The International Codes published by the International Code Council, www.iccsafe.org, are the most widely used model codes in the history of U.S. construction codes. In addition to their widespread use throughout the 50 U.S. states, numerous federal agencies—including the National Park Service and the U.S. Department of Defense—have adopted the International Codes. Adoption of the ICC codes is also starting in other countries, particularly the Middle East.

The following is intended as a summary of the major requirements set forth for windows, doors and other fenestration products in the 2012 International Building Code and International Energy Conservation Code.

Manufacturers that sell products in several states should be aware that, at this point, multiple editions of the International Codes are being enforced by various U.S. jurisdictions. Most jurisdictions are currently using the 2009 editions of these two codes. As of fall 2011, the 2009 IBC is being enforced in 24 states, and the 2009 IECC is being enforced in 22 states. Local jurisdictions in other states are enforcing each of these as well.

There are, however, several states and local jurisdictions that are still using the 2003 or 2006 editions of these codes. Some states are even still enforcing the first edition of the International Building Code, from 2000.

It is anticipated that adoption and enforcement of the 2012 editions of the International Codes will begin within the next few months. Therefore, this article will focus on the 2012 requirements. Users of this summary need to be aware that other editions of the International Codes might be enforced by any particular jurisdiction, and therefore, this summary might not be consistent with the requirements of some jurisdictions.

The ICC website, www.iccsafe.org, offers updated information on which code edition is in effect in each state, as well as various cities and counties.

This summary is not a full discussion of the 2012 International Code requirements for fenestration products. It identifies relevant sections of the codes. For more specific information, obtain a copy of the relevant code or codes from ICC. It is also important to note that some jurisdictions adopt one or more of the International Codes, and then make their own amendments to them, at the state
or local level. As a result, many jurisdictions have their own versions of these particular codes.

This summary does not attempt to address all of these variations of the base model code. In some cases, these jurisdiction-specific versions of the International Codes can also be obtained from the ICC. In other cases, the jurisdiction-specific versions must be obtained directly from that particular jurisdiction.

**Recent changes**

There are several significant changes between the 2009 edition and 2012 edition of the International Codes that relate to fenestration products. Cumulatively, these changes include:

- Removal of the distinction between metal and nonmetal framed fenestration in the prescriptive requirements of the IECC for commercial construction
- Addition of mandatory daylighting requirements, combined with automatic daylighting controls, in certain types of large, open public spaces in the IECC
- Updating to the strength design-based wind speed maps of ASCE 7-10 Minimum Design Loads for Buildings and Other Structures for the determination of design wind pressure in the IBC
- The addition of an exception to the minimum window sill height requirements for windows equipped with window-opening control devices in the IBC
- An increase in the minimum sill height required for operable windows in the IBC.

**Testing and labeling of windows, doors and skylights**

Exterior windows and doors are covered in Section 1710.5 of the 2012 IBC. This section requires windows and sliding doors to be tested and labeled in accordance with AAMA/WDMA/CSA 101/I.S.2/A440-11. The standard was developed jointly by the American Architectural Manufacturers Association, www.aamanet.org; the Window & Door Manufacturers Association, www.wdma.com; and the Canadian Standards Association, www.csa.ca. The 2011 edition of the standard referenced in the 2012 IBC and IECC represents an update from the previous reference to AAMA/WDMA/CSA 101/I.S.2/A440-08 in the 2009 IBC and IECC.

As in the 2009 IBC, the latest edition of the standard applies to windows and “sliding doors” in the 2012 IBC. Other types of fenestration assemblies not included within the scope of AAMA/WDMA/CSA 101/I.S.2/A440-11, such as curtain wall and storefront, are addressed in Section 1710.5 of the 2012 IBC. These assemblies are to be tested to 1.5 times design load in accordance with ASTM E330-02, and the glass is to be designed in accordance with ASTM E1300-07e01.

Exterior swinging doors can be tested and labeled in accordance with AAMA/WDMA/CSA 101/I.S.2/A440-11 or tested to 1.5 times design load in accordance with ASTM E330-02. The 2012 IBC also permits garage doors to be tested to ANSI/DASMA 108-05, in lieu of ASTM E330.

AAMA/WDMA/CSA 101/I.S.2/A440-11 contains provisions for some types of exterior swinging doors. AAMA has put into place a program to certify these types of products for compliance with AAMA/WDMA/CSA 101/I.S.2/A440-11. This program depends upon testing of each proposed door assembly, rather than the component-based approach offered by ANSI A250.13 and others.

The 2012 IBC also requires unit skylights be tested and labeled in accordance with AAMA/WDMA/CSA 101/I.S.2/A440-11. Unit skylights are factory-manufactured fenestration assemblies intended to be installed in a single roof opening without intermediate framing members. Tubular Daylighting Devices are included within the definition of unit skylights in the 2012 IBC.

The requirements for skylights and sloped glazing occur in Section 2405 of the 2012 IBC. Section 2405.5 permits unit skylights to be evaluated for different positive and negative design pressures. This is unique to unit skylights. Skylights are subject to snow load as well as wind and dead load. The combination of these loads will often result in varying required ratings for positive and negative pressures on unit skylights.

The 2012 IBC requires exterior wall cladding systems—including curtain wall, storefront and punched openings—in high-wind areas to be subject to special inspections. The high-wind areas are determined by exposure category of the building. If the building is in Exposure Category B (surrounded by low- to mid-rise buildings), then special inspection is required if the design wind speed is 120 mph or greater. If the building is in Exposure Category C (open prairies) or D (near large bodies of water), then special inspection is required if the design wind speed is 110 mph or greater.

Special inspections, by definition in the IBC, are to be performed by people who are specifically qualified to inspect the installation in question. They are necessary only for the part of the system design that requires a registered design professional. So, for a curtain wall system, the special inspection would be of the structural components: the framing members, anchorage, joinery, etc.

**Design loads**

Provisions for design loads are set forth in Chapter 16 of the 2012 IBC. The design loads of concern for vertical glazing are design wind load and impact resistance. Skylights and sloped glazing are also subject to snow load and dead load.

**Wind loads:** The engineer of record for the project is to calculate the design wind pressure for components of the building envelope. The calculations are to be based on the design wind speed of the specific location where construction is to take place, the mean height of the building and its exposure. There are significant changes to the design wind load requirements for fenestration between the 2009 IBC and the 2012 edition due to changes to the wind load provision of ASCE 7 between the 2005 and 2010 editions.

The design wind load provisions of the 2005 and earlier editions of ASCE 7 were based upon allowable stress design of building components. The intent was to provide loads to
which the building components had a fairly high likelihood of being exposed during the service life of the building. The building components were then designed to remain serviceable (i.e. not require replacement) when subjected to that load.

The 2010 edition of ASCE 7 provides design wind load provisions that are based upon strength design of building components. This method provides loads that have a lower likelihood of occurring during the service life of the building. The building components are then designed not to fail (rupture) when subjected to that load.

This change in methodology results in higher design wind speeds and pressures. At first glance, it might appear to require higher DP ratings for exterior windows, doors and skylights. In actuality, the 2012 IBC contains provisions to multiply this new, higher load by a factor of 0.6 for the purpose of conversion to the more traditional method of determining the design wind pressure based upon allowable stress design. It is very important that the builder, code official, manufacturer and anyone else involved in choosing or approving the windows, doors or skylights for a particular application understand that the higher design wind pressure provided by the 2012 IBC must be multiplied by this 0.6 conversion factor for the purposes of comparison to the Design Pressure rating of the fenestration product. In most, but not all, cases this conversion results in required design pressure ratings for fenestration that are roughly comparable to the more traditionally determined values. AAMA, WDMA, FMA and DASMA have published a technical bulletin on this topic that can be downloaded from the AAMA website at www.aamanet.org.

ASCE 7-10 also provides three different design wind speed maps. The different maps are based upon the assigned risk category of the building being designed. There is one map for buildings whose collapse would present a low risk to human life, such as barns and storage facilities. There is a second map for buildings whose collapse is considered to be a moderate hazard to human life. Most buildings fall within this category. There is a third map for buildings whose collapse is considered a high threat to human life, and for those that are considered essential facilities. The former includes assembly or education buildings designed to house groups of 250 or more people, some medical care facilities and any other buildings designed to house 5,000 people or more. Essential facilities include hospitals, and police and fire stations, which are essential during emergency response situations.

The new maps result in higher design wind loads for buildings of moderate hazard to human life than for those of lower hazard. The highest design wind loads are for buildings whose collapse poses a high hazard to human life, and essential facilities. Previous editions of ASCE 7 and the IBC also required these types of buildings to be designed to higher design loads, but the actual increase was applied in a different manner.

**Dead loads:** The provisions for dead load in Section 1606 of the 2012 IBC are also based on ASCE 7-10. There are no significant changes to the dead load requirements for fenestration between the 2009 IBC and the 2012 edition of the same code.

**Impact resistance:** Section 1609.1.2 of the 2012 IBC outlines the locations where impact-resistant products are required. All exterior openings in wind-borne debris areas are required to be impact resistant in the 2012 IBC.

Determination of wind-borne debris areas in the 2012 IBC is similar to that of ASCE 7-10 and primarily defined by design wind speed. Since the 2012 IBC has three different design wind speed maps, some areas might be considered wind-borne debris areas for buildings such as essential facilities, but not for buildings whose collapse is considered to be of moderate threat to human life. In other words, in some parts of the country impact-resistant openings will be required for hospitals and police and fire stations, but not...
for office buildings and retail stores. It might be appropriate to provide a higher level of safety for the former buildings, but it will also require those selling fenestration products in those areas to be aware of this distinction and when it applies in their market.

Products that need to meet impact resistance requirements must be tested to one of a few different sets of standards. One option is testing in accordance with ASTM E1886-05 and ASTM E1996-09, which must be used together. The 2012 IBC also permits the use of “other approved tests.” This may include Miami-Dade County test protocols, if approved by the authority having jurisdiction.

For residential applications, use of protective wood panels as an alternative to impact-resistant glazing or shutters continues to be permitted for limited applications. The 2012 IBC limits the use of protective wood panels to openings in one- and two-story single family dwellings, duplexes and residential care facilities.

**Energy**

Requirements for energy performance in both residential and commercial buildings are spelled out in the International Energy Conservation Code. Commercial buildings that comply with ASHRAE 90.1 are also considered to be in compliance with the IECC.

The 2012 IECC and ASHRAE 90.1-10 have similar formats. They both address the building envelope, mechanical systems of the building, lighting and hot water systems. Although the specific requirements for each of these systems differ between the two standards, they are considered to be very close with regards to the actual anticipated energy use of a commercial building built under either standard.

The 2012 IECC has two compliance paths for commercial construction. The first is the prescriptive path, which is the simplest to use, providing one set of energy efficiency requirements for each component of the building envelope.

The prescriptive path for commercial construction establishes maximum permitted U-factors and solar heat gain coefficients for fenestration. U-factor is to be determined in accordance with NFRC 100-04 or by use of a default table in the 2012 IECC. Similarly, the SHGC of the fenestration is to be determined in accordance with NFRC 200-04 or by use of a default table in the 2012 IECC.

Previous editions of the IECC contained separate U-factor provisions for metal and nonmetal framed windows and doors other than the main entrance door in commercial buildings. This distinction has been discontinued in the 2012 IECC. The 2012 IECC establishes maximum U-factors for fenestration based upon whether it is fixed, operable, or an entrance door.

The figures above show the maximum U-factor and SHGC permitted for fenestration in commercial buildings.

Use of the prescriptive path in commercial buildings is limited to buildings where the vertical glazing and skylight area do not exceed certain limits. New to the 2012 IECC, these limits are dependent upon whether or not automatic daylighting controls are provided in the daylight areas of the building. Automatic daylighting controls reduce the artificial lighting load when daylighting is provided to a room or space. Combining automatic daylighting controls with well-placed fenestration allows fenestration to have a positive impact on the overall energy use of the building by reducing the lighting load during daylight hours.

If (1) a building is equipped with automatic daylighting controls, (2) at least 50 percent of the conditioned floor area is in a daylight zone, and (3) the glazing has a VT/SHGC ratio > 1.1, then 40 percent of the above-grade wall area of a commercial building is permitted to be fenestration area. If all three of these criteria are not met, then the fenestration area is limited to 30 percent of the above-grade wall area.
Those parts of the exterior walls that are not included in the calculation of the window-to-wall ratio must meet the requirements of the 2012 IECC. For example, in order for those parts of a curtain wall system that are glazed with opaque glass to not be included in the calculation of the WWR of the building, they must be insulated as required for other metal-framed opaque walls in the building’s exterior envelope.

Similarly for skylights, if a building is equipped with automatic daylighting controls, up to 5 percent of the roof area is permitted to be skylights. If the building is not equipped with automatic daylighting controls, then skylights are not to exceed 3 percent of the roof area under the prescriptive provisions of the 2012 IECC.

Also new in the 2012 IECC are requirements for minimum skylight area. These provisions will require at least half the floor area of certain spaces to be toplit. These provisions apply to spaces that are directly under a roof, larger than 10,000 square feet in area, have ceilings in excess of 15 feet, and are used for offices, lobbies, atriums, concourses, corridors, storage areas, gymnasiums/exercise centers, convention centers, automotive service centers, manufacturing areas, nonrefrigerated warehouses, retail stores, distribution/sorting areas, transportation areas and workshops.

The 2012 IECC requires air leakage resistance of windows, door assemblies and unit skylights to be determined in accordance with AAMA/WDMA/CSA 101/I.S.2/A440-11 or NFRC 400-04, similar to the requirements in the 2009 IECC. The 2012 IECC also requires air-leakage resistance of curtain wall, storefront glazing and commercial doors to be determined in accordance with ASTM E 283-04.

Previous editions of the IECC used the same pass/fail criteria for air leakage of windows, door and unit skylights in commercial buildings as that established by AAMA/WDMA/CSA 101/I.S.2/A440. The 2012 IECC, however, establishes more stringent criteria than that currently in place for certain performance classes. Specifically, the maximum air leakage rate permitted for windows, sliding and swinging doors and unit skylights without condensation weepage openings is 0.2 cfm/sq. ft. when tested at 1.57 psf. The maximum air leakage rate permitted by AAMA/WDMA/CSA 101/I.S.2/A440 for some performance classes of fenestration is 0.3 cfm/sq. ft. when tested at the same pressure.

Emergency escape and rescue openings
The 2012 IBC requires emergency escape and rescue openings in sleeping rooms below the fourth floor of a building, and in all basements except those that are used only to house mechanical equipment and are less than 200 square feet in area. The 2012 IBC also contains some exceptions for rooms in buildings that are fully equipped with a fire sprinkler system, or for rooms that open directly to a corridor that leads to an exit in two directions.

Typically, the emergency escape and rescue opening requirements are met with operable windows or doors. Operable skylights and roof windows are also permitted to be used as emergency escape and rescue openings if they meet the size requirements and the bottom of their opening is within 44 inches of the floor below.
The requirements for sizes, locations, etc., are set forth in Section 1029 of the 2012 IBC. It is important to note that the required opening size of 24 inches high, 20 inches wide and 5.0 or 5.7 square feet in area must be met by “normal” operation of the window, door or skylight without the use of keys, tools or special knowledge, and without the removal of a second sash from the opening.

**Minimum window-sill heights**
The 2012 IBC requires the bottom of openings created by operable windows to be a minimum height above the adjacent interior floor when they are 72 inches or more above the grade outside the window. In the 2012 IBC, the required height of that window sill above the adjacent interior floor is 36 inches.

An exception is included, however, for windows that do not open more than 4 inches or that are equipped with window guards that comply with ASTM F2006-00 or ASTM F2090-08 or window opening control devices that comply with ASTM F2090-08. The window opening control device must limit the initial opening of the window to no more than 4 inches, but must also be releasable with no more than 15 pounds of force to open more fully. The intent of this later provision is to permit windows that are equipped with window opening control devices to also be used to meet the Emergency Escape and Rescue Opening requirements of the 2012 IBC.

**Means of egress doors**
Section 1008.1.7 of the 2012 IBC restricts the threshold height of the required exit door in residences and dwelling units to 1½ inches or ¾ inch, depending upon the type of door, from the top of the threshold to the floor or landing on each side of the door. The rise from floor or landing to the top of the threshold at other exterior doors that are not required to be accessible or which do not provide access to a Type A or Type B unit within the IBC, is limited to 7¾ inches, which is the riser height permitted for stairs.

**Window installation**
Section 1405.4 of the 2012 IBC requires window openings to be flashed “in such a manner as to prevent moisture from entering the wall or to redirect it to the exterior.”

**Safety glazing**
Section 2406.4 of the 2012 IBC establishes the locations where safety glazing is required. They include the following:
- Glazing in and near swinging and sliding doors
- Large lites of glass near walkways
- Glazing around tubs, showers, pools and similar fixtures
- Glazing near stairways, ramps and the landings for both.

In these applications, the glazing must be labeled per the Consumer Product Safety Commission CPSC 16 CFR 1201.
requirements. There are some exceptions for applications that are considered less hazardous, such as very small openings in doors, decorative glass, and glazing provided with a protective bar, etc.

The previous exception for wired glass in fire-rated assemblies that complied with ANSI Z97.1 in other than educational-use groups has been removed. In the 2012 IBC, wired glass is only permitted in doors that meet CPSC 16 CFR 1201, just like any other type of glass. The 2012 IBC also permits the use of glass that meets the two most stringent categories of ANSI Z97.1 in hazardous locations that are defined within those codes, but which do not fall within the scope of the federal law established by CPSC 16 CFR 1201. These locations include tub and shower enclosures, door sidelites, large lites of glass, and glazing near stairs, ramps and pools.

The criteria for these two categories of ANSI Z97.1 are similar to CPSC 16 CFR 1201 for these applications, but ANSI Z97.1 was updated in 2004, while CPSC 16 CFR 1201 was last updated in 1977. Therefore, ANSI Z97.1 is considered to be more up-to-date and consistent with products currently available than CPSC 16 CFR 1201.

The defined hazardous locations did not change significantly between the 2009 International Codes and the 2012 IBC.

**Replacement windows**
As a general rule, when an addition is made to a building or a component within a building is replaced, the International Codes require the new component or addition to comply with the requirements of the current code for new construction. This is also true for replacement windows. The 2012 IECC requires replacement windows to comply with the energy conservation requirements for fenestration in new construction. This requirement applies whether the entire window unit—including frame, sash and glazing—is being replaced, or just the sash and glazing.

**Sunroom additions**
The 2012 IECC permits glazing in thermally isolated sunrooms to have a maximum U-factor of 0.45 in climate zones 4 to 8. By definition, a thermally isolated sunroom must be separated from the remainder of the building by either existing exterior wall construction or construction that meets the energy efficiency requirements of the 2012 IECC for exterior walls. The sunroom must also be equipped with a separate heating or cooling system or thermostatically controlled as a separate zone, if conditioned. Previous editions of the IECC placed size restrictions on thermally isolated sunrooms but these restrictions do not occur in the 2012 IECC.

Sunrooms must be thermally isolated from the remainder of the home to take advantage of the higher permitted U-factor for fenestration. Under the 2012 IECC, sunrooms can be built as part of new construction, but they must still be thermally isolated from the remainder of the home, as discussed above, to use the U-factor of 0.50 rather than 0.35 in climate zones 5 to 8, or 0.40 in climate zone 4.

**Site-built glazing**
Chapter 24 of the 2012 IBC references ASTM E1300-07e01 for glass design. The 2007e01 edition of ASTM E 1300 addresses several types of glass layups and support combinations that were not addressed in previous editions of the standard. Having it referenced in the 2012 IBC greatly enhances the designer’s options in terms of providing glazed openings that can meet all the requirements of the code, including energy efficiency and impact resistance.

A previous provision that requires glass to be designed by a registered design professional if the glass framing deflects more than L/175 or ¾ inch remains in the 2012 IBC. An exemption to this requirement continues to be given in Section 1710.5 of the 2012 IBC for exterior windows and doors that are tested and labeled in accordance with AAMA/ WDMA/CSA 101/1.S.2/A440-11.

**Skylights and sloped glazing**
The 2012 IBC has different requirements for factory-built unit skylights than for other types of glazed assemblies in roofs such as skylights and sloped glazing. Factory-built unit skylights that contain only one panel of glazing material are required to be tested and labeled for performance grade in accordance with AAMA/ WDMA/CSA 101/1.S.2/A440-11 in the 2012 IBC. Section 2405.5 of the 2012 IBC establishes the required performance-grade rating based on the provisions of that code for wind, snow and dead loads.

As for vertical glass, glass in sloped glazing is to be designed in accordance with ASTM E 1300-07e01. The requirements for screening under skylights and sloped glazing, as set forth in Section 2405.3 of the 2012 IBC, are consistent with previous editions of the International Codes. This includes requiring the screening to be securely fastened to the framing and to be able to support twice the dead weight of the glass. Requirements for curbs on skylights and sloped glazing, when applicable, is also consistent with those in the previous editions of the International Codes, and are set forth in Section 2405.4 of the 2012 IBC.

**Code cycles**
As noted at the outset, this article focuses on the requirements of the 2012 editions of the International Codes. Heading into 2012, many states and local jurisdictions are still referencing older editions of the IBC and IECC. Adoption and enforcement of a new edition of a model construction code traditionally occurs most significantly in the second year after its publication. Therefore, we can expect 2012 to be a transition year, with some jurisdictions adopting and beginning enforcement of the 2012 International Codes, while others continue to enforce the 2009 or earlier edition of the International Codes. □