1.4 All roofing membranes and components shall be tested in compliance with the physical property test requirements detailed in TAS 110.

R4402.4.1.5 No loose laid ballasted or nonballasted system shall be allowed.

R4402.4.2 Guidelines for roofing applications.

R4402.4.2.1 Decks. All roofing systems and prepared roof coverings shall be installed over solid decks, unless otherwise specifically allowed in other sections of this code.

R4402.4.2.2 Minimum slope. All roofing assemblies must be installed in compliance with the slope requirements specified in the product approval, in compliance with Table R4402.4.2

TABLE R4402.4.2
MINIMUM SLOPE

SYSTEM TYPE	SLOPE
Fibrous Cement Shingles	4:12
Metal Panels	
Architectural	2:12
Metal Shingles	4:12
Mortar or Adhesive Tile	2:12
Mechanically Fastened Tile Ashphalt Shingles	4:12
Laminated	2:12
3-Tab	2:12
Quarry Slate	3-1/2:12
Wood	2:12
Shakes	4:12
Shingles	3-1/2:12

R4402.4.2.2.1 All roofing systems must be installed to ensure positive drainage. In new construction the minimum deck slope shall be not less than 1/4:12.

R4402.4.2.2.2 All roofing assemblies shall be installed at a slope no greater than the maximum allowed for the required fire classification

R4402.4.2.3 Deck preparation. All roof decks, substrates, existing roofing systems to which a new roofing assembly is to be installed shall be broom cleaned, free from dirt and silt and dry prior to commencement of the roofing application.

R4402.4.2.3.1 Cant strips, if required, shall be extended not less than 3-inch (76 mm) up vertical flashing surfaces, measured from the top of the new roof covering.

R4402.4.2.3.2 All eaves shall provide a firm nailable substrate for secure attachment of perimeter edge metal in compliance with RAS 111.

R4402.4.2.3.3 Perimeter edge metal shall be fastened with nails or fasteners fabricated from similar or compatible material. The nails or fasteners shall be as set forth in the roofing assembly product approval.

R4402.4.2.3.4 All precast and prestressed concrete deck components shall be leveled with leveling fill, where such components' edges are greater than 1/2 inch (12.7 mm) from being flush.

R4402.4.2.4 Impact resistance. Roof coverings installed on low slope roofs in accordance with R4402.8 shall resist impact damage based on the results of test conducted in accordance with ASTM D 3746, ASTM D 4272, CGSB 37-52, FM 4470, or TAS 114.

R4402.4.2.5 Ridge vents. Ridge vents shall have product approval, and shall be tested for wind driven rain in accordance with TAS 110 and R4402.12.

SECTION R4402.5
HIGH-VELOCITY HURRICANE ZONES — FIRE CLASSIFICATION

R4402.5.1 General. Roof assemblies shall be divided into the classes defined below. Class A, B and C roof assemblies and roof coverings required to be listed by this section shall be tested in accordance with ASTM E 108 or UL 790. In addition, fire retardant treated wood roof coverings shall be tested in accordance with ASTM D 2898.

R4402.5.2 Fire-resistant roofing assemblies and coverings shall be provided on all structures. Fire classification of roofing assemblies and coverings shall be based on the exposure hazard as follows:

R4402.5.2.1 Class A. Zero feet to 20 feet (0 to 6.1 m) distance separation measured horizontally from the closest point of any building edge to the nearest point to an adjoining structure, and all buildings with occupation greater than 300 persons.

Exception: Brick, masonry, slate, clay or concrete roof tile and exposed concrete roof deck are considered to meet Class A roof covering provisions without testing.

R4402.5.2.2 Class B. All other structures, except as noted below.

R4402.5.2.3 Class C. Structures not occupied by humans.

SECTION R4402.6
HIGH-VELOCITY HURRICANE ZONES — MATERIALS

R4402.6.1 Scope. Every roofing component shall comply with the applicable ASTM material standards adopted by this code. All such products shall bear the testing logo imprinted on the material and/or container or shall be marked in a distinctive manner to define compliance with the standards and shall be subject to be evaluated for compliance.

R4402.6.2 Compatibility of materials. Roofs and roof coverings shall be of materials that are compatible with each other and with the building or structure to which the materials are applied.

R4402.6.3 Material specification and physical characteristics. No roofing component containing asbestos shall be used in any roofing assembly.

R4402.6.4 Product identification. All roofing components shall be labeled and/or identified as mandated by the Product Approval.

R4402.6.4.1 ASTM standard roll goods shall be marked with a yellow line to identify the ASTM standard, or such other marking as may be deemed appropriate by the Product Approval.

R4402.6.5 Fasteners.

R4402.6.5.1 Nails shall be minimum 12 gauge, annular ring shank nails having not less than 20 rings per inch, heads not less than $^3/_8$-inch (9.5 mm) in diameter; and lengths sufficient to penetrate through the thickness of plywood panel or wood plank decking not less than $^3/_{16}$ inch (4.8 mm), or to penetrate into a 1-inch (25 mm) or greater thickness of lumber not less than 1 inch. Nails or wood screws shall be hot dipped electro or mechanically galvanized to a thickness sufficient to resist corrosion in compliance with TAS 114 Appendix E, Section 2 (ASTM G 85). All nails shall be Product Approved. All nail cartons or carton labels shall be labeled to note compliance with the corrosion resistance requirements. No roofing material shall be fully or partially adhered, unless otherwise noted in the roof assembly Product Approval directly to a nailable deck.

R4402.6.5.2 Such fasteners shall be applied through tin caps no less than $1^5/_8$-inches (41 mm) and not more than 2-inches (51 mm) in diameter and of not less than 32 gauge (0.010 inch) sheet metal. Cap nails or prefabricated fasteners with integral heads complying with this section shall be an acceptable substitute. All tin caps, cap nails, or prefabricated fasteners with integral heads shall be tested for corrosion resistance in compliance with TAS 114 Appendix E, Section 2 (ASTM G 85), and shall have Product Approval. All cartons or carton labels for tin caps, cap nails or prefabricated fasteners with integral heads shall note compliance with the corrosion resistance requirements.

R4402.6.6 Metal roofing accessories. All metal accessories for roofs shall be not less than 26 gauge G-90 galvanized or stainless steel, 16 ounce copper, 0.025-inch (0.6 mm) thick aluminum, lead sheet with a minimum 2.5 pound per square foot (12.2 kg/m^2) or equivalent noncorrosive metal alloys or composite materials manufactured for use as roof termination. All composite and nonmetallic flashing materials shall have Product Approval.

R4402.6.6.1 Metal accessories may be of a manufactured, shop fabricated or field fabricated type, providing the materials and fasteners are in compliance with the minimum requirements of this code and shall be sized, designed and installed in compliance with methods set forth in RAS 111.

R4402.6.6.2 Gravel stop or drip edge profiles shall be as follows:

R4402.6.6.2.1 The vertical face shall be a minimum of 1-$^1/_2$ inches (38 mm) and shall extend down not less than $^1/_2$ inch (12.7 mm) below the sheathing or other member immediately contiguous thereto. In all cases, the deck flange shall be not less than 2 inches (51 mm) in width. Gravel stop or drip edge shall be sized, designed and installed in compliance with RAS 111.

R4402.6.6.2.2 Gravel stop or drip edge shall be designed so that the bottom (the kick of the metal) of the drip edge shall have a minimum of $^1/_2$-inch (12.7 mm) clearance from the structure.

R4402.6.6.2.3 Reserved.

R4402.6.6.2.4 Gravel stops shall be installed after all roofing felts have been applied, or in compliance with the application method set forth in the roofing assembly product approval. All asphalt or approved cold adhesive bonding areas shall be coated with ASTM D 41 or ASTM D 43, as required, and allowed to dry prior to application.

R4402.6.6.2.5 Gravel stop and drip edges shall be joined by lapping a minimum of 4 inches (102 mm) and the entire interior of the joints shall be coated with approved flashing cement. Cover and splice plates shall be of the same material as the gravel stop and drip edge, and shall be sized, fabricated and installed in compliance with RAS 111.

R4402.6.6.2.6 The deck flange shall be nailed with an approved minimum 12 gauge annular ring shank nail at 4 inches (102 mm) o.c. The nail shall be manufactured from similar and/or compatible material to the termination profile. All composite materials shall be fastened with nonferrous nails.

R4402.6.6.3 Valley metal. Valley metal shall be of the materials set forth in R4402.6.6.

SECTION R4402.7
HIGH-VELOCITY HURRICANE ZONES — ROOF COVERINGS WITH SLOPES 2:12 OR GREATER

R4402.7.1 General. Prepared roof coverings shall be as defined in Section R4402.2 and in general limited to application over sloped roof decks capable of receiving mechanical fasteners. Prepared roof coverings may be mechanically

fastened or, in specific limited cases noted in the Product Approval, set in an adhesive bond.

R4402.7.2 Underlayments. Underlayment shall be as defined in Section R4402.2. Underlayment shall be installed in compliance with the roofing component Product Approval and shall be in compliance with the following minimum requirements:

R4402.7.2.1 Underlayment shall be attached to a nailable deck in a grid pattern of 12 inches (305 mm) between the sidelaps, with 6-inch (152 mm) spacing at the sidelaps.

R4402.7.2.2 Where the architectural appearance of the underside is to be preserved, the underlayment shall be secured in accordance with Section R4402.8.5.2.

R4402.7.2.3 Tin caps and nails or cap nails shall be defined in Section R4402.6.5.2.

R4402.7.2.4 Underlayment nails shall be as defined in R4402.6.5.1.

R4402.7.3 If the underlayment is a self-adhering membrane, the membrane shall be applied over a mechanically attached anchor sheet, attached in compliance with R4402.7.2.1.

R4402.7.4 All underlayment applications for prepared roof coverings shall be applied in compliance with the manufacturer roofing assembly Product Approval, and shall be not less than one of the following: (1) A double layer of an ASTM D 226 Type I, with a 19 inch headlap; or (2) A single layer of an ASTM D 226, Type II with a 4-inch (102 mm) headlap; or (3) A single layer of an ASTM D 2626 coated base sheet with a 4 inch (102 mm) headlap, and (4) All endlaps shall be a minimum of 6 inches (152 mm).

R4402.7.5 Fiber cement shingles. Fiber-cement shingles shall be applied in compliance with the shingle manufacturer's roofing assembly Product Approval. The roofing system assembly product approval shall meet the following minimum requirements:

R4402.7.5.1 All nonasbestos fiber-cement shingles shall conform to ASTM C 1225.

R4402.7.5.2 Fiber-cement shingles shall be installed in compliance with the nailing requirements set forth in the product approval; however, attachment of each component shall be with not less than two corrosion resistant fasteners. If adhesive is used at the head or side laps, the system shall be defined as a "sealed system" with load calculations in compliance with Section R4403.

R4402.7.5.3 All intersections shall be flashed in metal as provided in Section R4402.6.6 and RAS 111.

R4402.7.5.4 Fiber-cement shingles shall be tested as set forth in Section R4402.12.

R4402.7.6 Quarry slate. Quarry slates shall be applied in compliance with the slate manufacturer's Product Approval. The roofing assembly Product Approval shall meet the following minimum requirements:

R4402.7.6.1 Quarry slates shall be installed with not less than two approved fasteners per slate.

R4402.7.6.2 All terminations and intersections shall be flashed in metal as provided in Section R4402.6.6 and RAS 111.

R4402.7.6.3 Quarry slates shall be tested in compliance with the requirements set forth in Section R4402.12.

R4402.7.6.4 Installation of all quarry roof slates shall be limited to a roof mean height of 33 feet (10 m), unless otherwise specifically noted in the Product Approval.

R4402.7.7 Asphaltic shingles. Asphaltic shingles layout, alignment and placement of mechanical attachment shall be in compliance with the Product Approval, and shall be installed in accordance with RAS 115.

R4402.7.7.1 Underlayments exceeding minimum underlayments, as detailed in Section R4402.7, shall be applied in compliance with the application methods detailed in the Product Approval. Where the architectural appearance of the underside of the roof is to be preserved, refer to Section R4402.8.5.2.

R4402.7.7.2 Installation of all asphaltic shingles shall be limited to a roof mean height of 33 feet (10 m), unless otherwise specifically noted in the Product Approval.

R4402.7.7.3 The asphaltic shingle Product Approval shall meet the following minimum requirements:

R4402.7.7.3.1 Where asphaltic shingles are to be installed over insulated roof deck, a suitable nailable substrate, in accordance with Section R4402.9.5.7 must be installed over the insulation prior to the installation of approved underlayment and shingles.

R4402.7.7.3.2 Asphaltic shingles shall be installed in compliance with the Product Approval, but in no case with less than six approved roofing nails or approved fastening devices which penetrate through the thickness of sheathing or wood plank a minimum of $^{3}/_{16}$ inch (4.8 mm) or penetrate into a 1 inch (25 mm) or greater thickness of lumber a minimum of 1 inch (25 mm), except where architectural appearance is to be preserved, in which case a minimum of $^{3}/_{4}$ inch (19 mm) ring shank roofing nail may be used.

R4402.7.7.3.3 Intersections, eaves, rakes, valleys, gable ends, and the starter course of asphaltic shingles shall be set in an 8-inch (203 mm) wide bed of approved cold adhesive or roofing cement. Application of adhesive or cement shall be in compliance with the application instructions of the Product Approval. Shingles shall not extend more than $^{1}/_{4}$ inch (6.4 mm) beyond the eave drip.

R4402.7.7.3.4 All perimeter termination and valleys shall be fabricated from metal. Minimum metal requirements are set forth in Section R4402.6.6, and RAS 111.

R4402.7.7.3.5 Asphaltic shingles shall be tested in compliance with the provisions set forth in Section R4402.12.

R4402.7.8 Clay and concrete roof tile. Tile shall be clay, concrete or composition material of various configurations complying with the physical property requirements of this

code. All tile and tile systems shall be tested in compliance with the provisions set forth in Section R4402.12. Tile shall have a Product Approval for a complete tile system, which shall include the tile, underlayment and all tile related accessories required to provide a waterproof system.

R4402.7.8.1 Application. All tile systems shall be installed over solid sheathed decks. All tile installation shall be in accordance with RAS 118, RAS 119, and RAS 120, as applicable.

R4402.7.8.1.1 Roof tile mortar shall either be a pre-mixed unit having a Product Approval and tested in compliance with TAS 123 or a job-site mix approved by the building official and in compliance with TAS 113.

R4402.7.8.2 The roof tile product approval shall specify the slope requirement for each tile and underlayment system in accordance with Table R4402.4.2.

R4402.7.8.3 All roof tile fasteners shall be tested and comply with the requirements set forth in Section R4402.12.

R4402.7.8.4 All tile systems. All tile application designs shall comply with the following limitations in order to withstand the wind loads prescribed in this section, as well as all wind load requirements set forth in Section R4403.

R4402.7.8.4.1 Roof tiles systems, combining mechanically fastened tile and mortar and/or adhesive, shall be acceptable.

R4402.7.8.4.2 In an air permeable tile roofing systems: (1) the length of each tile shall be not less than 12 inches (305 mm) and not greater than 21 inches (533 mm) and the exposed width of the tile shall be between 8.5 inches and 15 inches (216 and 381 mm); (2) the maximum thickness of the nose (leading edge) of the tile shall not exceed 1.3 inches (33 mm); and (3) mortar or adhesive set system shall have at least two-thirds of the tile free of mortar and/or adhesive contact.

R4402.7.8.5 The proposed method of attachment for tile systems which are considered to be air permeable, shall provide sufficient attachment resistance (M_f) (listed in tile product approval) to meet or exceed the moment of resistance (M_r) as determined by following the procedures outlined in RAS 127. The aerodynamic multiplier (k) needed in RAS 127 shall be part of the tile Product Approval and shall be derived from the following formula:

For direct deck application $k = (0.156) \times (b) \times (l)^2$

For batten application $k = (0.144) \times (b) \times (l)^2$

Where b (in feet) = exposed width of the tiles

Where l (in feet) = length of tiles

R4402.7.8.6 The proposed method of attachment for tile systems which are not considered air permeable shall provide a minimum characteristic force (*F'*) (listed in tile product approval) to meet or exceed the required uplift resistance (F_r) as determined by following the procedures outlined in RAS 127.

R4402.7.8.7 Tile systems shall extend beyond the drip edge (not including the rake) not less than $^3/_4$ inch (19 mm) but not more than 2 inches (51 mm).

R4402.7.8.8 Spanish "S" tile, barrel tile or other tile systems that create a void between the deck and the underside of the tile shall be closed at the eaves with a prefabricated closure or mortar filler to close the eaves and elevate the butt ends of the first course, as detailed in the tile system Product Approval.

R4402.7.8.9 Apply a minimum $^3/_8$-inch (9.5 mm) diameter weep holes, spaced not more than 12 inches (305 mm) apart, located flush with the underlayment of all tile systems, except tile systems using thick-butt tile.

R4402.7.8.10 Mortar or adhesive set tiles applied at an incline from 6:12 up to and including 7:12 shall have the first course of tile (this applies to pan only on two-piece barrel tile) mechanically fastened with not less than one fastener per tile. As an alternate, the first course of tile shall be applied in mortar over a single layer of minimum 20 gauge galvanized wire mesh with openings of not less than $^1/_2$ inch (12.7 mm) or greater than $1^1/_2$ inches (38 mm) with minimum exposure of 12 inches (305 mm) which is mechanically attached to the deck through the underlayment with approved fasteners and tin-cap when back nailing the cap sheet. Additionally, for roof inclines of 6:12 up to and including 7:12, every third tile of every fifth course, shall be mechanically fastened with not less than one fastener per tile. For roof inclines above 7:12, in addition to the mortar or adhesive, all tiles shall be mechanically fastened with not less than one fastener per tile. Apply approved flashing cement to seal all tile fastener penetrations, for all roof inclines.

R4402.7.8.11 All tile systems shall be shingle lapped interlocking and installed with the headlap as specified in the tile system Product Approval. In no case shall the minimum headlap be less than 2 inches (51 mm) for mortar or adhesive set tile, or less than 3 inches (76 mm) for mechanically set tile, unless restricted by product design.

R4402.7.8.12 Where tiles are to be installed over an insulated roof deck, a suitable nailable substrate, in accordance with Sections R4402.9.5.6 and R4402.9.5.7 must be installed over the insulation prior to the installation of approved underlayment and tiles.

R4402.7.8.13 For mortar or adhesive set tile, no more than two tiles shall be loose per roofing square [100 square feet (9.3 m^2)]. No loose tile shall be adjacent to each other.

R4402.7.9 Metal panels/shingles. Steel panels/shingles shall be a minimum of G-90 corrosion resistant, and shall be not less than 26 gauge in thickness. Aluminum panels/shingles shall not be less than 0.025-inch (0.685 mm) thick. All other metal panel/shingle products shall be an equivalent weight. All metal panel/shingle assemblies shall be capable of withstanding foot traffic without damage to the metal panels/shingles. Metal panels/shingles shall have Product

Approval for a complete metal system, which shall include the panel/shingle, underlayment and all related accessories to provide a complete waterproof system.

R4402.7.9.1 All metal panels/shingles assemblies shall be tested in accordance with Section R4402.12, and TAS 125.

R4402.7.9.2 The entire application method of all metal panel/shingle systems shall be detailed in the Product Approval and RAS 133, as applicable.

R4402.7.9.3 Metal shingles may be applied as a recover over a single layer of asphaltic shingles or smooth surface roofing, providing the deck is solid sheathed and in compliance with the provisions of this code, the existing prepared roof covering is in compliance with provisions of this code and the entire metal shingle system is applied as set forth in the Product Approval.

R4402.7.9.4 Metal panel/shingle systems shall not extend more than 1 inch (25 mm) beyond the roof eave.

R4402.7.9.5 All intersections shall be flashed in metal as provided in Section R4402.6.6, RAS 111 and the roof assembly Product Approval.

R4402.7.10 Wood shingles and shakes. All wood shingles and shakes shall be installed in accordance with RAS 130. Installation of all wood shingles and shakes shall be limited to a roof mean height of 33 feet (10 m), unless otherwise specifically noted in the Product Approval.

R4402.7.10.1 All wood shingle/shake systems shall be tested in accordance with Section R4402.12.

R4402.7.11 Building integrated photovoltaic roofing modules/shingles. The installation of building integrated photovoltaic roofing modules/shingles shall comply with the provisions of this section.

R4402.7.11.1 Material standards. Building integrated photovoltaic roofing modules/shingles shall be listed and labeled in accordance with UL 1703.

R4402.7.11.2 Attachment. Building integrated photovoltaic roofing modules/shingles shall be attached in accordance with the manufacturer's product approval.

R4402.7.11.3 Wind resistance. Building integrated photovoltaic roofing modules/shingles shall be tested in accordance with procedures and acceptance criteria in TAS 107. Building integrated photovoltaic roofing modules/shingle packaging shall bear a label to indicate compliance with the procedures in TAS 107.

SECTION R4402.8
HIGH-VELOCITY HURRICANE ZONES — ROOF COVERINGS WITH SLOPES LESS THAN 2:12

R4402.8.1 General. All adhered roofing components shall be bonded to the various types of substrates in compliance with the requirements set forth in the roofing assembly Product Approval and the following minimum requirements. The authority having jurisdiction may adopt RAS 150 as the means of complying with the requirements listed in this section.

R4402.8.2 All packaged asphalt shall have the following data printed on the carton wrapper:

R4402.8.2.1 ASTM designation and type;

R4402.8.2.2 Flash point as determined by ASTM D 92, *Flash and Fire Point*, by Cleveland open cup; and

R4402.8.2.3 Equiviscous temperature (EVT) at which the asphalt attains a viscosity of 125 centipoise (25 centipoise for coal tar) as determined by ASTM D 4402, *Viscosity Determinations of Unfilled Asphalt Using The Brookfield Thermoset Apparatus*.

R4402.8.3 Asphalt types, as defined by ASTM D 312, shall be employed in all roofing assemblies. Application of asphalt shall be in compliance with Table R4402.8.3A and Table R4402.8.3B or as detailed in the roofing assembly Product Approval.

TABLE R4402.8.3A
SLOPE AND APPLICATION TEMPERATURE CRITERIA

ASTM D312 TYPES OF ASPHALT		MAXIMUM[1]		
		SLOPE (in./ft)	TEMPERATURE °F	
			MOP	MECHANICAL
Type I	Dead level	1/4	350 +/-25	375 +/-25
Type II	Flat	1/2	400 +/-25	425 +/-25
Type III	Steep	3	425 +/-25	450 +/-25
Type IV	Special steep (All roof tile systems)	N/A	450 +/-25	475 +/-25

1 inch = 25.4 mm; C° = [(ºF)-32)]/1.8

1. Temperature and slope measurements are at point of application

TABLE R4402.8.3B
SLOPE AND APPLICATION TEMPERATURE CRITERIA

ASTM 450 COAL TAR TYPE NO.	TYPE OF COAL TAR	MAXIMUM SLOPE (in./ft)	TEMPERATURE RANGE (ºF)
Type I	Coal tar pitch	1/4	360 +/-25
Type III	Coal Tar bitumen	1/4	375 +/-25

1 inch = 25.4 mm;C° = [(ºF)-32)]/1.8

R4402.8.4 Back nailing of inter-ply sheets shall not be required when using ASTM D 312 Type IV asphalt on slopes less than 3:12.

R4402.8.5 Mechanical attachment. All mechanically attached roofing components shall be attached to the various types of substrates in compliance with the requirements set forth in the roofing assembly Product Approval and the following minimum requirements.

R4402.8.5.1 Base sheet attachment on wood decks. Nails shall be minimum 12 gauge, annular ring shank nails having not less than 20 rings per inch; heads not less than 3/8-inch (9.5 mm) in diameter; and lengths sufficient to penetrate through the thickness of plywood panel or wood plank decking not less than 3/16 inch (4.8 mm), or to penetrate into a 1-inch (25.4 mm), or greater, thickness of lumber not less than 1 inch (25.4 mm). Nails shall be hot dipped; electro or mechanically galvanized to a thickness sufficient to resist corrosion in compliance with Appendix E of TAS 114. All nails shall be Product Approved. All nail cartons or carton labels shall be labeled to note

compliance with the corrosion resistance requirements. No roofing material shall be fully or partially adhered, unless otherwise noted in the roof assembly Product Approval directly to a nailable deck.

R4402.8.5.1.1 Tin caps shall meet the requirements of Section 4402.6.5.2

R4402.8.5.1.2 Prefabricated fastener systems complying with Sections R4402.8.5.1 and R4402.8.5.1.1 may be used, provided they have Product Approved.

R4402.8.5.1.3 Spacing of such fasteners shall be in compliance with patterns set forth in the roofing assembly Product Approval.

R4402.8.5.2 Where the architectural appearance of the underside is to be preserved, a base sheet may be secured in an alternate method of attachment prepared, signed, and sealed by a Florida-registered architect or engineer, or in buildings where the mean roof height does not exceed 15 feet (4.6 m), a base sheet may be secured with $1^1/_4$-inch (32 mm) fasteners on supporting members, with a minimum of $^1/_2$-inch (12.7 mm) fasteners between the supporting members, all of which shall be secured through tin caps and nailed 6 inches (152 mm) o.c. in all directions.

R4402.8.5.3 Lightweight insulating concrete. All lightweight insulated concrete shall be vented per roofing system manufacturer recommendations.

R4402.8.5.3.1 Lightweight concrete shall not be applied over an existing roof deck unless the supporting structure has been approved as adequate to sustain the added weight. Calculations verifying the adequacy of the existing structure to sustain the added weight shall be prepared, signed, sealed and dated by a Florida-registered architect or engineer, which architect or engineer is proficient in structural design, and submitted with the uniform roofing permit application.

R4402.8.5.4 Other nailable decks. The mechanical attachment of roofing components to other nailable decks shall be governed by the roofing assembly Product Approval.

R4402.8.6 Cast-in-place and precast structural concrete decks. Cast-in-place and precast structural concrete decks are considered non-nailable. Concrete decks shall be clean, dry and fully primed with ASTM D 41 or ASTM D 43, as required, primer applied at a rate of not less than 1 gallon (3.8 L) per square. Hot asphalt or cold adhesive shall not be applied until the primer has fully dried.

R4402.8.6.1 In hot mopped applications over precast panels, a minimum of 12-inch (305 mm) wide strips of roofing felt or modified bitumen shall be applied to all panel joints. Said strips shall be bonded to the panel joints with asphalt, approved mastic or approved cold applied adhesive or shall be torched to a primed surface.

R4402.8.7 Steel decks. Steel decks shall be covered with a roof insulation panel having its own Product Approval and listed in the roofing assembly product approval. Insulation panels shall be mechanically fastened in compliance with the mechanical attachment patterns listed in the roofing assembly product approval, and in accordance with the provisions of RAS 117.

R4402.8.7.1 If the deck thickness, on an existing steel deck, is less than 22 gauge, a field fastener withdrawal resistance test shall be conducted, in compliance with TAS 105, to confirm compliance with the wind load requirements of Section R4403. Test results shall be submitted with the uniform roofing permit application for review prior to issuance of the roofing permit. The field fastener withdrawal resistance test shall be carried out by a certified testing laboratory.

R4402.8.7.2 Steel decks shall be welded or mechanically attached to the structure in compliance with the design pressure requirements set forth in Section R4403.

R4402.8.7.3 Composite wood and insulation panels shall be mechanically attached to steel decks in compliance with the attachment requirements enumerated in the insulation roofing component Product Approval. The composite wood insulation panel shall be in compliance with the minimum sheathing requirements of this code.

R4402.8.8 Flashing. All flashing shall be installed according to the roof assembly manufacturer's published details and literature and in accordance with RAS 111.

R4402.8.9 Valleys. Valleys in BUR shall be installed in according to the roof assembly manufacturer's published literature for high wind areas and in compliance with the applicable detail described in the Product Approval.

R4402.8.10 Parapet walls. All parapet wall details shall be installed in accordance with the roofing system product approval, manufacturer's published details and literature and in accordance with approved methods detailed in RAS 111.

R4402.8.11 Insulation. Roof insulation shall be applied in compliance with the roofing system Product Approval and RAS 117.

R4402.8.12 Surfacing. Roofing assemblies shall be surfaced in compliance with the Product Approval. Surfacing shall be in sufficient quantity to comply with the required fire classification. Aggregate surfacing shall not be used on slopes greater than 3:12. Aggregate shall be embedded in a flood coat of bitumen applied over a prepared top ply.

R4402.8.12.1 On slopes of 3:12 or less, not less than 400 pounds (182 kg) of roofing gravel or 300 pounds (145 kg) of slag per square shall be applied. A minimum of 50 percent of the total aggregate shall be embedded in the flood coat of bitumen. Aggregate shall be dry and free from dirt and shall be in compliance with the sizing requirements set forth in ASTM D 1863. A building official may as an option, request a test to confirm compliance with these requirements.

R4402.8.12.2 On inclines greater than 3:12, a smooth surface coating shall be applied.

R4402.8.12.3 Mineral surfaced cap sheet applications shall not require any additional surfacing unless required with the particular assembly for a fire classification.

R4402.8.12.4 All smooth surface applications shall be coated with an aluminized or emulsion coating, having a valid and current Product Approval and shall be in compliance with the application instructions in said Product Approval. Coating quantity shall be in compliance with the required fire rating classification for the structure.

R4402.8.13 Attachment of metal termination. All edge metal and terminations shall be installed according to manufacturers published literature, provided it meets the minimum requirements as set for in RAS 111 and Section R4403.

R4402.8.14 Expansion joints. Expansion joint covers and expansion joint components shall be constructed and installed in accordance with the roofing assembly manufacturer's published literature.

R4402.8.15 Venting roofing assemblies. All roof assemblies shall be applied to a dry substrate. Vapor retarders shall be installed, where applicable, to reduce moisture vapor flow into insulation from the warm, humid building interior, leading to internal condensation. Vents shall be installed to assist in the expulsion of moisture vapor where such vapor may enter the roofing assembly or moisture, as defined in Section R4402.11.12, has been left in an existing roofing assembly. Venting units shall not allow vapor to enter the roofing assembly when the high vapor pressure side is above the roofing membrane.

R4402.8.16 Waterproofing. Waterproofing systems may be installed in lieu of an approved roof system over sloped or horizontal decks specifically designed for pedestrian and/or vehicular traffic, whether the deck is above occupied or unoccupied space. In new construction the minimum deck slope shall be $^1/_4$: 12.

R4402.8.16.1 The waterproofing system must possess a current and valid product approval.

R4402.8.16.2 If an overburden or wearing surface is not to be installed, the waterproofing system must be approved by the manufacturer for use in vehicular and/or pedestrian traffic locations.

R4402.8.16.3 The waterproofing assembly must possess a Class A, Class B or Class C fire rating as required herein.

R4402.8.16.4 If any portion of the waterproofing membrane is to remain exposed, the waterproofing system shall be ultraviolet resistant.

R4402.8.16.5 Flashings must be installed according to the waterproofing manufacturer's published specifications and in compliance with the material and attachment standards of RAS 111.

R4402.8.16.6 The waterproofing system shall be flood tested in accordance with ASTM D 5957.

R4402.8.16.6.1 The flood test shall take place after installation of the waterproofing membrane and prior to the installation of any above membrane components, wearing surface or overburden.

R4402.8.16.6.2 An approved testing lab shall provide written verification to the building official confirming that the flood test was performed along with the results, prior to final inspection.

SECTION R4402.9
HIGH-VELOCITY HURRICANE ZONES — ROOF INSULATION

R4402.9.1 General. All roof insulation shall have Product Approval as an approved roofing component for use in roofing assemblies. All insulation shall be tested for physical properties in accordance with TAS 110.

R4402.9.2 Foam plastic. Foam-plastic roof insulation shall conform to the material and insulation requirements of Section R4412.

R4402.9.2.1 Foam insulation panels shall be overlaid with a perlite, fiberglass, wood fiber or mineral wool overlay unless specifically stated to the contrary in the roof assembly Product Approval.

R4402.9.3 Cellulose fiberboard. Cellulosic fiberboard roof insulation requirements shall conform to the materials and insulation requirements of Section R4409.

R4402.9.4 Insulation fasteners, membrane fasteners and stress plates. All Insulation fasteners, membrane fasteners and stress plates shall have a roof component Product Approval, and shall be tested in compliance with RAS 117, Appendixes A, B and C, and TAS 110 and TAS 114, Appendix E, Section 3 (DIN 50018), for corrosion resistance.

R4402.9.5 Application. Roof insulation shall be applied in strict compliance with the application methods detailed in the roof assembly Product Approval and with the requirements set forth in RAS 117.

R4402.9.5.1 Roof insulation, either on the ground or on the roof top, shall be kept dry. The building official shall instruct the removal of the insulation from the job when elevated moisture levels are found in the insulation or where panels cannot achieve 85 percent adhesion.

R4402.9.5.2 When applied in hot asphalt or cold adhesive, no insulation panel's dimension shall be greater than 4 feet (1219 mm).

R4402.9.5.3 Strip or spot mopping of insulation panels shall be used as an application method only when approved in the roof assembly Product Approval.

R4402.9.5.4 Where more than one layer of insulation is applied, joints between layers shall be staggered.

R4402.9.5.5 Application in approved cold adhesive shall be as detailed in the Product Approval and shall be in compliance with the required fire classification.

R4402.9.5.6 Nail boards or composite panels with a nailable surface may be applied to sloped decks for the application of prepared roof covering or metal roofing systems, providing that the nailing surface is minimum $^{15}/_{32}$-inch (12 mm) exterior grade plywood sheathing, and has been attached to the deck with approved fastening assemblies in accordance with the windload requirements of Section R4403. Composite panels shall be gapped a

minimum of $^1/_8$ inch (3.2 mm) to allow for expansion of the sheathing panel.

R4402.9.5.7 Suitable nailable decks installed over rigid board roof insulation in buildings of mean roof height of 35 feet (10.7 m) or less, shall be a minimum of $^{15}/_{32}$-inch (12 mm) exterior grade plywood sheathing. These decks shall be fastened to every structural roof frame member or to the existing deck under the insulation, at intervals of not more than 24 inches (610 mm) apart, with a minimum #12 approved insulation fastener spaced at a maximum of 12 inches (305 mm) apart in one direction with a minimum penetration of $1^1/_2$ inches (38 mm) into the structural member or deck. In these cases the maximum thickness of the rigid insulation board shall not exceed 2 inches (51 mm). An alternate method of attachment may be proposed, provided it is in compliance with Section R4403, and it is prepared, signed and sealed by a Florida-registered architect or a Florida professional engineer, which architect or engineer shall be proficient in structural design.

R4402.9.5.8 Mechanical attachment of insulation panels at uneven areas shall be acceptable. Hollowing, cutting or scoring of insulation panels to provide contact shall not be acceptable.

SECTION R4402.10
HIGH-VELOCITY HURRICANE ZONES — REROOFING

R4402.10.1 General. Materials and methods of application used for recovering or replacing an existing roof covering, system or assembly shall comply with the requirements set forth in Sections R4402.1 through R4402.14.

R4402.10.2 Repairs shall be carried out with roofing components as defined in this section having Product Approval.

R4402.10.3 Repairs shall be carried out in such a manner as to not to create additional ponding water.

R4402.10.4 Not more than 25 percent of the total roof area or roof section of any existing building or structure shall be repaired, replaced or recovered in any 12-month period unless the entire existing roofing system or roof section is replaced to conform to requirements of this code.

R4402.10.5 A roofing system shall not be applied over an existing roof or over an existing roof deck where the roof sheathing has not been fastened in compliance with this code or where the roof sheathing will not permit effective fastening or where sheathing is water soaked or deteriorated so that effective attachment is not possible. All areas of deteriorated sheathing shall be removed and replaced. The building official shall not be required to inspect the renailing of the sheathing under this section.

R4402.10.6 Structural concrete decks shall be allowed to dry or shall be dried prior to application of an ASTM D 41 or ASTM D 43, as required, or roofing system proprietary primer where the base sheet or base insulation layer is bonded to the concrete deck.

R4402.10.7 On lightweight concrete, gypsum and cementitious wood fiber roof decks a field fastener withdrawal resistance test, in compliance with TAS 105, shall be carried out to confirm compliance with wind load requirements of Section R4403.

R4402.10.7.1 If the tested fasteners exhibit a minimum characteristic resistance force less than 80 percent than that listed in the product approval, a structural engineer shall examine the deck's integrity and provide a proposed attachment specification. Such specification shall be submitted with the uniform roofing permit application for review and approval by the building official prior to the issuance of a roofing permit. Calculations for the attachment of the anchor sheet/base sheet or insulation over these deck types, shall be in compliance with RAS 117.

R4402.10.8 Steel decks shall be examined prior to recover for indication of corrosion. Any corrosion identified and exposed on the roof side shall be treated with a rust inhibitor, providing the field fastener withdrawal resistance values of the proposed mechanical fasteners comply with the requirements of Section R4403 of this code. All steel decks less than 22 gauge shall be field tested for fastener withdrawal resistance for compliance with Section R4403 prior to application of a new roofing system. Test results shall be submitted with the uniform roofing permit application.

R4402.10.9 One additional roofing system may be applied over an original roofing assembly, providing the existing roofing assembly complies with the requirements of Section R4402.10.

R4402.10.10 If the recover roofing assembly is to be bonded to an existing roofing membrane, the existing roofing membrane shall be tested in compliance with TAS 124 for uplift resistance. The existing roofing membrane shall resist the design pressures calculated under Section R4403 of this code. Test results shall be submitted with the uniform roofing permit application.

R4402.10.11 If the recover roofing assembly is mechanically attached through either a base sheet or insulation layer, the attachment assembly shall be field tested for fastener withdrawal resistance, in compliance with TAS 105, and laboratory tested for pull-over resistance to ensure compliance with wind uplift requirements set forth in Section R4403 of this code. Test results shall be submitted with the uniform roofing permit application. Recover roofing assembly anchor sheet or base sheet shall not be mechanically fastened directly to existing gravel roof unless all gravel is completely removed.

R4402.10.12 Moisture content of the existing roofing assembly to be covered by a new roofing system shall not exceed 5 percent by weight in the roofing membrane and 8 percent by weight in the insulation system, as verified by moisture survey performed in accordance with TAS 126. Test results shall be submitted with the uniform roofing permit application.

R4402.10.13 Prior to starting the work the contractor has the responsibility of notifying the owner, by means of the roofing permit and required owners notification for roofing

considerations herein, of any possibility of ponding water and recommend a structural review if ponding water is a possibility.

R4402.10.14 If the new roofing system is to be bonded to the existing roof surface, the surface shall be free of all loose gravel, dirt and silt and dry prior to commencement of the roofing application. All blisters shall be cut and repaired prior to roofing application.

R4402.10.14.1 If the existing roof surface has gravel embedded in hot asphalt, all loose gravel shall be removed together with any dirt and silt. The dry membrane surface shall be primed with ASTM D 41 primer or proprietary roofing system primer and allowed to dry thoroughly. A flood coat of ASTM D 312, type III or IV asphalt shall be applied to sufficient depth to cover the remaining embedded gravel. The prepared substrate shall be suitable for application of a new insulation layer only.

R4402.10.14.2 In the case of existing coal tar assemblies, the existing roof surface shall be primed with ASTM D 43 primer or covered with a mechanically attached separation board prior to application of a new coal tar assembly. If an existing coal tar assembly is to be covered with an asphalt applied roofing system, only the separation board is acceptable. The attachment of the entire assembly, including the separation board, shall meet the design pressure requirements set forth in Section R4403.

R4402.10.14.3 Insulation shall have product approval as a roofing component approved for use as a part of the roofing assembly. The insulation panels shall be bonded or mechanically attached in compliance with the Product Approval and RAS 117.

R4402.10.15 Where an existing sloped roof is sheathed with spaced sheathing, any existing prepared roof covering shall be removed. New sheathing shall be applied in compliance with Section R4403, or open spacing shall be filled with dimensional lumber to create solid wood sheathing providing the spaced sheathing is in compliance with this code. Spaced sheathing is approved for use with wood shakes and wood shingles only.

R4402.10.16 No recover application shall take place over existing wood shingles, shakes, slate, tile or metal shingles.

R4402.10.17 Asphaltic shingle assemblies may be applied over one existing layer of asphaltic shingles having not more than $^1/_8$ inch (3.2 mm) difference in level in the existing shingle material. Recover over an existing shingle system shall be with a product having Product Approval as prepared roof covering, in strict compliance with the application method detailed in the Product Approval.

R4402.10.17.1 Application of elastomeric and or maintenance coating systems over existing asphalt shingles shall be in accordance with the shingle manufacturer's approved installation instructions.

R4402.10.18 Sprayed polyurethane foam (PUF) and elastomeric coating systems may be applied over existing roofing assemblies providing the PUF system has obtained Product Approval, the deck has been prepared in compliance with the Product Approval and this code, the application is in strict compliance with the foam manufacturer's published application instructions for the environmental conditions at the time of application and post-application inspections conform to RAS 109.

R4402.10.18.1 No sprayed polyurethane foam (PUF) system shall be applied over existing composition shingles.

R4402.10.18.2 Upon completion of a PUF system, an inspection of the system shall be carried out by an authorized representative of the coating manufacturer. A certification shall be furnished to the building official within 30 days of completion, confirming that the quality control tests detailed in the PUF system Product Approval have been carried out with satisfactory results.

R4402.10.18.3 Should a PUF system have inadequate adhesion to meet the design pressures, as set forth in Section R4403, the roofing system shall be removed and replaced with a roofing system tested to adequate adhesion. An additional inspection shall be required once the roofing system has been replaced. A field adhesion test may be requested by the building official during the application or at the completion of the project to confirm adequate adhesion.

R4402.10.18.4 The PUF system shall comply with R4402.10.

R4402.10.18.5 All PUF systems shall be installed by licensed roofing contractors holding an applicator's certificate from the manufacturer holding the Product Approval for the PUF system.

R4402.10.19 Roof coverings or roofing components, such as tile, slate or similar, shall not be applied over an existing roofing system.

R4402.10.20 Lightweight insulated concrete shall not be applied over an existing roofing system unless the existing roofing assembly is verified to be adequate to accept the new lightweight insulating concrete and is in compliance with the testing required herein.

R4402.10.21 Existing ventilation. Ridge ventilation is recommended whenever possible to create airflow entering the soffit and exiting the ridge. Ridge ventilation shall not be installed without adequate soffit ventilation to draw outside air through the ridge void. When recovering, repairing or reroofing, the existing amount of attic ventilation shall not be reduced.

Exception: Attic spaces designed by a Florida-licensed engineer or registered architect to eliminate the attic venting.

SECTION R4402.11
HIGH-VELOCITY HURRICANE ZONES — ROOFTOP STRUCTURES AND COMPONENTS

R4402.11.1 Rooftop structures. Rooftop structures shall be designed and constructed in accordance with the *Florida Building Code, Building.*

R4402.11.2 Rooftop mounted equipment. All rooftop equipment and supports shall be secured to the structure in compliance with the loading requirements of Section R4403. The use of wood "sleepers" shall not be permitted.

R4402.11.3 Machinery, piping, conduit, ductwork, signs and similar equipment may be mounted on roofs in compliance with the following:

R4402.11.3.1 Permanently mounted rooftop equipment shall be installed to provide clearances, in accordance with Table R4402.11.3, to permit repairs, replacement and/or maintenance of the roofing system or any of its components.

TABLE R4402.11.3
ROOF MOUNTED EQUIPMENT HEIGHT REQUIREMENTS

WIDTH OF EQUIPMENT (in.)	HEIGHT OF LEGS (in.)
Up to 24	14
25 to 36	18
37 to 48	24
49 to 60	30
61 and wider	48

For SI: 1 inch = 25.4 mm

R4402.11.3.2 When reroofing, recovering, performing repair or roof maintenance, and where the roof top equipment is moved to properly execute such work, the minimum clearances of the said equipment support shall be in accordance with Table R4402.11.3.

R4402.11.3.3 In buildings where the existing rooftop equipment, in the opinion of the building official, provides sufficient clearance to repair, recover, replace and/or maintain the roofing system or any of its components, such existing equipment need not comply with Table R4402.11.3.

R4402.11.3.4 Electrical conduit, mechanical piping or any other service lines running on the roof shall be raised not less than 8 inches (203 mm) above the finished roof surface.

R4402.11.3.5 Condensate lines shall not drain on the roofing system or any of its components. Condensate lines need not comply with the minimum clearance requirements.

SECTION R4402.12
HIGH-VELOCITY HURRICANE ZONES — TESTING

R4402.12.1 Scope. This section defines the minimum testing requirements for substrates, roofing components, roofing systems and roofing assemblies. All roofing products shall be tested for physical properties, water-infiltration, uplift performance and fire resistance, as addressed within this code.

R4402.12.1.1 Testing requirements for physical properties of all roofing products shall be as set forth in TAS 110.

R4402.12.1.2 Testing requirements for fire resistance shall be in compliance with ASTM E 108 or UL 790.

R4402.12.2 Application. Testing for substrates, roofing components, roofing systems and roofing assemblies shall comply with the provisions herein and those of *Florida Building Code, Building* TAS and RAS listed in this code.

R4402.12.3 Laboratory certification. All testing required by this code shall be performed by a certified testing laboratory.

R4402.12.4 Margin of safety. A margin of safety of 2:1 shall be applied to all wind uplift resistance test results. All in-situ (on site) testing shall have an applied 1.45:1 margin of safety.

R4402.12.5 Material labeling. All products shall be identified with the product approval number or logo; or the manufacturer's name or logo. ASTM standard roll goods shall be marked with a yellow line to identify the ASTM standard, or such other marking indicated in the Product Approval.

R4402.12.5.1 All asphaltic shingles, tile products and metal roofing panels and clips shall be labeled on the underside with the *Florida Building Code, Building* insignia, or Product Approval number, or the wording "Florida Building Code, Building Product Approved," and manufacturer's initials or manufacturer's logo, or as specified in the manufacturer's Product Approval.

R4402.12.6 Testing requirements.

R4402.12.6.1 Reserved.

R4402.12.6.2 Continuous roofing systems. All continuous roofing systems shall be tested in compliance with TAS 110 and TAS 114 in its entirety. All continuous roofing systems shall resist a minimum of 90 pound per square foot (psf) (4309 Pa) tested wind uplift pressure resistance. Continuous roofing system testing requirements shall be as follows:

R4402.12.6.2.1 Spray applied polyurethane foam. All spray applied polyurethane foam systems shall be tested in compliance to RAS 109 and TAS 110 and TAS 114.

R4402.12.6.2.1.1 Physical properties testing for acrylic coatings used on spray applied polyurethane foam roofing assemblies shall be tested in compliance with ASTM D 6083-97a and Federal Specification TTC-555B, *Test Specification for Wind-Driven Rain Infiltration Resistance*.

R4402.12.6.3 Liquid applied roofing membranes systems. All liquid applied roofing membranes systems shall be tested in compliance with TAS 114, in addition to the physical properties testing requirements set forth in TAS 110, and fire resistance.

R4402.12.6.3.1 For liquid applied acrylic roofing membrane assemblies, physical properties testing shall be in compliance with ASTM D 6083-97a and Federal Specification TTC-555B, *Test Specification for Wind Driven Rain Infiltration Resistance*.

R4402.12.6.4 The building official may request that a quality control field uplift test be carried out on a continuous roofing system in compliance with test procedure TAS 124. Single-ply systems are not required to meet the

deflection requirements established in the test protocol. The roofing system shall resist the design pressures as calculated in compliance with Section R4403 and as established in TAS 124.

R4402.12.6.4.1 Should a roofing system fail to meet a quality control field uplift test, the roofing contractor may propose to the building official an acceptable method of repair that is in compliance with the requirements of this code.

R4402.12.6.5 Discontinuous roofing systems. All discontinuous roofing systems shall be tested in compliance with TAS 100 for wind driven water infiltration resistance. Test specimens used for this test shall be constructed at the approved test facility. Testing requirements shall be as follows:

R4402.12.6.5.1 Asphaltic shingle systems. All asphaltic shingle systems shall comply with the following requirements: TAS 100, TAS 107, ASTM D 3462 and ASTM D 3018. Asphaltic shingle systems shall have a quality control testing program by an approved independent listing agency.

R4402.12.6.5.2 Clay and cement roof tiles. All roof tiles shall be tested in compliance with TAS 100. Physical properties testing for clay roof tiles shall be in compliance with ASTM D 1167. Physical properties testing for concrete roof tiles shall be in compliance with TAS 112. All roof tiles shall resist a minimum wind uplift resistance as determined by Section R4403 of this code and RAS 127. Clay and cement roof tile systems requirements are as follows:

R4402.12.6.5.2.1 Underlayment. All underlayments used in discontinuous roof tile systems shall be tested in compliance with TAS 103 and TAS 104, unless otherwise specifically listed in the applicable RAS.

R4402.12.6.5.2.2 Mortar or adhesive set roof tile systems. All mortar or adhesive set tile systems shall be tested for static uplift resistance in compliance with TAS 101, the results of which shall be listed in the system manufacturer's Product Approval.

R4402.12.6.5.2.2.1 Additionally, roof tile system manufacturers may test for wind characteristics in compliance with TAS 108, provided the system is determined to be air permeable by testing in compliance with TAS 116; and the tiles meet the size criteria set forth in TAS 108. The result from this testing shall be an aerodynamic multiplier (l) which represents the system's wind characteristics and shall be listed in the system manufacturer's Product Approval.

R4402.12.6.5.2.2.2 Systems which are tested for characteristics, in compliance with TAS 108 as specified above, shall have the results of the TAS 101 testing treated as attachment resistance moment (M_f), which is representative of the tile bond's resistance to overturning moment, and the tile's restoring moment due to gravity (M_g). Such systems shall use the system's aerodynamic multiplier (l) in conjunction with the system's attachment resistance moment (M_f) and restoring moment due to gravity (M_g), as determined from the TAS 101 static uplift testing. These results shall be used in conjunction with the attachment calculations outlined in TAS 115 as a moment-based system. Such calculations shall be submitted to the building official for review.

R4402.12.6.5.2.2.3 Systems that are not tested in compliance with TAS 108 as specified above shall have their Product Approval based on the system's uplift minimum characteristic resistance force (*F'*), as determined from TAS 101 static uplift testing. These results shall be used in conjunction with the attachment calculations outlined in TAS 115 as an uplift-based system. Such calculations shall be submitted to the building official for review.

R4402.12.6.5.2.2.4 Testing in accordance with TAS 106 shall be considered a product application quality control test to determine the general adhesion properties of the system.

R4402.12.6.5.2.3 Mechanically fastened, rigid roofing systems. All mechanically attached set tile systems shall be tested for static uplift resistance in compliance with TAS 102 or TAS 102(A), the results of which shall be listed in the system manufacturer's Product Approval.

R4402.12.6.5.2.3.1 Additionally, roof tile system manufacturers may test for wind characteristics in compliance with TAS 108, provided the system is determined to be air permeable by testing in compliance with TAS 116; and the tiles meet the size criteria set forth in TAS 108. The result from this testing shall be an aerodynamic multiplier (l) which represents the system's wind characteristics and shall be listed in the system manufacturer's Product Approval.

R4402.12.6.5.2.3.2 Systems which are tested for wind characteristics in compliance with TAS 108 as specified above shall have the results of the TAS 102 or TAS 102(A) testing treated as an attachment resistance moment (M_f) which is representative of the rigid component's attachment resistance to an overturning moment, and the tile's restoring moment due to gravity (M_g). Such systems shall use the system's aerodynamic multiplier (l), in conjunction with the system's attachment resistance moment (M_f) and restoring moment due to gravity (M_g), as determined from the TAS 102 or TAS 102(A) static uplift testing. These results shall be used in conjunction with the attachment calculations outlined in TAS 115 as a

moment-based system. Such calculations shall be submitted to the building official for review.

R4402.12.6.5.2.3.3 Systems that are not tested in compliance with TAS 108 as specified above shall have their Product Approval based on the system's uplift minimum characteristic resistance force (*F'*), as determined from TAS 102 or TAS 102(A) static uplift testing. These results shall be used in conjunction with the attachment calculations outlined in TAS 115 as an uplift-based system. Such calculations shall be submitted to the building official for review.

R4402.12.6.5.2.3.4 TAS 106 quality control field static uplift testing shall be considered a product application quality control test to determine the general uplift resistance properties of the system.

R4402.12.6.5.2.4 Metal shingles/panels. All metal roofing shall be tested in compliance with TAS 100. All metal roofing shall resist a minimum wind uplift resistance as determined by Section R4403 for a roof slope of 9.5 degrees (0.0166 rad) and a roof mean height of 15 feet (4.6 m). All metal roofing systems testing requirements shall be as follows:

R4402.12.6.5.2.4.1 All metal roofing shall be test in compliance with requirements set forth in TAS 110 and TAS 125, and shall be tested for wind driven rain infiltration resistance in compliance with TAS 100.

R4402.12.6.5.2.4.2 Rigid metal shingle systems may be tested in an identical manner to nail-on or batten tile systems as set forth in this code.

R4402.12.6.5.2.5 Wood shingles or shakes. All wood shingles and shakes shall be tested, as a system, for wind driven rain infiltration resistance in compliance with TAS 100. The same specimens as tested in TAS 100 shall be tested for pull through tear resistance, and such values shall be listed in the manufacturer's Product Approval.

R4402.12.6.5.2.6 Fiber cement shingle or tile panels. All fiber cement shingles or tiles shall resist a minimum wind uplift resistance as determined by Section R4403 for a roof slope of 9.5 degrees (0.0166 rad) and a roof mean height of 15 ft (4.6 m). All fiber cement shingle or tiles shall be tested in compliance with the following requirements. Wind driven water resistance in compliance with TAS 100, Physical properties in compliance with TAS 110, TAS 135 and uplift resistance.

R4402.12.6.5.2.6.1 Additionally, fiber cement tile system manufacturers may test for wind characteristics in compliance with TAS 108, provided the system is determined to be air permeable by testing in compliance with TAS 116 and the tiles meet the size criteria set forth in TAS 108. The result from this testing shall be an aerodynamic multiplier (l) which represents the system's wind characteristics and shall be listed in the system manufacturer's Product Approval.

R4402.12.6.5.2.6.2 Systems which are tested for wind characteristics in compliance with TAS 108 as specified above shall have the results of the TAS 102 or TAS 102(A) testing treated as an attachment resistance moment (M_f) which is representative of the rigid component's attachment resistance to an overturning moment, and the tile's restoring moment due to gravity (M_g). Such systems shall use the system's aerodynamic multiplier (l), in conjunction with the system's attachment resistance moment (M_f) and restoring moment due to gravity (M_g), as determined from the TAS 102 or TAS 102(A) static uplift testing. These results shall be used in conjunction with the attachment calculations outlined in TAS 115 as a moment-based system. Such calculations shall be submitted to the building official for review.

R4402.12.6.5.2.6.3 Systems that are not tested in compliance with TAS 108 as specified above shall have their Product Approval based on the system's uplift minimum characteristic resistance force (*F'*), as determined from TAS 102 or TAS 102(A) static uplift testing. These results shall be used in conjunction with the attachment calculations outlined in TAS 115 as an uplift-based system. Such calculations shall be submitted to the building official for review.

R4402.12.6.5.2.6.4 TAS 106 quality control field static uplift testing shall be considered a product application quality control test to determine the general uplift resistance properties of the system.

R4402.12.6.5.2.7 Quarry roof slate. All quarry roof slate shall be tested in compliance with TAS 100 and TAS 110.

R4402.12.6.5.2.8 Roof board insulation. All roof board insulation shall be tested for physical properties as set forth in Section 7 of TAS 110.

R4402.12.6.5.2.9 Insulation fasteners, membrane fasteners and stress plates. All insulation fasteners, membrane fasteners and stress plates shall be tested in compliance with TAS 117 Appendices A, B and C, and TAS 110 and TAS 114, Appendix E, Section 3, (DIN 50018), for corrosion resistance.

R4402.12.6.5.2.10 Roofing nails and tin-caps. All roofing nails and tin-caps shall be tested for corrosion resistance in compliance with TAS 114, Appendix E, Section 2 (ASTM G 85).

R4402.12.6.5.2.11 Roof tile nails or fasteners. All roof tile nails or fasteners, except those made

of copper, monel, aluminum or stainless steel, shall be tested for corrosion in compliance with TAS 114, Appendix E, Section 2 (ASTM G 85), for salt spray for 1,000 hours.

R4402.12.6.5.2.11.1 Tile fasteners used in coastal building zones, as defined in Section R4403 shall be copper, monel, aluminum or stainless steel.

R4402.12.6.5.2.12 Roofing adhesives, mastics and coatings. All roofing adhesives, mastics and coatings shall be tested in compliance with TAS 110 and TAS 121.

R4402.12.6.5.2.12.1 All roofing adhesives, mastics and coatings shall have a quality control testing program by an approved independent listing agency having unannounced follow-up visits.

R4402.12.6.5.2.12.2 Acrylic roof coatings shall be tested for physical properties in compliance with ASTM D 6083-97a.

R4402.12.6.5.2.13 Ridge vents of metal, plastic or composition material. All ridge vents shall be tested in compliance with TAS 110(A) for for wind driven water infiltration. All ridge ventilators shall be restricted to roof mean height as tested in compliance with TAS 100(A), and shall be listed in the system manufacturer's Product Approval.

R4402.12.6.5.2.13.1 All plastic ridge ventilators shall be tested for physical properties as set forth in TAS 110 and R4412.

R4402.12.6.5.2.13.2 All plastic ridge ventilator manufacturers shall have an unannounced follow-up quality control program from an approved listing agency. Follow-up test results shall be made available upon request.

R4402.12.6.5.2.14 Edge metal, flashings, and coping. All edge metal, flashing and copings, not specifically described in RAS 111, shall be tested in complianced with TAS 110, TAS 111(A), TAS 111(B) or TAS 111(C), respectively.

R4402.12.6.5.2.15 Roof tile premixed bagged mortar. All premixed roof tile mortar shall comply with the requirements set forth in TAS 110 and TAS 123, and shall have a quality control testing program by an approved independent listing agency having unannounced follow-up visits. Follow-up test results shall be made available upon request.

R4402.12.6.5.2.16 Roof tile adhesive used in repair or supplemental tile attachment. All roof tile adhesive used in repair or supplemental tile attachment shall comply with the requirements set forth in TAS 110 and TAS 123(A).

R4402.12.6.5.2.17 Roof tile adhesive used in adhesive set tiles systems. All roof tile adhesive used in adhesive set tile systems shall comply with the requirements set forth in TAS 110 and TAS 123. Physical properties shall be as follows:

R4402.12.6.5.2.17.1 Tested for compressive strength in compliance with ASTM D 1621 with a minimum strength of 18 psi (121 kPa) parallel to rise, and 12 psi (82.7 kPa) perpendicular to rise.

R4402.12.6.5.2.17.2 Tested for density in compliance with ASTM D 1622 with a minimum density of 1.6 pcf (25.6 kg/m^3).

R4402.12.6.5.2.17.3 Tested for tensile strength in compliance with ASTM D 1623 with a minimum requirement of 28 psi (193 kPa) parallel to rise.

R4402.12.6.5.2.17.4 Tested for dimensional stability taken from a free rise sample specimen. Tested in compliance with ASTM D 2126 with a maximum volume change of +0.07 percent volume change at -40ºF (-40ºC) for two weeks; and +6.0 percent volume change at 158ºF (70ºC) and 100 percent RH for two weeks.

R4402.12.6.5.2.17.5 Tested in compliance with ASTM D 2856 from a free rise sample specimen with a minimum requirement for 85 percent.

R4402.12.6.5.2.17.6 Tested for water absorption in compliance with ASTM D 2842 with a maximum requirement of 10 percent.

R4402.12.6.5.2.17.7 Tested in compliance with ASTM E 96 for moisture vapor transmission for a maximum of 3.1 perms.

SECTION R4402.13 HIGH-VELOCITY HURRICANE ZONES—REQUIRED OWNERS NOTIFICATION FOR ROOFING CONSIDERATIONS

R4402.13.1 Scope. As it pertains to this section, it is the responsibility of the roofing contractor to provide the owner with the required roofing permit, and to explain to the owner the content of this section. The provisions of Section R4402 govern the minimum requirements and standards of the industry for roofing system installations. Additionally, the following items should be addressed as part of the agreement between the owner and the contractor. The owner's initial in the designated space indicates that the item has been explained.

1. **Aesthetics–workmanship:** The workmanship provisions of Section R4402 are for the purpose of providing that the roofing system meets the wind resistance and water intrusion performance standards. Aesthetics (appearance) are not a consideration with respect to workmanship provisions. Aesthetic issues such as color or architectural appearance, that are not part of a zoning code, should be addressed as part of the agreement between the owner and the contractor.

2. **Renailing wood decks:** When replacing roofing, the existing wood roof deck may have to be renailed in accordance with the current provisions of Section R4403. (The roof deck is usually concealed prior to removing the existing roof system).
3. **Common roofs:** Common roofs are those which have no visible delineation between neighboring units (i.e., townhouses, condominiums, etc.). In buildings with common roofs, the roofing contractor and/or owner should notify the occupants of adjacent units of roofing work to be performed.
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.

   Exception: Attic spaces, designed by a Florida-licensed engineer or registered architect to eliminate the attic venting, venting shall not be required.

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

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

Florida Building Code Edition 2010
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

☐ Low Slope
☐ Asphaltic Shingles
☐ Mechanically Fastened Tile
☐ Metal Panel/Shingles
☐ Mortar/Adhesive Set Tile
☐ Wood Shingles/Shakes
☐ 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:

P1: _____ P2: _____ P3: _____

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

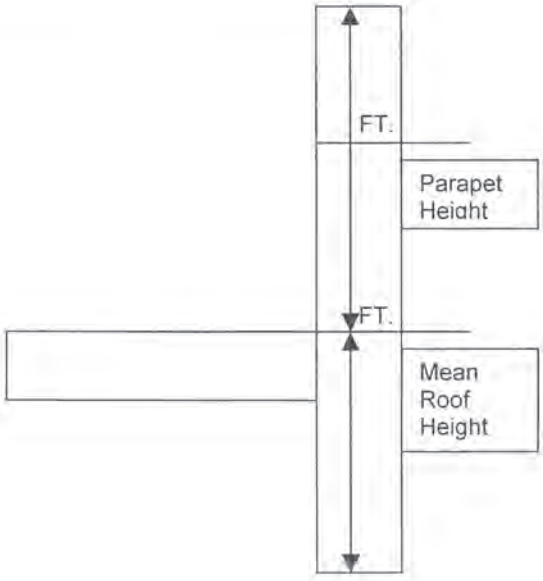
Number of Fasteners Per Insulation Board

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

Deck Type:

Type Underlayment:

Roof Slope: _____: 12

Insulation:

Fire Barrier:

Ridge Ventilation? _____

Fastener Type & Spacing:

Adhesive Type:

Type Cap Sheet:

Roof Covering:

Mean Roof Height:_____

Type & Size Drip Edge:

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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_f. If the M_f values are greater than or equal to the Mr 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:_____ x λ _____= _____) – M_g: _____ = M_{r1} _____ **Product Approval M_f _____**
(P_2:_____ x λ _____= _____) – M_g: _____ = M_{r2} _____ **Product Approval M_f _____**
(P_3:_____ x λ _____= _____) – M_g: _____ = M_{r3} _____ **Product Approval M_f _____**

Method 2 "Simplified Tile Calculation Per Table Below"

Required Moment of Resistance (M_r) From Table Below _____ **Product Approval M_f _____**

M_r Required Moment Resistance*					
Mean Roof Height → / Roof Slope ↓	15'	20'	25'	30'	40'
2:12	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: ____ x l: ____ = ____ x w: = ____) – W: ____ x cos θ: ____ = F_{r1}: ____ **F'** _____
(P_2: ____ x l: ____ = ____ x w: = ____) – W: ____ x cos θ: ____ = F_{r2}: ____ **F'** _____
(P_3: ____ x l: ____ = ____ x w: = ____) – W: ____ x cos θ: ____ = F_{r3}: ____ **F'** _____

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	Product Approval
Restoring Moment due to Gravity	M_g	Product Approval
Attachment Resistance	M_f	Product Approval
Required Moment Resistance	M_r	Calculated
Minimum Attachment Resistance	F'	Product Approval
Required Uplift Resistance	F_r	Calculated
Average Tile Weight	W	Product Approval
Tile Dimensions	l= length w= width	Product Approval
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.

R44003.2.1 Fences. Fences not exceeding 6 feet (183 cm) in height from grade may be designed for 75 mph (33 m/s) fastest mile wind speed or V_{asd} determined in accordance with Section R301.2.1.3 of 90 mph (40 m/s).

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 7feet 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 1foot 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.

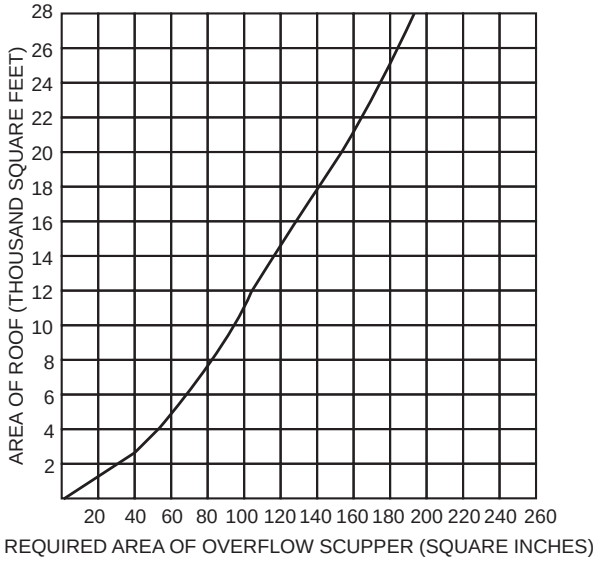

FIGURE R4403.6.3
REQUIRED AREA OF OVERFLOW SCUPPERS

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

loads, partial concentrations of loads, partial load, vibratory, transitory, impact and machine loads. Design shall be based on the load or combination of loads that produces the higher stresses.

R4403.7.2 Below grade structures.

R4403.7.2.1 In the design of basements, tanks, swimming pools and similar below grade structures, provisions shall be made for the forces resulting from hydrostatic pressure and lateral pressure of adjacent soil.

R4403.7.2.2 For the lateral loads of soil on below grade structures, unless substantiated by more specific information, the angle of repose of fragmental rock and natural confined sand shall be 30 degrees and the angle of repose of filled soil and muck shall be 15 degrees to a horizontal line.

R4403.7.2.3 For the hydrostatic pressure on any floor below a ground water level, calculations shall be based on full hydrostatic pressure, and such floors shall be designed for live load without hydrostatic uplift, and hydrostatic uplift without live load.

R4403.7.2.4 Private swimming pools may be designed with an approved hydrostatic relief valve or other device capable of preventing the pool water from being pumped to a level lower than the surrounding ground water but such device shall not be credited for more than 2 feet (610 mm) of the difference of head between the pool bottom and the flood criteria.

R4403.7.3 Safeguards. Safeguards shall be required in and around buildings and structures such as covers, railings, stair-railings, handrails or other safeguards as defined in the regulations of the Occupational Safety and Health Administration (OSHA) 29 CFR Part 1910 as applied to permanent structures and as specified herein.

R4403.7.3.1 Open or glazed wall openings; open or glazed sides of balconies, landings and other walking surfaces; unenclosed floor and roof openings; roofs used for other than services for the building or structure and any other abrupt differences in level exceeding 30 inches (762 mm), including yard areas, shall be provided with safeguards not less than 42 inches (1067 mm) in height.

R4403.7.3.2 Safeguards may be omitted at loading docks, truck wells and similar locations where it is apparent that the edge of the higher level is for loading, and on docks, seawalls and decorative fountains where the lower level is the water surface.

R4403.7.3.3 Safeguards in and around buildings of other than Group R occupancies shall be provided with additional rails, vertical pickets or ornamental filler below the top rail that will reject a 6-inch (152 mm) diameter object.

R4403.7.3.4 Safeguards in and around buildings of Group R occupancies shall provide protection for children by providing additional rails, vertical pickets or an ornamental filler below the top rail which will reject a 4-inch (102 mm) diameter object; permitting, however, such ornamental fillers to have individual openings not exceeding 64 square inches (413 cm^2) in area.

R4403.7.3.5 Where a balustrade is used to comply with the requirements of this paragraph, the maximum clearance between the bottom rail of the balustrade and the adjacent surface shall not exceed 2 inches (51 mm). For safeguards on stairs, the 2-inch (51 mm) clearance shall be measured from the bottom rail of the balustrade to a line passing through the tread nosings.

R4403.7.3.6 Railing.

R4403.7.3.6.1 Railings, stair-railings and other similar safeguards shall be designed to resist a load of 50 pounds per lineal foot (74 kg/m) or a concentrated load of 200 pounds (690 N) applied in any direction at the top of such barriers at any location on the safeguard, whichever condition produces the maximum stresses. The reactions and stresses caused by the above referenced uniform and concentrated loads shall be considered not be acting simultaneously.

R4403.7.3.6.2 Intermediate rails, balusters and panel fillers shall be designed for a uniform horizontal load of not less than 25 pounds per square foot (1197 Pa) over the gross area of the guard, including the area of any openings in the guard, of which they are a part without restriction by deflection. Reactions resulting from this loading need not be added to the loading specified in R4403.3.6.1 in designing the main supporting members of guards.

R4403.7.3.6.3 Laminated glazing will be permitted as an equal alternate to pickets, if tested by an accredited laboratory to satisfy the resistance requirements of this code for wind, live and kinetic energy impact loading conditions. The kinetic energy impact loading shall comply with ANSI Z97.1-1984 using a 400 foot-pound (542 N-m) energy impact. The safety requirements of the impact test shall be judged to have been satisfactorily met if breakage does not occur or numerous cracks and fissures occur but no shear or opening through which a 3-inches (76 mm) diameter sphere may freely pass. The glass panel shall remain within the supporting frame.

R4403.7.3.6.4 If the posts that support the top rail of exterior railings are substituted with glass, the assembly shall be tested to TAS 201, where the impacted glass continues to support the top rail and all applicable loads after impact.

R4403.7.3.7 Areas in all occupancies from which the public is excluded requiring such protection may be provided with vertical barriers having a single rail midway between a top rail and the walking surface.

R4403.7.4 Reserved.

R4403.7.5 Special requirements for cable safeguard barriers.

R4403.7.5.1 Horizontal deflection under design load shall not exceed 18 inches (457 mm).

R4403.7.5.2 The design load shall be assumed to be resisted by not more than two cables.

R4403.7.5.3 The cable system including anchors shall be protected against corrosion.

R4403.7.5.4 Cable tension under design load shall not exceed 90 percent of the yield strength of the cable.

R4403.7.5.5 The uppermost cable shall be at least 42 inches (1067 mm) above the adjacent surface. Cables shall not be spaced more than 6 inches (152 mm) apart.

R4403.7.5.6 An installation plan prepared by the structural engineer of record shall be submitted to the building official for his or her approval.

R4403.7.5.7 Installation shall be witnessed by the structural engineer of record who shall certify the following:

1. That the installation has been in accordance with the approved installation plan.
2. That the initial tension designated by the structural engineer of record has been provided in all cables.
3. That all anchors have been seated at a total load, including initial tension, equal to 85 percent of the yield strength of the cable, unless a positive locking device is provided that does not require a tension jack for the tensioning of the barrier strand.

R4403.7.5.8 Drawings shall indicate the initial tension, the expected increase in tension under vehicular impact and the required maximum capacity of the strand barrier system.

R4403.7.6 Ornamental projections. Ornamental cantilevered projections on the exterior of buildings shall be designed for not less than 60 pounds per square foot live load (2873 Pa) or 200 pounds per lineal foot (2919 N/m) applied at the outer edge, whichever is more critical.

R4403.7.7 Interior wall and partitions. Permanent, full-height interior walls and partitions shall be designed to resist a lateral live load not less than 5 pounds per square foot (239 Pa) and if sheathed with lath and plaster, deflection at this load shall not exceed L/360.

R4403.7.8 Load combination. The safety of structures shall be checked using the provisions of 2.3 and 2.4 of ASCE 7 with commentary. Flood Load Fa mentioned in these load combinations shall be in accordance with Chapter 5 of ASCE 7.

Exception: Increases in allowable stress shall be permitted in accordance with TMS 402/ACI 530/ASCE 5 provided the load reduction factor of 0.75 of combinations 4 and 6 of ASCE 7 Section 2.4.1 shall not be applied.

SECTION R4403.8
HIGH-VELOCITY HURRICANE ZONES — LIVE LOAD REDUCTIONS

R4403.8.1 Application. No reduction in assumed live loads set forth in this section shall be allowed in the design of columns, walls, beams, girders and foundations, except as permitted by the provisions of Section 4.7 ASCE 7 with commentary.

Exceptions:

1. No reduction of the assumed live loads shall be allowed in the design of any slabs, joists or other secondary members, except as set forth herein.
2. No reduction in roof live loads shall be permitted except as set forth by Section R4403.5.1.

R4403.8.2 Allowable live load reductions.

R4403.8.2.1 Permissible reduction in live loads shall be as provided in Section 4.7 of ASCE 7 with commentary.

R4403.8.2.2 Limitations on live load reduction shall be as noted in Section 4.7 of ASCE 7 with commentary.

R4403.8.2.3 No reduction in live loads shall be permitted for buildings or structures of Group A assembly occupancy.

SECTION R4403.9
HIGH-VELOCITY HURRICANE ZONES — WIND LOADS

R4403.9.1 Buildings and structures, and every portion thereof, shall be designed and constructed to meet the requirements of Chapters 26 through 31of ASCE 7.

R4403.9.2 Wind velocity (3-second gust) used in structural calculations shall be 170 miles per hour (76 m/s) in Broward County and 175 miles per hour (79 m/s) in Miami-Dade County.

R4403.9.3 All buildings and structures shall be considered to be in Exposure Category C, unless Exposure Category D applies, as defined in Section 26.6 of ASCE 7.

R4403.9.4 For wind force calculations, roof live loads shall not be considered to act simultaneously with the wind load.

R4403.9.5 Utility sheds shall be designed for a wind load of not less than 15 pounds per square foot (718 Pa).

R4403.9.6 The lateral force on rooftop structures and equipment with A_f less than (0.1Bh) located on buildings of all heights shall be determined from Equation 29.5-1 of ASCE 7 in which the value of GC_f is 3.1. GC_f shall be permitted to be reduced linearly from 3.1 to 1.1 as the value of A_f is increased from (0.1Bh) to (Bh). The value of G from Section 26.9 of ASCE 7 shall not be used. Additionally, a simultaneous uplift force shall be applied, given by Equation 29.5-1 of ASCE 7 in which $GC_f = 1.5$ and A_f is replaced by the horizontal projected area, A_r, of the rooftop structure or equipment. For the uplift force GC_f shall be permitted to be reduced linearly from 1.5 to 1.0 as the value of A_r is increased from (0.1 BL) to (BL).

SECTION R4403.10
HIGH VELOCITY HURRICANE ZONES — OVERTURNING MOMENT AND UPLIFT

R4403.10.1 Computations for overturning moment and uplift shall be based on ASCE 7.

R4403.10.2 Overturning and uplift stability of any building, structure or part thereof taken as a whole shall be provided, and be satisfied by conforming to the load combination requirements of ASCE 7.

SECTION R4403.11
HIGH VELOCITY HURRICANE ZONES — SUNROOMS

R4403.11.1 Wind Loads. Basic wind speed in miles per hour (mph) shall be determined in accordance with Section R4403.9.2. Sunrooms including exposed structures, components, cladding, and roof covering shall be designed to resist the wind loads as established in Section R4403.9.

R4403.11.2 Sunroom Categories. Sunrooms shall be categorized in one of the following categories by the permit applicant, design professional, or the property owner where the sunroom is being constructed.

Category I: A roof or a covering of an outdoor space. The openings shall be permitted to be enclosed with insect screening or 0.5 mm (20 mil) maximum thickness plastic film. The space is defined as nonhabitable and unconditioned.

Category II: A roof or a covering of an outdoor space with enclosed walls. The openings are permitted to be enclosed with translucent or transparent plastic or glass. The space is defined as nonhabitable and unconditioned.

Category III: A roof or a covering of an outdoor space with enclosed walls. The openings are permitted to be enclosed with translucent or transparent plastic or glass. The sunroom complies with additional requirements for forced-entry resistance, air-leakage resistance and water-penetration resistance. The space is defined as nonhabitable and unconditioned.

Category IV: A roof or a covering of an outdoor space with enclosed walls. The sunroom is designed to be heated and/or cooled by a separate temperature control or system and is thermally isolated from the primary structure. The sunroom complies with additional requirements for forced-entry resistance, water penetration resistance, air-leakage resistance, and thermal performance. The space is defined as habitable and conditioned.

Category V: A roof or a covering of an outdoor space with enclosed walls. The sunroom is designed to be heated and/or cooled and is open to the main structure. The sunroom complies with additional requirements for forced-entry resistance, water-penetration resistance, air-leakage resistance, and thermal performance. The space is defined as habitable and conditioned.

SECTION R4403.12
HIGH-VELOCITY HURRICANE ZONES — SCREEN ENCLOSURES

R4403.12.1 Screen enclosures.

R4403.12.1.1 The wind loads on screen surfaces shall be per ASCE 7 Figure 29.5-2 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.

Exception: Screen enclosures shall be permitted to be designed in accordance with the AAF *Guide to Aluminum Construction in High Wind Areas*. Construction documents based on the AAF *Guide to Aluminum Construction in High Wind Areas* shall be prepared and signed and sealed by a Florida licensed architect or engineer.

R4403.12.2 Windbreakers.

R4403.12.2.1 Vinyl and acrylic glazed panels shall be removable. Removable panels shall be identified as removable by a decal. The identification decal shall essentially state “Removable panel SHALL be removed when wind speeds exceed 75 mph (34 m/s).” Decals shall be placed such that the decal is visible when the panel is installed.

R4403.12.2.2 Permanent frame shall be designed per Sections R4403.9 and R4402.12.1.2.

SECTION R4403.13
HIGH VELOCITY HURRICANE ZONES— FLOOD RESISTANCE

R4403.13.1 Flood Resistance.

R4403.13.1.1 Flood resistance. Where the building or structure is located in a flood hazard area established in Table 301.2(1), the building or structure, including enclosures below elevated buildings, shall be designed and constructed in accordance with Section R322 and this section.

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 $0.5p_{max}$[2]	600
0 to $0.6p_{max}$	70
0 to $1.3p_{max}$	1

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.
2. p_{max} = 0.6 × ultimate design load in accordance with ASCE 7.

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 m^2) 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.

R4403.16.2.8 A particular system of construction shall be deemed to comply with this recommended practice if three test specimens reject the two missile impacts without penetration and resist the cyclic pressure loading with no crack forming longer than 5 inches (127 mm) and $^{1}/_{16}$ inch (1.6 mm) wide through which air can pass.

R4403.16.2.9 If only one of the three test specimens in a test fails to meet the above listed criteria, one retest of this system of construction (another test sequence with three specimens) shall be permitted.

R4403.16.3 Small missile impact test.

R4403.16.3.1 This test shall be conducted on three test specimens. This test shall be applicable to the construction units, assemblies, and materials to be used above 30 feet (9.1 m) in height in any and all structures.

R4403.16.3.2 Each test specimen 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. The fasteners used in mounting the test specimen shall be identical in size and spacing to those to be used in field installations.

R4403.16.3.3 The missiles shall consist of solid steel balls each having a mass of 2 grams (0.07 oz) (+/-5 percent) with a $^{5}/_{16}$-inch (7.9 mm) nominal diameter.

R4403.16.3.4 Each missile shall impact the surface of each test specimen at a speed of 130 feet per second (40 m/s).

R4403.16.3.5 Each test specimen shall receive 30 small missile impacts except as noted in Sections R4403.16.3.5.1 and Section R4403.16.3.5.2 delivered in groups of 10 at a time: the first 10 distributed uniformly over a 2-square-foot (0.19 m^2) area located at the center of the test specimen, the second 10 distributed uniformly over a 2-square-foot (0.19 m^2) area located at the center of the long dimension of the specimen near the edge, and the third 10 distributed uniformly over a 2-square-foot (0.19 m^2) area located at a corner of the specimen.

R4403.16.3.5.1 For window and skylight assemblies, all 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 in accordance with Section R4403.16.3.5. If a light of glass is sufficiently small to cause the 5-inch (127 mm) radius circles to overlap, separate lights may be impacted; however, there must be a total of 30 impacts within the assembly.

R4403.16.3.5.1.1 For window, fixed glass and skylight assemblies comprised of glass with different thickness, types of glass or different types of glazing infill, each separate thickness or type shall be impacted in accordance with Section R4403.16.3.5.

R4403.16.3.5.2 For doors, wall cladding and external protection devices, all impacts shall be to the thinnest section through the assembly. For doors, wall cladding and external protection devices with horizontal and/or vertical bracing, all impacts shall be within a single area that is not reinforced and shall be impacted in accordance with Section R4403.16.3.5.

R4403.16.3.5.2.1 For doors with glass, the glass shall be impacted in accordance with Section R4403.16.3.5 and the thinnest section through the assembly that is not glass shall be impacted in accordance with Section R4403.16.3.5.

R4403.16.3.6 In the case of glazing, after completion of the small missile impacts, each test specimen shall then be subjected to the cyclic pressure loading defined in Table R4403.16.

R4403.16.3.6.1 If external protection devices are employed to protect windows, doors or skylights, they must resist the small missile impacts specified in Sections R4403.16.3.3 and R4403.16.3.4 without deformations that result in contact with the windows, glass, doors or skylights they are intended to protect.

R4403.16.3.6.2 If external protection devices are not designed to be air tight, following the small 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.

R4403.16.3.7 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 for the full load to be transferred to the specimen and to ensure 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.

R4403.16.3.8 A particular system of construction shall be deemed to comply with this test if three test specimens reject the small missile impacts without penetration and resist the cyclic pressure loading with no crack forming longer than 5 inches (127 mm) and $^{1}/_{16}$ inch (1.6 mm) in width through which air can pass.

R4403.16.3.9 If only one of the three test specimens in a test fails to meet the above listed criteria, one retest of the system (another test sequence with three specimens) of construction shall be permitted.

R4403.16.4 Construction assemblies deemed to comply with R4403.16.

1. Exterior concrete masonry walls of minimum nominal 8 inch (203 mm) thickness, constructed in accordance with Section R4407 of this code.
2. Exterior frame walls or gable ends constructed in accordance with Section R4408 and Section R4409 of this code, sheathed with a minimum $^{19}/_{32}$-inch (15 mm) CD exposure 1 plywood and clad with wire lath and stucco installed in accordance with Section R4411 of this code.
3. Exterior frame walls and roofs constructed in accordance with Section R4408 of this code sheathed with a minimum 24-gauge rib deck type material and clad with an approved wall finish.
4. Exterior reinforced concrete elements constructed of solid normal weight concrete (no voids), designed in accordance with Section R4405 of this code and having a minimum 2 inches (51 mm) thickness.
5. Roof systems constructed in accordance with Section R4408 or Section R4409 of this code, sheathed with a minimum $^{19}/_{32}$-inch (15 mm) CD exposure 1 plywood or minimum nominal 1-inch (25 mm) wood decking and surfaced with an approved roof system installed in accordance with Section R4402 of this code.

All connectors shall be specified by the building designer of record for all loads except impact.

TABLE R4403.16
CYCLIC WIND PRESSURE LOADING

INWARD ACTING PRESSURE		OUTWARD ACTING PRESSURE	
RANGE	NUMBER OF CYCLES[1]	RANGE	NUMBER OF CYCLES[1]
0.2 P_{max} to 0.5 P_{max}[2]	3,500	0.3 P_{max} to 1.0 P_{max}	50
0.0 P_{max} to 0.6 P_{max}	300	0.5 P_{max} to 0.8 P_{max}	1,050
0.5 P_{max} to 0.8 P_{max}	600	0.0 P_{max} to 0.6 P_{max}	50
0.3 P_{max} to 1.0 P_{max}	100	0.2 P_{max} to 0.5 P_{max}	3,350

Notes:

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 1.
2. p_{max} = 0.6 × ultimate design load in accordance with ASCE 7. The pressure spectrum shall be applied to each test specimen beginning with inward acting pressures followed by the outward acting pressures in the order from the top of each column to the bottom of each column.

SECTION R4404
HIGH-VELOCITY HURRICANE ZONES—
FOUNDATIONS AND RETAINING WALLS

R4404.1 Excavations.

R4404.1.1 General. Until provisions for permanent support have been made, all excavations shall be properly guarded and protected so as to prevent them from becoming dangerous to life and property and shall be sheet piled, braced and/or shored, where necessary, to prevent the adjoining earth from caving in; such protection to be provided by the person causing the excavation to be made. All excavations shall comply with the minimum requirements of Florida Statute 553.60, "Trench Safety Act," and 29-CFR1926-650 (P) "Occupational Safety and Health Administration Excavation Safety Act." No excavation, for any purpose, shall extend within 1 foot (305 mm) of the angle of repose of any soil bearing footing or foundation unless such footing or foundation is first properly underpinned or protected against settlement.

R4404.1.2 Permanent excavations. No permanent excavation shall be made nor shall any construction excavations be left on any lot that will endanger adjoining property or buildings or be a menace to public health or safety. Any such excavations made or maintained shall be properly drained and such drainage provisions shall function properly as long as the excavation exists. Permanent excavations shall have retaining walls of steel, masonry, concrete or similar approved material of sufficient strength to retain the embankment together with any surcharged loads.

R4404.1.3 Enforcement. Where, in the opinion of the building official, an unsafe condition may result or damage may occur as the result of an excavation, he may order the work stopped or may approve the work of excavation subject to such limitations, as he may deem necessary.

SECTION R4404.2
HIGH-VELOCITY HURRICANE ZONES—
BEARING CAPACITY OF SOIL

R4404.2.1 Design bearing capacity. Plans for new buildings, structures or additions shall clearly identify the nature of the soil under the structure and the allowable bearing capacity used in sizing the building foundation support system.

Exception: See Section R4404.6.1 for plans for new buildings, structures or additions that are to be supported on a piling foundation system.

R4404.2.2 Allowable bearing capacity. Prior to the installation of any footing foundation system for new buildings, structures or additions, the building official shall be provided with a statement of allowable bearing capacity from an architect or professional engineer. Said statement shall clearly identify the allowable in-place bearing capacity of the building pad for the new building or addition and verify the existing soil conditions. The certified in-place bearing capacity shall have been determined by way of recognized tests or rational analysis and shall meet or exceed the design bearing capacity identified under Section R4404.2.1.

SECTION R4404.3
HIGH-VELOCITY HURRICANE ZONES—
SOIL BEARING FOUNDATIONS

R4404.3.1 General. Footings shall be constructed of reinforced concrete, as set forth in Section R4405 of this code and in this section, and shall, insofar as is practicable, be so designed that the soil pressure shall be reasonably uniform to minimize differential settlement.

R4404.3.2 Continuous wall footings.

R4404.3.2.1 Footings under walls shall be continuous or continuity otherwise provided and shall be not less than required to keep the soil pressure within that set forth in Section R4404.2 nor less than the following minimums:

(Allowable bearing capacity, pounds per square foot)	No. of Stories	Minimum depth and width (inches)[2]
2000	1	12 × 16[1]
2000	2	12 × 24

Notes:

1. For single-story wood-frame exterior walls, the minimum size continuous footing shall be 16 inches deep by 24 inches (406 mm by 610 mm) wide.
2. Any continuous wall footing acting as a shear wall foundation shall be specifically designed for that purpose.

Based on rational analysis and soil investigation as set forth in Section R4410, the footing size or bearing capacity may vary, but the minimum width of a footing under the main walls of the building shall not be less than 16 inches (406 mm) nor less than 8 inches (203 mm) more than the width of the wall.

R4404.3.2.2 Masonry fences, flower bins, steps and similar decorative structures shall have reinforced concrete foundations designed for all live, dead and wind loads as set forth in R4403. The minimum size of these foundations shall be as follows:

(Allowable bearing capacity, pounds per square foot)	Unbraced wall above grade (ft)	Minimum depth and width (inches)[2]
2000	Less than or equal to 3 feet	12 × 16
2000	Greater than 3 feet but less than and including 6 feet	12 × 36
2000	Greater than 6 feet	None provided[1]

Notes:

1. Foundations for masonry fences, flower bins, steps and similar decorative structures with unbraced heights in excess of 6 feet (1829 mm) shall be based on rational analysis.
2. The minimum continuous footings specified in this section shall be reinforced in accordance with Section R4404.3.3.

R4404.3.2.3 Based on rational analysis and soil investigation as set forth in Section R4404, the footing size or bearing capacity may vary, but the minimum width of a footing under masonry fences, flower bins, steps and similar decora-

tive structures shall not be less than16 inches (406 mm) nor less than 8 inches (203 mm) more than the width of the wall.

Exception: Masonry fences, wing walls and other similar walls that are exposed to lateral wind forces and do not have any lateral restraint above grade, shall have their continuous wall footings placed so the top of footing is no less than 16 inches (406 mm) below grade.

R4404.3.3 The minimum continuous footings specified in this section shall be reinforced as follows:

Reinforcing	Width Foundation
2 #5	16 and 20 inches wide
3 #5	24 and 30 inches wide
4 #5	36 inches wide

R4404.3.3.1 Where footings are 30 inches (762 mm) or more in width, cross bars designed to resist bending at the face of the foundation wall shall be provided.

R4404.3.3.1.1 Equivalent areas in #4 reinforcing bars may be substituted for the sizes as specified in Section R4404.3.3.

R4404.3.3.1.2 Splices in reinforcing bars shall be not less than 36 bar diameters and reinforcement shall be continuous around all corners and changes in direction. Continuity shall be provided at corners or changes in direction by bending the longitudinal steel around the corner 48 bar diameters or by adding matching reinforcing steel, which shall extend 48 bar diameters from each corner or change in direction When three or more bars are required, the bars shall be held in place and aligned by transverse bars spaced not more than 4 feet (1219 mm) apart.

R4404.3.3.1.3 The reinforcement for footings and other principal structural members in which concrete is deposited against the ground shall have not less than 3 inches (76 mm) of concrete between the reinforcement and the ground contact surface. If concrete surfaces after removal of the forms are to be exposed to the weather or be in contact with the ground, the reinforcement shall be protected with not less than 2 inches (51 mm) of concrete for bars larger than #5 and $1^1/_2$ inches (38 mm) for #5 or smaller bars.

R4404.3.3.1.4 Excavations for continuous footings shall be cut true to line and grade and the sides of footings shall be formed, except where soil conditions are such that the sides of the excavation stand firm and square. Excavations shall be made to firm, clean bearing soil.

R4404.3.4 Continuous footings shall be placed level and any changes in the grade of such footings shall be made with a vertical tie of the same cross section and design as the footings, or the smaller of the footings, so joined.

R4404.3.4.1 Continuous footings with eccentric loading shall be designed to limit the soil pressure at the edges to within acceptable values by means of counterbalancing or by other approved methods.

R4404.3.4.2 When foundation walls are to be poured separately from the footing, they shall be keyed and doweled to the footing with no less than #4 dowels, 20 diameters in length above and below the joint, spaced not more than 4 feet (1219 mm) apart. Where footing depth does not allow straight dowels, standard hooks will be allowable.

R4404.3.4.3 Concrete footing and pads shall not receive superimposed loads until 12 hours or more after the concrete is placed.

R4404.3.4.4 Excavations for footings and foundations, which are to serve as forms, shall be thoroughly wetted prior to the placement of concrete.

R4404.3.4.5 The top of all continuous footings shall be a minimum of 8 inches (203 mm) below grade.

R4404.3.5 Isolated footings. Dimensions for an isolated footing shall not be less than 12 inches (303 mm) deep and 24 inches (610 mm) square. Isolated footings in soil having low lateral restraint and isolated piers shall be provided with adequate bracing to resist lateral movement.

R4404.3.5.1 Isolated footings with eccentric loading shall be designed to limit the soil pressure at the edges by means of footing straps or other approved methods.

R4404.3.5.2 When isolated footings support reinforced concrete columns, dowels equivalent in number and area to the column reinforcement and having a length not less than 36 diameters above and below the joint shall be provided in the footing. Where the footing depth precludes straight dowels, standard ACI hooks will be allowable. Such dowels, or anchor bolts as required for steel columns, shall be held to proper grade and location during the pouring of the footing by means of templates or by other approved methods.

R4404.3.5.3 The top of all isolated footings shall be a minimum of 8 inches below grade.

R4404.3.5.4 Any isolated footing subjected to uplift and/or overturning forces shall be specifically designed for that purpose, as set forth in Section R4406.10.

R4404.3.6 Lateral sliding resistance. The resistance of structural walls to lateral sliding shall be calculated by combining the values derived from the lateral bearing and the lateral sliding resistance shown in Table R4404.3.6 unless data to substantiate the use of higher values are submitted for approval. For clay, sandy clay and clayey silt, in no case shall the lateral sliding resistance exceed one-half the dead load.

R4404.3.6.1 Increases in allowable lateral sliding resistance. The resistance values derived from the table may be increased by the tabular value for each additional foot of depth to a maximum of 15 times the tabular value. Isolated poles for uses such as flagpoles or signs and poles used to support buildings which are not adversely affected by $^1/_2$-inch (12.7 mm) motion at the ground surface because of short-term lateral loads may be designed using lateral bearing values equal to two times the tabular values.

R4404.3.7 Designs employing lateral bearing. Designs to resist lateral loads employing posts or poles as columns embedded in earth or embedded in concrete footings in the earth shall conform to the requirements of Sections R4404.3.7.1 through R4404.3.7.2.1.

R4404.3.7.1 Limitation. Posts embedded in earth shall not be used to provide lateral support for structural or non structural

materials such as plaster, masonry or concrete unless bracing is provided that develops the limited deflection required.

R4404.3.7.2 Design criteria. The depth to resist lateral loads shall be determined by the design criteria in Sections R4404.3.7.2.1 through R4404.3.7.2.2 or by other methods approved by the building official.

R4404.3.7.2.1 Unconstrained. The following formula shall be used in determining the depth of embedment required to resist the lateral loads where no constraint is provided at the ground surface, such as a structural diaphragm.

$d = 0.5A\{1 + [1 + (4.36h/A)]^{1/2}\}$

Where:

A = $2.34P/(S_1b)$

b = Diameter of round post or diagonal dimension of square post or footing, feet.

d = Depth of embedment in earth in feet but not over 12 feet (3658 mm) for purpose of computing lateral pressure.

h = Distance in feet from ground surface to point of application of P.

P = Applied lateral force, pounds.

S_1 = Allowable lateral soil-bearing pressure as set forth in Table R4404.3.6 based on a depth of one-third the depth of embedment, pounds per square foot.

S_3 = Allowable lateral soil-bearing pressure as set forth in Table R4403.3.6 based on a depth equal to the depth of embedment, pounds per square foot.

R4404.3.7.2.2 Constrained. The following formula shall be used in determining the depth of embedment required to resist the lateral loads where constraint is provided at the ground surface, such as a rigid floor or rigid ground surface pavement.

$d^2 = 4.25(Ph/ S_3b)$

or alternately

$d^2 = 4.25(Mg/ S_3b)$

Where:

M_g = Moment in the post at grade, foot-pounds.

TABLE R4404.3.6
ALLOWABLE LATERAL PRESSURE

Class of Materials	Lateral Bearing (psf/ft below natural grade)	Lateral Sliding	
		Coefficient of Friction[a]	Resistance[b] (psf)
1. Sedimentary and foliated rock	400	0.35	
2. Sandy gravel and/or gravel	200	0.35	
3. Sand, silty sand, clayey sand, silty grave land clayey gravel	150	0.25	
4. Clay, sandy clay, silty clay, clayey silt, silt and sandy silt	100		130

Notes:

a. Coefficient to be multiplied by the dead load

b. Lateral sliding resistance to be multiplied by the contact area, as limited by Section R4404.3.6.

SECTION R4404.4
HIGH-VELOCITY HURRICANE ZONES — CONCRETE SLABS ON FILL

R4404.4.1 Concrete floors placed directly on the supporting soil shall comply with this section.

R4402.4.2 Where it is proposed to place concrete slabs directly on the supporting soil, a subgrade shall be thoroughly compacted by approved methods. All fill placed under slabs shall be clean sand or rock, free of debris and other deleterious materials. The maximum size of rock within 12 inches (305 mm) below the floor slab in compacted fill shall be 3 inches (76 mm) in diameter. Where fill material includes rock, large rocks shall not be allowed to nest and all voids shall be carefully filled with small stones or sand, and properly compacted.

R4404.4.3 Concrete floor slabs placed directly on the supporting soil shall be a minimum of 4 inches (102 mm) in thickness, reinforced with not less than 0.028 square inches (0.000018 m^2) of reinforcing per linear foot of slab in each direction.

R4404.4.3.1 Fill supporting such slabs shall be compacted under the supervision of a special inspector to a minimum of 95 percent of maximum dry density for all layers, as verified by field density tests specified in Section R4404.4.3.2.

R4404.4.3.2 Tests shall be made in accordance with *Methods of Test for Moisture Density Relations of Soils*, ASTM D 1557 modified to use 25 blows on five layers with a 10-pound (4.5 kg) hammer dropping 18 inches. In addition, a minimum of one in-place field density test shall be performed for each 2500 square feet (232 m^2), or fraction thereof, for each lift of compacted soil, and such testing shall be performed in accordance with either ASTM D 1556, *Standard Test Method for Density of Soil In-Place by the Sandcone*; or ASTM D 2922, *Standard Test Methods for Density of Soil and Soil Aggregate* in-place by nuclear methods (shallow depth), or other approved methods.

R4404.4.3.3 Where a concrete slab is supported by a foundation wall or continuous footing, the effect of the support shall be considered in the design.

R4404.4.3.4 All concrete slab edges and concrete beams supporting exterior walls shall be recessed a minimum of $^3/_4$ inch (19 mm) below top of slab for a width of the exterior wall, or provided with an alternate-water stop method approved by the building official.

R4404.4.3.5 The discontinuous edges of all slabs surrounding swimming pools and floor slabs for screen patios and utility sheds shall be at least a minimum of 8 inches (203 mm) deep and 8 inches (203 mm) wide and shall be reinforced with one continuous #5 bar.

R4404.4.3.6 Reinforced concrete slabs on fill for garbage containers shall be a minimum of 1 foot (305 mm) larger on all sides than the garbage receptacle (dumpster) and a minimum thickness of 6 inches (152 mm).

R4404.4.4 When polyethylene sheets are used as a vapor barrier beneath a ground floor slab, the subgrade for that slab shall be considered a formed surface for the purpose of reinforcing steel coverage.

R4404.4.5 Concrete slabs outside of buildings, other than patios and pool slabs, where placed directly on the supporting soil, for minor accessory uses such as, but not limited to, walkways, driveways, minor equipment pads, etc, shall be not less than 4 inches (102 mm) thick. Such slabs shall be placed on clean, thoroughly compacted sand or crushed rock free from organics, debris or other deleterious materials.

SECTION R4404.5
HIGH-VELOCITY HURRICANE ZONES — MONOLITHIC FOOTINGS

R4404.5.1 Monolithic footings under walls shall be continuous or continuity otherwise provided and shall be not less than required to keep the soil pressure within that set forth in Section R4404 nor less than the following minimums:

(Allowable bearing capacity, pounds per square foot)	No. of Stories	Minimum depth and width (inches)[2]
2000	1	12 × 16[1]
2000	2	12 × 24

Notes:

1. For single story wood frame exterior walls, the minimum size continuous footing shall be 16 inches deep by 24 inches (406 mm by 610 mm) wide.
2. Any continuous wall footing acting as a shear wall foundation shall be specifically designed for that purpose.

Based on rational analysis and soil investigation as set forth in Section R4404, the footing size or bearing capacity may vary, but the minimum width of a footing under the main walls of the buildings shall not be less than 16 inches (406 mm) nor less than 8 inches (203 mm) more than the width of the foundation wall.

R4404.5.1.1 A minimum outside finish grade of 8 inches (203 mm) above the bottom of the exterior monolithic footing shall be required, but in no case shall the outside finish grade be above the top of the finish slab surface unless sufficient means to minimize moisture intrusion into the structure have been provided to the satisfaction of the building official.

R4404.5.1.2 Continuous monolithic footings shall be placed level and any change in the grade of such footings shall be made with a step of the same cross section and design as the monolithic footings, or the smaller of the monolithic footings, so joined.

R4404.5.1.3 Continuous monolithic footings with eccentric loading shall be designed to limit the soil pressure at the edges to within acceptable values by means of counterbalancing or by other approved methods.

R4404.5.1.4 Concrete monolithic footings and pads shall not receive superimposed loads until 12 hours or more after the concrete is placed.

R4404.5.1.5 Excavations for monolithic footings and foundations, which are to serve as forms, shall be thoroughly wet prior to placing concrete.

R4404.5.1.6 Monolithic foundation systems shall be limited for the support of a maximum of two stories and/or floors or a maximum mean roof height of 25 feet (7620 mm) above grade unless the monolithic foundation system has been designed by a professional engineer and ample consideration has been given to the eccentric loading, foundation rotation and shear cracking at the slab/foundation interface.

R4404.5.1.7 The minimum continuous monolithic footings specified in this section shall be reinforced as follows:

Reinforcing	Minimum Width Foundation
2 #5	16 and 20 inches wide
3 #5	24 and 30 inches wide
4 #5	36 inches wide

R4404.5.1.8 Where footings are 30 inches (762 mm) or more in width, cross bars designed to resist bending at the face of the foundation wall shall be provided.

R4404.5.1.9 Equivalent areas in #4 reinforcing bars may be substituted for the sizes as specified in Section R4404.5.1.7.

R4404.5.1.10 Splices in reinforcing bars shall be not less than 36 bar diameters and reinforcement shall be continuous around all corners and changes in direction. Continuity shall be provided at corners or changes in direction by bending the longitudinal steel around the corner 48 bar diameters or by adding matching reinforcing steel, which shall extend 48 bar diameters from each corner or change in direction When three or more bars are required, the bars shall be held in place and alignment by transverse bars spaced not more than 4 feet (1219 mm) apart.

R4404.5.1.11 The reinforcement for monolithic footings and other principal structural members in which concrete is deposited against the ground shall have not less than 3 inches (76 mm) of concrete between the reinforcement and the ground contact surface. If concrete surfaces after removal of the forms are to be exposed to the weather or be in contact with the ground, the reinforcement shall be protected with not less than 2 inches (51 mm) of concrete for

bars larger than #5 and $1^1/_2$ inches (38 mm) for #5 or smaller bars.

R4404.5.1.12 Excavations for continuous monolithic footings shall be cut true to line and grade and the sides of footings shall be formed, except where soil conditions are such that the sides of the excavation stand firm and square. Excavations shall be made to firm, clean bearing soil.

R4404.5.1.13 Unless otherwise determined by rational analysis, monolithic footings shall have transfer reinforcement along the perimeter of the foundation. Said reinforcement shall be no less than #4 reinforcing steel bars spaced no greater than 12 inches (303 mm) on center and shall be no less than 5 feet (1524 mm) in length plus a standard ACI hook and shall be placed to transfer into the slab section commencing at a point no less than 3 inches (76 mm) from the edge form.

SECTION R4404.6
HIGH-VELOCITY HURRICANE ZONES—PILE FOUNDATIONS

R4404.6.1 Pile foundations shall be designed and installed on the basis of a geotechnical exploration which shall include field and/or laboratory tests.

R4404.6.1.1 Piles used for the support of any building or structure shall be driven to a resistance and penetration in accordance with the plans and/or specifications as set forth herein.

R4404.6.1.2 Piles may be jetted under the supervision of a professional engineer. Immediately after completion of jetting, piles shall be driven below the depth jetted to the required resistance, but not less than 1 foot (305 mm), or to nominal refusal whichever comes first. No jetting will be permitted that may be detrimental to existing adjacent structures or piles that have been driven.

R4404.6.1.3 When isolated columns, piers and other loads are supported on piles, a minimum of three piles shall be used for such support unless lateral bracing is provided at the pile cap to insure stability. Should a pile group be loaded eccentrically so as to produce an overload on any pile more than 10 percent of the allowable load, footing straps or other approved methods shall be required to counteract the effect of eccentric loading.

R4404.6.1.4 The minimum center-to-center spacing of piles shall be not less than twice the average diameter of round piles or one and three-fourths times the diagonal dimensions of rectangular piles but in no case less than 30 inches (762 mm). Piles supporting structural walls shall have dowels installed to offer sufficient resistance for lateral restraint of a grade beam.

R4404.6.1.5 Nonfluid soil shall be considered as providing full lateral support against column action. The portion of a pile that extends through air, water, fluid soil or other unstable material shall be designed as a structural column. Soils having a consistency stiffer than fluid soil may be considered as capable of providing lateral support. Where cast-in-place piles are used reinforcement shall extend 10 feet (3048 mm) below the plane where the soil provides lateral restraint. Sufficient reinforcement for all types of piles shall be provided at the junction of the pile and pile cap or grade beam to make a suitable connection. Shells conforming to Section R4404.10.1 may be considered as reinforcement.

R4404.6.1.6 Reinforced concrete caps shall be provided for all pile clusters and such caps shall extend laterally not less than 6 inches (152 mm) beyond the extreme pile surface and vertically not less than 4 inches (102 mm) below the pile butt. Pile caps may be omitted when piles are used to support grade beams, provided that the spacing of Section R4404.6.1.4 is complied with, and provided that the portions of the grade beams acting in place of the pile cap shall be computed by a recognized method of analysis to properly carry the loads.

R4404.6.1.7 Piles shall be driven using an approved cushion block consisting of material arranged to provide transmission of hammer energy equivalent to one-piece hardwood with the grain parallel to the axis of the pile and enclosed in a metal housing to prevent its lateral deformation between the hammer ram and the top of the pile.

R4404.6.1.8 Friction piles shall be driven to a minimum penetration of 12 feet (3658 mm) below the cutoff or the existing ground, whichever is the lower.

R4404.6.1.9 Diesel hammers may be used for driving piles if provided with one of the following means of determining the energy of the hammer's blow.

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 indictor 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 $^1/_4$ inch (6.4 mm) per foot from the vertical, or from the batter line indicted, 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

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.

official, the load on a pile shall not exceed that computed from the following driving formula:

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

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

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 AWPA 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 AWPA Use Category Systems Standard U1, Commodity Specification G Use Category 5C. Pile cutoffs shall be treated in accordance with AWPA 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.

R4404.8.1.1 All precast concrete piles shall have their date of manufacture and the lifting points clearly marked on the pile. Concrete piles shall not be driven until they have attained their full specification strength as verified by tests, nor shall the piles be removed from the forms until 50 percent of the specification strength has been attained. Piles shall not be transported nor driven until they have been cured not less than seven days for Type I cement and three days for Type III cement.

R4404.8.1.2 In the absence of load tests, the maximum allowable load per pile shall not exceed the values set forth in Table R4408.8.

TABLE R4404.8

SIZE (INCHES)	MAXIMUM LOAD (TONS)
10 × 10	17
12 × 12	25
14 × 14	35

SECTION R4404.9
HIGH-VELOCITY HURRICANE ZONES—
PRESTRESSED PRECAST CONCRETE PILES

R4404.9.1 Prestressed precast concrete piles shall conform to Section R4405 and to R4404.6.1.1, R4404.6.2, R4404.8. and R4404.12 except as specifically detailed in this section.

R4404.9.1.1 Prestressed concrete piles shall be cast of concrete having a compressive strength of not less than 5,000 psi (35 MPa) at time of driving and 3,000 psi (21 MPa) before transfer of the prestressing force. The prestressing elements shall not be stressed initially in excess of 75 percent of ultimate strength. The elements shall transfer a compressive stress to the concrete, after losses, of not less than 0.08 percent of the specified strength at driving. Under loads other than handling no tension will be permitted in the concrete.

R4404.9.1.2 Longitudinal reinforcing shall be protected by 2 inches (51 mm) of concrete and shall be tied by #2 hoops or #5 AS&W gauge spirals spaced at 8 inches (203 mm) in the body of piling 14 inches (336 mm) or smaller or 9 inches (229 mm) in the body of piling 16 inches or larger and not over 3 inches (76 mm) for the first 18 inches (457 mm) from both the butt and the tip.

SECTION R4404.10
HIGH-VELOCITY HURRICANE ZONES—
CAST-IN-PLACE

R4404.10.1 Cast-in place concrete piles shall consist of a steel shell driven in intimate contact with the surrounding soil and left in place and filled with concrete. Steel shells may be uniformly tapered, step-tapered, cylindrical or a combination of such shapes and may be laterally corrugated, spirally corrugated, longitudinally fluted or plain.

R4404.10.1.1 Pile shells and end closures shall be of sufficient strength and rigidity to permit their driving in keeping with the driving method used, and to prevent harmful distortion caused by soil pressures or the driving of adjacent piles until filled with concrete. A reduction of cross sectional area in excess of 15 percent shall be cause for rejection. The shells shall also be sufficiently water tight to exclude water during the placing of concrete.

R4404.10.1.2 The minimum diameter shall be 8 inches.

R4404.10.1.3 Concrete for cast-in-place piles shall develop a compressive strength of not less than 3,000 psi (21 MPa) in 28 days. The concrete shall be deposited in a continuous operation to ensure a full-sized pile without voids or separation. Concrete shall be placed in the dry. The pile may be sealed by depositing concrete by tremie or other approved method.

R4404.10.1.4 Splices of shell sections shall be designed to insure the alignment of the shells and develop the full strength of the shell station.

R4404.10.1.5 The load on the shell shall not exceed 25 percent of the minimum average tensile yield strength of the steel multiplied by the area of the shell.

R4404.10.1.5.1 Shells having a wall thickness of 0.119 inch (3 mm) or more may be considered as carrying part of the load.

R4404.10.1.5.2 Adequate allowance for corrosion shall be considered in the design but not less than the outer inch of the shell thickness shall be deducted before computing the area of the shell considered as carrying load.

R4404.10.1.5.3 The metal for the shells shall conform to the *Standards of Welded and Seamless Steel Pipe Piles, Grade 2*, ASTM A 252, for *Hot-Rolled Carbon Steel Sheets and Strip of Structural Quality*, ASTM A 570 and *Carbon Structural Steel, Cold-Rolled Sheet*, ASTM A 611.

R4404.10.1.5.4 The yield strength used in design shall be that of the material in the fabricated shell.

R4404.10.1.6 For friction piles, the allowable load shall be computed at the cross section located at a point two-thirds of the embedded length of the pile, in material providing suitable lateral support, measured upward from the tip. The load on the concrete shall not exceed 25 percent of the 28-day strength of the concrete multiplied by the concrete area.

R4404.10.1.7 For end-bearing piles, the concrete area of the critical section shall be such that the unit stress on the concrete does not exceed 0.25 f'_c under the pile load. The area of the shell and the critical section of the concrete shall be taken at the elevation where the pile enters the stratum furnishing and bearing.

SECTION R4404.11
HIGH-VELOCITY HURRICANE ZONES—
ROLLED STRUCTURAL SHAPES

R4404.11.1 Rolled structural steel piles shall conform to the *Standards for General Requirements for Hot-Rolled and Cold-Finished Carbon and Alloy Steel Bars*, ASTM A 29, and *Carbon Steel Bars Subject to Mechanical Property Requirements*, ASTM A 306, except that copper may be added to increase the corrosion-resistant properties of the material.

R4404.11.1.1 Sections of such pile of H form shall have flange projections not exceeding 14 times the thickness of web or flange and total flange width not less than 85 percent of the depth of the section.

R4404.11.1.2 No section shall have a nominal thickness of metal less than $^3/_8$ inch (9.5 mm).

R4404.11.1.3 For end-bearing piles, the allowable stress may be determined on the basis of an allowable stress of 25 percent of the yield value of the steel.

R4404.11.1.4 In the absence of adequate corrosion protection, $^1/_{16}$ (1.6 mm) inch shall be deducted from each face in determining the area of the pile section.

R4404.11.1.5 The allowable load, when used as friction piles, shall be determined by load tests at the site.

SECTION R4404.12
HIGH-VELOCITY HURRICANE ZONES—
SPECIAL PILES OR SPECIAL CONDITIONS

R4404.12.1 The use of types of piles or conditions not specifically covered herein may be permitted, subject to the approval of the building official, upon submission of acceptable test data, calculations or other information relating to the properties and load-carrying capacity of such piles.

SECTION R4404.13
HIGH-VELOCITY HURRICANE ZONES—
LOAD TESTS ON PILES

R4404.13.1 Single piles tested shall be loaded to at least twice the desired design load and should pile groups be tested, the test load shall be not less than one and a half times the total desired load for the group.

R4404.13.1.1 The apparatus for applying known vertical loads to the top of the pile shall maintain constant load under increasing settlement, and shall apply the loads in such a way that no lateral forces or impact will occur. Hydraulic jacks when used shall be equipped with a calibrated pressure gauge. Uplift piles used to provide the jacking resistance shall be a sufficient distance from the test pile so as not to influence its behavior under test.

R4404.13.1.2 The test load shall be applied in increments of not more than 25 percent of the design load until the total test load has been applied.

R4404.13.1.3 The method for determining vertical movement shall be subject to the approval of the building official. Readings shall be sufficient in number to define the time settlement and rebound curve.

R4404.13.1.4 Each load increment shall be maintained for a minimum of 1 hour, and until the rate of settlement is less than 0.01 inch (.25 mm) per hour. The total load shall be maintained until settlement does not exceed 0.01 inch (.25 mm) in 24 hours. Settlement readings shall be taken at regular intervals during the test period.

R4404.13.1.5 After the maximum load has remained on the pile for 24 hours and final settlement readings have been taken, the pile shall be unloaded in 50 percent decrements of design load. Rebound readings shall be taken at regular intervals during the unloading period, and final reading taken approximately 12 hours after the entire load has been removed.

R4404.13.1.6 The maximum allowable pile load shall be one-half of that load which causes a net settlement of not more than 0.005 inch (.13 mm) per ton of test load, a gross settlement of 1 inch (25 mm) (whichever is less) or a disproportionate increase in settlement.

R4404.13.1.7 Control test piles shall be tested in accordance with ASTM D 1143, *Method of Testing Piles Under Axial Compressive Load*. If quick load test procedures are used, the applied test load shall be not less than three times the working pile capacity and in accordance with the standard.

SECTION R4404.14
HIGH-VELOCITY HURRICANE ZONES—
FOUNDATION WALLS AND GRADE BEAMS

R4404.14.1 Exterior foundation walls of buildings, where the character of the soil is such that allowable soil loads of 1,500 pounds per square foot (psf) (72 kN/m^2)or less are used for design, shall be poured-in-place reinforced concrete from the footing to the bottom of the first or ground floor construction.

R4404.14.1.1 Exterior foundation walls of building, where the character of the soil is such that allowable soil loads of more than 1,500 psf (72 kN/m^2) are used for design, may be of unit masonry or concrete on continuous concrete footings.

R4404.14.1.2 Under the exterior walls of buildings of Type V construction, in locations where extreme dampness exists, the building official may approve isolated piers, provided such piers are as otherwise set forth in Section R4404.7.1.1.

R4404.14.2 Detailed requirements.

R4404.14.2.1 The thickness of the foundation wall shall be not less than 8 inches (203 mm).

R4404.14.2.2 Where wood joist construction is used for the first or ground floor, the thickness of the exterior foundation walls shall be not less than 8 inches (203 mm), plus 4 inches (102 mm) for the bearing of joists.

R4404.14.2.3 Foundations of unit masonry supporting joists shall be capped with 4 inches (102 mm) of concrete.

R4404.14.3 Interior bearing walls. Interior foundation walls shall be of the material and design as specified in Section R4404.14.1 except as follows.

R4404.14.3.1 Interior foundation walls that support stud walls shall be exempted from the additional 4 inches (102 mm) of width required for the bearing of joists.

R4404.14.3.2 The use of isolated piers, girders and beams may be substituted for interior foundation walls when designed by a registered architect and/or engineer.

R4404.14.4 Grade beams.

R4404.14.4.1 Grade beams supporting loads between piles or piers shall be reinforced concrete or structural steel protected by 2 inches of concrete cover.

R4404.14.4.2 Grade beams shall be the thickness of the wall they support but never less than 8 inches (203 mm) nor less than set forth for foundation walls herein.

R4404.14.4.3 Grade beams shall be suitably designed and reinforced around access openings and vents.

SECTION R4404.15
HIGH-VELOCITY HURRICANE ZONES—
GRADES UNDER BUILDINGS

R4404.15.1 The grade of the ground under buildings of joist or suspended slab construction having no basements shall not be lower than the lowest surrounding finished lot area grade in order to prevent the accumulation and standing of ground, storm

or tide water under such buildings unless provided with other approved means of drainage.

R4404.15.1.1 Plans for future raising of lots shall be taken into account in planning the grade of the ground under such buildings.

R4404.15.1.2 The building official may establish grades under such buildings based on present or future street or sidewalk grades abutting the property.

SECTION R4404.16
HIGH-VELOCITY HURRICANE ZONES—RETAINING WALLS

R4404.16.1 All walls exceeding 24 inches (610 mm) in height built to retain or support earth, or subject to pressure from adjoining earth, and any surcharge shall be designed to resist the pressure to which they are subjected, including water pressure that may exist.

SECTION R4404.17
HIGH-VELOCITY HURRICANE ZONES—SEAWALLS AND BULKHEADS

R4404.17.1 All dredging, filling, excavation and waterfront construction such as docks, piers, wharves, bridges, groins, jetties, moles, breakwaters, seawalls, revetments, causeways, artificial nourishment of beaches or other deposition or removal of material in all water areas within the area of jurisdiction of this code shall be planned and designed by a licensed engineer, except as noted in Section R4404.17.2, in accordance with this code and the applicable standards and requirements of the administrative authority.

R4404.17.2 The requirement for professional design will not be required by the building official for bulkheads, docks, piers and similar structures constructed in conjunction with private residences on lakes, private canals and similar water frontage not subject to wind, wave or tidal action; do not involve unusual soil conditions, slopes or unstable soil and are not part of a foundation or support for an above-grade structure.

SECTION R4404.18
HIGH-VELOCITY HURRICANE ZONES — SOIL IMPROVEMENT

R4404.18.1 The application of soil improvement techniques shall comply with this section.

R4404.18.1.1 Methods of soil improvement for a specific site shall be determined by a registered professional engineer, hereinafter referred to as the geotechnical engineer, and such methods shall provide for field testing as required herein.

R4404.18.1.2 A permit shall be required prior to the commencement of any soil improvement, and no building permit shall be issued until it has been determined that adequate bearing capacity has been obtained for the foundation, and the requirements of this section have been satisfied.

R4404.18.2 Limits on application.

R4404.18.2.1 Soil improvement shall not be permitted where subsurface conditions consist of zones of organic materials of sufficient quality above or below the ground water table which cannot be dispersed or displaced to levels not exceeding 5 percent dry weight of organic content in any undisturbed sample.

R4404.18.2.2 Dynamic compaction, vibro-compaction, preloading, surcharging or other similar methods of soil improvements shall not be permitted near or within coastal areas subject to storm surge, scour or other forms of water erosion without suitable protection provided for the building foundation.

R4404.18.3 Required testing.

R4404.18.3.1 A rational program of field tests and soil analyses shall be part of the soil improvement treatment.

R4404.18.3.2 Such tests shall determine the soil characteristics after treatment, and the results of the tests shall demonstrate whether the subsurface improvement has increased the bearing capacity of the soil to that which is capable of safely supporting the proposed construction.

R4404.18.3.3 The testing shall be performed in accordance with the provisions of ASTM D 1586, *Standard Penetration Test*; ASTM D 3441, *Static Cone Soundings*; or by Menard Pressuremeter; Dilatometer or other on-site tests recognized by the industry.

R4404.18.3.4 The test results shall be used to determine the achieved bearing capacity and the anticipated settlement.

R4404.18.4 Requirements for acceptance. The efficacy of any application of soil improvement techniques shall be verified by appropriate calculations, testing and documentation as required in this section.

R4404.18.4.1 All organics, including any organic lens, shall be displaced by the injection of sand or other suitable fill material, or otherwise dispersed in accordance with the provisions of this section, to levels not exceeding 5 percent by weight of organic content in any undisturbed sample.

R4404.18.4.2 Complete documentation of required tests shall be required, and shall included as a minimum, but shall not be limited to:

1. A description of the stratigraphy and densification required and
2. Foundation bearing capacity and settlement analysis performed by an independent testing laboratory.
3. The anticipated settlement potential under superimposed loads shall be acknowledged and accepted by the engineer of record in writing prior to issuance of a building permit.
4. The results of testing to determine subsurface conditions shall be retained by the geotechnical engineer and submitted to the building official upon request.

SECTION R4405
HIGH-VELOCITY HURRICANE ZONES—CONCRETE

R4405.1 General.

R4405.1.1 Scope. This section prescribes requirements for reinforced concrete in construction regulated by this code.

R4405.1.2 Application. Reinforced concrete shall be of the materials, proportions strength and consistency as set forth in this section and shall be designed by methods admitting of rational analysis according to established principles of mechanics.

R4405.1.3 Requirements. All structures of reinforced concrete, including prestressed concrete, shall be designed and constructed in accordance with the provisions of ACI 318 as adopted herein.

R4405.1.4 Workmanship. Concrete construction shall be in conformance with the tolerance, quality and methods of construction set forth in Section R4405.2.

SECTION R4405.2
HIGH-VELOCITY HURRICANE ZONES—STANDARDS

R4405.2.1 The following Standards are hereby adopted as part of this code as set forth in Chapter 43 of this code.

R4405.2.2 American Concrete Institute (ACI).

1. Standard Tolerances for Concrete Construction and Materials, ACI 117.
2. Specifications for Structural Concrete for Buildings, ACI 301.
3. Manual of Standard Practice for Detailing Reinforced Concrete Structures, ACI 315.
4. Building Code Requirements for Reinforced Concrete, ACI 318.
5. Recommended Practice for Concrete Formwork, ACI 347.
6. Recommended Practice for Shotcreting, ACI 506.
7. Specification for Materials, Proportioning, and Application of Shotcrete, ACI 506.2.
8. Deformed and Plain Billet Steel Bars for Concrete Reinforcement, ASTM A615, including S1.

R4405.2.3 American National Standards Institute (ANSI)/American Society of Civil Engineers (ASCE).

1. Specifications for the Design and Construction of Composite Slabs and Commentary on Specifications for the Design and Construction of Composite Slabs, ANSI/ASCE 3.
2. Guideline for Structural Assessment of Existing Buildings, ANSI/ASCE 11.

R4405.2.4 American Society for Testing Materials (ASTM).

1. Deformed and Plain Billet Steel Bars for Concrete Reinforcement, ASTM A 615, including.S1.
2. Testing Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation, ASTM C 1077.

SECTION R4405.3
HIGH-VELOCITY HURRICANE ZONES—DEFINITIONS

R4405.3.1 The following definitions apply to the provisions of Sections 4405.1 through 4405.11.

PLAIN CONCRETE. Concrete that is either unreinforced or contains less reinforcement than the minimum amount specified for reinforced concrete.

REINFORCED CONCRETE. Concrete reinforced with no less than the minimum amount required by ACI 318, prestressed or non-prestressed, and designed on the assumption that the two materials act together in resisting forces.

PRESTRESSED CONCRETE. Reinforced concrete in which internal stresses have been introduced to reduce potential tensile stresses in concrete resulting from loads, The term prestressed concrete refers to pretensioned concrete in which the reinforcing is tensioned before hardening of the concrete, to postensioned concrete in which the reinforcing is tensioned after hardening of the concrete, or combinations of both pretensioning and posttensioning.

PRECAST CONCRETE. Plain or reinforced concrete elements cast elsewhere than their final position in a structure.

SHOTCRETE. Mortar or concrete pneumatically projected at high velocity onto a surface.

SECTION R4405.4
HIGH-VELOCITY HURRICANE ZONES—MATERIALS

R4405.4.1 Cements. Cements shall conform to one of the following specifications for Portland cement as set forth in Chapter 43.

1. **Portland Cement**, ASTM C 150
2. **Blended Hydraulic Cements**, ASTM C 595, excluding Types S and SA, which are not intended as principal cementing constituents of structural concrete.

R4405.4.2 Aggregates for concrete shall conform to one of the following specifications as set forth in Chapter 43 of this code or Paragraph R4405.4.2.1.

1. **Concrete Aggregates**, ASTM C33.
2. **Lightweight Aggregates for Structural Concrete**, ASTM C330.

R4405.4.2.1 Gradation of locally produced sand and crushed rock aggregate shall be as follows:

COARSE AGGREGATE	PERCENT PASSING
$1^1/_2$-inch sieve	100
1-inch sieve	95 - 100
$^1/_2$-inch sieve	25 - 60
#4 sieve	0 - 10
#8 sieve	0 - 5

FINE AGGREGATE	PERCENT PASSING
$^3/_8$-inch sieve	100
#4 sieve	90 - 100
#8 sieve	70 - 95
#16 sieve	50 - 85
#30 sieve	30 - 70
#50 sieve	10 - 45
#100 sieve	0 - 10

R4405.4.2.2 Aggregates failing to meet ASTM C 33, ASTM C 330 or the above special gradation but which have been shown by special test or actual service to produce concrete of adequate strength and durability may be used when certified by the engineer.

R4405.4.2.3 Aggregates shall be quarried or washed in fresh water and shall contain not more than 1/20 of 1 percent salt by weight.

R4405.4.3 Water used in mixing concrete shall be clean and free from injurious amounts of oils, acids, alkalis, salts, organic materials or other substances that may be deleterious to concrete or reinforcement.

R4405.4.3.1 Mixing water for concrete, including that portion of mixing water contributed in the form of free moisture on aggregates, shall not contain deleterious amounts of chloride ion.

R4405.4.4 Reinforcement.

R4405.4.4.1 Deformed reinforcement shall conform to one of the specifications as set forth in Chapter 43, except as provided in Section 3.5 of ACI 318.

R4405.4.4.2 Prestressing tendons shall conform to one of the specifications as set forth in Chapter 43.

Exception: Wire strands and bars not specifically listed in ASTM A 421, A 416, or A 722 may be used provided they conform to minimum requirements of these specifications and do not have properties that make them less satisfactory than those listed in ASTM A 416, A 421 or A 722.

R4405.4.4.3 Reinforcement consisting of structural steel, steel pipe or steel tubing may be used as specified in ACI 318.

R4405.4.4.4 All welding of reinforcement shall conform to the *Structural Welding Code—Reinforcing Steel*, AWS D1.4, as set forth in Chapter 43.

R4405.4.4.5 Reinforcement to be welded shall be indicated on the drawings, and welding procedures to be used shall be specified. ASTM steel specifications, except ASTM A 706, shall be supplemented to require a report of material properties necessary to conform to welding procedures specified in AWS D1.4.

R4405.4.4.6 Deformed reinforcement may be galvanized or epoxy-coated in accordance with the *Specifications for Zinc-Coated (galvanized) Bars for Concrete Reinforcement*, ASTM A 767 or the *Specification for Epoxy-Coated Bars*, ASTM A 775. Zinc or epoxy-coated reinforcement shall conform to ASTM A 615, A 616 (S1), A 617 or A 706.

R4405.4.5 Admixtures.

R4405.4.5.1 Admixtures to be used in concrete shall conform to one of the specifications set forth in Chapter 43.

R4405.4.5.2 An admixture shall be shown capable of maintaining essentially the same composition and performance throughout the work as the product used in establishing concrete proportions.

R4405.4.5.3 Admixtures containing chloride ions shall not be used in concrete if their use will produce a deleterious concentration of chloride ion in the mixing water.

R4405.4.6 Test of materials.

R4405.4.6.1 The building official, or his authorized representative, shall have the right to order the test of any material entering into concrete or reinforced concrete to determine its suitability for the purpose; to order reasonable tests of the concrete from time to time to determine whether the materials and methods in use are such as to produce concrete of the necessary quality; and to order the test under load of any portion of a completed structure when conditions have been such as to leave doubt as to the adequacy of the structure to serve the purpose for which it is intended.

R4405.4.6.2 Materials and of concrete shall be tested in accordance with applicable standards of the ASTM International (ASTM) as listed in Chapter 43. Tests shall be made by an approved testing laboratory and results of such tests shall be submitted to the building official. Approved testing laboratories shall comply with ASTM C 1077.

R4405.4.6.3 A complete record of tests of materials and of concrete shall be available to the building official for inspection during progress of work and for five years after completion of the project, and shall be preserved by the inspecting engineer or architect for that purpose.

R4405.4.6.4 If doubt develops concerning the safety of a structure or member, the building official may order a structural strength investigation by analysis or by means of load tests, or by a combination of analyses and load test as set forth in Chapter 20 of ACI 318.

SECTION R4405.5
HIGH VELOCITY HURRICANE ZONES—CONCRETE QUALITY

R4405.5.1 General.

R4405.5.1.1 Concrete shall be proportioned and produced to provide an average compressive strength sufficiently high to minimize the frequency of strength test below the specified compressive strength of concrete, f'_c.

R4405.5.1.2 Requirements for f'_c shall be based on tests of cylinders made and tested as prescribed in Section R4405.5.2.2.3.

R4405.5.1.3 Unless otherwise specified, f'_c shall be based on 28-day tests. If other than 28-day tests are called for, f'_c shall be indicated in design drawings or specifications.

R4405.5.1.4 Design drawings shall show the specified compressive strength of concrete, f'_c for which each part of the structure is designed.

R4405.5.2 Evaluation and acceptance concrete.

R4405.5.2.1 Frequency of testing.

R4405.5.2.1.1 The building official may require a reasonable number of tests to be made during the progress of the work, or may promulgate and set forth in writing such reasonable rules for requiring tests to be made by an approved laboratory as he may consider necessary to insure compliance with this code.

R4405.5.2.1.2 Not less than three specimens shall be made for each standard test.

R4405.5.2.1.3 Samples for strength of each class of concrete placed each day shall be taken not less than once a day, nor less than once for each 150 cubic yard (4.3 m^3) of concrete, nor less than once for each 5,000 square feet (465 m^2) of surface area for slabs or walls.

R4405.5.2.1.4 On a given project, if total volume of concrete is such that frequency of testing required by Section R4405.5.2.1.1 would provide less than five strength tests for a given class of concrete, tests shall be made from at least five randomly selected batches or from each batch if fewer than five batches are used.

R4405.5.2.1.5 Test cylinders taken on truck-mixed concrete shall be taken at the approximate one-quarter point of the load.

R4405.5.2.1.6 The age for strength tests shall be 28 days, or where specified, at the earlier age at which the concrete is to receive its full working load.

R4405.5.2.2 Laboratory cured specimens.

R4405.5.2.2.1 A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days or at a test age designated for determination of f'_c.

R4405.5.2.2.2 Samples of strength tests shall be taken in accordance with the *Method of Sampling Fresh Concrete*, ASTM C 172, as set forth in Chapter 43.

R4405.5.2.2.3 Cylinders for strength tests shall be molded and laboratory-cured in accordance with the *Method of Making and Curing Concrete Test Specimens in the Field*, ASTM C 31, as set forth in Chapter 43 of this code, and tested in accordance with the *Method of Test for Compressive Strength of Cylindrical Concrete Specimens*, ASTM C 39, as set forth in Chapter 43.

R4405.5.2.2.4 The strength level of an individual class of concrete shall be considered satisfactory if both of the following requirements are met:

1. Average of all sets of three consecutive strength tests equal or exceed f'_c
2. No individual strength test (average of two cylinders) falls below f'_c by more than 500 psi (3448 kPa).

R4405.5.2.2.5 If any of the requirements of Section R4405.5.2 are not met, steps shall be taken to increase the average of subsequent strength test results. Requirements of Section R4405.5.2.4 shall be observed if any individual strength test falls below f'_c by more than 500 psi (3448 kPa).

R4405.5.2.3 Field cured specimens.

R4405.5.2.3.1 The building official may require strength tests of cylinders cured under field conditions to check adequacy of curing and protection of concrete in the structure.

R4405.5.2.3.2 Field-cured cylinders shall be cured under field conditions in accordance with Section 7.4 of the *Method of Making and Curing Concrete Test specimens in the Field*, ASTM C 31.

R4405.5.2.3.3 Field-cured test cylinders shall be molded at the same time and from the same samples as laboratory-cured test cylinders.

R4405.5.2.3.4 Procedures for protecting and curing concrete shall be improved when the strength of field-cured cylinders at test age designated for determination of f'_c is less than 85 percent of that of companion laboratory cured cylinders. The 85 percent may be waived if field cured strength exceeds f'_c by more than 500 psi (3448 Pa).

R4405.5.2.4 Investigation of low strength test results.

R4405.5.2.4.1 When there is a question as to the quality of the concrete in the structure, the building official may require core tests in accordance with the *Standard Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete*, ASTM C 42, as set forth in Chapter 43 of this code, or order load tests on that portion of the structure where the questionable concrete has been placed.

R4405.5.2.4.2 When concrete in structures has failed to meet the minimum standard, the building official shall order analysis and reports by a registered engineer to determine the adequacy of the structure.

R4405.5.2.4.3 If the likelihood of low-strength concrete is confirmed and computations indicate that load-carrying capacity may have been significantly reduced, tests of cores drilled from the area in question may be required in accordance with the *Method of Obtaining and Testing*

Drilled Cores and Sawed Beams of Concrete, ASTM C 42, as set forth in Chapter 43 of this code. In such case, three cores shall be taken for each strength test more than 500 psi (3448 kPa) below specified value of f'_c.

R4405.5.2.4.4 If concrete in the structure will be dry under service conditions, cores shall be air dried at a temperature between 60°F and 80ºF (16°C and 27°C) and a relative humidity less than 60 percent for seven days before testing and shall be tested dry. If concrete in the structure will be more than superficially wet under service conditions, cores shall be immersed in water for at least 40 hours and be tested wet.

R4405.5.2.4.5 Concrete in an area represented by core tests shall be considered structurally adequate if the average of three cores is equals to at least 85 percent of f'_c and if no single core is less than 75 percent of f'_c. To check testing accuracy, locations represented by erratic core strengths may be retested.

R4405.5.2.4.6 Slump considerations. The maximum allowable slump of concrete shall be 6 inches (152 mm). On the jobs controlled and supervised by a professional engineer, this maximum may be exceeded, but no concrete shall exceed the slump as indicated on the approved plans for proposed work.

SECTION R4405.6 HIGH-VELOCITY HURRICANE ZONES—MIXING AND PLACING CONCRETE

R4405.6.1 Preparation of equipment and place of deposit.

R4405.6.1.1 Preparation before concrete placement shall include the following:

1. All equipment for mixing and transporting concrete shall be clean.
2. All debris shall be removed from the spaces to be occupied by the concrete.
3. Forms shall be properly coated.
4. Masonry filler units that will be in contact with concrete shall be well drenched.
5. Reinforcement shall be thoroughly cleaned of deleterious coatings.
6. Water shall be removed from place of deposit before concrete is placed unless a tremie is to be used or unless otherwise permitted by the professional engineer.
7. All laitance and other unsound material shall be removed before additional concrete is placed against hardened concrete.

R4405.6.2 Mixing.

R4405.6.2.1 All concrete shall be mixed until there is uniform distribution of materials and shall be discharged completely before the mixer is recharged.

R4405.6.2.2 Ready-mixed concrete shall be mixed and delivered in accordance with requirements of the *Specifications for Ready-Mixed Concrete*, ASTM C 94, or the *Specifications for Concrete* made by *Volumetric Batching and Continuous Mixing*, ASTM C 685, as set forth in Chapter 43 of this code.

R4405.6.2.3 Job-mixed concrete shall be mixed in accordance with the following:

1. Mixing shall be done in a batch mixer of approved type.
2. Mixer shall be rotated at a speed recommended by the manufacturer.
3. Mixing shall be continued for at least $1^1/_2$ minutes after all materials are in the drum, unless a shorter time is shown to be satisfactory by the mixing uniformity test of *Specification for Ready-Mixed Concrete*, ASTM C 94.
4. Materials handling, batching, and mixing shall conform to applicable provisions of the *Specifications for Ready-Mixed Concrete*, ASTM C 94.
5. A detailed record shall be kept to identify:
   - 5.1 Number of batches produced.
   - 5.2 Proportions of materials used.
   - 5.3 Approximate location of final deposit in structure.
   - 5.4 Time and date of mixing and placing.

R4405.6.3 Conveying.

R4405.6.3.1 Concrete shall be conveyed from mixer to the place of final deposit by methods that will prevent separation or loss of the materials.

R4405.6.3.2 Conveying equipment shall be capable of providing a supply of concrete at the site of placement without separation of ingredients and without interruptions sufficient to permit loss of plasticity between successive increments.

R4405.6.4 Depositing.

R4405.6.4.1 Concrete shall be deposited as nearly as practicable in its final position to avoid segregation caused by rehandling or flowing.

R4405.6.4.2 Concreting shall be carried on at such a rate that concrete is at all times plastic and flows readily into the spaces between reinforcement.

R4405.6.4.3 Concrete that has partially hardened or been contaminated by foreign materials shall not be deposited in the structure.

R4405.6.4.4 Retempered concrete or concrete that has been remixed after initial set shall not be used unless approved by the building official.

R4405.6.4.5 After concreting is started, it shall be carried on as a continuous operation until placing of the panel or section, as defined by its boundaries or predetermined joints is completed except as permitted or prohibited by Section R4405.7.4.

R4405.6.4.6 Top surfaces of vertically formed lifts shall be generally level.

R4405.6.4.7 When construction joints are required, joints shall be made in accordance with Section R4405.7.4.

R4405.6.4.8 All concrete shall be thoroughly consolidated by suitable means during placement and shall be thoroughly worked around the reinforcement and embedded fixtures and into corners of forms.

R4405.6.5 Curing.

R4405.6.5.1 Concrete, other than high-early-strength, shall be maintained in a moist condition for as least the first seve n days after placement, except when cured in accordance with Section R4405.6.5.3.

R4405.6.5.2 High-early-strength concrete shall be maintained in a moist condition for at least the first three days, except when cured in accordance with Section R4405.6.5.3.

R4405.6.5.3 Accelerated curing:

1. Curing by high pressure steam, steam at atmospheric pressure, heat and moisture, or other accepted processes, may be employed to accelerate strength gain and reduce time of curing.
2. Accelerated curing shall provide a compressive strength of the concrete at the load stage considered at least equal to required design strength at that load stage.
3. The curing process shall produce concrete with a durability at least equivalent to the curing method of Section R44405.6.5.3, Item 1 or 2.
4. Supplementary strength tests in accordance with Section R4405.5.2.3 may be required to assure that curing is satisfactory.

R4405.6.6 Bonding.

R4405.6.6.1 Before fresh concrete is deposited or placed on or against concrete which has hardened for 8 hours or longer, the forms shall be retightened, the surface of the hardened concrete shall be cleaned of all foreign matter and laitance, and dampened, but not saturated. Fresh concrete shall not be deposited or placed on or against hardened concrete so dampened before the surface is completely free of shiny spots indicating free moisture. When the concrete against which fresh concrete will be placed is less than 8 hours old, all laitance, loose particles and dirt shall be removed.

R4405.6.6.2 Where bonding of fresh to hardened concrete is necessary, construction joints and joints between footings and walls or columns, between walls or columns and beams or floors they support, and joints in unexposed walls shall be accomplished by reinforcement, dowels, adhesives, mechanical connectors or other approved methods. Hardened concrete at joints shall be dampened, but not saturated, immediately prior to the placement of fresh concrete.

SECTION R4405.7 HIGH-VELOCITY HURRICANE ZONES—FORMWORK, EMBEDDED PIPES AND CONSTRUCTION JOINTS

R4405.7.1 Design of formwork.

R4405.7.1.1 Forms shall be designed in accordance with ACI 347, *Recommended Practice for Concrete Formwork*.

R4405.7.1.2 Forms shall result in a final structure that conforms to shapes, lines and dimensions of the members as required by the design drawings and specifications.

R4405.7.1.3 Forms shall be substantial and sufficiently tight to prevent leakage of mortar.

R4405.7.1.4 Forms shall be properly braced or tied together to maintain position and shape.

R4405.7.1.5 Forms and their supports shall be designed so as not to damage previously placed structures.

R4405.7.1.6 Design of formwork shall include consideration of the rate and method of placing concrete; construction loads, including vertical, horizontal and impact loads; and special form requirements for construction of shells, folded plates, domes, architectural concrete or similar types of elements.

R4405.7.1.7 Forms for prestressed concrete members shall be designed and constructed to permit movement of the member without damage during application of prestressing force.

R4405.7.2 Removal of forms and shores.

R4405.7.2.1 No construction loads shall be supported on, nor any shoring removed from, any part of the structure under construction except when that portion of the structure in combination with the remaining forming and shoring system has sufficient strength to safely support its weight and loads placed thereon.

R4405.7.2.2 Sufficient strength shall be demonstrated by structural analysis considering proposed loads, strength of the forming and shoring system and concrete strength data. Concrete strength data may be based on tests of field-cured cylinders or, when approved by the building official, on other procedures to evaluate concrete strength. Structural analysis and concrete strength test data shall be furnished to the building official when so required.

R4405.7.2.3 No construction loads exceeding the combination of superimposed dead load plus specified live load shall be supported on any unshored portion of the structure under construction, unless analysis indicated adequate strength to support such additional loads.

R4405.7.2.4 Forms shall be removed in a manner that does not impair the safety and serviceability of the structure. All concrete to be exposed by form removal shall have sufficient strength not to be damaged thereby.

R4405.7.2.5 Form supports for prestressed concrete members may be removed when sufficient prestressing has been applied to enable prestressed members to carry their dead load and anticipated construction loads.

R4405.7.3 Conduits and pipes embedded in concrete.

R4405.7.3.1 Conduits, pipes and sleeves of any material not harmful to concrete, and with limitations of this section, may be embedded in concrete with approval of the professional engineer provided they are not considered to structurally replace the displaced concrete.

R4405.7.3.2 Conduits or pipes of aluminum shall not be embedded in structural concrete unless effectively coated or

covered to prevent aluminum-concrete reaction or electrolytic action between aluminum and steel.

R4405.7.3.3 Conduits, pipes and sleeves passing through a slab, wall or beam shall not impair the strength of the construction.

R4405.7.3.4 Conduits and pipes, with their fittings, embedded within a column shall not displace more than 4 percent of the area of cross section on which strength is calculated or which is required for fire protection.

R4405.7.3.5 Except when plans for conduits and pipes are approved by the professional engineer and other than those merely passing through, conduits and pipes embedded within a slab, wall or beam shall satisfy the following:

1. They shall not be larger in outside dimension than three-eighths of the overall thickness of slab, wall or beam in which they are embedded.
2. They shall not be spaced closer than three diameters or widths on center.
3. They shall not impair the strength of the construction.

R4405.7.3.6 Conduits, pipes and sleeves may be considered as replacing structurally in compression the displaced concrete, provided:

1. They are not exposed to rusting or other deterioration.
2. They are of uncoated or galvanized iron or steel not thinner than standard Schedule 40 steel pipe, and
3. They have a nominal inside diameter not over 2 inches (51 mm) and are spaced not less than three diameters on centers.

R4405.7.3.7 In addition to other requirements of Section R4405.7.3 pipes that will contain liquid, gas or vapor may be embedded in structural concrete under the following conditions:

1. Pipes and fittings shall be designed to resist effects of the material, pressure and temperature to which they will be subjected.
2. Temperature of liquid, gas or vapor shall not exceed 150ºF (66ºC).
3. Maximum pressure to which any piping or fittings shall be subjected shall not exceed 200 psi (1379 kPa) above atmospheric pressure.
4. All piping and fittings except as provided in Section R4405.7.3.5 shall be tested as a unit for leaks before concrete placement. Testing pressure above atmospheric pressure shall be 50 percent in excess of pressure to which piping and fittings may be subjected, but minimum testing pressure shall not be less than 150 psi (1034 kPa) above atmospheric pressure. Pressure test shall be held for 4 hours with no drop in pressure except that which may be caused by air temperature.
5. Drain pipes and other piping designed for pressures of not more than 1 psi (7 kPa) above atmospheric pressure need not be tested as required in Section R4405.7.3.7(4).
6. Pipes carrying liquid, gas or vapor that is explosive or injurious to health shall be tested again as specified in Section R4405.7.3.7(4) after concrete has hardened.
7. No liquid, gas or vapor, except water not exceeding 90ºF (32ºC) nor 50 psi (350 kPa) pressure, shall be placed in the pipes until the concrete has attained its design strength.
8. In solid slabs the piping, unless it is for radiant heating, shall be placed between top and bottom reinforcement.
9. Concrete cover for pipes and fittings shall not be less than $1^1/_2$ inches (38 mm) for concrete exposed to earth or weather, nor $^3/_4$ inch (19 mm) for concrete not exposed to weather or in contact with ground.
10. Reinforcement with an area not less than 0.002 times the area of concrete section shall be provided normal to the piping.
11. Piping and fittings shall be assembled by welding, brazing, solder sweating or other equally satisfactory methods. Screw connections shall not be permitted. Piping shall be so fabricated and installed that cutting, bending or displacement of reinforcement from its proper location will not be required.

R4405.7.4 Construction joints.

R4405.7.4.1 Surfaces of the concrete construction joints shall be cleaned and laitance removed.

R4405.7.4.2 Immediately before new concrete is placed, all construction joints shall be wetted and standing water removed.

R4405.7.4.3 Construction joints shall be so made and located as not to impair the strength of the structure. Provision shall be made for transfer of shear and other forces through construction joints.

R4405.7.4.4 Construction joints in floors shall be located near the middle of the spans of slabs, beams or girders, unless a beam intersects a girder at the middle location, in which case, joints in the girders shall be offset a distance approximately twice the width of the beam.

R4405.7.4.5 Beams, girders or slabs supported by columns or walls shall not be cast or erected until concrete in the vertical support members is no longer plastic.

R4405.7.4.6 Beams, girders, haunches, drop panels and capitals shall be placed monolithically as part of a slab system, unless otherwise shown on design drawing.

SECTION R4405.8
HIGH-VELOCITY HURRICANE ZONES—DETAILS OF REINFORCEMENT

R4405.8.1 Bending reinforcement.

R4405.8.1.1 All reinforcement shall be bent cold, unless otherwise permitted by the professional engineer.

R4405.8.1.2 Reinforcement partially embedded in concrete shall not be field bent, except as shown on the design drawings or permitted by the professional engineer.

R4405.8.2 Surface conditions of reinforcement.

R4405.8.2.1 At the time concrete is placed, reinforcement shall be free from mud, oil or other nonmetallic coatings that adversely affect bonding capacity.

R4405.8.2.2 Steel reinforcement, except prestressing tendons, with rust, mill scale or a combination of both shall be considered satisfactory, provided the minimum dimensions, including the height of deformations and weight of a hand-wire-brushed test specimen, are not less than applicable ASTM specification requirements.

R4405.8.2.3 Prestressing tendons shall be clean and free of oil, dirt, scale, pitting and excessive ruts. A light oxide is permissible.

R4405.8.3 Placing reinforcement.

R4405.8.3.1 Steel reinforcement shall be accurately placed and adequately secured in position by concrete or metal chairs or spacers or other acceptable methods. The minimum clear distance between parallel bars, except in columns, shall be equal to the nominal diameter of the bars. In no case shall the clear distance between bars be less than 1 inch (25 mm), or less than one and one-third times the maximum size of the coarse aggregate. When reinforcement in beams or girders is placed in two or more layers, the clear distance between layers shall not be less than 1 inch (25 mm) nor less than the diameter of the bars, and the bars in the upper layers shall be placed directly above those in the bottom layer.

R4405.8.3.2 Unless otherwise permitted by the building official and professional engineer, reinforcement, prestressing tendons and prestressing ducts shall be placed within the following tolerances:

1. Tolerance for depth, *d*, and minimum concrete cover in flexural members, walls and compression members shall be as follows, where d represents the distance from the extreme compression fiber to the centroid of the tension reinforcement:

	Tolerance on "d"	Tolerance on minimum concrete cover
d < 8 in.	+/- $^3/_8$ in.	- $^3/_8$ in.
d > 8 in.	+/- $^1/_2$ in	- $^1/_2$ in.

Exceptions:

a. Tolerance for the clear distance to formed soffits shall be minus $^1/_4$ inch (6.3 mm).

b. Tolerance for cover shall not exceed minus one-third the minimum concrete cover required in the contract drawings nor less than 1 inch (25 mm) when exposed to weather.

2. Tolerance for longitudinal location of bends and ends of reinforcement shall be +2 inches (+102 mm) except at discontinuous ends of members where tolerance shall be $+^1/_2$ inch (+12.7 mm).

R4405.8.3.3 Welded wire fabric with a wire size not greater than W5 or D5 used in slabs not exceeding 10 feet (3048 mm) in span may be curved from a point near the top of the slab over the support to a point near the bottom of the slab at midspan, provided such reinforcement is either continuous over, or securely anchored at, the support.

R4405.8.3.4 Welding of crossing bars shall not be permitted for assembly of reinforcement unless approved by the professional engineer of record.

R4405.8.3.5 Spacing limits and concrete cover for reinforcement shall be shown on the design drawings.

R4405.8.4 Splices in reinforcement.

R4405.8.4.1 In slabs, beams and girders, splices in reinforcement at points of maximum stress shall be avoided wherever possible. Such splices, where used, shall be welded, lapped or otherwise fully developed, but, in any case, shall transfer the entire stress from bar to bar without exceeding the allowable bond and shear stresses. The minimum overlap for a lapped splice shall be 24 bar diameters, but not less than 12 inches (25 mm) for bars and in accordance with Section 12.15 and 12.16 of ACI 318. The clear distance between bars shall also apply to the clear distance from a contact splice and adjacent splices or bars.

R4405.8.4.2 Reinforcement shall be spliced only as required or permitted on design drawings, or in specifications or as authorized by the licensed engineer of record.

R4405.8.4.3 Lap splices shall not be used for bars larger than #11 except as provided in ACI 318.

R4405.8.4.4 Lap splices of bundled bars shall be based on the lap splice length required for individual bars within a bundle, increased 20 percent for a 3-bar bundle and 33 percent for a 4-bar bundle. Individual bar splices within a bundle shall not overlap.

R4405.8.4.5 Bars spliced by noncontact lap splices in flexural members shall not be spaced transversely farther apart than one-fifth the required lap splice length, nor 6 inches (152 mm).

R4405.8.4.6 Welded splices may be used, provided the metallurgical properties of the bars are suitable as determined by the licensed engineer of record in accordance with AWS D1.4.

R4405.8.4.7 End-bearing splices.

R4405.8.4.7.1 In bars required for compression only, compressive stress may be transmitted by bearing of square cut ends held in concentric contact by a suitable device.

R4405.8.4.7.2 Bar ends shall terminate in flat surfaces within $1^1/_2$ degrees of a right angle to the axis of the bars and shall be fitted within 3 degrees of full bearing after assembly.

R4405.8.4.7.3 End bearing splices shall be used only in members containing closed ties, closed stirrups, or spirals.

R4405.8.4.8 Welded splices in reinforcing bars shall be by certified welders and shall comply with the *Stanmade dard Structural Welding Code-Reinforcing Steel*, AWS D1.4, as set forth in Chapter 43 of this code.

R4405.8.5 Concrete protection for reinforcement (nonprestressed).

R4405.8.5.1 The reinforcement of footings and other principal structural members in which the concrete is deposited against the ground shall have not less than 3 inches (76 mm) of concrete between it and the ground contact surface. If the concrete surfaces after removal of the forms are to be exposed to the weather or be in contact with the ground, the reinforcement shall be protected with not less than 2 inches (51 mm) of concrete for bars larger than No. 5 and $1^1/_2$ inches (38 mm) for No. 5 bars or smaller except as set forth in Section R4406.8.5.5.

R4405.8.5.2 The concrete protective covering for reinforcement at surfaces not exposed directly to the ground or weather shall be not less than $^3/_4$ inch (19 mm) for slabs and wall; and not less than $1^1/_2$ inches (38 mm) for beams, girders and columns. In concrete ribbed floors in which the clear distance between ribs is not more than 30 inches (762 mm), the protection of reinforcement shall be at least $^3/_4$ inch (19 mm).

R4405.8.5.3 Concrete protection for reinforcement shall in all cases be as least equal to the diameter of bars except for concrete slabs and joists as set forth herein.

R4405.8.5.4 Exposed reinforcement bars intended for bonding with future extensions shall be protected from corrosion by concrete or other adequate covering.

R4405.8.5.5 For exterior balcony slabs, slab surface shall be shall be sloped $^1/_8$ unit in 12 units or greater to safeguard against ponding of water and slabs shall be designed and constructed in accordance with the provisions of ACI 318.

R4405.8.5.6 Concrete cover for cast-in-place, precast and prestressed concrete shall be in accordance with ACI 318 if not otherwise specified in this section. When this code requires a thickness of cover for fire protection greater than the minimum concrete specified in ACI 318, the greater thickness shall be used.

R4405.8.5.7 Exposed reinforcement, inserts and plates intended for bonding with future extensions shall be protected from corrosion.

SECTION R4405.9
HIGH-VELOCITY HURRICANE ZONES—PRECAST CONCRETE UNITS

R4405.9.1 General.

R4405.9.1.1 Precast concrete units shall comply with the minimum requirements set forth in this section, and the standard set forth in Section R4405.2.3.

R4405.9.1.2 All precast concrete elements and their attachments (including imbedments) to the main structural frame shall be designed by, and bear the seal of a Florida-registered architect or a Florida-registered engineer, which architect or engineer shall be proficient in structural design. The design shall be based on rational analysis for loads set forth in Section R4403. The architect/engineer of record may delegate this responsibility to a Florida-registered delegated engineer. In that case, shop drawings and design calculations prepared by such delegated engineer shall be reviewed and approved by the architect and the engineer of record.

R4405.9.1.3 Only the material cast monolithically with the units at the time of manufacture shall be used in computing stresses unless adequate and approved shear transfer is provided.

R4405.9.1.4 The building official may promulgate and set forth in writing such reasonable rules for requiring tests to be made by an approved laboratory as he may consider necessary to insure compliance with this code or uniformity of the products produced. The quantity of tests shall be based on consideration of safety or volume of output.

R4405.9.1.5 The building official or his representative shall have free access to the plant of any producer at all hours of normal operation, and failure to permit such access shall be cause for revocation of approval.

R4405.9.1.6 Failure of any product to satisfy in every respect the quality prescribed, or failure to conform with plans and specifications, shall be cause for rejection of the products.

R4405.9.2 Statements of responsibilities of architects and professional engineers on design of structures using precast concrete components.

R4405.9.2.1 The structural construction documents shall indicate the configuration of precast components and shall include details of supports, anchors and connections for those components. Permit documents shall include sufficient details describing the attachment of precast units (including imbedments) to the main structure.

R4405.9.2.2 The precast permit documents shall bear the signature and seal of the professional architect or engineer charged with the responsibility of the design of the precast units. The architect or engineer of record may delegate this responsibility to a Florida-registered delegated engineer. In that case, shop drawings and design calculations prepared by such delegated engineer shall be reviewed and approved by the architect and/or the engineer of record as an indication that his intent has been understood and that the specified criteria have been used.

R4405.9.2.3 The structural submittals shall include component details, calculations and fabrication and erection drawings. All such submittals shall identify the specific project.

R4405.9.3 Aggregate. The maximum size of the aggregate for precast units shall be not larger than one-third of the narrowest dimension between sides of the forms of the member in which the unit is cast nor larger than three-fourths of the minimum clear spacing between reinforcing bars and sides of the forms, except that where concrete is placed by means of high frequency vibration, the maximum size of the aggregate shall not be larger than one-half of the narrowest dimension between sides of the form.

R4405.9.4 Strength of concrete.

R4405.9.4.1 Concrete for precast structural units made of crushed stone or other heavy aggregate shall have a compressive strength of not less than 2,500 psi (17 238 kPa) at 28 days.

R4405.9.4.2 Concrete for precast units made of light weight aggregate concrete shall follow the general provisions of

Section R4405.1.1.2 with consideration of the nature and limitations of the aggregate and the strength of the product.

R4405.9.5 Workmanship.

R4405.9.5.1 The mix, the gradation of the aggregate and the workability shall be such as to insure complete filling of the form and continuous intimate bond between the concrete and all steel.

R4405.9.5.2 Handling and conveying before curing shall be reduced to a minimum. Machinery for this purpose should be so designed that the unit will not be subject to bending or shock which would produce incipient cracks or broken edges or corners. Precast units shall not be freely transported or placed until the concrete is at least 14 days old, if made with regular cement, or at least seven days old, if made with Type III cement, or until its strength, as established by definite tests, is at least 60 percent of the required 28-day strength.

R4405.9.5.3 The use of precast structural units not complying with ACI requirements or having visible cracks, honeycomb, exposed reinforcing except at ends or, with a compressive section dimension more than $^1/_8$ inch (3.1 mm) less than specified dimension shall not be permitted.

R4405.9.6 Curing.

R4405.9.6.1 No precast structural unit shall be removed from the form until the concrete has attained a compressive strength of 50 percent of the 28-day design strength but not less than 1,250 psi (8619 kPa) as verified by representative tests.

R4405.9.6.2 Curing by high pressure steam, steam vapor or other accepted processes may be employed to accelerate the hardening of the concrete and to reduce the time of curing.

R4405.9.6.3 To ensure the eventual placement of the units in the structure without damage, the handling shall be done in such a manner that bending shall be reduced to a minimum or prevented.

R4405.9.7 Identification and marking. All joists, beams, girders and other units shall show some mark plainly indicating the top of the unit. This mark or symbol shall indicate the manufacturer, the date of manufacture and the length, size and type of reinforcing.

R4405.9.8 Cutting of holes. No openings or channels not provided for in the structural design shall be made on the job without the specific approval of the professional engineer in accordance with his written, detailed instructions covering such work.

R4405.9.9 Anchorage. Anchorage of all precast concrete units shall be designed, based on rational analysis, to transmit loads and other forces to the structural frame.

R4405.9.10 Bridging. Joists shall be secured against lateral displacement by cast-in-place bridging, and such bridging shall be spaced not to exceed 32 times the width of the compression flange of the joist except that for roof systems, cast-in-place Portland-concrete slabs embedding the top flanges not less than $^1/_2$ inch (13 mm), or steel inserts cast in the joist heads to which bulb-tees supporting gypsum decks are welded, shall be accepted in lieu of bridging.

R4405.9.11 Connections. All joints and connections will perform their function at all stages of loading without overstress and with proper safety factors against failure caused by overload. Loading conditions to be considered in the design of joints and connections are service loads, including wind forces, volume changes resulting from shrinkage, creep, and temperature change, reaction loads, and loading encountered in stripping forms, shoring and removal of shores, storage and transportation of members.

R4405.9.12 Inspections.

R4405.9.12.1 All structural precast units shall be inspected for quality control by an architect or professional engineer qualified to perform these inspections prior to the concrete placement at the casting yard.

R4405.9.12.2 All structural precast units and their attachments to the main structure shall be inspected after erection, but before concealment. Such inspections shall be performed by a Florida-registered architect or licensed engineer.

SECTION R4405.10
HIGH-VELOCITY HURRICANE ZONES—PRESTRESSED CONCRETE

R4405.10.1 Prestressed concrete, as defined in Section R4405.3, shall comply with this section.

R4405.10.1.1 All prestressed structural items shall be designed by a registered licensed engineer. Openings or channels not provided for in the structural design shall not be made on the job without the specific approval of the design licensed engineer.

R4405.10.1.2 The building official may promulgate and set forth in writing such reasonable rules for requiring tests to be made by an approved laboratory as he may consider necessary to insure compliance with this code or uniformity of the products produced.

R4405.10.1.3 The building official or his or her representative shall have free access to the plant of any producer at all hours of normal operation. Failure to permit such access shall be cause for revocation of approval.

R4405.10.1.4 Failure of any product to satisfy the quality prescribed or failure to conform to plans and specifications shall be cause for rejection of the product.

R4405.10.2 Statements of responsibilities of architects and professional engineers on design of cast-in-place post-tensioned concrete structural systems.

R4405.10.2.1 The structural construction documents shall show the magnitude and location of all prestressing forces and all design assumptions.

R4405.10.2.2 The structural engineer of record and/or the architect of record shall require the submission of calculations and installation drawings from a specialty engineer for post-tensioning systems for review by the structural engineer of record and/or the architect of record. Review is an indication that his or her intent has been understood and that the specified criteria have been used. The installation drawings shall provide full details of materials to be used includ-

ing necessary accessories and instructions for construction and shall identify the specific project and shall bear the impressed seal, signature and date of the specialty engineer who prepared them.

R4405.10.2.3 It is the responsibility of the structural engineer of record and/or the architect of record to review the post-tensioning system installation drawings so that the drawings are coordinated with the reinforcing steel shop drawings.

R4405.10.2.4 Determining the effect of post-tensioning on other parts of the building is the responsibility of the structural engineer of record and/or the architect of record.

R4405.10.3 Design and construction.

R4405.10.3.1 Design and construction shall be in accordance with Chapter 18 of ACI 318.

R4405.10.3.2 Calcium chloride shall not be used in concrete for prestressed members.

R4405.10.4 Tendon and anchorage zones.

R4405.10.4.1 Reinforcement shall be provided where required in tendon anchorage zones to resist bursting, splitting, and spalling forces induced by tendon anchorage. Regions of abrupt change in section shall be adequately reinforced.

R4405.10.4.2 End blocks shall be provided where required for support bearing or for distribution of concentrated prestressing forces.

R4405.10.4.3 Post-tensioning anchorage and supporting concrete shall be designed to resist maximum jacking force for strength of concrete at time of prestressing.

R4405.10.4.4 Post-tensioning anchorage zones shall be designed to develop the guaranteed ultimate tensile strength of prestressing tendons using a strength reduction factor of 0.90 for concrete.

R4405.10.5 Corrosion protection for unbonded prestressing tendons.

R4405.10.5.1 Unbonded tendons shall be completely coated with suitable material to ensure corrosion protection.

R4405.10.5.2 Tendon wrapping shall be continuous over the entire length to be unbonded, and shall prevent intrusion of cement paste or loss of coating materials during concrete placement.

R4405.10.6 Post-tensioning ducts.

R4405.10.6.1 Ducts for grouted or unbonded tendons shall be mortar-tight and nonreactive with concrete, tendons or filler material.

R4405.10.6.2 Ducts for grouted single wire, strand or bar tendons shall have an inside diameter at least $^1/_4$ inch (6.3 mm) larger than tendon diameter.

R4405.10.6.3 Ducts for grouted multiple wire, strand or bar tendons shall have an inside cross-sectional area at least two times the net area of the tendons.

R4405.10.7 Grout for prestressing tendons.

R4405.10.7.1 Grout shall consist of Portland cement and water; or Portland cement, sand and water.

R4405.10.7.2 Materials for grout shall conform as specified in ACI 318 and be as follows:

1. Portland cement.
2. Water content shall be minimum necessary for proper pumping of grout; however, water-cement ratio shall not exceed 0.45 by weight.
3. Sand, if used, shall conform to *Standard Specifications for Aggregate for Masonry Mortar*, ASTM C 144, except that gradation may be modified as necessary to obtain satisfactory workability.
4. Admixtures conforming to ACI 318 and known to have no injurious effects on grout, steel or concrete may be used. Calcium chloride shall not be used.
5. Water shall not be added to increase grout flow ability that has been decreased by delayed use of grout.
6. Grout temperatures shall not be above 90ºF (32ºC) during mixing and pumping.

R4405.10.8 Protection for prestressing tendons. Burning or welding operations in the vicinity of prestressing tendons shall be carefully performed, so that tendons are not subject to excessive temperatures, welding sparks or ground currents.

R4405.10.9 Application and measurement of prestressing force.

R4405.10.9.1 Prestressing force shall be determined by both of the following methods and the cause of any difference in force determination that exceeds 5 percent shall be ascertained and corrected.

1. Measurement of tendon elongation. Required elongation shall be determined from average load-elongation curves for prestressing tendons used.
2. Observation of jacking force on a calibrated gauge or load cell or by use of a calibrated dynamometer.

R4405.10.9.2 Where transfer of force from bulkheads or pretensioning bed to concrete is accomplished by flame cutting prestressing tendons, cutting points and cutting sequence shall be predetermined to avoid undesired temporary stresses.

R4405.10.9.3 Long lengths of exposed pretensioned strand shall be cut near the member to minimize shock to concrete.

R4405.10.9.4 Total loss of prestress as a result of unreplaced broken tendons shall not exceed 2 percent of total prestress.

R4405.10.10 Post-tensioning anchorages and couplers.

R4405.10.10.1 Couplers shall be placed in areas approved by the licensed engineer and enclosed in housing long enough to permit necessary movements.

R4405.10.10.2 In unbonded construction subject to repetitive loads, special attention shall be given to the possibility of fatigue in anchorages and couplers.

R4405.10.10.3 Anchorage and end fittings shall be permanently protected against corrosion.

SECTION R4405.11
HIGH-VELOCITY HURRICANE ZONES—PNEUMATICALLY PLACED CONCRETE (SHOTCRETE)

R4405.11.1 General.

R4405.11.1.1 Pneumatically placed concrete is a proportioned combination of fine aggregate Portland cement and water which, after mixing, is pneumatically projected by air directly onto the surface to which it is to be applied.

R4405.11.1.2 Pneumatically placed concrete shall conform to all requirements of Specifications for Materials, Proportioning and Application of Shotcrete, ACI 506.2 published by the American Concrete Institute, except as modified herein.

R4405.11.1.3 Pneumatically placed concrete shall be composed of Portland cement, aggregate and water proportioned to produce a concrete suitable for pneumatic application.

R4405.11.1.4 Concrete ingredients shall be selected and proportioned in a manner that will produce concrete which will be extremely strong, dense and resistant to weathering and abrasion.

R4405.11.2 Sampling and testing cement and aggregate. The contractor shall determine the source, kind and quality of the cement and aggregates to be used in the work well in advance of the time scheduled for starting the work and when so directed by the building official shall submit such information for approval before starting shotcrete operation.

R4405.11.3 Surface preparation. To ensure adequate bond, the newly chipped and sandblasted surface shall be thoroughly moistened with water prior to application of shotcrete. In no instance shall shotcrete be applied in an area where free running water exists.

R4405.11.4 Proportioning. Prior to the start of shotcreting, the contractor shall submit to the licensed engineer the recommended mix as a ratio of cement to aggregate. The recommended mix shall be on the basis of test data from prior experience.

R4405.11.5 Mixing.

R4405.11.5.1 Shotcrete shall be thoroughly mixed by machine and then passed through a sieve to remove all large particles before placing in the hopper of the cement gun. The mixture shall not be permitted to become damp. Each batch should be entirely discharged before recharging is begun. The mixer should be cleaned thoroughly enough to remove all adherent materials from the mixing vanes and from the drum at regular intervals.

R4405.11.5.2 Water in any amount shall not be added to the mix before it enters the cement gun. Quantities of water shall be controlled by a valve at the nozzle of the gun. Water content shall be adjusted as required for proper placement, but shall in no case exceed 4 gallons (15 L) of water per sack of cement, including the water contained in the aggregate.

R4405.11.5.3 Remixing or tempering shall not be permitted. Mixed material that has stood 45 minutes without being used shall be discarded. Rebound materials shall not be reused.

R4405.11.6 Application.

R4405.11.6.1 In shooting walls and columns, application shall begin at the bottom and the first coat shall completely embed the reinforcement to the form.

R4405.11.6.2 In shooting beams, application shall begin at the bottom and a surface at right angles to the nozzle shall be maintained.

R4405.11.6.3 In shooting slabs, the nozzle shall be held at a slight angle to the work so that rebound is blown on to the finished portion where it shall be removed.

R4405.11.6.4 Corners shall be filled first. "Shooting" shall be from an angle as near perpendicular to the surface as practicable, with the nozzle held approximately 3 feet (915 mm) from the work, except in confined control. If the flow of material at the nozzle is not uniform and slugs, sand spots or wet sloughs result, the nozzleman shall direct the nozzle away from the work until the faulty conditions are corrected. Such defects shall be replaced as the work progresses.

R4405.11.6.5 Shotcreting shall be suspended if:

1. Air velocity separates the cement from the sand at the nozzle.
2. Temperature approaches freezing and the newly placed shotcrete cannot be protected.

R4405.11.6.6 The time interval between successive layers in sloping, vertical or overhanging work must be sufficient to allow initial but not final set to develop. At the time the initial set is developing, the surface shall be cleaned to remove the thin film of laitance in order to provide a good bond with succeeding applications.

R4405.11.7 Construction joints. Construction joints or day's work joints shall be sloped off to a thin, clean, regular edge, preferably at a 45 degree (0.78 rad) slope. Before placing the adjoining work, the slope portion and adjacent shotcrete shall be thoroughly cleaned as necessary, then moistened and scoured with an air jet.

R4405.11.8 Curing and protection.

R4405.11.8.1 Curing shall be in accordance with ACI 506.2 depending upon atmospheric condition.

R4405.11.8.2 Immediately after placement, shotcrete shall be maintained in a moist condition for at least the first 24 hours.

R4405.11.8.3 Final curing shall continue for seven days after placement if Type I Portland cement is used, or for three days if high-early-strength Type III Portland cement is used, or until the specified strength is attained. Final curing may consist of the initial curing process or an approved moisture-retaining covering.

R4405.11.8.4 Natural curing may be used when relative humidity remains above 85 percent when approved by the licensed engineer of record.

SECTION R4405.12
HIGH-VELOCITY HURRICANE ZONES—
LIGHTWEIGHT INSULATING CONCRETE FILL

R4405.12.1 Lightweight insulating concrete fill. Material produced with or without aggregate additions to Portland cement, water and air to form a hardened material possessing insulating qualities, which, when oven dried shall have a unit weight no greater than 50 pcf (801 kg/m^3).

R4405.12.1.1 Aggregate lightweight insulating concrete. Insulating concrete fill formulated predominantly with perlite, vermiculite or expanded polystyrene beads. It shall have a minimum compressive strength of 125 psi (861.8 kPa) when tested in compliance with ASTM C 495 and C 796.

R4405.12.1.2 Cellular lightweight insulating concrete. Insulating concrete fill formulated by mixing a hydrated cementitious matrix around noninterconnecting air cells created by the addition of foam concentrates formed from hydrolyzed proteins or synthetic surfactants. The cured cellular lightweight insulating concrete shall have minimum compressive strength of 160 psi (1103 kPa) when tested in compliance with ASTM C 495 and C 796.

R4405.12.1.3 Cellular/aggregate (Hybrid) lightweight insulating concrete. Insulated concrete fill formulated by combining foam concentrates with low density aggregates to import properties of both aggregate and cellular lightweight insulating fill. It shall have a minimum compressive strength of 200 psi (1379 kPa) when tested in compliance with ASTM C 495 and C 796.

R4405.12.1.4 Walkability. A term defining the ability of lightweight insulating fill to withstand anticipated construction traffic during the roof membrane application without significant indentations in the lightweight insulating concrete fill surface.

R4405.12.2 Inspection.

R4405.12.2.1 Application of all lightweight insulating concrete fill roof decks shall be by applicators approved by the lightweight insulating concrete deck manufacturer. Product Approval shall be required for all lightweight insulation concrete fill systems.

R4405.12.2.2 The permit holder shall notify the building official 48 hours prior to the pouring of lightweight insulating concrete fill.

R4405.12.2.3 The permit holder shall make available to the building official a job log with the following minimum items.

1. Cast density recordings/hour
2. Product evaluation for application
3. Date and job locations identified
4. Results of any field test conducted.

R4405.12.2.4 The building official shall have clear access and clear path at his option for a walkability inspection of lightweight insulating concrete fill 24 hours after placement.

R4405.12.3 Testing. The building official may require tests of the lightweight insulating concrete fill to confirm the fastener withdrawal resistance, compressive strength or drainage ability.

R4405.12.3.1 Existing roof assemblies to receive lightweight insulating concrete fill other than galvanized G-90 steel deck or structural concrete deck shall be tested for uplift for adhesion to the substrate to confirm compliance with design pressure.

R4405.12.4 Materials and limitations of use. Lightweight insulating concrete fill, in conjunction with galvanized formed steel sheets, shall not be used as a roof deck in areas where highly corrosive chemicals are used or stored.

R4405.12.4.1 Lightweight insulating concrete fill shall be poured over bottom slotted galvanized (G-90) steel decking as follows; cellular, 0.5 percent open; hybrid, 0.75 percent open, aggregate 1.5 percent open. No lightweight insulating concrete shall be poured over a painted or non-galvanized steel deck.

1. Lightweight insulating concrete fill over structural concrete slabs, twin tees, precast units or other non venting substrates shall be vented, to allow the escape of excess moisture.

R4405.12.4.2 Minimum thickness of lightweight insulating concrete fill shall be 2 inches (51 mm) over the top plane of the substrate unless otherwise specified in the Product Approval. In all cases, lightweight insulating concrete shall be of sufficient thickness to receive the specific base ply fastener throughout the roof deck.

R4405.12.4.3 Minimum compressive strength at 28 days shall be as follows:

1. Aggregate concrete 125 psi (5985 Pa).
2. Cellular type: nailed base sheet 160 psi (7661 Pa).
3. Cellular type: adhered membrane systems 250 psi (11 970 Pa).

R4405.12.4.4 Galvanized coatings of formed steel sheets shall be in accordance with ASTM A 525 with a minimum coating designation of G-90. Base steel shall conform to ASTM A 446, grade A, B, C, D or greater and ASTM A 611 C, D or E.

R4405.12.4.5 Chemical admixtures shall be in compliance with ASTM C 494. Calcium chloride or any admixture containing chloride salts shall not be used in insulating concrete. Fiber reinforcement may be used to control cracking. Mineral admixtures shall conform to ASTM C 618.

R4405.12.4.6 Vermiculite or perlite shall be in compliance with ASTM C 332, Group I. Foam concentrates shall be in compliance with ASTM C 796 and ASTM C 869.

R4405.12.4.7 Mixing, placing and finishing shall be in compliance with the deck system Product Approval. Slurry coating, two-density casting and double casting shall be acceptable per the specific manufacturer's recommendations.

R4405.12.4.8 If the lightweight insulating concrete deck is to receive Product Approval for a direct-adhered roofing system, the deck surface shall be prepared to the requirements set forth in the roof system Product Approval.

R4405.12.4.9 All base ply fasteners for use in lightweight insulating concrete roof decks shall have a Product Approval for use with the specific lightweight insulating concrete roof system in compliance with manufacturer's recommendations and the design pressure of Section R4403.

R4405.12.4.10 The lightweight insulating concrete fill fastener withdrawal shall have a minimum resistance for new pours of:

1. 60 pounds (267 N) in 28 days when the fastener is installed and allowed to age in the concrete.
2. 40 pounds (178 N) at time of roofing.

R4405.12.4.11 Lightweight insulating concrete fill system expansion joint shall be provided at the following locations:

1. Where expansion or contraction joints are provided in the structural assembly.
2. Where steel framing, structural steel, or decking change direction.
3. Where separate wings of "L," "U," "T" or similar configurations exist.
4. Where the type of decking changes (for example, where a precast concrete deck and a steel deck abut).
5. Whenever additions are connected to existing buildings.
6. At junctions where interior heating conditions change.
7. Wherever differential movement between vertical walls and the roof deck may occur.

R4405.12.4.12 Insulation board with lightweight insulating concrete fill shall conform to Type I expanded polystyrene insulation as defined in ASTM C 578. 1. Installation of insulating board in conjunction with lightweight insulating concrete shall comply with uplift requirements set forth in Section R4403. Insulation panels shall be placed in a minimum $^1/_8$ inch (3.2 mm) slurry bed of insulating concrete while the material is still in a plastic state and shall be covered with insulating concrete within the same work day of placement of the insulating panel. The minimum 2 inch (51 mm) continuous pour is required so as not to compromise the diagram design. Insulation panels shall be provided with holes and/or slots for keying and/or slots for venting.

R4405.12.4.13 Reinforcing mesh shall be provided when necessary to meet fire-rating and/or special structural design requirements. Refer to a specific Product Approval for the specific requirements applicable to the product being installed.

1. Fibers may be added where control of plastic shrinkage and cracking is required. Refer to the Product Approval for the specific requirements applicable to the product being installed.

SECTION 4406
HIGH-VELOCITY HURRICANE ZONES—LIGHT METAL ALLOYS

R4406.1 Aluminum.

R4406.1.1 Design. Aluminum members shall be designed by methods admitting of rational analysis according to established principles of mechanics.

R4406.1.2 Standards. The following standards are hereby adopted as set forth in Chapter 43:

1. *Specifications for Aluminum Structures,* The Aluminum Association, Inc.
2. *The Aluminum Formed Sheet Building Sheathing Design Guide,* The Aluminum Association, Inc.
3. *The Commentary on Specifications for Aluminum Structures,* The Aluminum Association, Inc.
4. *Engineering Data for Aluminum Structures,* The Aluminum Association, Inc.
5. *Guidelines for Structural Condition Assessment of Existing Buildings,* ANSI/ASCE 11.

R4406.1.3 Workmanship. Aluminum construction shall be in conformance with the tolerances, quality and methods of construction as set forth in Section R4406.1.2 and the *American Welding Society's Structural Welding Code-Aluminum* (D1.2).

R4406.1.4 Definitions.

PRIMARY MEMBER. Structural framing members providing structural support to other members and/or surfaces of a structure including, but not limited to beams, posts, columns, joists, structural gutters, headers, etc.

SECONDARY MEMBERS. Structural framing members which do not provide basic support for the entire structure, generally including, but not limited to, such members as purlins, kickplate rails, chair rails, roof or wall panels, etc.

STRUCTURAL MEMBERS. Members or sections that provide support to an assembly and/or resist applied loads.

R4406.1.5 Identification. Aluminum for structural elements shall at all times be segregated or otherwise handled in the fabricator's plant so that the separate alloys and tempers are positively identified and, after completion of fabrication, shall be marked to identify the alloy and temper. Such markings shall be affixed to complete members and assemblies or to boxed or bundled shipments of multiple units prior to shipment from the fabricator's plant.

Exception: Certification by the fabricator and or contractor shall be provided attesting to the alloy and temper of the material.

R4406.1.6 Allowable unit stresses.

R4406.1.6.1 The design, fabrication and assembly of aluminum members for building and other structures shall conform to the standard set forth in Section R4406.1.2 and as otherwise set forth herein.

R4406.1.6.2 The use of aluminum alloys, other than those listed in the standard shall provide performance not less than those required by the standard and as set forth herein.

R4406.1.6.3 Aluminum members shall be limited by the deflections set forth in Section R4403.2.

R4406.1.7 The building official may require that any structure using aluminum primary or secondary members be designed by a Florida licensed professional engineer.

R4406.1.7.1 Increases in allowable unit stresses as set forth for wind loads in Section R4403.2 shall be applicable to aluminum structural members except that allowable unit stresses thus increased shall not exceed 75 percent of the minimum yield strength.

Exception: No increase in allowable stresses caused by wind loads shall be permitted for aluminum sheet decking, siding and cladding.

R4406.1.7.2 In addition to flexural and shearing stresses, the critical factors of buckling, fatigue, stress raisers such as notches or holes or shape reentrant corners, deflection and connections shall be considered and provided for by proper design.

R4406.1.7.3 All solid roof systems shall be designed for a minimum 30 psf (1436 Pa) live load.

R4406.1.7.4 All buildings and structures shall be designed to resist uplift. In the case of placement on existing slabs and foundations, sufficient information and calculations shall be provided by the professional engineer and/or architect to verify the ability of the slab or foundation to resist uplift loads.

R4406.1.7.5 All connection devices shall be rated by load testing by an approved testing laboratory.

R4406.1.7.5.1 All expansion anchors shall not be installed less than 3 inches (76 mm) from the edge of concrete slab and/or footings. All expansion anchors shall develop an ultimate withdrawal resisting force equal to four times the imposed load, with no stress increase for duration of load.

R4406.1.8 Fabrication and construction details.

R4406.1.8.1 Connections. Aluminum members shall be designed as set forth in the standards in Section R4406.1.2.

R4406.1.8.1.1 Fasteners. Bolts and other fasteners shall be aluminum, stainless steel, hot-dip or electro-galvanized steel. Double cadmium plated steel bolts may also be used.

R4406.1.8.1.2 Painting. Except as prescribed in Section R4406.1.8.4, painting or coating of aluminum alloy parts shall be required only when called for on the plans.

R4406.1.8.1.3 Welding. Aluminum parts shall be welded with an inert-gas-shielded arc or resistance welding process. No welding process that requires a welding flux shall be used. Filler alloys complying with the requirements of the standard in this section shall be used.

R4406.1.8.1.4 Welder qualifications. All welding of structural aluminum member shall be performed by certified welders.

R4406.1.8.1.5 Erection. During erection, structural aluminum shall be adequately braced and fastened to resist dead, wind and erection loads.

R4406.1.8.2 Structural aluminum decking and siding.

R4406.1.8.2.1 Aluminum sections spanning between supports shall be limited in span to satisfactorily support the positive and negative loads set forth in Section R4403.2. The deflection of decking shall not exceed that set forth in Section R4403.2.

R4406.1.8.2.2 Aluminum sheet used for roof decking or siding shall be not less than 0.032 inch (0.8 mm) in thickness.

R4406.1.8.2.3 Aluminum sheets shall be secured to the supports to adequately resist positive and negative loads. Attachments shall be at intervals not exceeding 8 inches (203 mm) o.c. and shall be secured to each other at side laps at intervals as required by rational analysis and/or tests, but shall not exceed 12 inches (305 mm) o.c.

R4406.1.8.2.4 Fasteners shall have a head, and/or be provided with washers not less than $^1/_2$ inch (13 mm) in diameter.

R4406.1.8.2.5 Fasteners located at end laps shall be placed not more than 2 inches (51 mm) nor less than 1 inch (25 mm) from the end of overlapping sheets.

R4406.1.8.2.6 Where roof or wall cladding is of aluminum, an approved membrane to protect against water intrusion to the interior shall be provided or the aluminum cladding shall be designed and constructed with an approved continuous edge-interlock, overlap or seam to prevent water intrusion.

R4406.1.8.3 Nonstructural aluminum decking and siding.

R4406.1.8.3.1 Nonstructural aluminum sheets shall be backed with cladding as set forth in Section R4409 and Section R4410.

R4406.1.8.3.2 Nonstructural aluminum sheets shall have a minimum thickness of 0.032 inches (0.8 mm).

R4406.1.8.3.3 An approved membrane to protect against water intrusion shall be provided or the aluminum. cladding shall be designed and constructed with an approved continuous edge-interlock, overlap or seam to prevent water intrusion.

R4406.1.8.3.4 Nonstructural decking and siding shall be attached as set forth in Section R4406.1.8.2 except that the attachment of aluminum residential siding shall be by rational analysis and/or tests using a minimum 0.120-inch (3 mm) diameter aluminum nails of sufficient length to penetrate studs a minimum of 2 inches (51 mm). Nails at wood studs shall be as required by rational analysis and/or tests, but spaced not greater than 24 inches (610 mm) o.c. horizontally and no greater than 8 inches (203 mm) o.c. vertically.

R4406.1.8.4 Dissimilar materials.

R4406.1.8.4.1 Aluminum may contact compatible metals such as, but not limited to:

1. Nonmagnetic stainless steel provided the contacting surfaces and any attachments are enclosed for protection from the weather.
2. Zinc.
3. White bronze.

R4406.1.8.4.2 Aluminum contacting metals not considered compatible shall be protected as follows:

1. Painting the dissimilar metal with a prime coat of zinc-chromate primer or other suitable primer, followed by one or two coats of aluminum metal-and-masonry paint or other suitable protective coating, excluding those containing lead pigmentation.
2. Painting the dissimilar metal with a coating of a heavy-bodied bituminous paint.
3. Placing a good quality caulking material between the aluminum and the dissimilar metal.
4. Applying a nonabsorptive tape or gasket.
5. Hot-dip galvanizing or zinc-plating steel members after fabrication.

R4406.1.8.4.3 Dissimilar metals shall be painted if used in locations where drainage from them passes over aluminum.

R4406.1.8.4.4 Aluminum surfaces in contact with lime-mortar, concrete, or other masonry materials, shall be protected with alkali-resistant, coatings, such as heavy-bodied bituminous paint or water-white methacrylate lacquer.

R4406.1.8.4.5 Aluminum in contact with wood or other absorbing materials which may become repeatedly wet shall be painted with two coats of aluminum metal-and-masonry paint or a coat of heavy-bodied bituminous paint, or the wood or other absorbing material shall be painted with two coats of aluminum house paint and the joints sealed with a good quality caulking compound.

R4406.1.8.4.6 Where aluminum is in contact with treated wood, wood shall be treated with pentachlorophenol, 5 percent minimum concentration, or creosote, or zinc naphthanate, following the protective measures outlined in Section R4406.1.8.4.5.

R4406.1.8.5 Expansion and contraction. Aluminum work shall be designed and anchored so that the work will not be distorted nor the fasteners over-stressed from the expansion and contraction of the metal.

SECTION 4407
HIGH-VELOCITY HURRICANE ZONES—MASONRY

R4407.1 Masonry shall be designed by a method admitting of rational analysis based on established principles of mechanics.

SECTION R4407.2
HIGH-VELOCITY HURRICANE ZONES—QUALITY, TESTS, AND APPROVALS

R4407.2.1 Quality. The quality of materials assembled into masonry and the method and manner of their assembly shall conform to the requirements of this section.

R4407.2.1.1 Workmanship. Masonry construction shall be in conformance with the tolerances, quality and methods of construction as set forth in standards referenced in this section; the *Portland Cement Association Concrete Masonry Handbook*, ANSI A41.1, A41.2 and *AWS Structural Welding Code: Reinforcing Steel* (D1.4).

R4407.2.1.2 Other materials. A material of masonry, other than set forth herein, which is incombustible and otherwise sufficiently embodies the characteristics and satisfies the requirements of one of the materials herein may be approved by the building official, subject to such tests as may be prescribed.

R4407.2.2 Tests.

R4407.2.2.1 The building official may require materials to be subjected to tests to determine their quality whenever there is reason to believe that a material is no longer up to the standards on which the approval was based. The cost of such tests shall be borne by the person or persons proposing to use or continue to use such material or product.

R4407.2.2.2 Materials shall be tested in accordance with the standard specifications of the ASTM International (ASTM) as such standard specifications are noted in this section.

R4407.2.3 Approvals.

R4407.2.3.1 Only such masonry units as bear the approval of the building official and are manufactured or fabricated by plants having a certificate of competency issued by the authority having jurisdiction, shall be considered acceptable for the construction of buildings or other structures.

R4407.2.3.2 Approval of masonry units and manufacturing or fabricating plants shall be for periods not to exceed one year and may be obtained upon application and the submission of certificates of tests in accordance with the provisions of this section.

R4407.2.3.3 The provisions for tests for approval of masonry units shall not be construed as in lieu of any tests otherwise required under this section.

R4407.2.3.4 Failure of a manufacturer of masonry units to obtain approval or to submit tests as required in this section, or such additional tests as the building official may require, shall be cause for rejection of such masonry units.

R4407.2.4 Brick.

R4407.2.4.1 General. Brick shall include masonry units usually $2^1/_4$ inches (57 mm) thick, $3^3/_4$ inches (95 mm) wide, and 8 inches (203 mm) long, and not less than 75 percent 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		
	Minimum Average Strength	
Type	(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 inch 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 m^2), 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 m^2) 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 $4^1/_2$ 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 cm^2) 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 cm^2) 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 mm^2) 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 cm^2) 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 same respective heights, but in no part less than 16 inches (406 mm).

R4407.4.2.9 Substitutions.

R4407.4.2.9.1 Where, for architectural reasons or otherwise, it is desirable to reduce the area of any required tie column or tie beam below the specified requirements, the building official may grant such reduction, provided that the area of concrete omitted shall be replaced by reinforcing or structural steel in the ratio 1:(n-1) where "n" is defined as the Modular Ratio of Elasticity (Esteel/Econcrete).

R4407.4.2.9.2 Where it is desired to substitute for the #5 reinforcing as required by this section, three #4 bars may be substituted to replace two #5 bars.

R4407.4.2.10 Wall additions. Where new walls are connected to existing walls, such connection shall be by means of a starter column of minimum 8 by 8 inches (203 by 203 mm) dimension reinforced with two #5 bars.

R4407.4.2.11 Chases, recesses and openings.

R4407.4.2.11.1 Unit masonry walls required to be a minimum of 8 inches (203 mm) thick, such as exterior walls, fire walls and bearing walls, may be chased or recessed not deeper than one-half the wall thickness for an area not exceeding 8 square feet (0.74 m^2), provided the horizontal dimension of the chase or recess does not exceed 4 feet (1219 mm) and provided the chasing shall not reduce the dimension of tie beams and tie columns to less than herein required, except as follows:

Exception: Four-inch (102 mm) deep chases or recesses in 8 inch (703 mm) unit masonry walls may be constructed with 4-inch (102 mm) unit masonry panels provided such 4-inch (102 mm) unit masonry panel does not exceed 5 feet (1524 mm) in width, does not exceed 8 feet (2.4 m) in height, is bonded on one vertical side to 8 inch (203 mm) masonry or a tie column, and is not load bearing. Where such panel exceeds 2 feet (610 mm) in width at locations 20 feet (6.1 m) or more above grade in exterior walls, resistance to wind load shall be considered in the design, and a minimum of 4-inch by 8-inch (102 mm by 203 mm) tie column with two #5 vertical bars shall be provided in the free standing end of such 4-inch (102 mm) wall.

R4407.4.2.11.2 Openings shall have lintels of reinforced concrete. Where such lintel is precast or formed separately from a tie beam, it shall bear not less than nominal 8 inches (203 mm) on the masonry, at each end except as may otherwise be approved for compliance with this code by Product Approval, or after rational analysis, but not less than 4 inches (102 mm). Where such lintel is formed integrally with the tie beam by deepening the tie beam above the opening, and the tie beam itself is capable of safely supporting all loads, the beam may span up to 6 feet (1.8 m) in length and may be deepened not to exceed 8 inches (203 mm) without additional reinforcing. Where the tie beam is deepened in excess of 8 inches (203 mm) with a span less than 6 feet (1.8 m) in length, and the tie beam itself is capable of supporting all loads, the dropped portion shall contain a #3 horizontal bar at the bottom, bent up at each end and fastened to the upper tie beam steel or two #4 horizontal bars. The dropped portion shall bear at least 4 inches (102 mm) on the masonry at each end. Where the span is in excess of 6 feet (1.8 m), the principal beam reinforcing shall be at the bottom of the beam.

R4407.4.2.12 Glass block.

R4407.4.2.12.1 Masonry of glass unit masonry may be used in nonload-bearing exterior or interior walls and in openings which might otherwise be filled with windows, either isolated or in continuous bands, provided the glass unit masonry panels have a thickness of not less than $3^1/_2$ inches (89 mm) at the mortar joint and the mortared surfaces of the units are satisfactorily treated for mortar bonding.

R4407.4.2.12.2 Glass unit masonry panels for exterior walls shall have a Product Approval.

R4407.4.2.12.3 Exterior unit masonry panels shall be set in recesses at the jambs and, for panels exceeding 10 feet (3 m) in horizontal dimension between supports, at the head as well, to provide a bearing surface at least 1 inch (25 mm) wide along the panel edges; except that when approved by the building official for panels exceeding neither 100 square feet (9.3.m^2) in area nor 10 feet (3 m) in either horizontal or vertical dimension, and situated four stories or less, and less than 52 feet (15.8 m) above grade level, anchorage may be provided by means of noncorrodible perforated metal strips.

R4407.4.2.12.4 Glass unit masonry panels shall have reinforcement in the mortar joints spaced not more than 2 feet (610 mm) apart vertically and below and above any openings within a pane. The reinforcement shall consist of two parallel longitudinal galvanized steel wires, No. 9 gauge or larger, spaced 2 inches (51 mm) apart, and welded to No. 14 or heavier cross wires at intervals not exceeding 8 inches (203 mm), or the equivalent approved by the building official.

R4407.4.2.12.5 Glass unit masonry shall be laid in only Type M or S mortar or equivalent approved material. Both vertical and horizontal mortar joints shall be at least $^1/_4$ inch (6 mm) and not more than $^3/_8$ inch (9.5 mm) thick and shall be completely filled.

R4407.4.2.12.6 Every exterior glass unit masonry panel shall be provided with expansion joints at the sides and top. Expansion joints shall be entirely free of mortar, and shall be filled with resilient material.

R4407.4.2.12.7 Glass masonry units required to provide a fire resistance rating shall comply with Section R4407.4.1.12.8 or shall be fire tested and listed for their intended use.

R4407.4.2.12.8 View panels in 1-hour fire-resistant walls shall be limited to glass unit masonry panels installed in steel channels, or panel anchor framing may be used where a $^3/_4$-hour fire rating is required. Three and seven-eighths inch (98 mm) thick glass masonry unit shall be limited to 120 square feet (1.1 m^2) with no dimension greater than 12 feet (3.7 m) for masonry wall construction or to 94 square feet (8.7 m^2) with no dimension greater than 10.75 feet (3.3 m) for nonmasonry wall construction. Three and one-eighths inch (79 mm) thick glass masonry units shall be limited to 100 square feet (9.3 m^2) with no dimension greater than 10 feet (3 m) for masonry wall construction or to 94 square feet (8.7 m^2) with no dimension greater than 10.75 feet (3.3 m) for nonmasonry wall construction. Three inches (76 mm) thick glass masonry units shall be limited to 100 square feet (9.3 m^2) with no dimension greater than 12 feet (3.7 m) for masonry wall construction or to 94 square feet

(8.7 m^2) with no dimension greater than 10 feet (3 m) for nonmasonry wall construction.

View panels in 2-hour fire resistant walls shall be limited to glass masonry units installed in steel channels and with a water curtain in conformance with NFPA 13 on each side at interior walls or at the interior of exterior walls. Three and seven-eighths inch (98 mm) thick glass masonry units shall be limited to 100 square feet (9.3 m^2) with no dimension greater than 10 feet (3 m).

The view panel assembly shall not exceed 25 percent of the wall separating a tenancy from a corridor or a corridor from an enclosed vertical opening or one fire-rated area from another fire-rated area.

Maximum $^3/_4$-hour fire-rated glass masonry units construction shall be used at nonmasonry wall construction. Panel anchors shall be provided at sill and jambs in nonmasonry wall construction using panel anchor framing. A fire retardant sealant shall be used at all channel and panel anchor framing. Expansion material at heads and jambs shall be either fibrous glass or mineral wool. All fire rated glass masonry units and panels shall conform to UL No. 9 and ASTM E 163.

R4407.4.2.12.9 Interior glass masonry unit panels having thickness of $3^7/_8$ inches (98 mm) shall not exceed 250 square feet (23.2 m^2) of unsupported wall surface and interior glass masonry unit panels having thickness of $3^1/_8$ inches (79 mm) shall not exceed 150 square feet (13.9 m^2) of unsupported wall surface nor more than 25 feet (7.6 m) in length nor more than 20 feet (6.1 m) in height between supports.

R4407.4.2.13 Grill block.

R4407.4.2.13.1 Decorative grills or screens constructed of unit masonry laid with cells open through the wall shall be as set forth herein or designs shall be based on rational analysis to resist applicable loads and computations shall be submitted to the building official for approval.

R4407.4.2.13.2 Unit masonry grills or screens as described in this paragraph shall not be load bearing.

R4407.4.2.13.3 Unit masonry in exterior wall shall be laid in Type M or S mortar.

R4407.4.3 Interior bearing walls. Interior-bearing walls shall be constructed as specified in Section R4407.4.2 for exterior walls, except that interior bearing walls in one-story building of Group H or I occupancy, where not required to be more than 1-hour fire-resistive, may be constructed of 4 inch (162 mm) concrete block not exceeding 9 feet (2.7 m) in height, capped with a reinforced concrete beam not less than 4 inches (102 mm) in width nor less than 12 inches (305 mm) in height, reinforced with two $^1/_2$-inch rods (12.7 mm), and such walls shall support only a roof or ceiling not in excess of 700 pounds per lineal foot (10.2 kN/m) with no chases or recesses.

R4407.4.4 Fire walls. Firewalls shall be constructed as set forth in Section R4407.4.2 for exterior walls.

R4407.4.5 Panel walls.

R4407.4.5.1 Panel walls of unit-masonry shall be not less than 8 inches (203 mm) thick and shall be limited in panel dimension as set forth in Section R4407.4.2.

R4407.4.5.2 Panel walls of reinforced concrete shall be not less than 4 inches (102 mm) thick nor less than required by design as specified in Section R4405.

R4407.4.6 Veneered walls.

R4407.4.6.1 Masonry backing.

R4407.4.6.1.1 Veneering or facing on masonry backing shall not be considered as adding any strength to such walls and shall be limited in height above foundations or between proper and adequate supports to 30 feet (9.1 m). Veneering shall be securely anchored to masonry backing by means of substantial, noncorroding metal wall ties, spaced not farther apart than 16 inches (406 mm) vertically or 24 inches (610 mm) horizontally.

R4407.4.6.1.2 Tile veneering, not more than 1 inch (25 mm) thick with individual units not exceeding 20 inches (508 mm) in any dimension and having not more than 200 square inches (1290 cm^2) of surface area with corrugations or scoring on the back side thereof, need not be anchored in accordance with the above requirements but shall be cemented solid to the backing with Portland cement mortar so as to provide a continuous integral support to the backing.

R4407.4.6.2 Wood backing.

R4407.4.6.2.1 In all cases, before applying masonry veneer, a substantial waterproofed paper or asphalt-saturated felt, weighing not less than 14 pounds per 100 square feet (0.68 kg/m^2) shall be applied horizontally, shingle fashion, over diagonal sheathing. Horizontal joints in the paper or felt shall be lapped not less than 4 inches (102 mm) and vertical end joints not less than 6 inches (152 mm).

R4407.4.6.2.2 Masonry veneer shall be not less than $3^3/_4$ inches (95 mm) thick and shall be bonded to the backing by means of substantial noncorroding metal wall ties spaced not farther apart than 16 inches (406 mm) vertically and 24 inches (610 mm) horizontally.

R4407.4.7 Partitions.

R4407.4.7.1 The requirements specified herein shall apply to non-bearing interior separations, other than firewalls, of unit masonry construction.

R4407.4.7.2 The lateral distance between vertical supports of non-bearing interior partitions of unit-masonry shall not exceed 72 times the actual thickness of the partition, including plaster.

R4407.4.7.3 The height of unit masonry partitions shall not exceed 36 times the actual thickness, including plaster.

R4407.4.7.4 All interior unit masonry partitions shall be designed to meet the lateral live load requirements with corre-

sponding perimeter anchorage supports, in accordance with Section R4403.7.8.

R4407.4.8 Fences.

R4407.4.8.1 Masonry fences so located on a property that such fence, at the proposed height or by a future addition to height, could be used as a wall of a building shall be constructed with foundations and tie columns as provided for an exterior wall. Such fence shall be capped with a coping beam not less than 64 square inches (413 cm^2) in cross-section reinforced with a minimum of two #4 rods, when not exceeding a height of 5 feet (1.5 m), or shall be capped by a tie beam as provided for exterior walls if exceeding a height of 5 feet (1.5 m).

R4407.4.8.2 Masonry fences, so located on a property that by zoning regulation such fence could not be used as a wall of a building, shall be constructed as follows:

R4407.4.8.2.1 Fences not exceeding 5 feet (1.5 m) in height shall be 8 inches (203 mm) thick and shall not be required to have tie columns, but shall be required to have a coping as provided herein; or such fences may be 4 inches (102 mm) thick with tie columns and coping not less than 8 inches (203 mm) thick.

R4407.4.8.2.2 Fences exceeding 5 feet (1.5 m) in height shall be not less than 8 inches (203 mm) thick and shall have tie columns and tie beams as required for exterior walls.

R4407.4.9 Other masonry walls. Walls of masonry materials or arrangements of masonry units other than those specifically set forth in this section shall be in conformance with the general provisions of this code, may be classified by the subject to all or any of the requirements therefor to and any such additional requirements as the building official may prescribe.

SECTION R4407.5
HIGH-VELOCITY HURRICANE ZONES—REINFORCED UNIT MASONRY

R4407.5.1 Standards. The provisions of TMS 402/ACI 530/ASCE 5, and TMS 602/ACI 530.1/ASCE6 are hereby adopted as a minimum for the design and construction of reinforced unit masonry. In addition to TMS 402/ACI 530/ASCE 5 and TMS 602/ACI 530.1/ASCE 6 reinforced unit masonry structures shall comply with Section R4407.2.

Exception: Unless otherwise specified by the designing architect or engineer, where plan review and inspections are performed by a local building department in accordance with Sections 106 and 109, the provisions of TMS 402/ACI 530/ASCE 5/TMS 402, Chapter 1, Section 1.18 and TMS 602/ACI 530.1/ASCE 6/ Sections 1.5 and 1.6 shall not apply.

R4407.5.2 General. Reserved.

R4407.5.3 The design of buildings and structures of reinforced unit masonry shall be by a professional engineer or registered architect.

R4407.5.4 Special inspector. A Florida-registered architect or professional engineer shall furnish inspection of all reinforced unit masonry structures.

R4407.5.5 Concrete masonry strength. Concrete masonry strength shall be determined by unit strength method from TMS 602/ACI 530.1/ASCE 6 Section 1.4 or in accordance with ASTM C 1314.

R4407.5.6 Reinforcement. Reinforcement shall comply with TMS 402/ACI 530/ASCE 5 and TMS 602/ ACI 530.1/ASCE 6 except as modified herein.

R4407.5.6.1 Development of bars in tension and compression shall be in accordance with TMS 402/ASCE 530/ ASCE5 Section 2.1.9.3 with the following changes to the factor γ of Equation 2-12.

$\gamma = 1.0$ for No. 3 (M#10) through No. 5 (M#16) bars;

$\gamma = 1.04$ for No. 6 (M#19) through No. 7 (M#22) bars; and

$\gamma = 1.2$ for No. 8 (M#25) through No. 11 (M#36) bars

Where epoxy coated bars are used, lap length shall be increased by 50 percent.

R4407.5.6.2 Splices of reinforcement shall be in accordance with TMS 402/ACI 530/ASCE 5. Lap splices, welded splices, or mechanical splices are permitted in accordance with the provisions of TMS 402/ACI 530/ASCE 5 Section 2.1.9.7. Welding shall conform to AWS D1.4.

R4407.5.6.3 Lap splices shall be in accordance with TMS 402/ACI 530/ASCE 5, Section 2.1.9.7.1.1 with the modifications of Section 2122.4.1 to the factor γ of Equation 2-12. In no case shall the length of the lapped splice be less than 48 bar diameters, but not less than 12 inches.

R4407.5.6.4 Joint reinforcement. Horizontal joint reinforcement shall be provided at every other course. Joint reinforcement shall be a minimum of No. 9 gauge and shall comply with TMS 602/ACI 530.1/ASCE 6 Sections 2.4C through 2.4F. Joint reinforcement shall be placed in accordance with TMS 602/ACI 530.1/ASCE 6 Section 3.4 B.7.

R4407.5.7 Concentrated loads shall be in accordance with TMS 402/ACI 530/ASCE 5 Sections 1.9.7.2 and 2.1.8 and shall not be assumed distributed across continuous vertical joints, including stack bond joints, unless reinforcing elements are designed and provided to distribute such loads.

R4407.5.8 Reinforced masonry bearing walls shall have a nominal thickness of not less than 8 inches (203 mm).

R4407.5.9 Anchorage requirements. Anchorage shall be in accordance with TMS 402/ACI 530/ASCE 5. Loading shall comply with TMS 402/ACI 530/ASCE 5 Section 1.7 and the following.

R4407.5.9.1 Reinforced masonry walls shall be securely anchored to adjacent structural members such as roofs, floors, columns, pilasters, buttresses and intersection walls.

R4407. 5.9.2 Masonry walls shall be anchored to all floors and roofs that provide lateral support to such walls.

R4407.5. 9.3 Such anchorage shall provide a positive direct connection capable of resisting the horizontal forces as re-

quired in Chapter 16 (High-Velocity Hurricane Zones), or a minimum force of 200 pounds per lineal foot (2919 N/m) of wall, whichever is greater.

R4407.5.9.4 Required anchors shall be embedded in reinforced grouted cells.Anchor bolts shall be installed in accordance with TMS 602/ACI 530.1/ASCE 6 Section 3.4 D.

R4407.5.9.5 Wood framing connected by nails shall not be considered as acceptable anchorage.

R4407.5.10 Mortar and grout.

R4407.5.10.1 Mortar materials shall comply with TMS 602/ACI 530.1/ASCE 6 Section 2.1. Grout materials shall comply with TMS 602/ACI 530.1/ASCE 6 Section 2.2.

R4407.5.10.2 Vertical cells to be grouted shall provide vertical alignment sufficient to maintain clear, unobstructed, continuous, vertical cores measuring not less than $2^1/_2$ inches by 3 inches (51 mm by 76 mm) for fine aggregate grout and 3 inches by 3 inches for coarse aggregate grout as defined by ASTM C 476. The architect or engineer may specify other grout space sizes shall be permitted provided they comply with TMS 402/ACI 530/ ASCE 5 Section 1.19 and TMS 602/ACI 530.1/ASCE 6 Section 3.5C.

R4407.5.10.3 Placing of mortar and masonry units shall comply with TMS 602/ACI 530.1/ASCE 6 Section 3.3.

R4407.5.10.4 Grout placement. Grout placement shall be in accordance with TMS 402/ACI 530/ASCE 5 and TMS 602/ACI 530.1/ASCE 6.

R4407.5.10.5 Confinement. Confine grout to the areas indicated on the project drawings. Use material to confine grout that permits bond between masonry units and mortar.

R4407.5.10.6 Unless otherwise required, mix grout other than self-consolidating grout to a consistency that has a slump between 8 and 11 inches (203 and 279 mm). Self-consolidating grout shall comply with TMS 602/ACI 530.1/ASCE 6.

R4407.5.10.7 Grout shall be placed before any initial set has occurred, but in no case more than $1^1/_2$ hours after the mix-designed water has been added.

R4407.5.10.8 Grouting shall be a continuous operation in lifts not exceeding 5 feet (1.5 m) and a maximum pour of 12 feet 8 inches (3.8 m). Grout placement shall comply with TMS 602/ACI 530.1/ASCE 6.

R4407.5.10.9 Grouting shall be consolidated between lifts by puddling, rodding or mechanical vibration.

R4407.5.10.10 Grout keys shall be formed between grout pours. Grout keys shall be formed between grout lifts when the first lift is permitted to set prior to placement of the subsequent lift.

1. Form a grout key by terminating the grout a minimum of $1^1/_2$ in. (38.1 mm) below a mortar joint.
2. Do not form grout keys within beams.
3. At beams or lintels laid with closed bottom units, terminate the grout pour at the bottom of the beam or lintel without forming a grout key.

R4407.5.11 Bearing. Precast floor and roof units supported on masonry walls shall provide minimum bearing of 3 inches (76 mm) and anchorage in accordance with Section R4407.5.9.4.

R4407.5.12 Intersecting walls shall comply with TMS 402/ACI 530/ASCE 5 Section 1.9.4.

SECTION R4408
HIGH-VELOCITY HURRICANE ZONES—STEEL

R4408.1 General. Steel construction.

R4408.1.1 Design. Steel and iron members shall be designed by methods admitting of rational analysis according to established principles or methods.

R4408.1.2 The design, fabrication and erection of iron and steel for buildings and other structures shall be as set forth in this section. The requirements set forth in Sections R4408.2 through R4408.8 herein, inclusive, apply to structural steel for buildings and other structures. Sections R4408.9 and R4408.10, apply to cold-formed members of sheet or strip steel and light-gauge steel construction.

R4408.1.3 The following standards, as set forth in Chapter 43 of this code, are hereby adopted.

1. American Institute of Steel Construction, AISC:
    a. Manual of Steel Construction, 2005 Thirteenth Edition AISC, including Specification for Structural Steel Buildings, 360-05.
    b. Serviceability Design Considerations for Low-Rise Buildings, AISC.
    c. Engineering for Steel Construction, AISC.
    d. Detailing for Steel Construction, AISC.
    e. Iron and Steel Beams - 1873 to 1952, AISC.
    f. Torsional Analysis of Steel Members, AISC.
2. American Iron and Steel Institute, AISI:
    a. Specification for the Design of Cold-Formed Steel Structural Members, AISI.
    b. Fire-Resistant Steel-Frame Construction, AISI.
    c. Fire-Safe Structural Steel – A Design Guide, AISI.
    d. Designing Fire Protection for Steel Trusses, AISI.
    e. Cold-Formed Steel Design Manual, AISI
    f. Specifications for the Design of Light-gauge Cold-Formed Stainless Structural Members, AISI.
    g. Specification for the Criteria for Structural Application of Steel Cables for Buildings, AISI.
    h. Designing Fire Protection for Steel Columns, AISI.
    i. Design Manual for Structural Tubing, AISI.
3. American National Standards Institute/American Society of Civil Engineers, ANSI/ASCE.

a. Specifications for the Design and Construction of Composite Slabs and Commentary on Specifications for the Design and Construction of Composite Slabs, ANSI/ASCE 3.

b. Specifications for the Design of Cold-Formed Stainless Steel Structural Members, ANSI/ASCE 8.

c. Guideline for Structural Condition Assessment of Existing Buildings, ANSI/ASCE 11.

4. American National Standards Institute/American Welding Society, ANSI/AWS.

a. Standard Welding Procedure and Performance Qualification, AWS B2.1.

b. Recommended Practice for Stud Welding, AWS C5.4.

c. Structural Welding Code - Steel, ANSI/AWS D1.1.

d. Structural Welding Code - Sheet Metal, AWS D1.3.

e. Structural Welding Code – Reinforcing Steel, ANSI/AWS D1.4.

f. Specification for Welding of Sheet Metal, AWS D9.1.

g. Standard for Qualification of Welding Procedures and Welders for Piping and Tubing, AWS D10.9.

5. American Society for Testing and materials, ASTM.

a. Standard Specification for General Requirements for Rolled Steel Plates, Shapes, b. Sheet Piling and Bars for Structural Use, ASTM A 6.

b. Standard Specifications for High-Strength Bolts for Structural Steel Joints, ASTM A 325.

c. Standard Specification for Heat-Treated Steel Structural Bolts. 150 KSI Minimum Tensile Strength, ASTM A 490.

d. Standard Specification for General Requirements for Steel Sheet, Zinc Coated (Galvanized) by the Hot Dip Process, ASTM A 525.

6. National Association of Architectural Metal Manufacturers, NAAMM.

a. Metal Grating Manual, NAAMM.

7. Rack Manufacturers Institute/American National Standards Institute, RMI/ANSI.

a. Industrial Steel Storage Racks Manual, RMI.

b. Manual of Safety Practices - A code of Practices for the Use of Industrial and Commercial Steel Storage Racks, RMI/ANSI MH16.2.

8. Research Council on Structural Connections of the Engineering Foundation, RCSCEF.

a. Specification for Structural Joints Using ASTM A 325 or A 490 Bolts, RCSCEF.

9. Shelving Manufacturers Association, a Products Section of the Material Handling Institute/American National Standards Institute, SMA/ANSI.

a. Specification for the Design, Testing, Utilization and Application of Industrial Grade Steel Shelving, SMA/ANSI MH281.

10. Steel Deck Institute, Inc., SDI.

a. Standard Practice Details, SDI.

b. SDI Manual of Construction with Steel Deck, SDI.

c. Deck Damage and Penetrations, SDI.

d. Steel Deck Institute Design Manual.

e. LRFD Design Manual for Composite Beams and Girders with Steel Deck, SDI.

f. Diaphragm Design Manual, SDI.

11. Steel Joist Institute, SJI.

a. Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders, SJI.

b. Structural Design of Steel Joist Roofs to Resist Ponding Loads, Technical Digest No. 3, SJI.

g. Vibration of Steel Joist-Concrete Slab Floors, Technical Digest No. 5, SJI.

h. Structural Design of Steel Joist Roofs to Resist Uplift Loads, Technical Digest No. 9, SJI.

i. Welding of Open Web Steel, Technical Digest No. 8, SJI.

j. Handling and Erection of Steel Joists and Joist Girders, Technical Digest No. 9, SJI.

k. 60-Year Steel Joist Manual, SJI.

12. Steel Structures Painting Council, SSPC.

a. Steel Joist Shop Paint, SSPC - Paint 15.

b. A Guide to the Shop Painting of Structural Steel, SSPC/AISC.

13. Underwriters Laboratories, Inc., UL.

a. Test for Uplift Resistance of Roof Assemblies, UL 580.

14. Welded Steel Tube Institute, Inc., WSTI.

a. Manual of Cold Formed Welded Structural Steel Tube.

R4408.1.4 Workmanship. Steel construction shall be in conformance with the tolerances, quality and methods of construction as set forth in Section R4408.1.3.

R4408.1.5 Statements of the structural responsibilities of architects and licensed engineers on the design of structural steel systems.

R4408.1.5.1 The structural engineer of record and/or the architect of record shall be responsible for all aspects of the structural design including the design of components and connections. The structural construction documents may assign to the fabricator the responsibility for implementing the design as specified and for maintaining fabrication and erection tolerances and for ensuring the fit and erectability of the structure.

R4408.1.5.2 The structural engineer of record and/or the architect of record may elect to detail all connections on the

structural construction documents and require fabrication in accordance with those details.

R4408.1.5.3 Alternately the structural engineer of record and/or the architect of record may permit the fabricator to select or modify connections subject to review and approval by the structural engineer of record and/or the architect of record. In that case, the structural construction documents shall specify criteria for the design of connections and shall identify the nature, magnitude and location of all design loads.

R4408.1.5.4 The structural engineer of record and/or the architect of record shall require the submission of fabrication and erection drawings for review as an indication that his or her intent has been understood and the specified criteria have been used.

R4408.1.5.5 Structural submittals requiring engineering input, such as dealing with substitute connections, shall be accompanied by design calculations and shall bear the impressed seal, signature and date of the specialty engineer who prepared them.

SECTION R4408.2
HIGH-VELOCITY HURRICANE ZONES—MATERIAL

R4408.2.1 Steel. Steel shall conform to the physical requirements set forth in the applicable standard in Section R4408.1.3.

R4408.2.2 High-strength steel bolts. High-strength steel bolts shall conform to the requirements set forth in the applicable standards of Section R4408.1.3.

R4408.2.3 Used and damaged material. All steel shall be straight and true, and any section damaged to be out of shape shall not be used. Steel previously used or fabricated for use or fabricated in error shall not be used except with the approval of the building official. Filled holes or welds shall not be concealed. Straightened or retempered fire-burned steel shall not be used except with the approval of the building official.

R4408.2.4 Tests. The building official may require tests and/or mill records to determine the quality of materials.

R4408.2.5 Ribbed bolts. Ribbed bolts shall be made from carbon manganese steel with a minimum tensile strength of 70,000 psi (482.7 MPa).

SECTION R4408.3
HIGH-VELOCITY HURRICANE ZONES—DESIGN LOADS

R4408.3.1 Design shall be based on the dead, live, wind and other loads set forth in Section R4403 and the additional stress considerations set forth in this section.

SECTION R4408.4
HIGH-VELOCITY HURRICANE ZONES—MINIMUM THICKNESS OF MATERIAL

R4408.4.1 The minimum thickness of material shall not be less than as set forth in the applicable standards listed in Section R4408.1.3 except as otherwise set forth herein.

SECTION R4408.5
HIGH-VELOCITY HURRICANE ZONES—CONNECTIONS

R4408.5.1 Connections shall conform to the requirements of the applicable standards set forth in Section R4408.1.3.

R4408.5.2 A Florida-registered architect or licensed engineer shall inspect the welding and high-strength bolting of structural steel framing and welding, bolting and fastening of lightweight material systems and metal sidings of buildings with areas exceeding 1,000 square feet (93 m^2).

R4408.5.3 Welding in the shop or field may be done only by AWS certified welders.

SECTION R4408.6
HIGH-VELOCITY HURRICANE ZONES—TUBULAR COLUMNS

R4408.6.1 Tubular columns and other primary compression members, excluding secondary posts and struts not subject to bending and whose design load does not exceed 2,000 pounds (8900 N), shall have a minimum least dimension of $2^1/_2$ inches (64 mm) and a minimum wall thickness of $^3/_{16}$ inch (4.8 mm).

R4408.6.2 Tubular members when filled with concrete shall have $^1/_4$ inch (6.4 mm) diameter pressure relief holes drilled through the shell, within 6 inches (152 mm) of the top and bottom of the exposed length of the member and one hole at mid-height.

R4408.6.3 Concrete fill in tubular members shall not be assumed to carry any of the load except in compression members having a least dimension of 8 inches (203 mm) or greater and having a 1-inch (25 mm) inspection hole in the plate at each end.

SECTION R4408.7
HIGH-VELOCITY HURRICANE ZONES—PROTECTION OF METAL

R4408.7.1 All field rivets, bolts, welds and abrasions to the shop coat shall be spot painted or treated with the material used for the shop coat, or an equivalent comparable to the shop coat, after removal of all objectionable deleterious materials.

R4408.7.2 Primary structural steel members, except where intended to be encased in concrete, shall have one shop coat of paint and, if exposed to the atmosphere or elements in the completed building or structure shall receive a second shop coat of paint or be field painted in addition to the initial shop coat with lead, graphite or asphalt paint or other approved coating compatible with the shop coat, except as herein provided. Surfaces of members in contact with, but not encased in, concrete or ma-

sonry shall be asphalt coated or otherwise effectively coated where the thickness of the metal is $^3/_{16}$ inch (4.8 mm) or less.

R4408.7.3 Members having a corrosion-resistive metallic coating of zinc of not less than G90 coating designation (1.25 ounces; 35 grams) or other equivalent approved coating are not required to have the shop and field coating.

R4408.7.4 Where structural members are exposed to industrial fumes, fresh and/or salt water, salt water spray, and other corrosive agents, such members shall be effectively protected with a corrosion-resistive metallic or other equivalent approved coating.

R4408.7.5 Corrosion-resistant steels with or without painting or coating may be approved where sufficient test or other factual data establishing the satisfactory performance under the particular exposure conditions or usage is submitted to and approved by the building official.

SECTION R4408.8
HIGH-VELOCITY HURRICANE ZONES—OPEN WEB STEEL JOISTS

R4408.8.1 Standards. Open web steel joists shall comply with the standards set forth in Section R4408.1.3.

R4408.8.2 Statements of responsibilities of architects and professional engineers on the design of structural systems using open web steel joists.

R4408.8.2.1 The structural construction documents shall designate the standards for joist design and shall indicate layout, end supports, anchorage, bridging requirements, etc., including connections to walls. The structural construction documents shall indicate special requirements for concentrated loads, openings, extended ends and resistance to uplift.

R4408.8.2.2 The structural engineer of record and/or the architect of record shall require structural submittals for the structural engineer of record's review and/or the architect of record's review as an indication that his or her intent has been understood and that the specified criteria have been used. The structural submittals, unless catalog submittals, shall bear the impressed seal, signature and date of the specialty engineer who prepared them.

R4408.8.2.3 The structural submittals shall identify the specific project, shall list the design criteria and shall show all joist location information and details necessary for proper installation.

R4408.8.3 Design.

R4408.8.3.1 Open web steel joist systems shall be designed to accommodate the loads and forces set forth in Section R4403.

R4408.8.3.2 Net uplift forces for all zones, applied to the joist systems, shall be clearly indicated on the structural construction documents.

R4408.8.3.3 Where the net uplift force is equal to or greater than the gravity load of construction, all web and bottom chord members shall comply with slenderness ratio requirements for top chord and for compression members other than top chord as provided for in the standards set forth in Section R4408.1.3(11).

R4408.8.3.4 The slenderness ratio about the horizontal axis can be used in determining the capacity of the top chord provided the top chord is stayed laterally by the deck system. The top chord for superimposed dead and live loads shall be considered to be stayed laterally if:

1. A poured-in-place concrete slab is in direct contact with the top chord.
2. A light gauge steel deck complying with Section R4408.9 is fastened to the top chord.
3. Any other approved deck system such that attachments of the top chord to the deck are capable of resisting a lateral force specified in the standard set forth in Section R4408.1.3 and the spacing of the fasteners does not exceed 24 inches (610 mm) along the chord.

R4408.8.3.5 When the bottom chord under net uplift loads is in compression, the bottom chord shall be stayed laterally by a bracing system adequately anchored at each end.

R4408.8.3.6 Fastenings shall be bolting, welding or other approved fastening device that provides a resistance to lateral movement as required by rational analysis or by test, but not less than 400 pounds per foot (5838 N/m).

R4408.8.4 Connections. The joints and connections of members of steel joists shall be made by welding or bolting.

R4408.8.5 Bridging.

R4408.8.5.1 All bridging and anchors shall be completely installed before application of any construction loads. Bridging shall secure the chords against lateral movement and shall position and hold the joists vertical and in a straight line.

R4408.8.5.2 Bridging members shall be of material having a thickness not less than:

1. $^1/_8$ inch (3.2 mm) for hot-rolled sections.
2. 16 gauge for cold-formed sections.
3. $^1/_2$ inch (12.7 mm) diameter for round members.

R4408.8.5.3 Bridging shall be connected to the chords of the joists by welding, bolting or other positive mechanical means. Each attachment shall be capable of resisting a horizontal force specified in the standard set forth in Section R4408.1.3.

R4408.8.5.4 Bridging shall be connected to the chords of the joists by bolting or welding at all points of contact and shall be capable of transmitting the forces required of the bridging members. The ends of all bridging lines shall terminate at walls or beams and shall be anchored thereto and where anchorage is not possible, stability shall be provided by additional bracing.

R4408.8.5.5 Where uplift forces are a design requirement, a single line of continuous bottom chord bridging shall be provided near the first panel points.

R4408.8.6 End supports and anchorage.

R4408.8.6.1 Joists shall not bear directly on unit masonry unless masonry is designed as engineered unit masonry with properly reinforced, grout-filled continuous bond beam.

R4408.8.6.2 The ends of every joist shall be bolted, welded or encased in concrete at each point of bearing to provide not less resistance in any direction than 50 percent of the Steel Joist Institute rated end reaction horizontally and 100 percent of the net uplift reaction specified in the structural construction documents.

R4408.8.6.3 The ends of joists shall have a minimum bearing, on reinforced concrete and steel supports as specified in the standard set forth in Section R4408.1.3(11).

R4408.8.7 Fabrication. Steel joists shall be manufactured by plants having a certificate of competency issued by the authority having jurisdiction.

R4408.8.8 Shop standards. The applicant for building permit will not be required to submit shop drawings for steel joists except as set forth in Sections R4408.8.8.1 and R4408.8.8.2.

R4408.8.8.1 The master permit drawings required by this code shall describe all steel to be used in the proposed building or structure, including open-web frames and trusses, and shall detail member sizes, spacing, attachment and welding including provision for unusual loading such as concentrated loads, unusual cantilevering, soffit framing and continuity except that such prime drawings may designate standard open-web steel joists by SJI number and symbol.

R4408.8.8.2 Where standard open-web steel joists are designated on the prime drawings by customary SJI numbers or symbols, the manufacturer, fabricator or supplier may be required to submit design computations, stress diagrams, sizes of members and sizes of welds to the building official for approval before installation to demonstrate that the units to be provided do, in fact, comply with the specifications and performance standards set forth by SJI. Only design computations prepared by a professional engineer will be accepted. Resubmission of any fabricator designs so submitted and approved will not be required for each subsequent job. Proof of the characteristics of the material may be required for any steel for which a minimum yield strength in excess of 36,000 psi (248.2 MPa) is used as the basis of design.

SECTION R4408.9
HIGH VELOCITY HURRICANE ZONES—
COLD-FORMED STEEL CONSTRUCTION

R4408.9.1 Cold-formed steel construction shall include individual structural members, structural decks or wall panels, and nonstructural roofing, siding and other construction elements formed from sheet or strip steel and as set forth in Section R4408.1.3(2).

R4408.9.2 Standards. Cold-formed steel used in structural applications shall conform to the standards set forth in Section R4408.1.3(2).

R4408.9.2.1 Galvanizing as referred to herein is to be zinc coating conforming to the standard set forth in Section R4408.1.3(5)(d).

R4408.9.3 Individual structural members. Design, fabrication and erection of individual cold-formed steel structural members shall be as set forth herein.

R4408.9.3.1 All structural members shall be positively connected to resist the loads set forth in Section R4403.

R4408.9.3.2 All connections shall be by welding, riveting, bolting or other approved fastening devices or methods providing positive attachment and resistance to loosening. Fasteners shall be of compatible material.

R4408.9.3.3 Cables and rods shall not be used as lateral bracing in habitable structures. Lateral bracing, when used, shall have a slenderness ratio of 300 or less, unless restricted by any other section of this code.

R4408.9.3.4 Doors and windows in preengineered metal building systems shall be designed as a structural component member and shall conform to all requirements in this section.

R4408.9.3.5 All doors shall be anchored as part of the frame in the closed position.

R4408.9.3.6 No increase in strength shall be allowed for the effect of cold work.

R4408.9.4 Structural sheets. Decks and panels with or without an approved fill material may be designed as diaphragms in accordance with *Diaphragm Design Manual* of the Steel Deck Institute, provided other limitations in this code are complied with.

R4408.9.4.1 Poured fill on roof and floor decks shall not be assumed to have any structural value to support or resist vertical or lateral loads or to provide stability or diaphragm action unless so designed, and poured fill and/or applied materials do not degrade when subjected to moisture.

R4408.9.4.2 Positive attachment of sheets shall be provided to resist uplift forces. Attachment shall be as set forth in Section R4408.9.3.1 and as required by rational analysis, and/or tests, but not less frequently than the following maximum spacing:

1. One fastener shall be placed near the corner of each sheet or at overlapping corners of sheets.
2. Along each supporting member, the spacing of fasteners shall not exceed 8 inches (203 mm) on centers at ends of sheets or 12 inches (305 mm) on centers.
3. The spacing of edge fasteners between panels, and between panels and supporting members, parallel to the direction of span, where continuous interlock is not otherwise provided shall be not more than 12 inches (305 mm) on centers.
4. Fastening shall be by bolting, welding or other approved fastening device that provides a resistance to lateral movement as required by rational analysis or by test, but not less than 400 pounds per lineal foot (5838 N/m).

5. Poured lightweight concrete fill will be acceptable as continuous interlock.
6. Attachment to the supporting structure shall be provided at all perimeters and discontinuities by fasteners spaced at no more than 8 inches (203 mm) on center.
7. Wall panels shall be attached as set forth in Section R4408.9.4.2(1),(2) and (3).

R4408.9.4.3 Metal siding and roof panels shall be not less than 24 gauge.

Exception: Roof panels having an approved fill material designed to act as a diaphragm may use a lighter deck gauge provided that the Product Approval for the fill material allows its use over the same deck gauge, but in no case shall the deck be less than 26 gauge. The permit applicant shall provide the building official with signed and sealed structural calculations for the diaphragm design prepared by a licensed architect or engineer proficient in structural design. The diaphragm design shall comply with the applicable requirements of Section R4403 and Section R4408.

R4408.9.4.4 Deflection of metal siding and roof panels shall not exceed L/240.

R4408.9.4.5 The bending stress of metal siding and roof panels shall be designed using a safety factor of not less than 2.5.

R4408.9.4.6 Minimum roof decking uplift loads shall comply with the design requirements of Section R4403 utilizing rational analysis, but not less than UL 580 Class 90.

R4408.9.4.7 Reserved.

R4408.9.4.8 Metal siding and roof panels shall be designed, where possible, to be continuous over two or more spans.

R4408.9.5 Nonstructural sheets. Steel sheet sections not suitable by rational analysis for self-supporting structural sheets shall be termed roofing and siding. Roofing and siding shall be used only over solid wood sheathing or equivalent backing.

R4408.9.5.1 Attachment of sheets shall be as set forth in Section R4408.9.4.2

R4408.9.6 Protection of metal. All members shall be treated with protective paint coatings or equivalent protection except as permitted in Sections R4408.9.6.1 or R4408.9.6.2.

R4408.9.6.1 All steel sheets having a thickness of less than 20 gauge, i.e., materials of higher gauge, shall be galvanized in accordance with the standards of Section R4408.1.3(5)(d) herein to provide a minimum coating designation of G90.

R4408.9.6.2 Abrasions or damages to the protective coating shall be spot-treated with a material and in a manner compatible to the shop protective coating.

R4408.9.7 Welding shall conform to the requirements of Sections R4408.1.3, R4408.5.2 and R4408.5.3.

SECTION R4408.10
HIGH-VELOCITY HURRICANE ZONES—PREENGINEERED, PREFABRICATED METAL BUILDING SYSTEMS AND COMPONENTS (PREENGINEERED STRUCTURES)

R4408.10.1 Scope. Metal buildings (preengineered structures) shall include, but not be limited to, tapered or straight web structural steel frames and predominantly cold formed steel secondary components, including, but not limited to, girts, purlins, roof sheets, wall sheets, etc.

R4408.10.2 Standards. Frames and components shall comply with the standards set forth in Section R4408.1.3.

R4408.10.3 Structural construction documents for preengineered structures shall indicate the necessary measures for adapting the structures to the specific site. The structural construction documents shall indicate all openings, concentrated loads and other special requirements. Foundation conditions assumed in the design shall be indicated as well as the location and magnitude of building reactions on that foundation under all design conditions.

R4408.10.4 Structural submittals.

R4408.10.4.1 The structural engineer of record and/or the architect of record shall require structural submittals for review as an indication that his or her intent has been understood and that the specified criteria have been used. The structural submittals shall bear the impressed seal, signature and date of the specialty engineer who prepared them.

R4408.10.4.2 The structural submittals shall identify the project and list loading and other design criteria. The fabrication and erection drawings shall indicate in detail the construction of the standard structure used or as modified to comply with the requirements of the particular project. The fabrication and erection drawings shall indicate all connection details, openings and other special details. The fabrication and erection drawings shall show the magnitude and location of building reactions on the foundation under all design conditions. Calculations supporting the design shall be submitted not only for the standard structure, but also for modifications and for related components requiring structural design.

R4408.10.5 Design. A building or component system in this section shall have a structural engineer of record and/or architect of record responsible for the overall design and performance of the entire building including the foundation and the anchorage of the preengineered metal systems buildings thereto. The structural engineer of record and/or the architect of record shall provide the structural construction documents necessary for permitting.

R4408.10.5.1 Calculations for drift and deflection of the metal system building shall be by the specialty engineer.

R4408.10.5.2 Calculations for deflection shall be done using only the bare frame method. Reductions based on engineering judgment using the assumed composite stiffness of the building envelope shall not be allowed. Drift shall follow AISC serviceability design considerations for low-rise buildings. The use of composite stiffness for deflection calculations shall be permitted only when actual calculations

for the stiffness are included with the design for the specific project. When maximum deflections are specified by the structural construction documents, calculations shall be included in the design data.

R4408.10.5.3 The manufacturer shall design the metal system building and/or component system in accordance with the provisions of Section R4403, and the design shall be signed, dated and sealed by the specialty engineer and reviewed by the structural engineer of record and/or the architect of record. The manufacturer of the metal system building and or component system shall be responsible to provide all reactions to the structural engineer of record and/or the architect of record.

R4408.10.5.4 Fastenings shall be by bolting, welding or other approved fastening device that provides a resistance to lateral movement as required by rational analysis or by test, but not less than 400 pounds per lineal foot (5838 N/m).

R4408.10.6 Permitting.

R4408.10.6.1 The applicant for a building permit will be required to submit structural construction documents indicating the overall building dimensions, haunch and eave heights, roof slopes, bay spacing, column locations, approximate frame and component profiles, foundation details and fire rating details and the magnitude and location of building reactions on the foundation under all design conditions prior to the issuance of the permit.

R4408.10.6.2 Prior to the commencement of erection of the structure, the structural submittal and calculations, including, but not limited to, fabrication and erection drawings signed, dated and sealed by the specialty engineer and reviewed by the architect of record and/or the structural engineer of record, shall be submitted and approved by the building department.

R4408.10.6.3 Where the roofing and siding are structural sheets consisting of clip-mounted standing seam or other direct screw attached panel system and are in themselves the finished product, a separate roofing permit shall not be required.

R4408.10.7 Fabrication and erection.

R4408.10.7.1 Fabrication shall be done in accordance with the standards mentioned above. The manufacturer shall provide a letter certifying that the building has been designed and fabricated in accordance with the above referenced standards.

R4408.10.7.2 Temporary bracing shall be provided during erection and shall remain in place until all structural frames, purlins, girts, flange braces, cable or rod bracing and sheets used as diaphragms have been installed,

R4408.10.8 Roof sheets, wall sheets, roof panels and wall panels.

R4408.10.8.1 All building envelope components shall have Product Approval.

R4408.10.8.2 The fusion welding of structural members and structural sheets defined in Section R4408.9.4 and less than 22 gauge (0.0299 inch nominal) in thickness shall have minimum of $^5/_8$ inch (17 mm) diameter welds through weld washers not less than 14-gauge in thickness and 1 inch (25 mm) in diameter, contoured if necessary to provide continuous contact, or an equivalent device.

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	$2^3/_8 \times 0.042$	$1^5/_8 \times 0.047$	10 × 24	8 × 24
Over 4 to 5	$2^3/_8 \times 0.042$	$1^7/_8 \times 0.055$	10 × 24	8 × 24
Over 5 to 6	$2^3/_8 \times 0.042$	$1^7/_8 \times 0.065$	10 × 24	8 × 24
Over 6 to 8	$2^3/_8 \times 0.110$	$2^3/_8 \times 0.095$	10 × 36	10 × 36
Over 8 to 10	$2^7/_8 \times 0.110$	$2^3/_8 \times 0.130$	12 × 40	10 × 40
Over 10 to 12	$2^7/_8 \times 0.160$	$2^7/_8 \times 0.120$	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: $12^1/_2$ 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.

R4408.10.8.3 Clip-mounted standing-seam roof sheets shall not be used as diaphragms nor shall they be considered as adequate lateral bracing of the flange of the secondary member to which they are attached unless one or both of these features are designed into the sheathing system and the manufacturer can certify by testing and/or analysis that such capabilities exist and are appropriately defined.

R4408.10.8.4 Structural standing-seam roof sheets shall be a minimum of 24 gauge (0.0239 inch nominal) in thickness.

R4408.10.8.5 Direct screw attached roof and wall sheets may be used as diaphragms provided the sheets are a minimum of 24 gauge (0.0239 inch nominal) in thickness. Additionally, these sheets shall be considered to laterally brace the flange of the secondary member to which they are attached.

R4408.10.8.6 See Section R4408.9 for additional requirements for roof sheets, wall sheets, roof panels and wall panels.

R4408.10.9 Roof purlins and wall girts.

R4408.10.9.1 Adequate bracing shall be provided to the compression flanges of secondary members with special attention to those members subject to uplift or outward pressures where no roof or wall sheets are attached to provide such bracing. Sag rods shall not be considered bracing when located in the neutral axis of the web of the secondary members.

R4408.10.9.2 Roof purlins and wall girts shall be laterally braced in addition to relying on deck and panel diaphragm action.

R4408.10.9.3 The ends and bearing points of secondary members shall be designed to carry 100 percent of dead, live and collateral loads superimposed on them by wind.

R4408.10.9.4 Upward or outward forces of wind are to be calculated without live and collateral loads. When downward or inward forces caused by wind are involved, the dead forces plus collateral load forces must be combined but the roof live load may be omitted.

R4408.10.10 Individual structural members.

R4408.10.10.1 Cables and rods shall not be used as lateral bracing in habitable structures. Lateral bracing, when used, shall have a slenderness ratio of 300 or less, unless restricted by any other section of this code.

R4408.10.10.2 Doors and windows in preengineered metal building systems shall have Product Approval.

R4408.10.10.3 All doors shall be anchored as part of the frame in the closed position.

R4408.10.10.4 No increase in strength shall be allowed for the effect of cold work.

R4408.10.10.5 See Section R4408.9 for additional requirements for preengineered metal building systems and components.

R4408.10.11 Inspection.

R4408.10.11.1 Metal system buildings shall be inspected by a Florida-registered architect or professional engineer.

R4408.10.11.2 Metal systems building construction shall comply with the requirements of the AISC Metal Building Certification Program, Category MB Certified.

R4408.10.11.3 Letter of certification. The metal systems building manufacturer shall submit a written certification prepared, signed, dated and sealed by the specialty engineer registered to practice in the State of Florida verifying that the building system design and metal wall and roof system design including, but not limited to, panels, clips, support system components, etc., meet the indicated loading requirements and codes of the authorities having jurisdiction. The certification shall reference specific dead loads, live loads, wind loads/speeds, tributary area load reductions (if applicable), collateral loads, end use categories, crane loads, accessory loads, load combinations, governing code bodies including year and load applications. The letter of certification shall be provided to the structural engineer of record and/or the architect of record, the special inspector and the building department prior to the issuance of the certificate of occupancy.

R4408.10.11.4 Structural construction documents demonstrating compliance with this code shall be reviewed and approved by the special inspector prior to the issuance of a certificate of occupancy.

SECTION R4408.11
HIGH-VELOCITY HURRICANE ZONES—CHAIN LINK FENCES

R4408.11.1 Chain link fences in excess of 12 feet (3.7 m) in height shall be designed according to the loads specified in Section R4403.

R4408.11.2 Chain link fences less than 12 feet (3.7 m) in height shall be designed according to the loads specified in Section R4403 or may be constructed to meet the minimum requirements specified in Table R4408.11.

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 mechani-

cal 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
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. AWPA Use Category Systems Standard U1
2. AWPA 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

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, 2005
2. ANSI/AF&PA Design Values for Wood Construction, 2005
3. Wood Structural Design Data, 1992
4. Span Tables for Joists and Rafters, 2005
5. Design Values for Joists and Rafters, 2005
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, 2003
8. Wood Construction Data No. 5, Heavy Timber Construction Details, 2004
9. Wood Construction Data No. 6, Design of Wood Frame Structures for Permanence, 2006
10. ANSI/AF&PA PWF-2007 Permanent Wood Foundation (PWF) Design Specification, 2007
11. ANSI/AF&PA WFCM-2001, Wood Frame Construction Manual for one and Two-Family Dwellings, 2001

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 R4409.14.4. 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 AWPA 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 AWPA 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 1 × 5 or 2 × 4, or lumber 36 inches (914 mm) and shorter, except that $^{5}/_{4} \times 4$ 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.

R4409.5.1.1 Minimum size. Studs shall be not less than 2 × 6 for exterior walls or 2 × 4 for interior bearing or load resisting walls unless designed by rational analysis by a registered licensed engineer or registered architect proficient in structural design.

R4409.5.1.2 Spacing. Studs shall be spaced not more than 16 inches (406 mm) on center unless designed by rational analysis as a system of columns and beams by a registered licensed engineer or registered architect proficient in structural design.

R4409.5.1.3 Placing.

R4409.5.1.3.1 Studs in exterior and bearing walls shall be placed with the longer dimension perpendicular to the wall.

R4409.5.1.3.2 Studs in exterior walls and in bearing walls shall be supported by foundation plates, sills, or girders or floor framing directly over supporting walls or girders. Stud bearing walls when perpendicular to supporting joists may be offset from supporting walls or girders not more than the depth of the joists unless such joists are designed for the extra loading conditions.

R4409.5.1.3.3 Stud walls framing into base plates of exterior walls and interior bearing walls resting on masonry or concrete shall be anchored past the plate to the masonry or concrete, or shall be anchored to a sill plate which is anchored in accordance with Section R4409.5.1.4.1 when the net wind uplift is up to 500 pounds per foot (7297 N/m).

R4409.5.1.4 Sills and/or base plates.

R4409.5.1.4.1 Sills and/or base plates, where provided in contact with masonry or concrete, shall be of an approved durable species or be treated with an approved preservative and shall be attached to the masonry or concrete with $^1/_2$ inch (13 mm) diameter bolts with oversized washer spaced not over 2 feet (610 mm) apart and embedded not less than 7 inches (178 mm) into a grout filled cell of masonry or into concrete. Base plates shall be placed in a recess $^3/_4$ inch (19 mm) deep and the width of the base plate at the edge of a concrete slab, beam/slab or any other type of construction which uses a masonry surface or concrete slab, or be provided with an alternate waterstop method as approved by the building official. Alternate methods of anchorage may be designed by rational analysis by a registered professional engineer or a registered architect proficient in structural design.

R4409.5.1.4.2 Where the base plate of a bearing wall is supported on joists or trusses running perpendicular to the wall and the studs from the wall above do not fall directly over a joist or truss, a double base plate or a single base plate supported by a minimum 2 × 4 inset ribbon shall be used to support the upper stud wall.

R4409.5.1.5 Top plates.

R4409.5.1.5.1 The top plate of stud bearing walls shall be doubled and lapped at each intersection of walls and partitions.

R4409.5.1.5.2 Joints shall be lapped not less than 4 feet (1219 mm).

R4409.5.1.6 Corners. Corners of stud walls and partitions shall be framed solid by not less than three studs.

R4409.5.1.7 Splicing. Studs, other than end-jointed lumber, shall be spliced only at points where lateral support is provided.

R4409.5.1.8 Framing types.

R4409.5.1.8.1 Wood framing may be any one, or a combination of, the following types: Platform, balloon, plank and beam or pole type.

R4409.5.1.8.2 Exterior stud walls of two-story buildings shall be balloon-framed with studs continuous from foundation to second floor ceiling and with second floor joists supported as indicated in Section R4409.6.3.3. Gable end walls in wood frame buildings shall be balloon framed with studs continuous from foundation to roof.

Exception: Platform framing is allowed in buildings over one story in height provided an additional mandatory inspection for floor level connectors is made before the framing/firestopping inspection. Gable end walls shall be balloon framed with studs continuous from top floor to roof.

R4409.5.1.9 Notching.

R4409.5.1.9.1 Studs that carry loads in excess of 75 percent of their capacity shall not be notched or cut.

R4409.5.1.9.2 Studs that carry loads 75 percent or less of their capacity may be notched to one-third of the depth without limit of the number of consecutive studs.

R4409.5.1.10 Pipes in walls.

R4409.5.1.10.1 Stud walls and partitions containing pipes shall be framed to give proper clearance for the piping.

R4409.5.1.10.2 Where walls and partitions containing piping are parallel to floor joists, the joists shall be doubled and may be spaced to allow vertical passage of pipes.

R4409.5.1.10.3 Where vertical pipe positions necessitate the cutting of plates, a metal tie not less than 1inch by $^1/_8$ inch (25 mm by 3 mm) shall be placed on each side of the plate across the opening and nailed with not less than two 16d or three 8d nails at each end.

R4409.5.1.11 Headers.

R4409.5.11.1 All headers in bearing walls shall be designed by rational analysis.

R4409.5.1.11.2 Headers or lintels over stud wall openings shall have not less than nominal 2-inch (51 mm) bearings.

R4409.5.1.12 Studs joining masonry or reinforced concrete walls. Where stud walls or partitions join masonry or concrete walls, such studs shall be secured against lateral movement by bolting to the masonry or concrete with $^1/_2$ inch (13 mm) diameter anchor bolts with oversized washer spaced not more than 4 feet (1219 mm) apart and embedded not less

than 5 inches (127 mm) into a grout filled cell or into concrete or as designed by a registered licensed engineer or registered architect proficient in structural design using rational analysis.

R4409.5.1.13 Wind bracing. Exterior stud walls shall be effectively wind-braced in accordance with Section R4409.9.3. Such bracing shall be designed by a registered licensed engineer or registered architect proficient in structural design.

R4409.5.1.14 The intermixing of wall framing described in this section with other types of structural wall systems as provided in this code shall not be permitted unless such wall framing and connections are designed by a registered professional engineer or registered architect proficient in structural design.

R4409.5.1.15 Wall hung fixtures. Studs in bearing walls, exterior walls and nonbearing partitions supporting wall hung plumbing fixtures and wall cabinets shall be not less than 2 × 4, where spaced not more than 16 inches (406 mm) on center or, not less than 2 × 6, where spaced not more than 24 inches (610 mm) on center.

R4409.5.1.15.1 A minimum 2 × 4 horizontal wood member, securely fastened to not less than two such studs, shall be installed for the attachment of each wall hung plumbing fixture and wall cabinet.

R4409.5.2 Interior nonbearing partitions.

R4409.5.2.1 Studs in interior nonbearing partitions shall be of not less than 2 × 4 spaced not more than 24 inches (610 mm) o.c.

R4409.5.2.2 Interior nonbearing stud partitions may have a single top plate.

R4409.5.2.3 Headers over openings not exceeding 4 feet (1219 mm) in width may be of 2-inch (51 mm) nominal thickness placed flat and end-nailed through the studs with no solid bearing provided.

R44.9.5.2.4 Studs in interior nonbearing partitions shall be placed with the longer dimension perpendicular to the partition.

R4409.5.2.5 Stud partitions subject to frequent wetting shall be of pressure treated wood or shall be protected with 15-pound (7 kg) asphalt-saturated felt, or by other approved design methods.

R4409.5.2.6 Wardrobe units serving as non-bearing partitions, prefabricated or partially prefabricated may be of 2 × 2 studs spaced not farther apart than 16 inches (406 mm) provided there is a wood-based structural panel skin-glued or nailed to the studs.

R4409.5.3 Columns and posts.

R4409.5.3.1 Columns and posts shall be framed to true end bearing, shall be securely anchored against lateral and vertical forces, and shall be designed by a registered professional engineer or registered architect proficient in structural design.

R4409.5.3.2 The bottom of columns and posts shall be protected against deterioration by an approved product or method.

R4409.5.3.3 Columns and posts shall be spliced only in regions where lateral support is adequately provided about both axes and is designed by rational analysis. Such design shall be prepared, signed and sealed by a registered professional engineer or registered architect proficient in structural design.

R4409.5.3.4 Design dimensions of columns and posts shall not be reduced by notching, cutting or boring.

SECTION R4409.6
HIGH-VELOCITY HURRICANE ZONES—HORIZONTAL FRAMING

R4409.6.1 Size.

R4409.6.1.1 The minimum size of joists and rafters shall be as set forth in Section R4409.4.

R4409.6.1.2 The design of horizontal framing other than joists and rafters shall be as set forth in Section R4409.4.1.1.

R4409.6.1.3 Horizontal wood members independently supporting a suspended ceiling shall be not less than 2 × 4 and hangers shall be not less than the equivalent of 1 × 4 wood members providing proper nailing.

R4409.6.2 Spacing. Joists and rafters, where a plaster ceiling is directly supported, shall comply with Section R4411.1.2.3.

R4409.6.3 Bearing.

R4409.6.3.1 Joists and rafters shall have not less than three inches of bearing, on wood, metal, grout filled masonry or concrete except as provided in Sections R4409.6.3.2, R4409.6.3.3 and R4409.6.3.4.

R4409.6.3.2 Masonry and concrete.

R4409.6.3.2.1 Joists and rafters may bear on and be anchored by steel strap anchor embedded into a grout filled cell of the masonry or reinforced concrete, as described in Section R4409.8.5.1, to a wood plate provided such wood plate is of an approved durable species or pressure treated with an approved preservative and such plate shall be not less than 2 × 4 and attached as per Section R4409.5.1.4.1. The net uplift on the plate shall be limited to 300 pounds per foot (4378 N/m).

R4409.6.3.2.2 Joists and rafters may bear on a product control approved channel-shaped metal saddle and fastened to the masonry by a steel strap anchor embedded into a grout filled cell of the masonry or concrete.

R4409.6.3.2.3 Joists and rafters may bear on masonry, provided that each joist or rafter in contact with masonry is of an approved durable species or pressure treated with an approved preservative and anchored as in Section R4409.6.3.2.2 above.

R4409.6.3.3 Floor joists may butt into a header beam if effectively toenailed and if an approved metal hanger providing not less than 3 inches (76 mm) of bearing transmits the vertical load to the top of the header, provided, however, that

approved devices or other approved means of support may be used in lieu of such bearing. All hangers and devices shall have Product Approval.

R4409.6.3.4 Ceiling joists may butt into a header beam, as set forth for floor joists, or approved devices or other approved means of support may be used in lieu of such bearing. All devices shall have Product Approval.

R4409.6.3.5 In lieu of the above, bearing and anchorage may be designed by rational analysis by a registered professional engineer or registered architect proficient in structural design.

R4409.6.4 Splicing. Horizontal members shall not be spliced between supports except that properly designed splices or approved end-jointed lumber may be used.

R4409.6.5 Notching and boring.

R4409.6.5.1 Unless local unit stresses are calculated on the basis of reduced size, wood members in bending shall not be cut, notched or bored except as provided in Sections R4409.6.5.1.1 and R4409.6.5.1.2.

R4409.6.5.1.1 Notches may be cut in the top or bottom not deeper than one-sixth of the depth not longer than one-third of the depth of the member and shall not be located in the middle one-third of the span. Where members are notched at the ends, over bearing points, the notch depth shall not exceed one-fourth the member depth.

R4409.6.5.1.2 Holes may be bored in the middle one-third of the depth and length and not larger than one-sixth of the depth. Space between any two holes in the same joist shall be not less than the depth of the joist.

R4409.6.5.2 Where necessary to run service pipes in the space between the ceiling and floor larger than can be accommodated by the above provision, such ceilings shall be furred or provision made for headers or beams and/or for changing direction of the joists where the design permits.

R4409.6.6 Openings.

R4409.6.6.1 Joists shall be doubled adjacent to openings where more than one joist is cut out or shall be so increased in size or number as may be needed to meet the stress requirements.

R4409.6.6.2 Headers shall be of the same size as the joists and where supporting more than one joist shall be double members.

R4409.6.6.3 Headers shall be supported by approved metal hangers or ledgers or other approved members.

R4409.6.7 Wood entering masonry or reinforced concrete.

R4409.6.7.1 Wood joists, beams or girders which frame into masonry or reinforced concrete shall have a minimum of $^1/_2$ inch (13 mm) air space at the top, end and sides or shall be preservative pressure treated or of an approved durable species.

R4409.6.7.2 Where masonry extends above such wood members, joists shall be fire-cut so the top edge does not enter the masonry more than 1 inch (25 mm) or shall be provided with wall plate boxes of self-releasing type or approved hangers.

R4409.6.7.3 Where joists enter a masonry wall required to be fire resistive, such joists shall be separated from the opposite side of the wall by at least 4 inches (102 mm) of solid masonry.

R4409.6.8 Floor joists.

R4409.6.8.1 Floor joists under all walls or partitions parallel to the joists shall be doubled.

R4409.6.8.2 Doubled joists may be separated not more than 6 inches (152 mm).

R4409.6.8.3 Floor joists supporting concrete or grout for tile floors shall have a maximum spacing of 12 inches (305 mm).

R4409.6.9 Ceiling joists.

R4409.6.9.1 In buildings with pitched roofs the ceiling joists, where practicable, shall be nailed to the rafters and shall be designed to carry all imposed loads including but not limited to lateral thrust.

R4409.6.9.2 Ceiling joists spanning more than 10 feet (3 m) shall be laterally supported at mid-span.

R4409.6.9.3 Ceiling joists shall not be used to support rafter loads unless the joists and connections are properly designed for the total load being imposed.

R4409.6.10 Roof framing. The permit documents shall include roof framing plans showing spacing and spans of all roof members indicating any fabricated elements to be designed and furnished by others and shall include the details for support and bearing of the roof structural system, for the permanent cross/lateral/diagonal bracing and anchorage required to resist dead, live and wind loads as set forth in Section R4403.9. The framing plans shall also indicate the uplift forces applied on the roof, sheathing type, thickness and nailing requirements for the sheathing. The roof framing plans shall be prepared by and bear the sign and seal of, a registered professional engineer or registered architect of record proficient in structural design.

R4409.6.11 Roof joists. Roof joists may cantilever over exterior walls as limited by the allowable stress, but the length of such cantilever shall not exceed half the length of the portion of the joist inside the building; and where the cantilever of tail joists exceeds 3 feet (914 mm), the roof joist acting as a header shall be doubled.

R4409.6.12 Roof rafters.

R4409.6.12.1 Hip rafters, valley rafters and ridge boards shall be provided and shall be not less in size than the largest rafter framing thereto nor less than required to support the loads.

R4409.6.12.2 Collar ties.

R4409.6.12.2.1 Collar ties and their connections shall be provided to resist the thrust of rafters and shall be designed by a registered engineer or registered architect proficient in structural design.

R4409.6.12.2.2 Collar ties shall not be required if the ridge is designed as a supporting beam. Such design shall

be done by a registered licensed engineer or registered architect proficient in structural design.

R4409.6.12.2.3 Ceiling joists may serve as collar ties when properly designed by a registered professional engineer or registered architect proficient in structural design.

R4409.6.12.3 The actual roof and ceiling dead loads may be used to resist uplift loads, but the maximum combined dead load used to resist uplift loads shall not exceed 10) pounds per square foot (479 Pa).

R4409.6.13 Heavy timber construction. Heavy timber construction of floors or roofs shall comply with the standards in Section R4409.1.4. All heavy timber construction shall be designed by a registered professional engineer or registered architect proficient in structural design to withstand the loads required in Section R4403.

R4409.6.14 Vertically laminated beams. Vertically laminated built-up beams shall be designed and made up of members continuous from bearing to bearing.

R4409.6.15 Glued laminated members. Glued laminated members shall be designed to comply with applicable AITC standards adopted by this code.

R4409.6.16 Stair stringers.

R4409.6.16.1 Stair stringers shall, where practicable, be framed to provide 4 inches (102 mm) of bearing at the ends.

R4409.6.16.2 Where it is not practicable to provide such bearing, the stringers shall be hung in steel hangers of approved type.

R4409.6.16.3 Stair stringers shall not be notched or cut in the effective area.

R4409.6.16.4 Two stringers shall be provided for each flight of stairs no more than 36 inches (914 mm) in width, and an additional stringer shall be provided for each 18 inches (457 mm) of additional stair width except for public stairs where the number of stringers shall be determined by rational analysis by a registered professional engineer or registered architect proficient in structural design.

R4409.6.17 Wood trusses.

R4409.6.17.1 Trussed rafters. Trussed rafters shall be designed by methods admitting of rational analysis by a registered professional engineer or registered architect proficient in structural design based on the standards set forth in Section R4409.1.4.

R4409.6.17.1.1 Where steel is used for connecting wood members, such connectors shall be not less than 20 U.S. gauge and shall be protected with a zinc coating conforming to the ASTM A361 Standard set forth in Chapter 43 of this code. Connectors shall have Product Approval or shall be designed by methods admitting of rational analysis by a registered professional engineer or registered architect proficient in structural design.

R4409.6.17.1.2 Where a ceiling is to be attached directly to the underside of trusses, the trusses shall be laterally braced with continuous 1 × 4 members nailed with 8d common nails to the upper side of the bottom chord at panel points but not to exceed 10 feet (3 m) apart. This lateral bracing shall be restrained at each end and at 20 foot (6 m) intervals. Drywall may be considered a rigid ceiling in enclosed areas where it is protected from the elements. The drywall ceiling is not to be considered a ceiling diaphragm.

R4409.6.17.1.3 Where a ceiling is to be attached to wood stripping which is nailed to the underside of the bottom chord of trusses with two 8d common nails at each intersection, stripping shall be not less than 1 × 3 spaced not more than 24 inches (610 mm) apart. Wood stripping may be replaced by furring channels. Furring channels shall be a minimum of $^{7}/_{8}$ inch (22 mm) hat shaped channels weighing 287 pounds per 1000 lineal foot (41.4 kg per 100 m) with minimum based steel of 0.0179 inch (0.445 mm) and complying with ASTM C 645 attached to trusses with minimum two #6 $1^{1}/_{4}$ inch (32 mm) screws per intersection. Said stripping or metal furring channels may serve also as the lateral bracing of the truss bottom chord so as to minimize the effects of buckling of the bottom chord when subjected to compressive stresses under reverse load conditions. In addition, the rigid ceiling that is created by this 1 × 3 stripping or metal furring channels must also be restrained from lateral movements, in accordance with the details provided by the architect or licensed engineer of record.

Exception: Where fire-rated design assembly does not allow for this specific installation, see Section R4409.6.17.1.2

R4409.6.17.1.4 Where a ceiling is attached to wood members suspended beneath trusses, the provisions of Section R4409.6.1 shall apply.

R4409.6.17.2 Prefabricated wood trusses. Prefabricated wood trusses shall comply with this section.

R4409.6.17.2.1 Design.

R4409.6.17.2.1.1 Prefabricated wood trusses shall be designed by a registered professional engineer (delegated engineer) and fabricated in accordance with the *National Design Standard for Metal Plate Connected Wood Truss Construction* of the Truss Plate Institute (TPI). The truss system designer (delegated engineer) shall prepare the truss system shop drawings. Such shop drawings shall be submitted to the building official for review and approval. The shop drawings shall meet the following requirements:

1. All shop drawings shall be in conformity with the architect or engineer of record framing plans unless prior written approval is obtained from the architect or engineer of record. If reframing is approved, the architect or engineer of record shall resubmit revised framing plans to the building official after receiving updated plans from the delegated engineer showing all adjustments necessary to safely transmit all applied loads to the foundation.
2. Permanent bracing of individual truss members may be required on certain members of the

trusses to prevent the members from buckling in the plane normal to the trusses (buckling in the narrow direction). This bracing shall be designed for both upward and downward loads and shall be shown on the individual truss drawings [truss engineering usually shown on $8^1/_2$-inches by 11-inch (216 mm by 279 mm) sheets ("A" size drawings)]. The design of this bracing shall be the responsibility of the delegated engineer. The contractor shall be responsible for seeing that this bracing is properly installed. This bracing may be in the form of (but not limited) to "T" bracing of an individual member, or lateral bracing of a series of members common to a number of trusses. Where lateral bracing is used, this bracing shall be restrained against lateral movement, in accordance with details provided by the delegated engineer or by the architect or professional engineer of record. All details and sections required to show the size and connections of all secondary members will be supplied on the delegated engineering plans and shall show all framing, connections and bracing on one or more primary plans of minimum size 24 inches by 36 inches (610 mm by 914 mm).

3. A size $8^1/_2$-inches by 11-inches (216 mm by 279 mm) cut sheets showing individual member design shall also be furnished to the architect or engineer of record so that all gravity and uplift loads shown on these cut sheets can be transferred to the primary plans.
4. The size and location of all plates at each joint shall be shown on the truss design drawings.
5. The connection between trusses shall be detailed in the shop drawings. Hip sets shall be detailed in a manner to indicate all connections according to engineering drawings for the attachment of skewed members.
6. Truss design drawings shall indicate the support and minimum bearing of the roof structural system, the permanent cross/lateral bracing, bracing to transfer member buckling forces to the structure and all bracing and anchorage required to resist uplift and lateral forces.
7. Flat and floor trusses must be clearly marked so that they will be installed right side up. These marks must remain after the flooring, sheathing and insulation have been installed.

The intent of the above requirements is to provide all information on framing, connections and bracing on one composite set of plans approved by the architect or engineer of record to aid in the review, approval and field inspections for the portion of the property.

R4409.6.17.2.1.2 Trusses shall be designed for wind loads per Section R4403, uniformly distributed live, dead and concentrated loads, and such loads shall be indicated on the roof framing plans and the truss design drawings. Where a girder or truss is subjected to concentrated loads or any unusual loading condition, such conditions must be clearly indicated on the roof framing plans and on the truss design drawings. Where truss members have been cut, shifted or altered in any manner to meet construction needs or for any other reason, additional drawings and additional calculations must be prepared, signed and sealed by the truss designer (a Florida-delegated engineer). Such additional drawings and calculations must be approved by the engineer or architect of record and must be submitted to the building official for review and approval.

R4409.6.17.2.1.3 Roof trusses shall be designed for a minimum live load of 30 psf (1436 Pa), a minimum dead load of 15 psf (718 Pa) on the top chord, and a minimum dead load of 10 psf (479 Pa) on the bottom chord; and wind loads per Section R4409 of this code. Where the roof design is such that water is not directed to the interior of the roof and there are no parapets or other roof edge drainage obstructions, roof trusses with slopes of $1^1/_2$:12 or greater may be designed for a live load of 20 psf (958 Pa) and a minimum total load of 45 psf (2155 Pa). Adjustment of the allowable design stress for load duration shall be in accordance with *National Design Specification for Wood Construction.*

R4409.6.17.2.1.4 The allowable deflection under live load for trusses shall not exceed span/360 for plastered ceilings, span/240 for unplastered finished ceilings, or span/180 for trusses without a ceiling.

R4409.6.17.2.1.5 Flat roof trusses shall be designed for not less than the loads set forth in Section R4409.6.17.2.1.3 above, except that the dead load on the top chord may be taken as 10 psf (479 Pa) in lieu of 15 psf (718 Pa), and the total load reduced to 50 psf (2394 Pa). Adjustment of the allowable design stress for load duration shall be in accordance with *National Design Specification for Wood Construction.*

R4409.6.17.2.1.6 Where gable end trusses are permitted in this code, they shall be designed for a minimum live load of 30 psf (1436 Pa) and a minimum dead load of 15 psf (718 Pa) on the top chord. The minimum load of 10 psf (479 Pa) on the bottom chord may be omitted where continuous support is provided. In addition, the gable end trusses shall be designed to sustain wind load as specified in Section R4403 but not less than 30 psf (1436 Pa) perpendicular to the plane of the truss. Such trusses shall use a rationally designed system to resist lateral wind loads and be anchored to the substructure at intervals no greater than 4 feet (1219 mm) on center to resist the uplift forces and shall be designed to transfer the loads to the substructure. The design of the system used to resist the lateral loads imposed on the truss shall be prepared by the engineer or architect of record.

R4409.6.17.2.1.7 When girders exceed two members and when girder reactions exceed the capacity of standard connectors or hangers, these reactions shall be shown on the drawings and the connection must be designed, signed and sealed by a registered professional engineer or registered architect proficient in structural design and such design shall be included as part of the shop drawings.

R4409.6.17.2.1.8 All trusses shall be properly braced to act as a system. Such bracing shall be included as part of the design document.

R4409.6.17.2.2 Materials and specifications.

R4409.6.17.2.2.1 Trusses shall be fabricated applying the design values listed in the standard *Design Values for Wood Construction* of the American Forest and Paper Association.

R4409.6.17.2.2.2 Top and bottom chords shall be of No. 2 grade or better. Web members shall be of No. 3 grade or better. A chord member is defined as the entire top or bottom truss member which may consist of shorter spliced pieces.

R4409.6.17.2.2.3 For trusses spanning 20 feet (6 m) or less, the minimum percentage of grade-marked members among top and bottom chords shall be 50 percent.

R4409.6.17.2.2.4 For trusses spanning more than 20 feet (6 m) the minimum percentage of grade-marked percent, and there shall be a minimum of one marked members among top and bottom chords shall be 75 web on each truss.

R4409.6.17.2.2.5 All lumber shall be 2 × 4 nominal or larger, and no 2-inch (51 mm) nominal member shall be less in size than $1^1/_2$ inch (38 mm).

R4409.6.17.2.2.6 The moisture content of all lumber used in wood truss fabrication shall not exceed 19 percent.

R4409.6.17.2.2.7 Connector plates shall be not less than 20 gauge galvanized steel meeting ASTM A 653/A 653M or A 924/A 924M, and shall be identified by the manufacturer's stamp. The size and location of all plates shall be shown on the truss design drawings. Connectors shall have Product Approval.

R4409.6.17.2.2.8 All connector plates over 3 inches (76 mm) and 25 percent of 3 inch (76 mm) or less, as per TPI standards, shall bear the name, logo or other markings, which clearly identify the manufacturer. Semiannually, plate manufacturers shall certify compliance with the provisions of Section 6 of the Truss Plate Institute, TPI-95 or latest edition, *National Design Standard for Metal Plate Connected Wood Truss Construction*, with respect to the grade of steel, thickness or gauge of material, and galvanizing to ASTM G 60 as a minimum. This certification requirement shall be satisfied by submitting by an approved independent laboratory to the product control division.

R4409.6.17.2.3 Fabrication.

R4409.6.17.2.3.1 Manufacturers of prefabricated wood truss assemblies shall obtain a valid certificate of competency from the authority having jurisdiction.

R4409.6.17.2.3.2 Each truss shall bear the fabricators stamp on a web member and 75 percent shall be placed so as to be clearly visible after erection and before placement of ceiling.

R4409.6.17.2.3.3 Multiple member girder trusses shall be predrilled at the truss plant for connection bolts only. Hanger bolt holes shall be drilled on-site on location indicated on approved drawings.

R4409.6.17.2.3.4 Each manufacturer or fabricator shall retain the services of applicable organizations among those listed below for monthly inspections of the lumber grade used in fabrication. Following each inspection, a report shall be submitted by the inspection agency to the authority having jurisdiction. All inspection agencies providing any type of inspection services shall be approved by the authority having jurisdiction.

For Pine:

Southern Pine Inspection Bureau or Timber Products Inspection Inc. or other grading agencies with appropriate jurisdiction.

For Douglas Fir, Hem-Fir or Fir-Larch:

Western Wood Products Association or West Coast Lumber Inspection Bureau. Timber Products Inspection Inc. or other grading agencies with appropriate jurisdiction.

R4409.6.17.2.3.5 In addition, the fabricator shall employ an approved testing laboratory to conduct inspections of fabrication compliance. Such inspections shall be made unannounced and at random at least once a month. Following each inspection, a report on approved forms shall be submitted by the laboratory to the authority having jurisdiction and such reports shall bear the date, signature and seal of the supervising Florida-registered architect or professional engineer.

R4409.6.17.2.3.6 When there is evidence of noncompliance with the provisions for fabrication set forth in this paragraph or with the approved plans, the authority having jurisdiction may require the inspection laboratory to make additional jobsite or plant inspections.

R4409.6.17.2.3.7 The authority having jurisdiction may require load testing on noncomplying wood trusses. The test results shall be reported to the authority having jurisdiction.

R4409.6.17.2.3.8 Failure of units tested or receipt of inspection reports indicating fabrication not in accordance with approved truss design drawings, or failure to submit required inspection and/or test reports, shall be cause for suspension or revocation of the certificate of competency of the manufacturer or fabricator.

R4409.6.17.2.4 Truss erection.

R4409.6.17.2.4.1 All trusses shall be erected in accordance with TPI/WTCA BCSI 1 in addition to any requirements indicated on the approved permit document.

R4409.6.17.2.4.2 For trusses having an overall length of the bottom chord in excess of 35 feet (10.7 m) or 6 feet (1829 mm) overall height erection shall be supervised by either a registered licensed engineer or registered architect retained by the contractor. A retainer letter from the registered licensed engineer or registered architect shall be submitted along with the shop drawings as part of the permit document.

R4409.6.17.2.4.3 Temporary bracing shall be required during the erection of roof trusses to keep the trusses in a true plumb position and to prevent toppling of the trusses during erection, until the roof sheathing is applied. The provisions for temporary bracing shown in TPI/WTCA BCSI 1 shall be used for this bracing or a professional engineer or architect shall design the temporary bracing system. The ultimate responsibility to see this bracing is installed properly during the erection process lies with the permit holder. This bracing is extremely important for the protection of life and property during the erection process. Temporary truss bracing shall always be required.

R4409.6.17.2.4.4 At gable ends, this diaphragm shall be designed to transmit lateral loads imposed on the gable to roof diaphragms and/or ceiling diaphragms where available. Where the wall supporting the gable is not designed to withstand lateral loads independent of the gable (by using shear walls or other methods), anchorage of the gable to the wall shall be designed to transmit the loads from the wall to the bracing and the bracing designed to transmit the lateral loads from the gable and wall to the roof diaphragms and/or ceiling diaphragms where available. Ceiling diaphragms that provide lateral support at gable walls shall be designed by the architect or professional engineer of record, and shall have continuous bottom chord bracing, end restraints, intermediate restraints and conditions so as to sufficiently transfer the lateral loads at the top of the gable end walls to the intersecting shear walls. In no case shall the rigid ceiling as defined in Section R4409.6.17.1.2 be used as an integral part of the system needed for lateral bracing of the gable end walls.

R4409.6.17.2.4.5 Where masonry or reinforced concrete extends above wood trusses; trusses shall be designed so as not to compromise the structural integrity of the masonry or concrete wall it abuts in the event of collapse caused by fire.

SECTION R4409.7
HIGH-VELOCITY HURRICANE ZONES — FIRESTOPS

R4409.7.1 Firestopping shall be provided to cut off all concealed draft spaces both vertical and horizontal.

R4409.7.1.1 Firestops shall form effective fire barriers between stories and between a story and roof space.

R4409.7.1.2 Firestopping shall be tightly and securely fitted into place and where of wood, shall be not less than a nominal 2 inches (51 mm) in thickness.

R4409.7.1.3 Spaces between chimneys and wood framing shall be solidly filled with mortar or loose incombustible materials supported on incombustible supports.

R4409.7.1.4 Firestopping shall consist of 2-inch (51 mm) nominal lumber, or two thicknesses of 1-inch (25 mm) nominal lumber with broken lap joints, or one thickness of $^{23}/_{32}$ inch (18 mm) plywood, with joints backed by $^{23}/_{32}$ inch (18 mm) plywood, or other approved materials.

R4409.7.1.5 Draftstopping materials shall be not less than $^{3}/_{8}$ inch (9.5 mm) plywood or other approved materials adequately supported.

R4409.7.1.6 Required firestops and draftstops shall be continuous, and such continuity shall be maintained throughout. Penetrations of firestops or draft stops shall be sealed or protected in an approved manner.

R4409.7.1.7 Ventilation of concealed roof spaces shall be maintained in accordance with Section R4409.13.3.2.

R4409.7.2 Firestopping shall be installed in wood frame construction in the locations specified in Sections R4409.7.2.1 through R4409.7.2.6.

R4409.7.2.1 In concealed spaces of stud walls and partitions including furred spaces at ceiling and floor levels to limit the maximum dimension of any concealed space to 8 feet (2438 mm).

R4409.7.2.2 At all interconnections between concealed vertical and horizontal spaces such as occur at soffits, drop ceilings, cove ceilings and similar features.

R4409.7.2.3 In concealed spaces between stair stringers at least once in the middle of each run, at the top and bottom, and between studs along and in line with adjacent run of stairs of the run.

R4409.7.2.4 At openings around vents, pipes, ducts, chimneys and fireplaces at ceiling and floor levels with approved noncombustible materials, except in the case of approved metal chimney installation.

R4409.7.2.5 In concealed spaces created by an assembly of floor joists, firestopping shall be provided for the full depth of the joists at the ends and over the support.

R4409.7.2.6 Around the top, bottom and sides of door pockets.

R4409.7.3 Draftstopping. Draftstopping shall be provided in wood frame construction in the locations specified in Sections R4409.7.3.1 and R4409.7.3.2.

R4409.7.3.1 Floor-ceiling assemblies.

R4409.7.3.1.1 Other Occupancies. All other buildings, in floor-ceiling assemblies so that horizontal areas do not exceed 1,000 square feet (93 m^2).

R4409.7.3.2 Attics.

R4409.7.3.2.1 Group R3. None required.

Exceptions:

1. Where corridor walls provide a tenant separation, draftstopping shall be required above only one of the corridor walls.
2. Where flat roofs with solid joist construction are used, draftstopping over tenant separation walls is not required.
3. Where approved sprinklers are provided, draftstopping shall be required for attic spaces over 9,000 square feet (836 m^2) in area.

SECTION R4409.8
HIGH-VELOCITY HURRICANE ZONES—ANCHORAGE

R4409.8.1 Anchorage shall be continuous from the foundation to the roof and shall satisfy the uplift requirements of Section R4403.9.

R4409.8.2 Joists.

R4409.8.2.1 Fire-cuts into a masonry wall shall be anchored to the concrete beam on which they bear.

R4409.8.2.2 Such anchors shall be spaced not more than 4 feet (1219 mm) apart and shall be placed at opposite ends across the building on the same run of joists.

R4409.8.3 Joists shall be nailed to bearing plates, where such plates occur, to each other where continuous at a lap and to the studs where such studs are contiguous; and ceiling joists shall be nailed to roof rafters where contiguous.

R4409.8.4 Every roof rafter and/or roof joist shall be anchored to the beam or studs on which they bear, and roof rafters opposing at a ridge shall be anchored across the ridge as set forth in Section R4409.8.6.

R4409.8.5 Anchorage to concrete.

R4409.8.5.1 Anchorage designed to resist uplift forces, securing wood to concrete shall be steel straps embedded in the concrete minimum of 4 inches (102 mm) with hooking devices to top steel of tie beam designed to withstand the uplift forces set forth by the design professional. Straps shall be an approved product. All anchors and related fasteners shall be galvanized.

R4409.8.5.2 As an alternate to using the straps described in this section, the building official may approve other anchorage submitted by a Florida-registered professional engineer or a Florida-registered architect, proficient in structural design, provided that the information set forth in Section R4409.8.7(1), (2) and (3) submitted in connection with such anchors and such anchors and the proposed assembly otherwise comply with the requirements of this code.

R4409.8.6 Anchorage to wood.

R4409.8.6.1 Anchorage designed to resist uplift forces, securing wood to wood shall be steel straps nailed to each member and shall be designed to resist uplift forces set forth by the design professional. Straps shall be an approved product. All anchors and relative nails shall be galvanized.

R4409.8.6.2 As an alternate to using straps described in this section, the building official may approve other anchorage submitted by a Florida-registered architect or a florida registered professional engineer, proficient in structural design, provided that the information set forth in Sections R4409.8.7(1), (2) and (3) submitted in connection with such anchors and such anchors and the proposed assembly otherwise comply with the requirements of this code.

R4409.8.7 Testing of anchoring. Anchoring required by R4409.8. and R4409.8.6 shall be tested under the following criteria:

1. Concrete to wood straps: Minimum design uplift load 700 pounds (3114 N), with 4 16d nails with upper end bent over truss chord and nailed. Nails shall be clinched. Anchors shall have devices to hook into upper tie beam steel and embedded a minimum of 4 inch (102 mm) in concrete.
2. Wood to wood straps: Minimum design uplift 700 lb (3114 N) with four 16d nails in each member.
3. Other anchors: Minimum design uplift 700 pounds (3114 N).
4. The criteria stated in Sections R4409.8.7(1), (2) and (3) above are minimum requirements for Product Approval. Anchor design and uplift forces shall be approved site for the inspector to.

SECTION R4409.9
HIGH-VELOCITY HURRICANE ZONES—SHEATHING

R4409.9.1 Floor sheathing.

R4409.9.1.1 Floor sheathing, where a part of a required fire-resistive assembly, shall comply with a nationally recognized testing agency (Underwriter's Laboratory, Factory Mutual, etc.).

R4409.9.1.2 The finish floor shall be tongue-and-grooved not less than nominal one inch (25 mm) lumber laid perpendicular to the joists with end joints on the joists, or a sub-floor shall be provided as set forth in Sections R4409.9.1.3, R4409.9.1.4, R4409.9.1.5, and R4409.9.1.6.

R4409.9.1.3 Square-edged or spaced subflooring may be used only under a finish floor having a strength equal to or greater than $^1/_2$ inch (12.7 mm) tongue-and-groove wood strip flooring; and under finish floors of less strength, a tongue-and-groove or plywood subfloor shall be required.

R4409.9.1.4 Lumber subflooring shall be not less than $^5/_8$-inch (17 mm) thick when joists are spaced no more than

16 inches (406 mm) on center nor less than $^3/_4$-inch (19 mm) thick when joists are spaced no more than 24 inches (610 mm) on center. End joints shall be on joists, joints shall be staggered and parallel to the joists, and ends at walls and similar places shall be supported by a ribbon or by blocking.

R4409.9.1.5 Plywood subfloors of C-D grade or Underlayment grade bonded to wood joist using adhesives meeting the requirements of ASTM D 3498 shall be applied as indicated in Section R4409.9.1.6.

R4409.9.1.6 Plywood subflooring shall be continuous over two or more spans with face grain perpendicular to the supports. The allowable spans shall not exceed those set forth in Table R4409.9.1.6.

TABLE R4409.9.1.6
PLYWOOD SUBFLOOR[1]

PANEL SPAN RATING[2]	MAXIMUM PLYWOOD SPAN (IN.)[3]
32/16	16[4]
40/20	20[4]
48/24	24

For SI: 1 inch = 25.4 mm.

Notes:

1. These values apply for Sheathing C-D and C-C grades only. Spans shall be limited to values shown, and reduced for the possible effects of concentrated loads.
2. Span Ratings shall appear on all panels.
3. Plywood edges shall have approved tongue-and-groove joints or shall be supported with blocking unless $^1/_4$ inch minimum thickness underlay is installed or $^1/_2$ inch of approved cellular or lightweight concrete is installed or unless finish floor is 1-inch nominal woodstrip. Allowable uniform load based on deflection of $^1/_{360}$ of span is 100 pounds per square foot.
4. May be 24 inches if nominal 1-inch wood strip finish floor is laid at right angles to joists.

R4409.9.1.6.1 Plywood panels shall be nailed to supports with 6d common nails when up to $^1/_2$ inch (13 mm) thick, 8d common nails when $^{19}/_{32}$ to $^3/_4$ inch (15 to 19 mm) thick and 10d common nails or 8d ring shank when $1^1/_8$ inches (29 mm) thick.

R4409.9.1.6.2 Nail spacing shall be 6 inches (152 mm) o.c. at panel edges and 10 inches (254 mm) o.c. at intermediate supports.

R4409.9.1.7 Any other subfloor panel shall have product control division approval and shall be installed in accordance with the procedures set forth in the approval.

R4409.9.1.8 Flooring shall be nailed with 8d common nails up to $^3/_4$ inch (19 mm) thick, and 10d common nails or 8d ring shank nails when greater than $^3/_4$ inch (19 mm) thick up to $1^1/_8$ inches (29 mm) thick.

R4409.9.1.8.1 Nails shall be hand driven 8d common nails [(0.131 inch (3.3 mm) diameter by $2^1/_2$ (inches (63.5 mm) long with 0.281 inch (7.1 mm) diameter full round head)] or power driven 8d nails of the same dimensions (0.131 inch diameter by $2^1/_2$ inches long with 0.281 inch diameter full round head). Nails of a smaller diameter or length may be used only when approved by an architect or licensed engineer and only when the spacing is reduced accordingly.

R4409.9.1.8.2 Nails shall be hand driven 10d common nails (0.148 inch (3.8 mm) diameter by 3 inch (76 mm) long with 0.312 inch (7.9 mm) diameter full round head) or power driven 10d nails of the same dimensions (0.148 inch diameter by 3 inch long with 0.312 inch diameter full round head). Nails of a smaller diameter or length may be used only when approved by an architect or licensed engineer and only when the spacing is reduced accordingly.

R4409.9.1.9 Nail spacing shall be 6 inches (152 mm) on center at panel edges and 10 inches (254 mm) on center at intermediate supports.

R4409.9.1.10 Flooring shall be nailed with 8d common nails not less than two in each board at each support.

R4409.9.1.11 Floors for heavy timber buildings shall be sheathed as specified for mill floors in Section R4409.9.13.

R4409.9.1.12 Flooring shall not extend closer than $^1/_2$ inch (12.7 mm) from masonry walls.

R4409.9.1.13 If resilient flooring is to be applied directly to a plywood subfloor without separate underlayment, the plywood shall have a top ply of C-plugged grade or better, and the ply immediately under the face shall be at least C grade unless the face ply is $^1/_6$ inch (4.2 mm) or more in nominal thickness. Plywood shall be continuous over two or more spans with face grain perpendicular to supports. Maximum thickness and maximum joist spacing shall comply with Table R4409.9.1.13.

TABLE R4409.9.1.13
ALLOWABLE SPAN FOR PLYWOOD COMBINATION SUBFLOOR UNDERLAYMENT[1] (SINGLE FLOOR PANELS)

SPECIES GROUPS	MAXIMUM PLYWOOD SPAN (IN.)[2,3]			
	16[4]	20[4]	24	48
1	$^1/_2$″	$^5/_8$″	$^3/_4$″	
2,3	$^5/_8$″	$^3/_4$″	$^7/_8$″	
4	$^3/_4$″	$^7/_8$″	1″	
1, 2 and 3				$1^1/_8$″

For SI: 1 inch = 25.4 mm.

Notes:

1. Applicable underlayment grade, C-C (plugged) and all grades of sanded Exterior type plywood.
2. Spans shall be limited to values shown, and reduced for the possible effects of concentrated loads.
3. Allowable uniform load based on deflection of 1/360 of span is 100 pounds per square foot except that total load for 48" on center is 65 pounds per square foot. Plywood edges shall have approved tongue-and-groove joints or shall be supported with blocking unless 1/4 inch minimum thickness underlay is installed or 1/2 inch of approved cellular or lightweight concrete is placed over the subfloor and the sheathing is rated for Exposure 1.
4. If a wood finish floor is laid perpendicular to the joists or supports, thickness shown for 16-inch and 20-inch spans may be used for 24-inch spans.

R4409.9.1.14 Underlayment hardboard shall meet the property requirements for $^7/_{32}$ inch (5.6 mm) and $^1/_4$ inch (6.4 mm) service hardboard and shall be 0.215 +/-0.005 inch (5.5 +/-0.13 mm) thickness; when supported in subflooring such subflooring shall comply with the requirements of Sections R4409.9.1.3, R4409.9.1.4, R4409.9.1.5 and R4409.9.1.6.

R4409.9.1.15 Particleboard floor underlayment shall conform to Type 1-B-1 of the standard listed in Section R4409.1.4. Underlayment shall be not less than $^1/_4$ inch (6.4 mm) in thickness and shall be installed in accordance with the installation instructions of the National Particleboard Association.

R4409.9.1.16 Diaphragm boundaries. All floor sheathing acting as a diaphragm shall be attached to a minimum 2-inch (51 mm) thick nominal nailer with its depth equal to or one size greater than the intersecting top chord. The nailer shall be connected to the wall to resist the gravity loads from the floor, wind pressure/suction from the exterior wall and the diaphragm forces. The floor sheathing shall be attached to the nailer to resist the wind pressure/suction from the exterior wall and the diaphragm forces.

R4409.9.2 Roof sheathing.

R4409.9.2.1 Wood roof sheathing shall be boards or shall be plywood.

R4409.9.2.2 Board roof sheathing shall have a net thickness of not less than $^3/_4$ inch (19 mm) when the span is not more than 28 inches (711 mm) or $^5/_8$-inch (17 mm) when the span is not more than 24 inches (610 mm), shall have staggered joints and shall be nailed with 8d common nails not less than two in each 6-inch (152 mm) board nor three in each 8 inch (203 mm) board at each support.

R4409.9.2.3 Plywood roof sheathing shall be rated for Exposure 1, have a minimum nominal thickness of $^{19}/_{32}$ inch (21 mm) and shall be continuous over two or more spans with face grain perpendicular to supports. Roof sheathing panels shall be provided with a minimum of 2×4 edgewise blocking at all horizontal panel joints with edge spacing in accordance with manufacturer's specifications, for a distance at least 4 feet (1219 mm) from each gable end. The allowable spans shall not exceed those set forth in Table R4409.9.2.3.

TABLE R4409.9.2.3
ALLOWABLE SPAN FOR PLYWOOD ROOF SHEATHING[1]

PANEL SPAN RATING[2]	MAXIMUM SPAN IF BLOCK OR OTHER EDGE SUPPORTS (IN.)	MAXIMUM SPAN WITHOUT EDGE SUPPORT (IN.)
32/16	24	24
40/20	40	32
48/24	48	36

For SI: 1 inch = 25.4 mm.

Notes:

1. Values apply to sheathing grade, C-C and C-D panels.
2. Span Rating appears on all C-C and C-D panels.

R4409.9.2.4 Plywood panels shall be nailed to supports with 8d ring shank nails.

R4409.9.2.5 Nail spacing shall be 6 inches (152 mm) on center at panel edges and at intermediate supports. Nail spacing shall be 4 inches (102 mm) on center at gable ends with either 8d ring shank nails or 10d common nails.

R4409.9.2.5.1 Nails shall be hand driven 8d ring shank or power driven 8d ring shank nails of the following minimum dimensions: (a) 0.113 inch (2.9 mm) nominal shank diameter, (b) ring diameter of 0.012 inch (0.3 mm) over shank diameter, (c) 16 to 20 rings per inch, (d) 0.280 inch (7.1 mm) full round head diameter, (e) $2^3/_8$ inch (60.3 mm) nail length. Nails of a smaller diameter or length may be used only when approved by an architect or licensed engineer and only when the spacing is reduced accordingly.

R4409.9.2.5.2 Nails at gable ends shall be hand driven 8d ring shank or power driven 8d ring shank nails of the following minimum dimensions: (a) 0.113 inch (2.9 mm) nominal shank diameter, (b) ring diameter of 0.012 inch (0.3 mm) over shank diameter, (c) 16 to 20 rings per inch, (d) 0.280 inch (7.1 mm) full round head diameter, (e) 23/8 inch (60.3 mm) nail length or as an alternative hand driven 10d common nails [(0.148 inch (3.8 mm) diameter by 3 inches (76 mm) long with 0.312 inch (7.9 mm) diameter full round head)] or power driven 10d nails of the same dimensions [0.148 inch (3.8 mm) diameter by 3 inches (76 mm) long with 0.312 inch (8 mm) diameter full round head]. Nails of a smaller diameter or length may be used only when approved by an architect or professional engineer and only when the spacing is reduced accordingly. Other products with unique fastening methods may be substituted for these nailing requirements as approved by the building official and verified by testing.

R4409.9.2.5.3 Other products with unique fastening methods may be substituted for these nailing requirements as approved by the building official and verified by testing.

R4409.9.2.6 Roof sheathing for heavy timber construction shall comply with Section R4409.6.13 of this code.

R4409.9.2.7 Diaphragm boundaries. All roof sheathing acting as a diaphragm shall be attached to a minimum 2-inch (51 mm) thick nominal member with its depth equal to or one size greater than the intersecting top chord. This shall be

achieved with a continuous structural subfascia, fascia or blocking at 4 inches (102 mm) on center with nails as required for the appropriate thickness of sheathing.

R4409.9.2.8 When existing roofs are reroofed to the point that the existing roofing is removed down to the sheathing, the existing roof sheathing shall be renailed with 8d common nails [(0.131 inch (3.3 mm) diameter by $2^1/_2$ inches (63.5 mm) long with 0.281 inch (7.9 mm) diameter full round head)]. Nail spacing shall be 6 inches (152 mm) on center at panel edges, 6 inches (152 mm) on center at intermediate supports and where applicable 4 inches (102 mm) on center over gable ends and subfascia. Existing fasteners may be used to achieve such minimum spacing.

R4409.9.3 Storm sheathing. Exterior stud walls shall be sheathed to resist the racking load of wind as set forth in Section R4403.9 and the concentrated loads that result from hurricane-generated wind-borne debris as set forth in Section R4403.16 of this code and shall be at a minimum any of the following types:

1. Tightly fitted, diagonally placed boards not less than $^5/_8$ inch (17 mm) thickness, nailed with three 8d common nails to each support for 1 inch by 6 inch (25 mm by 152 mm) boards and four 8d common nails for 1 inch by 8 inch (25 mm by 203 mm) boards.
2. Wall sheathing shall be plywood, or Product Approved structural panel, rated Exposure 1 with a minimum thickness of $^{19}/_{32}$ 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 $^{19}/_{32}$ 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 $^3/_8$ 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 and 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 re-

TABLE R4409.13.1
NAIL CONNECTION FOR WOOD MEMBERS

CONNECTION	COMMON NAILS	NUMBER OR SPACING
Joists to sill or girder, toe nail	16d	2
Bridging to joist, toe nail	8d	2 each end
1" × 6" subfloor or less to each joist, face nail	8d	2
Over 1" × 6" subfloor to each joist, face nail	8d	3 + 1 for each size increase
2" subfloor to joist or girder, blind and face nail	16d	2
Sole plate to joist or blocking, face nail	16d	16" o.c.
Top or sole plate to stud, end nailed	16d	2
Stud to sole plate, toe nail	3d	3 or 2 16d
Doubled studs, face nail	16d	24" o.c.
Doubled top plates, face nail	16d	16" o.c.
Top plates, laps and intersections, face nail	16d	2
Continuous header, two pieces	16	16" o.c. along each edge
Ceiling joists to plate, toe nail	16d	2
Continuous header to stud, toe nail	16d	3
Ceiling joists, laps over partitions, face nail	16d	3
Ceiling joists to parallel rafters, face nail	16d	3
Rafter plate, toe nail	16d	3
1" × 6" sheathing or less, to each bearing, face nail	8d	2
Over 1" × 6" sheathing, to each bearing, face nail	8d	3 + 1 for each size increase
Built-up corner studs, face nail	16d	30" o.c.
Built-up girders and beams	20d	32" o.c. at top and bottom and staggered, 2 at ends and at each splice
2 inch planks	16d	2 each bearing

For SI: 1 inch = 25.4 mm.
Note: In spacing specifications, o.c. means "on center."

quirements 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 Association 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 $^1/_{16}$ 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 m^2) 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 $^1/_{150}$.

Exception: The venting ratio may be reduced to $^1/_{300}$ 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 $^1/_8$ 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.
3. Where wood shingles or shakes are used, a minimum continuous ¼ inch (6 mm) vented air space separates the shingles or shakes from the roofing underlayment.
4. One of the following shall be met, depending on the air permeability of the insulation under the structural roof sheathing:
   a. Air-impermeable insulation only. Insulation shall be applied in direct contact to the underside of the structural roof sheathing.
   b. Air-permeable insulation only. In addition to air-permeable insulation installed directly below the structural sheathing, at least R-5 rigid board or sheet insulation shall be installed directly above the structural roof sheathing for condensation control.
   c. Air-impermeable and air-permeable insulation. At least R-5 air-impermeable insulation shall be applied in direct contact to the underside of the structural roof sheathing for condensation control. The air-permeable insulation shall be in-

stalled directly under the air-impermeable insulation.

R4409.13.4 Debris.

R4409.13.4.1 Before any new building is erected, all stumps and roots shall be removed from the soil to a depth of at least 12 inches (305 mm) below the surface of the ground in the area to be occupied by the building.

R4409.13.4.2 In buildings or portions thereof having wood first-floor systems, all wood forms which have been used in placing concrete, if within the ground or less than 18 inches (457 mm) above the ground, shall be removed before the building is occupied or used for any purpose.

R4409.13.4.3 Loose or casual wood shall not be stored in direct contact with the ground under any building, and this space must be thoroughly cleaned of all wood and debris.

R4409.13.5 Termite protection. All buildings shall have a pre-construction treatment protection against subterranean termites. The rules and laws as established by the Florida Department of Agriculture and Consumer Services shall be deemed as approved with respect to preconstruction soil treatment for protection against subterranean termites. A certificate of compliance shall be issued to the building department by the licensed pest control company that contains the following statement: "The building has received a complete treatment for the prevention of subterranean termites. Treatment is in accordance with rules and laws established by the Florida Department of Agriculture and Consumer Services."

R4409.13.6 Existing buildings. Whenever the building official has knowledge of the existence of termites in any building or structure, he shall notify the owner in writing and direct that necessary measures be taken for the extermination of the termites within a reasonable length of time, not to exceed 60 days.

R4409.13.6.1 The building official shall inspect existing buildings having wood-stud exterior walls for which application for a permit for exterior wall coverings is made and shall have the authority to order the uncovering of structural elements for inspection and to require necessary repairs as a part of such approval for a permit, or may order demolition.

SECTION R4409.14
HIGH-VELOCITY HURRICANE ZONES—
FIRE-RETARDANT WOOD

R4409.14.1 Fire-retardant-treated wood shall be defined as any wood product which, when impregnated with chemicals by a pressure process, or other means during manufacture, shall have when tested in accordance with ASTM E 84, *Standard Test Method for Surface Burning Characteristics of Building Materials,* a flame spread index of 25 or less and show no evidence of significant progressive combustion when the test is continued for an additional 20 minute period. In addition, the flame front shall not progress more than 10 feet (3 m) beyond the centerline of the burner at any time during the test.

R4409.14.2 The allowable unit stresses for fire-retardant-treated wood including fastener values, shall be developed from an approved method which considers the effects of anticipated temperatures and humidity to which the fire-retardant wood will be subjected, the type of treatment and the redrying process.

R4409.14.3 All fire-retardant-treated wood shall bear an identification mark showing the flame spread classification thereof issued by an approved agency having a reexamination service which maintains a continued supervision and inspection over method of drying. If intended for exterior use, the wood shall be further identified to indicate suitability for exposure to the weather, as defined in Section R4409.14.5.

R4409.14.4 Where fire-retardant-treated wood is exposed to the weather, it shall be further identified to indicate that there is no increase in the listed flamespread classification as defined in Section R4409.14.1 when subjected to ASTM D 2898, *Standard Method for Accelerated Weathering of Fire Retardant Treated Wood for Fire Testing.*

R4409.14.5 Where experience has demonstrated a specific need for use of material of low hygroscopicity, fire-retardant-treated wood to be subjected to high humidity conditions shall be identified as Type A to indicate the treated wood has a moisture content of not over 28 percent when tested in accordance with ASTM D 3201 procedures at 92 percent relative humidity.

R4409.14.6 Fire-retardant-treated wood shall be dried to a moisture content of 19 percent or less for lumber and 15 percent or less for plywood before use. The identification mark shall show the method of drying after treatment. When fire retardant treated wood is air dried after treatment (ADAT) it shall be protected so that no leaching of chemicals will occur. Fire retardant treated wood kiln dried after treatment (KDAT) shall not be exposed to a dry bulb temperature exceeding 160ºF (71ºC). If required for curing, exterior fire retardant treated wood can be exposed to elevated temperatures when the moisture content of the wood does not exceed 19 percent for lumber or 15 percent for wood structural panels. The curing time shall not exceed 48 hours and the temperature shall not exceed 210ºF (99ºC).

SECTION R4409.15
HIGH-VELOCITY HURRICANE ZONES—
WOOD FENCES

R4409.15.1 Wood fences, so located on a property that by zoning regulations they cannot be used as a wall of a building, shall be constructed to meet the minimum specifications in Sections R4409.15.2 and R4409.15.3.

R4409.15.2 Fences not exceeding 6 feet (1829 mm) in height, shall be constructed to meet the following minimum requirements: from nominal 4 x 4 x 8 feet (2438 mm) long posts No. 2 Grade or better spaced 4 feet (1219 mm) on center, and embedded 2 feet (610 mm) into a concrete footing 10 inches (254 mm) in diameter and 2 feet (610 mm) deep.

R4409.15.3 Fences not exceeding 5 feet (1524 mm) or 4 feet (1219 mm) in height shall be constructed as provided in Section R4409.15.2, except that the spacing of posts may be increased to 5 feet (1524 mm) and 6 feet (1829 mm) on center for these heights, respectively.

SECTION R4409.16
HIGH-VELOCITY HURRICANE ZONES—FIRE-RETARDANT-TREATED SHAKES AND SHINGLES

R4409.16.1 Treated shakes and shingles, when impregnated with chemicals by the full-cell vacuum pressure process, shall be considered fire retardant (classified) roof coverings when tested in accordance with ASTM E 108, *Fire Tests of Roof Coverings*, Including the rain test, ASTM D 2898, *Accelerated Weathering of Fire Retardant Treated wood for Fire Testing*. The fire-resistance tests shall include the intermittent flame test, spread of flame test, burning brand test and flying brand test. In addition, at the conclusion of the rain test, test panels shall be subjected to intermittent flame test, burning brand test and flying brand test.

R4409.16.2 Each bundle of fire-retardant-treated shakes and shingles shall be identified with labels indicating the manufacturer, the classification of the material (Class B) and the quality control agency.

SECTION R4409.17
HIGH-VELOCITY HURRICANE ZONES—WOOD BLOCKING

R4409.17.1 General.

R4409.17.1.1 Blocking is defined as wood pieces attached to the roof deck or to each other for the purpose of securing roof membrane or accessories.

R4409.17.1.2 Wood blocking attachment for buildings greater than 40 feet (12.2 m) in height must be designed by a registered architect or professional engineer.

R4409.17.1.3 Wood blocking attachment for lightweight insulating concrete, gypsum concrete, cementitious wood fiber and cellular concrete decks shall be designed by a registered architect or licensed engineer. The decks themselves shall not be used as a wood blocking attachment substrate.

R4409.17.1.4 Wood blocking shall not be less than nominal 2 × 6. The maximum unsupported overhang shall be 2 inches (51 mm). When the maximum overhang is employed, a nominal 2 × 8 blocking shall be installed.

R4409.17.1.5 In recover applications, wood blocking may be reduced to nominal 1 inch (25 mm), providing the attachment is secured in compliance with this code.

R4409.17.1.6 Sound wood blocking may be reused in a recover or reroof application, providing the attachment is secured in compliance with the requirements of this code.

R4409.17.1.7 A fastener shall be placed within 3 inches (761 mm) of the end of each section of wood blocking and a $^1/_4$ inch (6 mm) gap shall be left between each section of wood blocking. No piece of wood shall have less than two fasteners.

R4409.17.1.8 Fasteners other than nails shall be predrilled prior to attachment and countersunk to be flush with the surface of the wood blocking.

R4409.17.1.9 Wood shall be protected according to Section R4409.13.

R4409.17.1.10 Powder actuated fasteners shall not be used in wood blocking attachment.

R4409.17.2 Attachment to masonry block and concrete.

R4409.17.2.1 Prior to the installation of wood blocking to standard weight masonry block, the two top courses shall be solidly filled with concrete or a tie beam shall be provided as required by this code.

R4409.17.2.2 The fastener's average withdrawal resistance per lineal foot shall be not less than 250 pounds per foot (3649 N/m) after the application of a 4:1 safety factor.

R4409.17.2.3 The pullover value of the proposed fastener though the wood blocking shall be not less than 125 percent of the design load of the proposed fastener. If less, a larger bearing washer shall be added to the fastener assembly to meet this requirement. Wood blocking thickness shall be not less than $1^1/_2$ inch (38 mm) if a bearing washer is required.

SECTION R4410
HIGH-VELOCITY HURRICANE ZONES—GLASS AND GLAZING

R4410.1 General.

R4410.1.1 Exterior wall cladding, surfacing and glazing, where provided, shall be as set forth in Sections R4410 through R4415.

R4410.1.2 Exterior wall cladding, surfacing and glazing shall be designed and constructed to sufficiently resist the full pressurization from the wind loads prescribed in Section R4403 and the concentrated loads that result from hurricane-generated wind-borne debris.

1. Exterior wall cladding, surfacing and glazing, within the lowest 30 feet (9.1 m) of the exterior building walls shall be of sufficient strength to resist large missile impacts as outlined in Section R4403.
2. Exterior wall cladding, surfacing and glazing located above the lowest 30 feet of the exterior building walls shall be of sufficient strength to resist small missile impacts as outlined in Section R4403.

   Exception: Exterior wall cladding, surfacing and glazing when protected by fixed, operable or portable shutters or screens which have Product Approval to resist full pressurization from wind loads as well as large and small missile impacts as outlined in Section R4403, without deforming to the point where the substrate being protected is compromised.

R4410.1.3 Workmanship. Cladding and glazing shall be in conformance with the tolerances, quality and methods of construction as set forth in the standards reference in Chapter 43.

R4410.1.4 All exterior wall cladding, surfacing, garage doors, skylights, operative and inoperative windows shall have Product Approval.

SECTION R4410.2
HIGH-VELOCITY HURRICANE ZONES—WINDOWS, DOORS, GLASS AND GLAZING

R4410.2.1 General.

R4410.2.1.1 Windows, doors, glass and glazing shall be as set forth in this section.

R4410.2.1.2 Glass shall comply with ASTM C 1036 requirements for flat glass Type I and II and GSA DD-G-451c *Standard for Glass, Flat and Corrugated, for Glazing Mirrors and Other Uses*.

R4410.2.1.3 Tempered glass shall comply with 16 CFR 1201.

R4410.2.1.4 Transparent and obscure safety glazing shall conform to the *Performance Specifications and Methods of Test for Transparent Safety Glazing Materials Used in Buildings*, ANSI Z97.1.

R4410.2.1.5 Heat-strengthened and ceramic-coated spandrel glass shall comply with ASTM C 1048.

R4410.2.1.6 Wired glass shall comply with ANSI Z97.I and shall only be used in fire doors and in glazed panels where safety glazing is not required.

R4410.2.1.7 Installed glass shall not be less than single strength B quality unless otherwise approved by the building official, and where edges are exposed they shall be seamed or ground.

R4410.2.1.8 Where a light of glass is of such height above grade that the top 50 percent or more is in a zone of greater wind load, the area of the entire light shall be limited as for the greater height above grade.

R4410.2.1.9 Replacement of any glazing or part thereof shall be designed and constructed in accordance with *Florida Existing Building Code*.

R4410.2.1.10 Replacement of glazing of more than one light or more than 30 percent of the total area glazed shall conform to the requirements of the section.

R4410.2.1.11 Fixed glazing used as an exterior component shall require Product Approval. Comparative analysis in compliance with R4410.2.3.2.6 by a Florida licensed engineer or architect may be accepted when the actual pressure and geometry conditions differ from the conditions shown in the approval.

R4410.2.2 Fixed glass in exterior walls.

R4410.2.2.1 Limits of size of glass.

R4410.2.2.1.1 The minimum thickness of annealed float glazing materials used in exterior walls shall be determined and shall not be less than as set forth in ASTM E 1300.

R4410.2.2.1.2 For glazing materials other than annealed float, use the glazing material resistance factor used in ASTM E 1300.

R4410.2.2.1.3 Corrugated glass and other special glass shall be limited to spans determined by analysis and test to resist the loads set forth in Section R4403 based on fiber stresses not exceeding 4,000 psi (27.58 MPa).

R4410.2.2.1.4 Glass block shall have Product Approval.

R4410.2.3 Doors and operative windows in exterior walls.

R4410.2.3.1 Design and approval.

R4410.2.3.1.1 The design and approval of sliding doors, swinging doors and operative windows in exterior walls, including the supporting members shall be based on the proposed use-height above grade in accordance with Section R4403.

R4410.2.3.1.2 Maximum glass sizes shall comply with ASTM E 1300.

R4410.2.3.1.3 Glazing in sliding and in swinging doors shall be safety-glazing complying with 16 CFR 1201, *Safety Standard for Architectural Glazing Materials, Consumer Product Safety Commission,* and as described in Sections R4410.2.3.1.3.1 through R4410.2.3.1.3.5.

R4410.2.3.1.3.1 Doors containing glazing material not greater than 9 square feet (0.84 m^2) in surface area shall be classified as Category I glazing products.

R4410.2.3.1.3.2 Doors, bath and shower enclosures, and sliding glass doors containing glazing material greater than 9 square feet (0.84 m^2) in surface area shall be classified as Category II glazing products.

R4410.2.3.1.3.3 Category I glazing products shall be capable of withstanding a 150 foot-pound (102 Nm) impact test.

R4410.2.3.1.3.4 Category II glazing products shall be capable of withstanding a 400 foot-pound (542 Nm) impact test.

R4410.2.3.1.3.5 Doors shall be designed to be readily operative without contact with the glass.

R4410.2.3.1.4 The architect or professional engineer of record shall be required to specify the design wind pressure, determined in accordance with Section R4403, for all garage doors, skylights operative windows and fixed glazing. The design wind pressure for each component of the exterior building surface, shall be incorporated into the building design drawing so as to allow the respective manufacturer to size the prefabricated assembly for the proper wind pressures.

R4410.2.3.1.5 Exterior garage doors shall be designed and constructed to actively or passively lock in the closed position when subjected to a uniform lateral pressure in excess of 50 percent of the design wind pressure as prescribed in Section R4403.

R4410.2.3.1.6 The architect or professional engineer of record shall be required to detail on the drawings submitted for permit, rough opening dimensions, supporting framework, method of attachment and waterproofing procedures for all garage doors, passage doors, skylights, operative and inoperative windows in exterior walls. Said framework and method of attachment shall be designed and constructed so as to sufficiently resist the design wind pressures as outlined in Section R4403.

Exception: When detailed engineered shop drawings, along with the notices of Product Approval, pro-

duced by the manufacturer's specialty engineer and approved by the architect or professional engineer of record, are admitted at the time of permit application, which completely identifies rough openings, supporting framework, method of attachment and waterproofing procedures are prepared and bear the signature and seal of a professional engineer.

R4410.2.3.2 Tests.

R4410.2.3.2.1 Operative windows and door assemblies shall be tested in accordance with TAS 202 and ANSI/AAMA/NWWDA101/I.S.2, or 101/I.S.2/NAFS or AAMA/WDMA/CSA 101/I.S.2/A440 or TAS 202 and the forced entry prevention requirements of the Architectural Manufacturers Association (AAMA), Sections 1302.5 and 1303.5.

Exceptions:

1. Door assemblies installed in nonhabitable areas where the door assembly and area are designed to accept water infiltration, need not be tested for water infiltration.
2. Door assemblies installed where the overhang (OH) ratio is equal to or more than 1 need not be tested for water infiltration. The overhang ratio shall be calculated by the following equation:

   OH ratio = OH Length/OH Height

   Where:

   OH Length = The horizontal measure of how far an overhang over a door projects out from door's surface.

   OH Height = The vertical measure of the distance from the door's sill to the bottom of the overhang over a door.

R4410.2.3.2.1.1 Glazed curtain wall, window wall and storefront systems shall be tested in accordance with the requirements of this section and the requirements of the American Architectural Manufacturers Association (AAMA) Standard 501, following test load sequence and test load duration in TAS 202.

Exceptions:

1. Door assemblies installed in nonhabitable areas where the door assembly and area are designed to accept water infiltration, need not be tested for water infiltration.
2. Door assemblies installed where the overhang (OH) ratio is equal to or more than 1 need not be tested for water infiltration. The overhang ratio shall be calculated by the following equation:

   OH ratio = OH Length/OH Height

   Where:

   OH Length = The horizontal measure of how far an overhang over a door projects out from door's surface.

   OH Height = The vertical measure of the distance from the door's sill to the bottom of the overhang over a door.
3. Pass-through windows for serving from a single-family kitchen, where protected by a roof overhang of 5 feet (1.5 m) or more shall be exempted from the requirements of the water infiltration test.

R4410.2.3.2.2 Such assemblies with permanent muntin bars shall be tested with muntin bars in place.

R4410.2.3.2.3 Such assemblies shall be installed in accordance with the conditions of test and approval.

R4410.2.3.2.4 Test loads for inward and outward pressures shall be equal to the velocity pressures for the appropriate height in accordance with Section R4403 as further modified by a factor of 1.5.

R4410.2.3.2.5 Comparative analysis of operative windows and glazed doors may be made provided the proposed unit complies with the following:

1. Shall always be compared with a tested and currently approved unit.
2. Varies only in width, height and/or load requirements.
3. Shall not exceed 100 percent of the proportional deflection for fiber stress of the intermediate members of the approved unit.
4. Shall conform as to extruded members, reinforcement and in all other ways with the tested approved unit.
5. Shall not exceed 100 percent of the concentrated load at the juncture of the intermediate members and the frame of the approved unit.
6. Shall not permit more air and water infiltration than the approved unit based on the height above grade.
7. Compared unit shall not exceed the maximum cyclic pressure when tested per TAS 203.

R4410.2.3.2.6 Comparative analysis of fixed glass windows may be made provided the proposed unit complies with the following:

1. Shall always be compared with a tested and currently approved unit.
2. Varies only in width, height and/or load requirements.
3. The design is identical in all respects. e.g.: extrusions, glazing system, joinery, fasteners, etc.
4. Shall not permit more air and water infiltration than the approved unit based on height above grade.
5. The maximum uniform load distribution (ULD) of any side is equal to the uniform load carried by the side divided by the length of the side.

6. The ULD of any member must not exceed the ULD of the corresponding member of the tested window.
7. The uniform load distribution on each member shall be calculated in accordance to "Section 2, Engineering Design Rules" of the AAMA 103.3-83 Procedural Guide.
8. Compared unit shall not exceed the maximum cyclic pressure when tested per TAS 203.

R4410.2.3.3 Construction details. Construction details for fixed glass shall comply with the requirements of this paragraph except that structural glazing as defined in Section 202 need not comply with this section, but shall comply with Section R4410.6.

R4410.2.3.3.1 Each light of fixed glass more than 3 feet (914 mm) in width shall have two approved setting blocks or approved suspension clamps. Setting blocks shall be Neoprene 70-90 Shore A durometer hardness or approved equal.

R4410.2.3.3.2 Fixed glass lights shall be set in corrosion-resistant metal frames and shall comply with applicable requirements of Section R4403 for wind loads, allowable stresses and load tests. Fixed glass lights may be set in wood, metal or concrete frames as permitted for the types of construction by Chapters 3 through 4 of the *Florida Building Code, Building.*

R4410.2.3.3.3 Wood shall have been preservative treated or shall be of a durable species as defined in Section R4409.13.2.

R4410.2.3.3.4 Attachment shall be as set forth in Section R4403 and shall be corrosion resistant.

R4410.2.3.3.5 Glass in fixed lights shall be securely and continuously supported at the perimeter of each sheet unless the design is based on one or more unsupported edges. Supporting members such as division bars and mullions shall be designed by rational analysis to support the wind pressures set forth in Section R4403. Supporting bars shall be attached at the ends to resist the loads set forth in Section R4403 .

R4410.2.3.3.6 The depth of the glazing rabbet and depth of engagement in the rabbet, for fixed glass, shall be based on consideration of the dimensional reduction from deflection and the dimensional changes caused by temperature.

R4410.2.3.4 Gaskets used in glazing systems shall comply with the following standards as applicable:

1. ASTM C 864, *Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers*.
2. ASTM C 509, *Elastomeric Cellular Preformed Gaskets and Sealing Material*.
3. ASTM C 1115, *Dense Elastomeric Silicone Rubber Gaskets and Accessories*.
4. ASTM E 2203, *Dense Thermoplastic Elastomers Used for Compression Seals, Gaskets, Setting Blocks, Spacers and Accessories.*

R4410.2.4 Glazed panel safeguards. Glazed panels shall be protected in accordance with this section.

R4410.2.4.1 Where there is a drop of 4 feet (1219 mm) or more on the far side of fixed glazed panel 24 inches (610 mm) or more in width, the bottom of which is less than 36 inches (914 mm) above the near side walking surface, safeguards as set forth in Section R4403.7.3 shall be provided.

R4410.2.4.2 Where there is a drop of less than 4 feet (1219 mm) on opposite sides of an operable or nonoperable glazed panel 24 inches (610 mm) or more in width and 9 square feet (0.84 m^2) or more in area, one of the following safeguards shall be provides where persons might walk into or through such glazing:

1. Safety glazing conforming to federal standard 16 CFR 1201.
2. An opaque bulkhead not less than 18 inches (457 mm) higher than the upper level.
3. A single horizontal bar of handrail strength requirements not less than $1^1/_2$ inches (38 mm) in width measured parallel to the plane of the glazing and located between 24 inches and 36 inches (610 and 914 mm) above the upper level.
4. A planter with plantings not less than 18 inches (457 mm) higher than the upper level.

R4410.2.4.3 Glazed panels located adjacent to, or in doors, shall be of safety glazing, in accordance with the following:

1. All glazed panels through which a 3 inch (76 mm) diameter sphere is able to pass.
2. In all occupancies, any glazing material adjacent to door within 48 inches (1219 mm) of the door in the closed position and below the top of the door.

Exceptions:

1. Wired glass in fire doors.
2. Leaded glass of 30 square inches (194 cm^2) or less.
3. Curved glass in revolving doors.
4. Commercial refrigerated cabinet doors.
5. A solar screen may serve as a safeguard where such screen complies with strength requirements of railings.

R4410.2.5 Operable window safeguards. Operable windows shall be protected in accordance with this section.

R4410.2.5.1 Where there is a drop of more than 4 feet (1219 mm) on the far side of such windows and the sill is less than 36 inch (914 mm) above the near side walking surface, safeguards shall be provided to prevent the fall of persons when such windows are open as set forth in Section R4403.7.3.

Exceptions:

1. Where the vent openings are 12 inches (305 mm) or less in least dimension and are restricted in opera-

tion to reject objects as required for safeguard in Section R4403.7.3.

2. Slats or grille work constructed to comply with Standard OSHA-1910, set forth in Section R4403.7.3 of this code, or other construction approved by the building official, may be provided in lieu of other safeguards.
3. Where the near side of such windows is less than 4 inches (102 mm) above the floor and falling objects could present a hazard, toeboards shall be provided as required by 29 CFR 1910.
4. Alternate approved designs.

R4410.2.5.2 Where the drop from such windows is less than 4 feet (1219 mm) or where such windows are adjacent to a door, the glazing shall comply with Sections R4410.2.4.2 and R4410.2.4.3.

R4410.2.6 Interior locations.

R4410.2.6.1 Swinging or sliding doors of glass without a continuous frame shall be of only fully tempered glass not less than $^3/_8$ inch (9.5 mm) in thickness.

R4410.2.6.2 Safeguards. The glazing in sliding and swinging doors and in shower to tub enclosures, including any glazing within 60 inches (1.5 m) of the finished floor surface in walls surrounding any tub or shower enclosure, shall be safety glazing as set forth in Section R4410.2.3.1.3 for Category II glazing products.

R4410.2.6.3 Glass or mirrors immediately surrounding a bathtub or shower enclosure shall be safety glazing where the glass or mirrors are less than 60 inches (1.5 m) above the floor of the tub or the shower.

R4410.2.6.4 The glazing in fixed panels adjacent to paths of egress shall comply with Section R4410.2.4.3.

R4410.2.6.5 Glass shall not be solid painted or otherwise concealed where such painted glass may be mistaken for other construction materials.

R4410.2.6.6 Glass mirrors of more than 9 square feet (0.84 m^2) in area that are used as surface finish material on walls in public spaces shall be directly secured to supports and shall not be hung.

R4410.2.7 Safety glazing.

R4410.2.7.1 Safety glazing, where required, shall be as set forth in this section.

R4410.2.7.2 Safety glazing shall comply with the standard set forth in Section R4410.2.1.4 for transparent and obscure safety-glazing materials, and plastic glazing shall in addition comply with the specifications of Section R4410.2.7.3.

R4410.2.7.3 Plastics, with or without reinforcing or acrylic modifiers shall comply with Section R4412.1, and consideration of dimension reduction caused by deflection and/or dimensional instability of the materials shall be given in the determination of the depth of the glazing rabbet and engagement of the plastic in the rabbet. Plastics shall be limited to spans determined by analysis and test to resist the loads set forth in Section R4403.

R4410.2.7.4 Glass louvered doors need not be safety glazed.

R4410.2.8 Sloped glazing.

R4410.2.8.1 Sloped glazing includes any installation of glass or other transparent, translucent or opaque glazing material installed at a slope of 15 degrees (0.26 rad) or more from the vertical plane. Glazing materials in skylights, roofs and sloped walls are included with this definition.

R4410.2.8.2 Allowable glazing materials. Sloped glazing shall be any of the following materials subject to the limitations specified in Section R4410.2.8.3.

R4410.2.8.2.1 For monolithic glazing systems, the glazing material of the single light or layer shall be laminated with a minimum 30 mil polyvinyl butyryl (or equivalent) interlayer, wire glass, approved plastic material meeting the requirements of this section, heat strengthened glass or fully tempered glass.

R4410.2.8.2.2 For multiple glazing systems, each light or layer shall consist of any glazing materials specified in Section R4410.2.8.2.1.

R4410.2.8.2.3 See Section R4412.1 for additional requirements for plastic skylights.

R4410.2.8.3 Limitations. Heat strengthened and fully tempered glass when used in monolithic glazing systems shall have screens installed below the glazing material to protect building occupants from falling glass should breakage occur. The screens shall be capable of supporting the weight of the glass and shall be substantially supported below and installed within 4 inches (102 mm) of the glass. They shall be constructed of a noncombustible material not thinner than 0.0808 inch (2 mm) (12 B and S gauge) diameter with a mesh not larger than 1inch by 1 inch (25 mm by 25 mm). In a corrosive atmosphere structurally equivalent corrosion-resistant screening materials shall be used. Heat-strengthened glass, fully tempered glass and wire glass, when used in multiple glazing systems as the bottom layer over the walking surface, shall be equipped with screening meeting the requirements for monolithic glazing systems.

Exceptions:

1. In monolithic and multiple layer sloped glazing systems, any glazing material, including annealed glass, may be installed without required screens if the walking surface below the glazing material is permanently protected from the risk of falling glass or if the area below the glazing material is not a walking surface.
2. In monolithic and multiple layer sloped glazing systems, any glazing material, including annealed glass, may be installed in the sloped glazing systems of greenhouses (structures used primarily for growing plants) without screens provided the height of the penthouse at the ridge does not exceed 20 feet (6.1 m) above grade. Frames may be of wood construction in greenhouses located outside the fire district if the height of the sloped glazing does not exceed 20 feet (6.1 m) above grade. In other cases, noncombustible frames shall be used.

R4410.2.8.4 Sloped glazed framing. In other than Types IV, IIB and IIIB construction, all sloped glazing skylight

frames shall be constructed of noncombustible materials. In foundries or buildings where acid fumes deleterious to metal are incidental to the use of the building, approved pressure treated woods or other approved noncombustible material shall be permitted for sash and frames. All sloped glazing and skylights shall be designed for the roof and wind loads in Section R4403. All skylights set at an angle of less than 45 degrees (0.79 rad) from the horizontal shall be mounted at least 4 inches (102 mm) above the planer of the roof on a curb construction as required for the frame. Sloped glazing may be installed in the plane of the roof where the roof pitch is greater than 45 degrees (0.79 rad) from the horizontal.

SECTION R4410.3
HIGH-VELOCITY HURRICANE ZONES—GLASS VENEER

R4410.3.1 Glass veneer shall be as set forth in this section.

R4410.3.2 Dimension. Glass-veneer units shall be not less than $1^{1}/_{32}$ inch (8.7 mm) in thickness. No unit shall be larger in area than 10 square feet (0.93 m^2) where 15 feet (4.6 m) or less above the grade directly below, nor larger than 6 square feet (0.56 m^2) where more than 15 feet (4.6 m) above the grade directly below.

R4410.3.3 Attachment. Every glass-veneer unit shall be attached to the backing with approved mastic cement and corrosion-resistant ties and shall be supported on shelf angles.

R4410.3.3.1 Where more than 6 feet (1829 mm) above grade, veneer shall be supported by shelf angles, and ties shall be used in both horizontal and vertical joints.

R4410.3.3.2 Below a point 6 feet (1829 mm) above grade, glass veneer shall rest on shelf angles. Veneering shall not be supported on construction which is not an integral part of the wall, and over sidewalks shall be supported on a shelf angle not less than $^{1}/_{4}$ inch (6.4 mm) above grade.

R4410.3.3.3 All edges of glass veneer shall be ground.

R4410.3.4 Mastic.

R4410.3.4.1 The mastic shall cover not less than one-half of the area of the unit after the unit has been set in place and shall be neither less than $^{1}/_{4}$ inch (6.4 mm) nor more than $^{1}/_{2}$ inch (12.7 mm) in thickness.

R4410.3.4.2 The mastic shall be insoluble in water and shall not lose its adhesive qualities when dry.

R4410.3.4.3 Absorbent surfaces shall be sealed by a bonding coat before mastic is applied. The bonding coat shall be cohesive with the mastic.

R4410.3.4.4 Glass veneer surfaces to which mastic is applied shall be clean and uncoated.

R4410.3.4.5 Space between edges of glass veneer shall be filled uniformly with an approved type pointing compound.

R4410.3.5 Shelf angles and ties.

R4410.3.5.1 Shelf angles shall be of corrosion-resistant material capable of supporting four times the width of the supported veneer. The shelf angles shall be spaced vertically in alternate horizontal joints, but not more than 3 feet (914 mm) apart. Shelf angles shall be secured to the wall at intervals not exceeding 2 feet (610 mm) with corrosion-resistant bolts not less than $^{1}/_{4}$ inch (6.4 mm) diameter. Bolts shall be set in masonry and secured by lead shields.

R4410.3.5.2 Ties shall be of corrosion-resistant metal as manufactured especially for holding glass-veneer sheets to masonry surfaces. There shall be not less than one such approved tie for each 2 square feet (0.19 m^2) of veneer surface.

R4410.3.6 Backing. Exterior glass veneer shall be applied only upon masonry, concrete or stucco.

R4410.3.7 Expansion joints. Glass veneer units shall be separated from each other and from adjoining materials by an expansion joint at least $^{1}/_{16}$ inch (1.6 mm) in thickness. There shall be at least $^{1}/_{64}$ inch (0.4 mm) clearance between bolts and the adjacent glass.

SECTION R4410.4
HIGH-VELOCITY HURRICANE ZONES—STORM SHUTTERS/EXTERNAL PROTECTIVE DEVICES

R4410.4.1 General. Unless exterior wall components including but not limited to structural glazing, doors and windows of enclosed buildings have specific Product Approval to preserve the enclosed building envelope against impact loads as set forth in Section R4403, all such components shall be protected by product approved storm shutters.

R4410.4.2 The storm shutters shall be designed and constructed to insure a minimum of 1 inch (25 mm) separation at maximum deflection with components and frames of components they are to protect unless the components and frame are specifically designed to receive the load of storm shutters, and shall be designed to resist the wind pressures as set forth in Section R4403 by methods admitting of rational analysis based on established principles of design. Storm shutter shall also be designed to comply with the impact load requirements included within Section R4403.

R4410.4.3 The storm shutter design calculations and detailed drawings, including attachment to the main structure, shall be prepared by and bear the seal of a qualified Florida-registered delegated engineer, or if qualified to prepare such design, by the engineer or architect of record, which architect or engineer shall be proficient in structural design. The architect or engineer of record shall, in all instances, review and approve documents prepared by the delegated engineer.

R4410.4.4 Storm shutters shall be approved by the product control section and shall bear the name of the company engraved in every section of the system.

R4410.4.5 Deflection shall not exceed the limits set forth in Section R4403.

R4410.4.6 Unless storm shutters are permanently attached to the main structure, all such storm shutters shall, where practicable, be neatly stored at all times in a designated and accessible area within the building.

R4410.4.6.1 Shutters used to protect openings above the first story of any building or structure must be permanently installed and closable from the inside of the building or

structure unless such openings are accessible without the use of a ladder or lift, or shutters can be installed from the interior of the building or structure.

Exception: Group R3 detached single-family residences not exceeding two stories.

R4410.4.7 Storm shutters must completely cover an opening in all directions.

R4410.4.7.1 On any side of an opening, the maximum side clearance between the shutter and a wall or inset surface shall be $^1/_4$ inch (6.4 mm). Any distance in excess of $^1/_4$ inch (6.4 mm) shall require end closure or shutter overlap, where applicable.

R4410.4.7.2 Shutter overlap shall be a minimum of one and one-half times the side clearance between the shutter and wall.

R4410.4.7.3 End closures shall be designed to resist wind loads specified in Section R4403, based on rational analysis.

SECTION R4410.5
HIGH-VELOCITY HURRICANE ZONES—CURTAIN WALLS

R4410.5.1 Scope. This section prescribes requirements for curtain walls of buildings or structures regulated by this code.

R4410.5.2 Definition. A curtain wall is any prefabricated assembly of various components to enclose a building usually attached to and/or supported by the building frame other than a single door, or window, masonry units, poured in place concrete and siding of single membrane metal, wood or plastic.

R4410.5.3 Curtain walls, as defined in Section R4410.5.2, shall be designed and constructed in accordance with the requirements of this section.

R4410.5.4 Structural glazing in curtain walls shall also comply with the requirements of Section R4410.6.

R4410.5.5 General.

R4410.5.5.1 All structural elements of curtain wall systems and their attachments (including embedments) to the main structural frame shall be designed by and bear the seal of a qualified Florida-registered delegated engineer, or if qualified to prepare such design, by the engineer or architect of record, which architect or engineer shall be proficient in structural design. The engineer of record shall, in all instances, review and approve documents prepared by the delegated engineer.

R4410.5.5.2 Curtain wall systems supported from more than two adjacent floors shall be designed to withstand all imposed loads without exceeding allowable stresses in the event of destruction or failure of any single span within the system. Documents for the main building permit shall include sufficient details describing the curtain wall system attachment to the main structure. This portion of the contract documents, if not prepared by the qualified engineer or architect of record, shall bear the signature and seal of the qualified Florida-registered delegated engineer charged with the responsibility for the design of the curtain wall system.

R4410.5.5.3 Individual mullions acting as a continuous member shall transfer loads through supports from no more than three adjacent floors.

R4410.5.5.4 Materials. The materials used in any curtain wall shall comply with the applicable provisions of this code.

R4410.5.6 Fire protection.

R4410.5.6.1 Curtain wall supports, spandrel panels, anchors and the connections at the intersection of the floor and wall shall be fire protected based on building distance separation as required in this code.

R4410.5.6.2 Irrespective of distance separation, anchors, embedded hardware, connections at the intersection of the wall and floor and other connectors used to attach the curtain wall framing system to the building frame shall be provided with fire protection from the floor below with fire-resistant materials having a fire rating equivalent to that of the floor.

R4410.5.6.4 Openings between curtain wall systems and fire resistive floors shall be protected against the passage of fire and smoke in accordance with Section R4410.5.6.2.

R4410.5.6.5 Where fire safing is used to achieve such protection, it shall be installed in such a manner that it will remain in place for at least a duration equivalent to the fire-resistive rating of the floor system.

R4410.5.7 Inspection. Curtain wall systems and their attachments to the main structure shall be inspected by a special inspector at both the point of assembly and the point of installation.

SECTION R4410.6
HIGH-VELOCITY HURRICANE ZONES—STRUCTURAL GLAZING SYSTEMS

R4410.6.1 Scope. This section prescribes requirements for structural glazing systems of buildings or structures regulated by this code.

R4410.6.2 Application.

R4410.6.2.1 Structural glazing, as defined in Section R4410.5.3, shall be designed and constructed in accordance with the requirements of this section.

R4410.6.2.2 Structural glazing systems used in curtain walls shall also comply with the requirements of Section R4410.

R4410.6.3 Definition. The terms used in this section shall be defined as set forth in Section Chapter 2 of this code.

R4410.6.4 Standards. Adhesives and sealants used in structural glazing systems shall comply with following standards:

ASTM C 794, Test Method for Adhesion-In-Peel of Elastomeric Joint Sealants.

ASTM C 920, Specification for Elastomeric Joint Sealants.

ASTM D 412, Test Methods for Rubber Properties in Tension.

ASTM D 624, Test Method for Rubber Property-Tear Resistance.

ASTM D 2240, Test Method for Rubber Property-Durometer Hardness.

Federal Specifications TT-S-001543A and TT-S-00230C.

ASTM E 331, Test Method for Water Penetration of Exterior Windows, Curtain Walls and Doors.

ASTM E 330, Test Method for Structural Performance of Exterior Windows, Curtain Walls and Doors.

R4410.6.5 Design.

R4410.6.5.1 General. Structural glazing systems shall be designed by and bear the seal of a Florida-registered professional engineer.

R4410.6.5.2 Materials.

R4410.6.5.2.1 Identification. All materials shall be clearly identified as to manufacturer and manufacturer's product number.

R4410.6.5.2.2 Adhesives and sealants.

R4410.6.5.2.2.1 Only approved silicone elastomer adhesives and sealants shall be used for fastening glass lights and other panels to curtain wall framing.

R4410.6.5.2.2.2 Such adhesives and sealants shall be of a polymer that is 100 percent silicone.

R4410.6.5.2.2.3 Adhesives and sealants shall have been tested in accordance with the standards set forth in Section R4410.6.4.

R4410.6.5.3 Manufacturer's testing, recommendation and approval.

R4410.6.5.3.1 Compatibility of all components and fabrication procedures of structural glazing systems shall be tested, approved and recommended in writing by the manufacturer of the adhesive; the manufacturer of the coating; whether it is anodized, baked or otherwise applied and the manufacturer of the glass panel.

R4410.6.5.3.2 Manufacturer's testing, recommendation and approval shall address, but shall not be limited in scope by the following sections.

R4410.6.5.3.2.1 The compatibility of the sealant with metal, glazing materials, shims, spacers, setting blocks, backer rods, gaskets and other materials.

R4410.6.5.3.2.2 Adhesion to the designated substrates and adhesion of the substrates to the base metal.

R4410.6.5.3.2.3 The design and structural capability of silicone joints and cross sections.

R4410.6.5.4 Structural requirements.

R4410.6.5.4.1 Design of structural seals.

R4410.6.5.4.1.1 The design stress of the structural silicone shall not exceed 20 psi (138 kPa) for materials having a minimum strength of 100 psi (690 kPa) at the weakest element in the line of stress.

R4410.6.5.4.1.2 Such design stress shall also provide for a safety factor of not less than 5.0.

R4410.6.5.4.1.3 Safety factors greater than 5.0 shall be specified by the engineer when required or recommended by the manufacturer.

R4410.6.5.4.1.4 The silicone structural seal shall have a maximum modulus of elasticity to allow no more than 25 percent movement of the joint width at 20 psi (138 kPa) stress.

R4410.6.5.4.1.5 In insulating glass units, the secondary silicone seal shall be designed to withstand a minimum of half the design negative wind load applicable to the outboard lights.

R4410.6.5.4.2 Bonding limits. Structural glazing shall be limited to adhesive bonding on one side or on two opposing sides of an infill glass lights or panel.

Exception: Three or four side bonding shall be permitted only when structural glazing units are shop fabricated and shop glazed.

R4410.6.5.4.3 Job-site reglazing.

R4410.6.5.4.3.1 Job-site replacement reglazing shall be permitted only when performed following a procedure approved in writing by the applicable structural silicone manufacturer.

R4410.6.5.4.3.2 Replacement shall be performed only by individuals or firms approved or certified by the silicone manufacturer.

R4410.6.5.5 Fire protection. Structural glazing in curtain walls shall be fire protected as required by Section R4410.5.6.

R4410.6.6 Inspections, testing and recertification.

R4410.6.6.1 A minimum of 1 percent of the structurally glazed panels shall be tested for load carrying capacity and sealant adhesion in accordance with Section R4403 and ASTM E 330.

R4410.6.6.2 Structural glazed panels shall be inspected by a Florida-registered architect or licensed engineer for conformance with the approved design and installation procedures determined by the authority having jurisdiction prior to the erection of such panels and after the seal curing period established by the silicone manufacturer.

R4410.6.6.3 It shall be the responsibility of the contractor to verify the adhesion of the cured sealant periodically throughout the application to assure compliance with the manufacturer's specifications and quality of application.

R4410.6.6.4 Structural glazing systems on threshold buildings shall be recertified by the owner as specified by the authority having jurisdiction at six-month intervals for the first year after installation. Subsequently, such systems shall be recertified every five years at regular intervals.

R4410.6.6.5 Such recertifications shall determine the structural condition and adhesion capacity of the silicone sealant.

SECTION R4411
HIGH-VELOCITY HURRICANE ZONES — GYPSUM BOARD AND PLASTER

R4411.1 Lathing.

R4411.1.1 General. Lath shall be gypsum, metal or wire lath, as set forth herein, and shall conform to the *Standard Specification for Interior Lathing and Furring*, ANSI A42.4.

R4411.1.2 Gypsum lath. Gypsum lath shall conform to the *Standard Specification for Gypsum Lath*, ASTM C 37.

R4411.1.2.1 Gypsum lath shall be nailed to wood supports, at intervals not to exceed 5 inches (127 mm), with 13-gauge galvanized or blued nails having $^{19}/_{64}$ inch (7.5 mm) diameter flat heads (7.5 mm). Nails shall be not less than $1^{1}/_{8}$ inches (29 mm) long for $^{3}/_{8}$ inch (9.5 mm) lath nor less than $1^{1}/_{4}$ inches (32 mm) for $^{1}/_{2}$ inch (12.7 mm) lath. Each 16-inch (406 mm) width of lath shall be secured to each support with not less than five nails except that where fire-resistive-rated construction is not required, there shall not be less than four nails.

R4411.1.2.2 Lath shall be secured to horizontal or vertical metal supports by means of approved special clips.

R4411.1.2.3 The center-to-center spacing of wood supports shall not exceed 16 inches (406 mm) for $^{3}/_{8}$ inch (9.5 mm) gypsum lath and shall not exceed 24 inches (610 mm) for $^{1}/_{2}$ inch (12.7 mm) gypsum lath.

R4411.1.2.4 The center-to-center spacing for gypsum lath applied to metal studs shall not exceed that set forth herein above for wood supports except that $^{3}/_{8}$ inch (9.5 mm) gypsum lath may be applied to metal studs spaced 24 inches (610 mm) on centers where a minimum of $^{3}/_{4}$-inch (19 mm), three-coat plaster is applied over the lath.

R4411.1.2.5 Lath shall be applied with face side out and with the long dimension at right angles to the framing members. Joints shall be broken in each course, except that end joints may fall on one support when such joints are covered with 3-inch- wide (76 mm) strips of metal lath. Lath shall be butted together.

R4411.1.2.6 Corner bead and inside angle reinforcing shall not be required.

R4411.1.2.7 No interior lath shall be applied until the roof is on and the building is dried in.

R4411.1.3 Metal and wire lath.

R4411.1.3.1 Metal and wire lath and metal accessories embedded in the plaster shall be galvanized or otherwise rust-resistant by approved means. Weight tags shall be left on all metal or wire lath until approved by the building official.

R4411.1.3.2 The weight of metal and wire lath and the spacing of supports shall conform to the requirements set forth in Table R4411.1.3.2.

TABLE R4411.1.3.2
WEIGHTS OF METAL AND WIRE LATH*

TYPE OF LATH	MINIMUM WGT. (lb per sq yd)	MAXIMUM SPACING OF SUPPORTS (in.)	
		For Walls	For Ceilings
Flat Expanded Metal Lath	2.5	16	0
Flat Expanded Metal Lath	3.4	16	16
Flat Rib Metal Lath	2.75	16	12
Flat Rib Metal Lath	3.4	19	19
$^{3}/_{8}$" Rib Metal Lath	3.4	24	24
Sheet-Metal Lath	4.5	24	24
Wire Lath	2.48	16	12
Wire Fabric	**	16	16

For SI: 1 inch = 25.4 mm, 1 square yard = 0.8361 m^2.

* V-stiffened that expanded metal lath of equal rigidity and weight is permissible on the same spacings as $^{3}/_{8}$" rib metal lath.

** Paper-backed wire fabric, No. 16-gauge wire, 2" × 2" mesh, with stiffner.

R4411.1.3.3 All metal lath shall be lapped 1 inch (25 mm) minimum.

R4411.1.3.4 All attachments for securing metal lath, wire lath and wire fabric to supports shall be spaced not more than 6 inches (152 mm) apart, and side laps shall be secured to supports and be tied between supports at not to exceed 9 inches (229 mm) intervals.

R4411.1.3.5 Metal and wire lath shall be attached to vertical wood supports with the equivalent of 4d galvanized or blue common nails driven to a penetration of at least $^{3}/_{4}$ inch (19 mm) and bent over to engauge not less than three strands of lath. Metal and wire lath shall be attached to ceiling joists or other horizontal wood supports with the equivalent of No. 11-gauge, barbed, galvanized or blued nails $1^{1}/_{2}$ (38 mm) inches long having a head not less than $^{3}/_{8}$ inch (9.5 mm) in diameter.

R4411.1.3.6 Metal and wire lath shall be attached to horizontal and vertical metal supports with the equivalent of No. 8 galvanized sheet-metal screws.

R4411.1.4 Nonbearing lath and plaster partitions.

R4411.1.4.1 Where reinforced plaster or pneumatically placed plaster partitions are used, they shall have vertical steel or iron channels with a depth of not less than one-third of the thickness of the partition and spaced not more than 24 inches (610 mm) on centers. The thickness of metal in the channels shall not be less than 16 U.S. standard gauge or light gauge steel studs.

R4411.1.4.2 Hollow nonbearing partitions of reinforced plaster or pneumatically placed plaster shall have a shell thickness of not less than $^3/_4$ inch (19 mm).

R4411.1.4.3 Metal reinforcing shall be as set forth in Table R4411.1.3.2, and gypsum lath shall not be less than $^3/_8$ inch (9.5 mm) in thickness. The minimum thickness of metal lath and plaster partitions shall be not less than 2 inches (51 mm) or $^1/_{84}$ of the distance between supports.

R4411.1.5 Suspended and furred plaster ceilings.

R4411.1.5.1 General. Suspended or furred plaster ceilings shall be designed and constructed as set forth herein.

R4411.1.5.2 Main runners. Main runners or carriers shall be rolled steel channels not less than the sizes and weights set forth in Table R4411.1.5.2.

A main runner shall be located not more than 6 inches (152 mm) from parallel walls to support the ends of cross furring. The ends of main runners at walls shall be supported by hangers located not more than 12 inches (305 mm) from such ends. Splices in main runners shall be lapped 12 inches (305 mm) and tied, each end, with double loops of No. 16-gauge wire.

TABLE R4411.1.5.2
SPANS AND SPACING OF MAIN RUNNERS

MINIMUM SIZE AND TYPE	MAXIMUM SPAN BETWEEN HANGERS OR SUPPORTS	MAXIMUM CENTER-TO-CENTER SPACING OF RUNNERS
$^3/_4$" - 0.3 lb per ft	2'-0"	3'-0"
1-$^1/_2$" - 0.475 lb per ft	3'-0"	4'-0"
1-$^1/_2$" - 0.475 lb per ft	3'-6"	3'-6"
1-$^1/_2$" - 0.475 lb per ft	4'-0"	3'-0"
1-$^1/_2$" - 1.12 lb per ft	4'-0"	5'-0"
2" -1.26 lb per ft	5'-0"	5'-0"
1-$^1/_2$" × 1-$^1/_2$" × $^3/_{16}$" angle	5'-0"	5'-0"

For SI: 1 in. = 25.4 mm;1 lb/ft = 1.4882 kg/m.

R4411.1.5.3 Cross furring. Cross furring, or spacers, for various spacing of main runners or other supports shall be not less than as set forth in Table R4411.1.5.3.

TABLE R4411.1.5.3
SIZES OF CROSS FURRING IN SUSPENDED AND FURRED CEILINGS

SIZE AND TYPE	MAXIMUM SPAN BETWEEN SUPPORTS	MAXIMUM SPACING
$^1/_4$" pencil rods	Up to 2'-0"	12"
$^3/_4$" channels	Up to 3'-0"	24"
$^3/_4$" channels	Up to 4'-0"	16"

For SI: 1 in. = 25.4 mm.

R4411.1.5.3.1 Cross furring shall be securely saddle-tied to the main runners by not less than two strands of No. 16 W and M gauge galvanized wire or equivalent approved attachments. Cross furring shall be attached to joists or beams with double No. 14 W and M gauge galvanized wire or equivalent approved attachments.

Splices in cross furring shall be lapped 8 inches (203 mm) and tied, each end, with double loops of No. 16-gauge wire.

R4411.1.5.4 Hangers. Hangers supporting suspended ceilings shall be not less than as set forth in Table R4411.1.5.4.

TABLE R4411.1.5.4
HANGERS SUPPORTING SUSPENDED CEILINGS

CEILING AREA SUPPORTED (SQUARE FEET)	MINIMUM SIZE OF HANGER
12.5	8-gauge wire
16	6-gauge wire
18	$^3/_{16}$" rod
22.5	$^1/_4$" rod
50	1" × $^3/_{16}$" flat bar

For SI: 1 in. = 25.4 mm.

R4411.1.5.4.1 Hangers shall be saddle-tied or wrapped around main runners to develop the full strength of the hangers. Hangers shall be fastened to or embedded in the structural framing, masonry or concrete. Lower ends of flat-strap hangers shall be bolted with $^3/_8$ inch (9.5 mm) bolts to runner channels or bent tightly around corners and bolted to the main part of the hanger. Where the area of a plastered ceiling exceeds 100 square feet (93 m^2), suitable methods to resist uplift forces shall be provided for each 64 square feet (6 m^2) of ceiling.

SECTION R4411.2
HIGH VELOCITY HURRICANE ZONES–PLASTER

R4411.2.1 General.

R4411.2.1.1 Gypsum plastering shall conform to the *Standard Specification for Gypsum Plastering*, ANSI A42.1.

R4411.2.1.2 Plastering with gypsum, hardwall, lime or cement plaster shall be three-coat work when applied over metal and wire lath and shall be not less than two-coat work when applied over gypsum lath or gypsum block.

R4411.2.1.3 Portland cement plaster shall not be applied directly to gypsum lath.

R4411.2.1.4 In no case shall a brush coat be accepted as a required coat where three-coat work is required by this section.

R4411.2.1.5 Grounds shall be installed to provide for the thickness of plaster, as set forth in Table R4411.2.1.5, as measured from the face of the lath.

TABLE R4411.2.1.5
REQUIRED THICKNESS OF INTERIOR PLASTER

TYPE OF LATH	THICKNESS OF PLASTER
Metal or wire lath	$^5/_8$" minimum
Gypsum lath	$^1/_2$" minimum

For SI: 1 in. = 25.4 mm.

R4411.2.1.6 If monolithic-concrete ceiling surfaces require more than $^3/_8$ inch (9.5 mm) of plaster to produce desired

lines or surfaces, metal lath or wire lath shall be attached thereto; except that special bonding agents approved by the building official may be used.

R4411.2.1.7 The building official may require test holes to be made for the purpose of determining the thickness of plaster.

R4411.2.2 Materials.

R4411.2.2.1 Aggregates.

R4411.2.2.1.1 Inorganic aggregates used for plaster and stucco shall conform to the *Standard Specification for Inorganic Aggregates for Use In Gypsum Plaster,* ASTM C 35, except that graduation of locally produced sand shall be such that the fineness modulus is between 1.20 and 2.35.

R4411.2.2.1.2 Aggregates shall be quarried or washed in fresh water and shall contain not more than $^1/_{20}$ of 1 percent salt, by weight.

R4411.2.2.2 Gypsum. Gypsum plaster shall conform to the *Standard Specification for Gypsum Plaster,* ASTM C 28.

R4411.2.2.3 Lime. Lime shall conform to the *Standard Specification for Quicklime for Structural Purposes*, ASTM C 5, and the *Standard Specification for Special Finish Hydrated Lime,* ASTM C 206.

R4411.2.2.4 Keene's cement. Keene's cement shall conform to the *Standard Specification for Keene's Cement,* ASTM C 61.

R4411.2.2.5 Portland cement.

R4411.2.2.5.1 Portland cement shall conform to the *Standard Specification for Portland Cement,* ASTM C 150.

R4411.2.2.5.2 Approved types of plasticity agents may be added to Portland cement in the manufacturing process or when mixing the plaster, but in no case shall the amount of the plasticity agent exceed 10 percent of the volume of cement in the plaster mixture.

R4411.2.2.6 Masonry cement. Masonry cement shall be Type II and shall conform to the *Standard Specification for Masonry Cement*, ASTM C 91.

R4411.2.3 Proportioning and mixing.

R4411.2.3.1 Base coats. The proportions of sand, vermiculite or perlite to 100 pounds (45.4 kg) of gypsum neat plaster shall not exceed the requirements in this section.

R4411.2.3.1.1 Gypsum or hardwall plaster. Gypsum or hardwall plaster shall be proportioned in accordance with Section R4411.2.3.1.1.

TABLE R4411.2.3.1.1
GYPSUM AND HARDWALL PLASTER

APPLICATION METHOD	DAMP LOOSE SAND (lb)	VERMICULITE OR PERLITE (cu ft)
TWO-COAT WORK (DOUBLE-UP METHOD)		
(1) Over gypsum lath	250	$2\ ^1/_2$
(2) Over Masonry[2]	300	3
THREE-COAT WORK		
(1) First (scratch) coat over lath	200[1]	2
(2) First (scratch) coat over masonry	300	3
(3) All second (brown) coats	300[1]	3

1. Except over monolithic concrete.
2. In lieu of the proportioning specified, the proportions may be 100 lb of gypsum neat plaster to not more than 250 lb of damp, loose sand or $2\text{-}^1/_2$ cu ft of vermiculite or perlite, provided this proportioning is used for both scratch and brown coats.

R4411.2.3.1.2 Wood-fiber gypsum plaster. Wood-fiber gypsum plaster for use on all types of lath shall be mixed with water only and shall be mixed in the proportion of one part of plaster to one part of sand, by weight, for use on masonry.

R4411.2.3.1.3 Ready mixed plaster. Gypsum ready-mixed plaster shall be in the proportion of 100 pounds (45.4 kg) of gypsum neat plaster to not more than 250 lb (113 kg) of sand; or when vermiculite or perlite is used as an aggregate, the proportions shall be 100 pounds (45.4 kg) of gypsum neat plaster to not more than $2^1/_2$ cubic feet (0.07 m^3) vermiculite or perlite.

R4411.2.3.1.4 Portland-cement plaster. For three-coat work, the first two coats shall be required for the first two coats of exterior stucco (see Section R4411.3).

R4411.2.3.1.5 Masonry cement plaster. For two- or three-coat work, all work shall be set forth in Section R4411.2.

R4411.2.3.2 Finish coats for gypsum or lime plaster. The finish coats shall be mixed and proportioned in accordance with this section.

R4411.2.3.2.1 Smooth white finish, mixed in the proportion of not less than one part gypsum gaging plaster to three parts lime putty, by volume, or an approved prepared gypsum trowel finish.

R4411.2.3.2.2 Sand-float finish, mixed in the proportion of one-half part of Keene's cement to two parts of lime putty and not more than four and one-half parts of sand, by volume, or an approved gypsum sand-float finish.

R4411.2.3.2.3 Keene's cement finish, mixed in the proportion of three parts Keene's cement to one part lime putty, by volume.

R4411.2.3.2.4 Lime sand-float finish, mixed in the proportion of three parts lime putty to three parts sand, by volume.

R4411.2.3.2.5 Finish coat for perlite or vermiculite aggregate plasters, mixed in the proportion of 1 cubic foot (28 339 cc) of aggregate to 100 pounds (45 kg) of unfibered gypsum plaster, or mixed according to manufacturer's specifications.

R4411.2.3.3 Finish coat for Portland cement plaster. Finish coats for interior Portland cement plaster shall be one of the following:

1. As required for the third coat of exterior stucco (see Section R4410.4).
2. A gauged cement plaster mixed in proportion of one part Portland cement to not more than 15 percent lime putty and not more than four parts of sand, by volume.

R4411.2.3.4 Finish coat for masonry cement plaster. Finish coat for masonry cement plaster shall be as set forth in Section R4411.2.4.2.3.

R4411.2.4 Application.

R4411.2.4.1 Base coats.

R4411.2.4.1.1 Gypsum plaster. The scratch coat shall be applied with sufficient material and pressure to form a full key or bond.

R4411.2.4.1.1.1 For two-coat work it shall be doubled back to bring the plaster out to grounds and straightened to a true surface and left rough to receive the finish coat.

R4411.2.4.1.1.2 For three-coat work, the scratch (first) coat shall be scratched to a rough surface. The brown (second) coat shall be applied after the scratch coat has set firm and hard, brought out to grounds, straightened to a true surface with rod and darby and left rough, ready to receive the finish (third) coat.

R4411.2.4.1.1.3 The finish coat shall be applied to a practically dry base coat or to a thoroughly dry base coat which has been evenly wetted by brushing or spraying. The use of excessive water shall be avoided in the application of all types of finish coat plastering.

R4411.2.4.1.2 Portland-cement plaster. The first two coats shall be as required for the first two coats of exterior stucco, except that the interval between the first and second coats shall be not less than 24 hours.

R4411.2.4.1.3 Masonry cement plaster. Where masonry cement is the only cementitious material, the second coat may be applied to the base coat as soon as the base coat has attained sufficient strength and rigidity to support the second (finish) coat.

R4411.2.4.2 Finish.

R4411.2.4.2.1 Smooth white finish shall be applied over the base coat that has set for a period of not less than 24 hours and is surface-dry. Thickness shall be from $^1/_{16}$ inch to $^1/_8$ inch (1.6 to 3.3 mm).

R4411.2.4.2.2 Sand-float finish shall be applied over the set base coat that is not quite dry.

R4411.2.4.2.3 Keene's cement finish shall be applied over the set base coat that is not quite dry. Thickness shall be from $^1/_{16}$ inch to $^1/_8$ inch (1.6 to 3.3 mm), unless finish coat is marked off or is jointed; in which case, the thickness may be increased as required by depth of marking or jointing.

R4411.2.4.2.4 The finish coat for interior Portland-cement plastering shall be applied in the same manner as required for the third coat of exterior stucco, except that other types of finish coat may be applied as specified in Section R4410.4.

R4411.2.4.2.5 The finish coat for lightweight aggregate plastering shall be from $^1/_{16}$ inch to $^1/_8$ inch (1.6 to 3.3 mm).

R4411.2.4.3 Plaster on concrete.

R4411.2.4.3.1 Monolithic-concrete surfaces shall be clean, free from efflorescence, damp and sufficiently rough to insure adequate bond.

R4411.2.4.3.2 Gypsum plaster applied to monolithic-concrete ceilings shall be specially prepared bond plaster for use on concrete, to which only water shall be added. Gypsum plaster on monolithic walls and columns shall be applied over a scratch coat of bond plaster, or other bonding material, before it has set. The brown coat shall be brought out to grounds, straightened to a true surface and left rough, ready to receive the finish coat.

R4411.2.4.3.3 Portland-cement plaster applied to interior concrete walls or ceilings shall conform to requirements for application to exterior concrete walls as specified in Section R4411.3.

SECTION R4411.3
HIGH-VELOCITY HURRICANE ZONES — STUCCO

R4411.3.1 General.

R4411.3.1.1 Portland cement-based plaster shall be applied in accordance with ASTM C 926, excluding Table 4 of that standard.

R4411.3.1.2 Stucco base and finish coats, where required to meet fire-resistance requirements, shall be mixed in proportion of at least one part Portland cement to a maximum of two and one-half parts sand by volume.

R4411.3.1.3 Approved manufacturing products may be used for base and finish coats.

R4411.3.1.4 Materials. The materials of stucco shall conform to ASTM C 926.

R4411.3.1.5 Admixtures.

R4411.3.1.5.1 Plasticity agents shall be of approved types and amounts and, where added to Portland cement in the manufacturing process, no additions shall be made later.

R4411.3.1.5.2 Color may be added to the finish coat in approved amounts.

R4411.3.1.6 Application.

R4411.3.1.6.1 Stucco applied to concrete or masonry to meet fire-resistance requirements shall consist of at least two coats, and the total thickness shall be not less than $^1/_2$ inch (12.7 mm).

R4411.3.1.6.2 Masonry surfaces on which all stucco is applied shall be clean, free from efflorescence, damp and sufficiently rough, or coated with an approved bonding agent, to insure proper bond.

R4411.3.1.6.3 All concrete surfaces shall be coated with an approved bonding agent or shall be effectively roughened.

R4411.3.1.6.4 The first coat shall be well forced into the pores of the masonry, shall be brought out to grounds, straightened to a true surface and left rough enough to receive the finish coat.

R4411.3.1.6.5 The first coat shall be rodded and waterfloated to a true surface approximately one-half the total thickness.

R4411.3.1.6.6 The base coat shall be damp cured for a period of not less than 24 hours.

R4411.3.1.6.7 In lieu thereof, the finish coat, where containing appropriate waterproofing or curing admixtures, may be applied as soon as the base coat has attained initial set and is sufficiently firm to receive the finish coat.

R4411.3.1.6.8 The finish coat shall be applied over a uniformly damp but surface-dry base.

R4411.3.1.6.9 Stucco shall be kept damp for a period of not less than 48 hours after application of the finish coat.

R4411.3.1.6.10 In lieu thereof, the finish coat may contain appropriate approved waterproofing or curing agents.

R4411.3.2 Stucco on walls other than concrete or masonry.

R4411.3.2.1 General. Stucco shall be as set forth in Section R4411.3.

R4411.3.2.2 Moisture barrier. Wood shall be covered with 15-pound (9 kg) roofing felt, or other approved equally moisture-resisting layer, and metal reinforcement as set forth herein.

R4411.3.2.3 Metal reinforcement.

R4411.3.2.3.1 Stucco shall be reinforced with galvanized expanded metal weighing no less than 1.8 pounds per square yard (0.98 kg/m^2), or galvanized welded or woven wire-fabric weighing no less than 1 pound per square yard (0.54 kg/m^2).

R4411.3.2.3.2 All metal lathing shall be lapped not less than 1 inch (25 mm).

R4411.3.2.3.3 Metal reinforcement shall be furred out from the backing by an approved method.

R4411.3.2.3.4 Fastenings into wood sheathing or wood framing shall be by galvanized nails, with heads not less than $^3/_8$ inch (9.5 mm) in diameter, driven to full penetration, using a minimum of two nails per square foot (0.093 m^2), or by approved staples having equal resistance to withdrawal.

R4411.3.2.3.5 The fastening of rib-lath to metal members shall be by #8 galvanized sheet-metal screws, using a minimum of two screws per square foot (0.093 m^2).

R4411.3.2.4 Application.

R4411.3.2.4.1 Stucco applied on metal lath shall be three-coat work applied to a total thickness of not less than $^1/_2$ inch (12.7 mm) thickness except as required to meet fire resistance requirements.

R4411.3.2.4.2 The first coat shall be forced through all openings in the reinforcement to fill all spaces and scored horizontally.

R4411.3.2.4.3 The second coat shall be applied after the first coat has set sufficiently to provide a rigid backing.

R4411.3.2.4.4 The third coat shall be applied as soon as the second coat has attained initial set.

R4411.3.3 Pneumatically placed stucco.

R4411.3.3.1 Pneumatically-placed stucco shall consist of a mixture of one part Portland cement to not more than five parts sand, conveyed through a pipe or flexible tube and deposited by pressure in its final position.

R4411.3.3.2 Rebound material may be screened and re-used as sand in an amount not greater than 25 percent of the total sand in any batch.

R4411.3.3.3 Plasticity agents may be used as specified in Section R4411.3.1.5.1.

SECTION R4411.4
HIGH-VELOCITY HURRICANE ZONES—GYPSUM BOARD PRODUCTS AND ACCESSORY ITEMS

R4411.4.1 General.

R4411.4.1.1 Gypsum wallboard products and related items and accessories to be used with or without the addition of plaster for partitions, walls and ceilings shall be as set forth in this section.

R4411.4.1.2 Where required to be fire resistive, such assemblies shall also comply with Chapter 7 the *Florida Building Code, Building*.

R4411.4.2 Standards. The following standards are adopted as set forth in Chapter 43.

Application and Finishing of Gypsum Panel Products, GA-216—07.

Fire Resistance Design Manual GA-600—06.

Specification for Gypsum Wallboard, ASTM C 36.

Specification for General Requirements for Zinc-Coated (Galvanized) Steel Sheets, by the Hot-Dip Process, ASTM A 525.

Specification for Light-gauge Steel Studs, Runners, and Rigid Furring Channels, ASTM C 645.

Specification for Joint Treatment Materials for Gypsum Wallboard Construction, ASTM C 475.

R4411.4.3 Gypsum wallboard.

R4411.4.3.1 The gypsum wallboard shall comply with the standards set forth in Section R4411.4.2, and single or multiple system combinations shall be not less than $^1/_2$ inch (12.7 mm) in thickness.

R4411.4.3.2 The span between supports for gypsum wallboard shall be not more than 24 inches (610 mm) for $^1/_2$ inch (12.7 mm) thick and $^5/_8$ inch (17.1 mm) thick wallboard.

R4411.4.3.3 Gypsum wallboard used in fire-rated assemblies shall be of a type for which test ratings are available.

R4411.4.4 Wood studs and wood ceiling supports. Wood studs and wood ceiling supports shall comply with Section R4409.

R4411.4.5 Steel studs, ceiling supports and track runners.

R4411.4.5.1 Steel studs and runners used to construct fire-resistive walls or partitions shall be hot-dipped galvanized in accordance with ASTM A 525, coating designation G40, minimum and be of channel or "C" Type shape. The total thickness of the base metal plus coating shall not be less than 0.0184 inch (0.467 mm) unpainted and not less than 0.0194 inch (0.493 mm) if coated and painted. Studs and runners shall comply with ASTM C 645 and have a base metal thickness, before application of any coating, of not less than 0.0179 inch (0.455 mm). Structural properties of such studs and runners shall comply with ASTM C 645.

R4411.4.5.1.1 Steel studs supporting wall hung plumbing fixtures shall be doubled or not less than 20 gauge with a minimum effective moment of inertia equal to 0.864 inch^4 (360 m^4).

R4411.4.5.1.2 Such studs shall be rigidly connected top and bottom to prevent significant end rotation or displacement.

R4411.4.5.1.3 A horizontal member securely fastened to not less than two studs shall be installed for the attachment of each wall hung plumbing fixture.

R4411.4.5.2 The unsupported height of partitions shall comply with the loads and deflections set forth in Section R4403 and where wallboard is suitably attached, the composite action may be accounted for in the design.

R4411.4.5.3 Steel ceiling supports shall comply with Section R4411.1.5.

R4411.4.5.4 Steel studs track runners and ceiling supports in walls, including curtain walls, shall comply with ASTM A 525.

Exception: Such members in interior nonload-bearing walls need not be galvanized but shall comply with ASTM C 645.

R4411.4.6 Attachments.

R4411.4.6.1 Attachments shall be as set forth herein and for fire-rated assemblies shall also conform to the material and conditions of the assembly tested.

R4411.4.6.2 Attachment to wood supporting members shall conform to the standard set forth in Section R4411.4.2.

R4411.4.6.3 Nails and screws attaching gypsum wallboard shall, without substantially fracturing the surface paper, be driven below the surface and spotted with finishing joint compound.

R4411.4.6.4 Attachment to metal members shall be in accordance with Sections R4411.4.6.4.1 through R4411.4.6.4.5.

R4411.4.6.4.1 Gypsum wallboard shall be attached to metal members by self-drilling, self-tapping sheet metal screws.

R4411.4.6.4.2 The spacing of screws attaching gypsum wallboard to metal studs and runners, shall be not more than 12 inches (305 mm) on center.

R4411.4.6.4.3 Screw for attaching gypsum wallboard to metal studs shall be not less than $^7/_8$ inch (22.2 mm) long for $^1/_2$ inch (17.7 mm) wallboard or 1 inch (25.4 mm) long for $^5/_8$ inch (17.1 mm) wallboard.

R4411.4.6.4.4 Screws attaching gypsum wallboard shall be driven below the surface and spotted with finishing compound.

R4411.4.6.4.5 Runners shall be fastened to the ceiling, contiguous walls and partitions and to the floor at intervals not exceeding 24 inches (610 mm) on center. Such attachment may be by nails penetrating the base material not less than $^5/_8$ inch (17.1 mm) or by self-drilling, self-tapping sheet metal screws attaching metal to metal.

SECTION R4411.5
HIGH-VELOCITY HURRICANE ZONES—SUSPENDED AND FURRED CEILINGS

R4411.5.1 General. Lath and plaster ceilings shall be as set forth in this section.

R4411.5.2 Suspended and furred ceilings, other than lath and plaster where providing fire protection shall comply with Chapter 7 of the *Florida Building Code, Building.*

R4411.5.3 Suspended and furred ceilings, other than lath and plaster, shall be suspended and supported in conformance with the conditions of fire tests or, if not tested, as recommended by the manufacturer or as required for structural stability.

SECTION R4411.6
HIGH-VELOCITY HURRICANE ZONES—ASBESTOS

R4411.6.1 Asbestos cement shall not be permitted for use under this code.

SECTION R4411.7
HIGH-VELOCITY HURRICANE ZONES—TILE

R4411.7.1 Ceramic and Portland cement floor tile shall be set on a concrete slab or on wood sheathing on wood joists protected by a waterproof membrane.

R4411.7.2 Floor tile shall be set in a mortar bed of one part Portland cement to three parts aggregate or otherwise bedded in an approved adhesive material.

R4411.7.2.1 Ceramic and Portland cement wall tile used in areas subject to frequent wearing shall be backed with masonry, stucco on wire lath or approved tile backer board.

R4411.7.2.2 Wall tile used in areas not subject to frequent wearing shall be backed by a cladding having the rigidity of stucco on wire lath and shall be bedded in cement mortar or other approved adhesive material.

R4411.7.3 Portland cement or other porous tile shall be soaked in water not less than 1 hour before placing.

R4411.7.4 Built-in tubs with overhead showers shall have waterproof joints between the tub and the wall and floor.

SECTION R4412
HIGH-VELOCITY HURRICANE ZONES—PLASTICS

R4412.1.1 General.

R4412.1.1.1 Plastic materials used as structural elements shall be designed by methods admitting of rational analysis according to established principles of mechanics.

R4412.1.1.2 Plastic materials may be permitted as set forth herein. The physical properties, such as, not but limited to, weather resistance, fire resistance and flame spread characteristics, shall comply with the requirements of this code.

R4412.1.1.3 Application and plans submitted for proposed construction shall identify the plastic material intended for use and such material shall be stamped or otherwise marked so as to be readily identifiable in the field.

R4412.1.1.4 Plastic structural elements, other than sheets, shall be designed by a Florida-registered professional engineer or a Florida-registered architect.

R4412.1.2 Definitions.

APPROVED FOAM PLASTIC. An approved foam plastic shall be any thermoplastic, thermosetting or reinforced thermosetting plastic material that has a minimum self-ignition temperature of 650ºF (343ºC) or greater when tested in accordance with ASTM D 1929. It shall have a smoke density rating not greater than 450 and a flame spread of 75 or less when tested in accordance with ASTM E 84.

APPROVED PLASTIC. An approved plastic shall be any thermoplastic, thermosetting or reinforced thermosetting plastic material which has a self-ignition temperature of 650ºF (343ºC), or greater when tested in accordance with ASTM D 1929, a smoke density rating no greater than 450 when tested in the way intended for use by ASTM E 84 or a smoke density rating no greater than 75 when tested in the thickness intended for use according to ASTM D 2843 and which meets one of the following combustibility classifications:

CLASS C-1. Plastic materials that have a burning extent of 1 inch per minute (25.4 mm) or less when tested in nominal 0.060 inch (1.5 mm) thickness or in the thickness intended for use by ASTM D 635.

CLASS C-2. Plastic materials that have a burning rate of $2^{1}/_{2}$ inches (64 mm) per minute or less when tested in nominal 0.060 inch (1.5 mm) thickness or in the thickness intended for use by ASTM D 635.

Approved plastics for outdoor exposure shall be evaluated for outdoor durability in accordance with the *Voluntary Standard Uniform Load Test Procedure for Thermoformed Plastic Domed Skylights,* of the AAMA/WDMA 101/IS2/NAFS, *Voluntary Performance Specification for Windows, Skylights and Glass Doors,* as follows:

1. Outdoor exposure conditions: Specimen exposed in Florida at 45 degree south exposure for a period of five years.
2. Alternate:
   a. Exposure to xenon arc weatherometer using a 6500-watt lamp per ASTM G 26-77 and ASTM D 2565 for a period of 4,500 hours.
   b. Impact testing, after exposure test as above, per ASTM D 256.

FINISH RATING. The time, as determined in accordance with ASTM E 119, at which a thermal barrier reaches a temperature rise of 240ºF (116ºC) , above ambient or an individual temperature rise of 324ºF (162ºC), above ambient as measured on the plane of the thermal barrier nearest to foam plastic.

FLAME SPREAD RATING. The measurement of flame spread on the surface of materials or their assemblies as determined in accordance with ASTM E 84.

GLASS FIBER REINFORCED PLASTIC. Plastic reinforced with glass fibers having not less than 20 percent of glass fibers by weight.

LIGHT DIFFUSING SYSTEM. A suspended construction consisting in whole or in part of lenses, panels, grids or baffles suspended below independently mounted electrical lighting sources.

PLASTIC GLAZING. Plastic materials that are glazed or set in frame or sash and not held by mechanical fasteners which pass through the glazing material.

PLASTIC ROOF PANELS. Plastic materials that are fastened to structural panels or sheathing and which are used as light transmitting media in the plane of the roof.

PLASTIC SANDWICH PANELS. Panels of foam plastic sandwiched between incombustible skins.

PLASTIC WALL PANELS. Plastic materials that are fastened to structural panels or sheathing and which are used as light transmitting medium in exterior walls.

SKYLIGHT. An assembly that includes plastic materials used as light transmitting medium and which is located above the plane of the roof.

SMOKE DENSITY. A numerical value of smoke development, determined by measuring the area under the curve of light absorption versus time, in accordance with ASTM E 84 or ASTM D 2843.

THERMOPLASTIC MATERIALS. A plastic material that is capable of being repeatedly softened by increase of temperature and hardened by decrease of temperature.

THERMOSETTING MATERIALS. A plastic material that is capable of being changed into a substantially nonreformable product when cured.

R4412.1.3 Foam plastics.

R4412.1.3.1 General.

R4412.1.3.1.1 Except as otherwise provided herein, all foam plastics or foam plastic cores in manufactured assemblies used in building construction shall have a flame

spread rating of not more than 75 and shall have a smoke-developed rating of not more than 450 when tested in the maximum thickness intended for use in accordance with ASTM E 84.

R4412.1.3.1.2 Except as otherwise provided herein, foam plastics shall be separated from the interior walls, floors and ceiling herein of a building by an approved thermal barrier of $^1/_2$ inch (13 mm) gypsum wallboard or equivalent thermal barrier material which will limit the average temperature rise of the unexposed surface to not more than 259ºF (126ºC), after 15 minutes of fire exposure complying with the ASTM E 119 standard time-temperature curve.

R4412.1.3.1.3 Foam plastics trim, defined as picture molds, chair rails, baseboards, handrails, ceiling beams, door trim and window trim, shall also meet requirements for interior finish in Section 805.3 of the *Florida Building Code, Building.*

R4412.1.3.1.4 Foam plastic not meeting the requirements of this section may be specifically approved on the basis of approved tests such as, but not limited to, FM procedure 4880, UL Subject 1040, NFPA 286 or UL 1715, or fire tests related to actual end-use configuration and shall be performed on the finished foam plastic assembly in the maximum thickness intended for use. Assemblies tested shall included seams, joints and other typical details used in the installation of the assembly and shall be tested in the manner intended for use.

R4412.1.3.2 Specific requirements. The following specific requirements shall apply to all uses of foam plastics unless otherwise permitted in this code.

R4412.1.3.2.1 Cold storage buildings.

R4412.1.3.2.1.1 Foam plastics when tested in a thickness of 4 inches (102 mm), may be used in a thickness up to 10 inches (254 mm) when the building is equipped with an approved automatic fire suppression system.

R4412.1.3.2.1.2 Such approved automatic fire suppression system shall be provided in both the cold storage room and the part of the building in which the room is located.

R4412.1.3.2.2 Walk-in coolers.

R4412.1.3.2.2.1 Foam plastic having a maximum flame spread of 75 may be used in a thickness up to 4 inches (102 mm) in free-standing walk-in cooler or freezer units less than 400 square feet (37 m^2) in floor area without a thermal barrier and without an automatic fire suppression system when the foam plastic is covered by a metal facing not less than 0.032 inch (0.813 mm) thick aluminum or corrosion-resistant steel having a minimum of base metal thickness of 0.016 inch (0.406 mm).

R4412.1.3.2.2.2 When protected by a thermal barrier, the foam plastic may be used in a thickness up to 10 inches (254 mm).

R4412.1.3.2.3 Exterior walls of one story buildings.

R4412.1.3.2.3.1 Foam-plastic insulation having a flame spread of 25 or less may be used without thermal barriers in or on exterior fire-resistive incombustible walls in a thickness of not less than 0.032 inch (0.813 mm) aluminum or corrosion-resistant steel having a minimum base metal thickness of 0.0160 inch (0.406 mm), and the insulated interior area is protected with automatic sprinklers.

R4412.1.3.2.3.2 Foam plastic may be used without the thermal barrier described herein when it is protected by a minimum of 1 inch (25.4 mm) thickness of masonry or concrete.

R4412.1.3.2.4 Exterior walls of multistory buildings.

R4412.1.3.2.4.1 Where walls face a street or permanent open space of 30 feet (9 m) or more, foam plastic insulation may be used in a nonfire-rated exterior wall assembly.

R4412.1.3.2.4.2 Where a separation of less than 30 feet (9 m) exists, foam plastic may be used within exterior walls, provided the wall assembly affords the required fire resistivity.

R4412.1.3.2.4.3 Foam plastic insulation shall be separated from the building interior by a thermal barrier having an index of 15 unless a specific approval is obtained on the basis of Section R4412.1.3.1.4.

R4412.1.3.2.4.4 The amount of foam plastic in any portion of the wall or panel shall not exceed 6000 Btu/square foot (68.1 MJ/m^2) of projected area as determined by tests conducted in accordance with NFPA 259.

R4412.1.3.2.4.5 The foam-plastic core, coatings and facings shall have a flame spread rating of 25 or less and smoke-developed rating of 450 or less as determined in accordance with ASTM E 84.

R4412.1.3.2.4.6 Facing, coating and core materials shall be mechanically or adhesively fastened to each other and to building members to prohibit failure in bond as a result of temperatures which may be experienced in a building fire from wind loads or other conditions.

R4412.1.3.2.4.7 Results of diversified or full-scale fire tests reflecting an end-use configuration shall be submitted to the building official demonstrating the assembly in its final form does not propagate the flame over the surface or through the core when exposed on the exterior face to a fire source.

R4412.1.3.2.5 Roofing.

R4412.1.3.2.5.1 Foam plastic may be used in a roof covering assembly without the thermal barrier when the foam is separated from the interior of the building by plywood sheathing not less than $^1/_2$ inch (12.7 mm) in thickness bonded with exterior glue, with edge supported by blocking, tongue-and-grooved joints or other approved type of edge support, or an equivalent or better material or system.

R4412.1.3.2.5.2 Foam-plastic roof insulation that complies with Factory Mutual Standard 4450 or Underwriters Laboratories Subject 1256 need not meet the requirements of Section R4412.1.3.1.2.

R4412.1.3.2.5.3 For all roof applications, the smoke developed rating shall not be limited.

R4412.1.3.2.6 Attics and crawl spaces.

R4412.1.3.2.6.1 Within an attic or crawl space where entry is made for service of utilities, exposed foam plastics shall be protected against ignition by 1-inch-thick (25 mm) mineral fiber insulation, $^1/_4$-inch (6.4 mm) thick plywood, particleboard or hardboard or $^3/_8$-inch (9.5 mm) gypsum wall board, corrosion-resistant steel having a base metal thickness of 0.0160 inch (0.406 mm) or other equivalent material installed in such manner that the foam plastic is not exposed.

R4412.1.3.2.6.2 The protective covering shall also meet the requirements for the type of construction.

R4412.1.3.2.7 Doors.

R4412.1.3.2.7.1 Where doors are permitted without a fire-resistance rating, foam plastic having a flame-spread rating of 75 or less may be used as a core material when the door facing is metal having a minimum thickness of 0.032 inch (0.813 mm) aluminum or sheet steel having a minimum thickness of 0.0160 inch (0.406 mm).

R4412.1.3.2.7.2 There shall be no thermal barrier requirements for these doors.

R4412.1.4 Light transmitting plastics.

R4412.1.4.1 General.

R4412.1.4.1.1 The provisions of this section shall govern the quality and methods of application of plastics for use as light transmitting media within buildings and structures.

R4412.1.4.1.2 All plastics to be used according to the provisions of this section shall be approved plastic and conform to Sections R4412.1.1 and R4412.1.2.

Exception: Roof coverings over terraces and patios of one- and two-family dwellings shall be permitted with approved plastics.

R4412.1.4.2 Glazing of openings in nonfire-rated walls.

R4412.1.4.2.1 Doors, sash and framed openings which are not required to be fire rated may be glazed with approved plastic materials in buildings of Type V construction.

R4412.1.4.2.2 In all other types of construction openings not required to be fire rated may be glazed or equipped with approved plastic material subject to the requirements listed below.

R4412.1.4.2.2.1 The area of such glazing shall not exceed 25 percent of the wall face of the story in which it is installed.

R4412.1.4.2.2.2 The area of a unit or pane of glazing installed above the first story shall not exceed 16 square feet (1.49 m^2) and the vertical dimension of a unit or pane shall not exceed 4 feet (1219 mm). There shall be a minimum 3 feet (914 mm) vertical spandrel wall between stories.

R4412.1.4.2.2.3 Approved plastics shall not be installed more than 75 feet (22.9 m) above grade level except as provided in Section R4412.1.4.2.2.4.

R4412.1.4.2.2.4 Approved thermoplastic materials may be installed in areas up to 50 percent of the wall area of each story in structures less than 150 feet (45.7 m) in height if continuous architectural projections constitute an effective fire barrier extending at least 3 feet (914 mm) from the surface of the wall on which the glazing is installed and are provided on each floor above the first floor. The size and the dimensions of individual units shall not be limited in such installations except as required to meet structural loading requirements.

R4412.1.4.2.3 Area increase based on fire protection. In buildings or portions thereof protected by approved automatic, fire extinguishing systems, the area of glazing permitted by Section R4412.1.4.2.2.1 may be increased by 100 percent.

R4412.1.4.3 Exterior nonfire-rated wall panels.

R4412.1.4.3.1 General. Approved plastic materials may be used as wall panels, in exterior walls not required to heave a fire-rating subject to the requirements in this section.

TABLE R4412.1.4.3.1.3
AREA LIMITATION AND SEPARATION REQUIREMENTS FOR PLASTIC WALL PANELS IN NONFIRE-RATED WALLS

FIRE SEPARATION (ft)	CLASS OF PLASTIC	MAX. AGGREGATE AREA (% OF EXTERIOR WALL)	MAX. SEPARATED PANEL AREA (sq ft)	MINIMUM SEPARATION OF PANELS (ft)	
				Vertical	Horizontal
10 up to and including 30	C1	25	90	6	4
	C2	15	70	8	4
Over 30	C1	50	No limit	3[1]	0
	C2	50	100	6[1]	3

1. See Exception 1 to R4412.1.4.3.1

R4412.1.4.3.1.1 Installation. Exterior wall panels installed as provided herein shall not alter the type of construction classification of the building.

R4412.1.4.3.1.2 Height limitation. Approved plastics shall not be installed more than 75 feet (22.9 m) above grade level except as permitted by Section R4412.1.4.3.1.4 (see Exception 3).

R4412.1.4.3.1.3 Area limitation and separation. Area limitation and separation requirements of exterior wall panels shall be provided in Table R4412.1.4.3.1.3.

R4412.1.4.3.1.4 Combination of glazing and wall panels. Combinations of plastic glazing and plastic wall panels shall be subject to the area, height and percentage limitations and separation requirements applicable to the class of plastics as prescribed for wall panel installations.

Exceptions:

1. Structures which provide continuous architectural projections extending at least 36 inches (914 mm) from the surface of the wall in which plastic wall panels are installed shall not be required to provide vertical separation at that floor.
2. Area increase based on in fire protection. In buildings or portions thereof protected by approved automatic fire-extinguishing systems the maximum percent area of plastic panes in exterior walls and the maximum square feet of separate panel are given in Table R4412.1.4.3.1.3 may be increased 100 percent but the area of plastic wall panels shall not exceed 50 percent of the wall area.
3. Approved thermoplastic materials may be installed in areas up to 50 percent of the wall area of each story in structures less than 150 feet (45.7 m) in width if continuous architectural projections constitute an effective fire barrier extending at least 3 feet (914 mm) from the surface of the wall on which the panels are installed and are provided on each floor above the first floor.
4. The use of plastics shall not be permitted in exterior walls in occupancies groups A, H and I.

R4412.1.4.4 Roof panels.

R4412.1.4.4.1 General. Approved plastic roof panels may be installed as follows.

R4412.1.4.4.1.1 Where the roof is not required to have a fire rating.

R4412.1.4.4.1.2 Where the roof panels meet the requirements for roof coverings of the particular occupancy.

R4412.1.4.4.1.3 In roofs of buildings protected by an approved automatic fire extinguishing system.

Exception: The use of plastics shall not be permitted in roofs of Group A, H and I occupancies.

R4412.1.4.4.2 Separations. Individual roof panels shall be separated from each other by a distance of not less than 4 feet (1219 mm) measured in a horizontal plane.

R4412.1.4.4.3 Location. Where exterior wall openings are required to be fire rated, a roof panel or unit shall not be installed within 6 feet (1829 mm) of such exterior wall.

R4412.1.4.4.4 Area limitations. Roof panels or units shall be limited in area, according to provisions set forth in Table R4412.1.4.4.4.

TABLE R4412.1.4.4.4
AREA LIMITATIONS FOR ROOF PANELS

CLASS OF PLASTIC	MAX. SEPARATED PANEL AREA (sq ft)	MAX. AGGREGATE AREA (% of floor area)
C1	300	30
C2	100	25

R4412.1.4.5 Skylight assemblies. Skylight assemblies may be glazed with approved plastic materials in accordance with this section.

R4412.1.4.5.1 Mounting.

R4412.1.4.5.1.1 The plastic shall be mounted a minimum of 4 inches (102 mm) above the plane of the roof on a curb constructed in accordance with requirements of types of construction.

R4412.1.4.5.1.2 Dome-shape skylights shall rise above the mounting flange a minimum distance equal to 10 percent of the maximum span of the dome, but not less than 4 inches (102 mm).

R4412.1.4.5.1.3 The edges of the skylights shall be protected by incombustible material in Types I, IV, protected and Type IIB construction.

R4412.1.4.5.2 Maximum area of skylight units. Each skylight unit shall have a maximum area within the curb of 100 square feet (9.3 m^2) for Class C-2 material and 200 square feet (18.6 m^2) for Class C-1 material.

R4412.1.4.5.3 Aggregate area of skylights. The aggregate area of skylights shall not exceed 33 percent when Class C-1 materials are used and 25 percent when Class C-2 materials are used, of the floor area of the room or space sheltered by the roof in which they are installed.

R4412.1.4.5.4 Separation. Skylights shall be separated from each other by a distance of not less than 4 feet (1219 mm) measured in a horizontal plane.

R4412.1.4.5.5 Location. Where exterior wall openings are required to be fire rated, a skylight shall not be installed within 6 feet (1829 mm) of such exterior wall.

Exceptions:

1. Skylight assemblies may not be glazed with approved plastic materials in buildings of Group H and I occupancies.
2. The aggregated area of approved plastic skylights may be increased 100 percent beyond the

limitations set forth herein if the skylights are used as an automatic fire venting system or if the building is equipped with an automatic fire extinguishing system.

3. When a building not more than one story in height has a minimum distance separation from other buildings of 30 feet (9.1 m) and is not used as an enclosed means of egress, skylights in such a building need not comply with the requirements set forth in this paragraph.
4. When skylights used in a building are made of approved plastic materials that meet the fire-rated requirements of the roof of the building, such skylight assemblies need not comply with the requirements set forth in this paragraph.
5. Skylights installed in detached buildings of Group R3 occupancy, Type IV and Type IIIB need not comply with this section.

R4412.1.4.6 Light diffusing systems.

R4412.1.4.6.1 General.

R4412.1.4.6.1.1 Light diffusing systems shall not be installed in Group I and H occupancies or in exitways unless they are protected with an approved automatic fire extinguishing system.

R4412.1.4.6.1.2 Approved plastic diffusers shall comply with the flame spread requirements for interior finishes, unless the individual plastic panels will fall from their mountings before igniting at an ambient temperature of at least 200ºF (93ºC) below their ignition temperature. The panels must, however, remain in place at an ambient room temperature of 175ºF (79ºC) for a period of not less than 15 minutes.

R4412.1.4.6.1.3 Location. Where fire-rated ceiling assemblies are required, plastic diffusers, if used, shall be located below such assemblies.

R4412.1.4.6.2 Installation. Plastic diffusers shall be supported directly or indirectly from ceiling or roof construction by use of incombustible hangers. Hangers shall be at least No. 12 Steel Wire gauge [0.0106 inch (0.27 mm)] galvanized wire or equivalent.

R4412.1.4.6.3 Size limitations. Individual panels or units shall not exceed 10 feet (3 m) in length or 30 square feet (2.8 m^2) in area.

R4412.1.4.6.4 When buildings are protected by an automatic fire extinguishing system, this section shall apply to light diffusing systems within such buildings.

R4412.1.4.6.4.1 Fire-extinguishing systems shall be located above and below the light diffusing system unless specifically approved for above such system only.

R4412.1.4.6.4.2 Areas of light diffusing systems protected by a fire-extinguishing system shall not have to comply with the size limitations set forth in this section.

R4412.1.4.6.5 Electrical lighting fixtures.

R4412.1.4.6.5.1 Plastic light-transmitting panels and light-diffuser panels installed in approval electrical lighting fixtures shall have flame spread ratings compatible with the occupancy of the building.

R4412.1.4.6.5.2 The area of approved plastic materials when used in required fire exits or corridors shall not exceed 30 percent of the aggregate area of the ceiling in which they are installed, unless the occupancy is protected by an approved fire-extinguishing system.

R4412.1.4.7 Partitions. Approved light-transmitting plastics may be used in or as partitions provided the requirement of the types of construction are met.

R4412.1.4.8 Bathroom accessories. Approved plastics shall be permitted as glazing in shower stalls, shower doors, bathtub enclosures and similar accessory units and shall conform to 16 CFR 1205 and the *Safety Standard for Architectural Glazing Materials*.

R4412.1.4.9 Awnings and similar structures. Approved light-transmitting plastics may be used on or as awnings and similar structures when in conformance with provisions as set forth in other sections of this code.

SECTION R4413
HIGH-VELOCITY HURRICANE ZONES—
STORM DRAINAGE

R4413.1 General.

R4413.1.1 Scope. The provisions of this section shall govern the materials, design, construction and installation of storm drainage.

R4413.1.2 Where required. All roofs, paved areas, yards, courts and courtyards shall drain into a separate storm sewer system, or a combined sewer system, or to an approved place of disposal. For one- and two-family dwellings, and where approved, storm water is permitted to discharge onto flat areas, such as streets or lawns, provided that the storm water flows away from the building.

R4413.1.3 Prohibited drainage. Storm water shall not be drained into sewers intended for sewage only.

R4413.1.4 Tests. The conductors and the building storm drain shall be tested in accordance with Section 312 of the *Florida Building Code, Plumbing*.

R4413.1.5 Continuous flow. The size of a drainage pipe shall not be reduced in the direction of flow.

R4413.1.6 Fittings and connections. All connections and changes in direction of the storm drainage system shall be made with approved drainage-type fittings in accordance with Table R4413.1.6 herein. The fittings shall not obstruct or retard flow in the system.

TABLE R4413.1.6
FITTINGS FOR CHANGE IN DIRECTION

TYPE OF FITTING PATTERN	CHANGE IN DIRECTION		
	Horizontal to vertical	Vertical to horizontal	Horizontal to horizontal
Sixteenth bend	X	X	X
Eighth bend	X	X	X
Sixth bend	X	X	X
Quarter bend	X	X[a]	X[a]
Short sweep	X	X[a,b]	X[a,b]
Long sweep	X	X	X
Sanitary tee	X[c]		
Wye	X	X	X
Combination wye and eighth bend	X	X	X

For SI: 1 inch = 25.4 mm.

a. The fittings shall only be permitted for a 2-inch or smaller fixture drain.
b. Three inches and larger.
c. For a limitation on double sanitary tees, see Section 706.3 of the *Florida Building Code, Plumbing.*

R4413.1.7 Roof design. Roofs shall be designed for the maximum possible depth of water that will pond thereon as determined by the relative levels of roof deck and overflow weirs, scuppers, edges or serviceable drains in combination with the deflected structural elements. In determining the maximum possible depth of water, all primary roof drainage means shall be assumed to be blocked.

R4413.1.8 Cleanouts required. Cleanouts shall be installed in the storm drainage system and shall comply with the provisions of this code for sanitary drainage pipe cleanouts.

SECTION R4413.2
HIGH VELOCITY HURRICANE ZONES—MATERIALS

R4413.2.1 General. The materials and methods utilized for the construction and installation of storm drainage systems shall comply with this section.

R4413.2.2 Inside storm drainage conductors. Inside storm drainage conductors installed above ground shall conform to one of the standards listed in Table R4413.2.2 herein.

TABLE R4413.2.2
ABOVE-GROUND DRAINAGE AND VENT PIPE

MATERIAL	STANDARD
Acrylonitrile butadiene styrene (ABS) plastic pipe	ASTM D 2661; ASTM F 628; CSA B181.1
Brass pipe	ASTM B 43
Cast-iron pipe	ASTM A 74; CISPI 301; ASTM A 888
Copper or copper-alloy pipe	ASTM B 42; ASTM B 302
Copper or copper-alloy tubing (Type K, L, M or DWV)	ASTM B 75; ASTM B 88; ASTM B 251; ASTM B 306
Galvanized steel pipe	ASTM A 53
Glass pipe	ASTM C 1053
Polyolefin pipe	CSA CAN/CSA-B181.3
Polyvinyl chloride (PVC) plastic pipe (Type DWV)	ASTM D 2665; ASTM D 2949; ASTM F 891; CSA CAN/CSA-B181.2

R4413.2.3 Underground building storm drain pipe. Underground building storm drain pipe shall conform to one of the standards listed in Table R4413.2.3 herein.

TABLE R4413.2.3
UNDERGROUND BUILDING DRAINAGE AND VENT PIPE

MATERIAL	STANDARD
Acrylonitrile butadiene styrene (ABS) plastic pipe	ASTM D 2661; ASTM F 628; CSA B181.1
Asbestos-cement pipe	ASTM C 428
Cast-iron pipe	ASTM A 74; CISPI 301; ASTM A 888
Copper or copper-alloy tubing (Type K or L)	ASTM B 75; ASTM B 88; ASTM B 251
Polyolefin pipe	CSA CAN/CSA-B181.3
Polyvinyl chloride (PVC) plastic pipe (Type DWV)	ASTM D 2665; ASTM D 2949; ASTM F 891; CSA CAN/CSA-B181.2

R4413.2.4 Building storm sewer pipe. Building storm sewer pipe shall conform to one of the standards listed in Table R4413.2.4.

R4413.2.5 Subsoil drain pipe. Subsoil drains shall be open-jointed, horizontally split or perforated pipe conforming to one of the standards listed in Table R4413.2.5.

R4413.2.6 Roof drains. Roof drains shall conform to ASME A112.21.2.

R4413.2.7 Fittings. Pipe fittings shall be approved for installation with the piping material installed, and shall conform to the respective pipe standards or one of the standards listed in Table R4413.2.7. The fittings shall not have ledges, shoulders or reductions capable of retarding or obstructing flow in the piping. Threaded drainage pipe fittings shall be of the recessed drainage type.

TABLE R4413.2.4
BUILDING STORM SEWER PIPE

MATERIAL	STANDARD
Acrylonitrile butadiene styrene (ABS) plastic pipe	ASTM D 2661; ASTM D 2751; ASTM F 628
Asbestos-cement pipe	ASTM C 428
Cast-iron pipe	ASTM A 74; CISPI 301; ASTM A 888
Concrete pipe	ASTM C 14; ASTM C 76; CSA A257.1; CSA CAN/CSA A257.2
Copper or copper-alloy tubing (Type K, L, M or DWV)	ASTM B 75; ASTM B 88; ASTM B 251; ASTM B 306
Polyvinyl chloride (PVC) plastic pipe (Type DWV, SDR26, SDR35, SDR41, PS50 or PS100)	ASTM D 2665; ASTM D 2797; ASTM D 3034; ASTM F 891; CSA-B182.2; CSA CAN/CSA-B182.4
Vitrified clay pipe	ASTM C 4; ASTM C 700

TABLE R4413.2.5
SUBSOIL DRAIN PIPE

MATERIAL	STANDARD
Asbestos-cement pipe	ASTM C 508
Cast-iron pipe	ASTM A 74; CISPI 301; ASTM A 888
Polyethylene (PE) plastic pipe	ASTM F 405
Polyvinyl chloride (PVC) plastic pipe (Type Sewer Pipe, PS25, PS50 or PS100)	ASTM D 2729; ASTM F 891; CSA-B182.2; CSA CAN/CSA-B182.4
Vitrified clay pipe	ASTM C 4; ASTM C 700

TABLE R4413.2.7
PIPE FITTINGS

MATERIAL	STANDARD
Acrylonitrile butadiene styrene (ABS) plastic pipe	ASTM D 2468
Cast iron	ASME B16.4; ASME B16.12; ASTM A 888
Chlorinated polyvinyl chloride (CPVC) plastic	ASTM F 437; ASTM F 438; ASTM F 439
Copper or copper-alloy	ASME B16.15; ASME B16.18; ASME B16.22; ASME B16.23; ASME B16.26; ASME B16.29; ASME B16.32
Gray iron and ductile iron	AWWA C110
Malleable iron	ASME B16.3
Plastic, general	ASTM F 409
Polyethylene (PE) plastic	ASTM D 2609
Polyvinyl chloride (PVC) plastic	ASTM D 2464; ASTM D 2466; ASTM D 2467; CSA CAN/CSA-B137.2
Steel	ASME B16.9; ASME B16.11; ASME B16.28

SECTION R4413.3
RESERVED

SECTION R4413.4
HIGH-VELOCITY HURRICANE ZONES—CONDUCTORS AND CONNECTIONS

R4413.4.1 Prohibited use. Conductor pipes shall not be used as soil, waste or vent pipes, and soil, waste or vent pipes shall not be used as conductors.

R4413.4.2 Combining storm with sanitary drainage. The sanitary and storm drainage systems of a structure shall be entirely separate except where combined sewer systems are utilized. Where a combined sewer is utilized, the building storm drain shall be connected in the same horizontal plane through a single-wye fitting to the combined sewer at least 10 feet (3048 mm) downstream from any soil stack.

R4413.4.3 Floor drains. Floor drains shall not be connected to a storm drain.

SECTION R4413.5
HIGH-VELOCITY HURRICANE ZONES—ROOF DRAINS

R4413.5.1 Strainers. Roof drains shall have strainers extending not less than 4 inches (102 mm) above the surface of the roof immediately adjacent to the roof drain. Strainers shall have an available inlet area, above roof level, of not less than one and one-half times the area of the conductor or leader to which the drain is connected.

R4413.5.2 Flat decks. Roof drain strainers for use on sun decks, parking decks and similar areas that are normally serviced and maintained shall comply with Section R4413.5.1 or shall be of the flat-surface type, installed level with the deck, with an available inlet area not less than two times the area of the conductor or leader to which the drain is connected.

R4413.5.3 Roof drain flashings. The connection between roofs and roof drains which pass through the roof and into the interior of the building shall be made water tight by the use of approved flashing material.

SECTION R4413.6
HIGH VELOCITY HURRICANE ZONES—
SIZE OF CONDUCTORS, LEADERS AND STORM DRAINS

R4413.6.1 General. The size of the vertical conductors and leaders, building storm drains, building storm sewers, and any horizontal branches of such drains or sewers shall be based on the 100-year hourly rainfall rate indicated in Figure R4413.6.1 or on other rainfall rates determined from approved local weather data.

R4413.6.2 Vertical conductors and leaders. Vertical conductors and leaders shall be sized for the maximum projected roof area, in accordance with Table R4413.6.2.

R4413.6.3 Building storm drains and sewers. The size of the building storm drain, building storm sewer and their horizontal branches having a slope of one-half unit or less vertical in 12 units horizontal (4-percent slope) shall be based on the maximum projected roof area in accordance with Table R4413.6.3. The minimum slope of horizontal branches shall be one-eighth unit vertical in 12 units horizontal (1-percent slope) unless otherwise approved.

R4413.6.4 Vertical walls. In sizing roof drains and storm drainage piping, one-half of the area of any vertical wall that diverts rainwater to the roof shall be added to the projected roof area for inclusion in calculating the required size of vertical conductors, leaders and horizontal storm drainage piping.

R4413.6.5 Parapet wall scupper location. Parapet wall roof drainage scupper and overflow scupper location shall comply with the requirements of the *Florida Building Code, Residential*.

R4413.6.6 Size of roof gutters. The size of semicircular gutters shall be based on the maximum projected roof area in accordance with Table R4413.6.6.

SECTION R4413.7
HIGH-VELOCITY HURRICANE ZONES—
SECONDARY (EMERGENCY) ROOF DRAINS

R4413.7.1 Secondary drainage required. Secondary (emergency) roof drains or scuppers shall be provided where the roof perimeter construction extends above the roof in such a manner that water will be entrapped if the primary drains allow buildup for any reason.

R4413.7.2 Separate systems required. Secondary roof drain systems shall have piping the end point of discharge separate from the primary system. Discharge shall be above grade, in a location which would normally be observed by the building occupants or maintenance personnel.

R4413.7.3 Sizing of secondary drains. Secondary (emergency) roof drain systems shall be sized in accordance with Section R4413.6 based on the rainfall rate for which the primary system is sized in Tables R4416.6.2, R4413.6.3 and R4413.6.6. Scuppers shall be sized to prevent the depth of ponding water from exceeding that for which the roof was designed as determined by Section R4413.1.7. Scuppers shall not have an opening dimension of less than 4 inches (102 mm). The flow through the primary system shall not be considered when sizing the secondary roof drain system.

FIGURE R4413.6.1

100-YEAR, 1-HOUR RAINFALL (inches)
EASTERN UNITED STATES

For SI: 1 inch = 25.4 mm.
Source: National Weather Service, National Oceanic and Atmospheric Administration, Washington, D.C.

TABLE R4413.6.2
SIZE OF VERTICAL CONDUCTORS AND LEADERS

DIAMETER OF LEADER (inches)[a]	HORIZONTALLY PROJECTED ROOF AREA (square feet) Rainfall Rate (inches per hour)											
	1	2	3	4	5	6	7	8	9	10	11	12
2	2,880	1,440	960	720	575	480	410	360	320	290	260	240
3	8,800	4,400	2,930	2,200	1,760	1,470	1,260	1,100	980	880	800	730
4	18,400	9,200	6,130	4,600	3,680	3,070	2,630	2,300	2,045	1,840	1,675	1,530
5	34,600	17,300	11,530	8,650	6,920	5,765	4,945	4,325	3,845	3,460	3,145	2,880
6	54,000	27,000	17,995	13,500	10,800	9,000	7,715	6,750	6,000	5,400	4,910	4,500
8	116,000	58,000	38,660	29,000	23,200	19,315	16,570	14,500	12,890	11,600	10,545	9,660

For SI: 1 inch = 25.4 mm,1 square foot = 0.0929 m^2.

a. Sizes indicated are the diameter of circular piping. This table is applicable to piping of other shapes provided the cross-sectional shape fully encloses a circle of the diameter indicated in this table.

TABLE R4413.6.3
SIZE OF HORIZONTAL STORM DRAINAGE PIPING

SIZE OF HORIZONTAL PIPING (inches)	HORIZONTALLY PROJECTED ROOF AREA (square feet) Rainfall Rate (inches per hour)					
	1	2	3	4	5	6
$^1/_8$ unit vertical in 12 units horizontal (1-percent slope)						
3	3288	1644	1096	822	657	548
4	7520	3760	2506	1800	1504	1253
5	13360	6680	4453	3340	2672	2227
6	21400	10700	7133	5350	4280	3566
8	46000	23000	15330	11500	9200	7600
10	82800	41400	27600	20700	16580	13800
12	133200	66600	44400	33300	26650	22200
15	218000	109000	72800	59500	47600	39650
$^1/_4$ unit vertical in 12 units horizontal (2-percent slope)						
3	4640	2320	1546	1160	928	773
4	10600	5300	3533	2650	2120	1766
5	18800	9440	6293	4720	3776	3146
6	30200	15100	10066	7550	6040	5033
8	65200	32600	21733	16300	13040	10866
10	116800	58400	38950	29200	23350	19450
12	188000	94000	62600	47000	37600	31350
15	336000	168000	112000	84000	67250	56000
$^1/_2$ unit vertical in 12 units horizontal (4-percent slope)						
3	6576	3288	2295	1644	1310	1096
4	15040	7520	5010	3760	3010	2500
5	26720	13360	8900	6680	5320	4450
6	42800	21400	13700	10700	8580	7140
8	92000	46000	30650	23000	18400	15320
10	171600	85800	55200	41400	33150	27600
12	266400	133200	88800	66600	53200	44400
15	476000	238000	158800	119000	95300	79250

For SI: 1 inch = 25.4 mm, 1 square foot = 0.0929 m^2.

TABLE R4413.6.6
SIZE OF SEMICIRCULAR ROOF GUTTERS

DIAMETER OF GUTTERS (inches)	HORIZONTALLY PROJECTED ROOF AREA (square feet) Rainfall rate (inches per hour)					
	1	2	3	4	5	6
1/16 unit vertical in 12 units horizontal (0.5-percent slope)						
3	680	340	226	170	136	113
4	1440	720	480	360	288	240
5	2500	1250	834	625	500	416
6	3840	1920	1280	960	768	640
7	5520	2760	1840	1380	1100	918
8	7960	3980	2655	1990	1590	1325
10	14400	7200	4800	3600	2880	2400
1/8 unit vertical in 12 units horizontal (1-percent slope)						
3	960	480	320	240	192	160
4	2040	1020	681	510	408	340
5	3520	1760	1172	880	704	587
6	5440	2720	1815	1360	1085	905
7	7800	3900	2600	1950	1560	1300
8	11200	5600	3740	2800	2240	1870
10	20400	10200	6800	5100	4080	3400
1/4 unit vertical in 12 units horizontal (2-percent slope)						
3	1360	680	454	340	272	226
4	2880	1440	960	720	576	480
5	5000	2500	1668	1250	1000	834
6	7680	3840	2560	1920	1536	1280
7	11040	5520	3860	2760	2205	1840
8	15920	7960	5310	3980	3180	2655
10	28800	14400	9600	7200	5750	4800
1/2 unit vertical in 12 units horizontal (4-percent slope)						
3	1920	960	640	480	384	320
4	4080	2040	1360	1020	816	680
5	7080	3540	2360	1770	1415	1180
6	11080	5540	3695	2770	2220	1850
7	15600	7800	5200	3900	3120	2600
8	22400	11200	7460	5600	4480	3730
10	40000	20000	13300	10000	8000	6660

For SI: 1 inch = 25.4 mm, 1 square foot = 0.0929 m^2.

TABLE R4413.7
SIZING SCUPPERS FOR A 5 INCHES PER HOUR RATE OF RAINFALL

HEAD IN INCHES	HORIZONTALLY PROJECTED ROOF AREA (SQUARE FEET) LENGTH OF WEIR IN INCHES						
	4	6	8	12	16	20	24
1	230	346	461	692	923	1153	1384
2	641	961	1282	1923	2564	3205	3846
3	1153	1730	2307	3461	4615	5769	6923
4	1794	2692	3589	5384	7179	8974	10769

For SI: 1 inch = 25.4 mm, 1 square foot = .0929 m^2.
Note: to adjust this table for other than a 5-inch design rainfall rate multiply the square footage on the table by 5 then divide by the local design rainfall rate.
Example: For 4 inches of design rainfall rate a 4-inch long scupper with a 1-inch head would accommodate 287 square feet. 230 × 5.4 = 287.