

EC145–09/10
Table 405.5.2(1)

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Revise as follows:

**TABLE 405.5.2(1)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS**

BUILDING COMPONENT	STANDARD REFERENCE DESIGN	PROPOSED DESIGN
Glazing ^a	Total area ^b = (a) The proposed glazing area; where the proposed glazing area is less than 15% of the conditioned floor area (b) 15% of the conditioned floor area; where the proposed glazing area is 15% or more of the conditioned floor area Orientation: equally distributed to four cardinal compass orientations (N,E,S, & W) U-factor: from Table 402.1.3 SHGC: From Table 402.1.1 except that for climates with no requirement (NR) SHGC = 0.40 shall be used Interior shade fraction: Summer (all hours when cooling is required) = 0.70 <u>0.90</u> Winter (all hours when heating is required) = 0.85 <u>0.90</u> ^c Exterior shading: none	As proposed As proposed As proposed As proposed Same as standard reference design As proposed

(Portions of table and footnotes not shown remain unchanged)

Reason: This proposal corrects a long-term flaw in the performance path – an unfounded assumption that interior shades are consistently used twice as much in the summer as in the winter – by setting the interior shade fraction at the same 0.90 level for both summer and winter. Another option would be to eliminate interior shading altogether, just as the performance path already assumes no exterior shading. Either approach would allow for the energy efficiency improvements of the home to be treated consistently throughout the year without impact from occupant behavior between seasons. Because there is no valid evidence as to actual, consistent human behavior in using shades, and indeed shade use is ultimately up to each individual occupant, we propose to treat all seasons equally.

The benefits of reducing solar heat gain for homes is well-known. However, it is not so well known that the code-assumed interior shading values reduce the perceived benefits of shading windows or reducing the SHGC of windows.

This proposal makes the performance path more accurate by establishing an equal interior shade fraction in all seasons. The current standard reference design assumes a 30% reduction in the benefit of reducing solar heat gain in the hottest time of the year when the solar heat gain reduction is most important to reducing the electric grid overload during peak hours. By contrast, the standard reference design assumes only 15% is blocked in the winter. These numbers are not supported by objective data or any studies, and the imbalance between the shading fractions creates inaccuracies in modeling programs. Because the performance path assumes that interior shading is used twice as much in the summer as in the winter, the equation shows higher relative energy use in the heating months than in the cooling months. In the performance path calculation, this translates to an artificially inflated heating budget and a bias in favor of measures used to reduce heating energy. This assumption is similar to assuming that heating equipment will operate 30% more efficiently due to occupant behavior. It is not accurate and promotes less efficiency. The assumption also makes no climate zone-specific distinctions, but rather assumes that shading tendencies are static nationally. The result is that the performance path may favor compliance measures that reduce heating energy over measures that reduce cooling energy, even in cooling-dominated climates.

Because there is no data to support the currently unbalanced assumptions of interior shading fractions, this proposal neutralizes the assumptions in the standard reference design at a uniform, conservative level. It assumes that a typical occupant will not radically alter behavior with regards to interior shade operation by season. It also makes the conservative assumption that the majority of windows will not have shades drawn during daytime hours to block solar radiation. As a result, the purchased energy estimated using the performance approach will be more accurate and representative of an actual residential building.

Although it can be argued that a conscientious building occupant may reduce heating or cooling loads by operating shades to minimize sunlight during the summer and maximize sunlight during winter, there is no data to suggest that occupants actually engage in these practices for the purpose of saving energy. There are many reasons why shades are operated throughout the year, and almost all of them have nothing to do with energy use.

The 2005 ASHRAE *Handbook of Fundamentals* outlines a number of variables affecting user-operated shading devices, each of which may have significant impacts on the effectiveness of the devices:

Shading devices vary in their operational effectiveness. Some devices, such as overhangs, light shelves, and tinted glazings, do not require operation, have long life expectancies, and do not degrade significantly over their effective life. **Other types of shading devices, especially operable interior shades, may have reduced effectiveness because of less than optimal operation and degradation of effectiveness over time. It is important to evaluate operational effectiveness when considering the actual heat rejection potential of shading devices.**

Handbook, at 31.54, emphasis added. The *Handbook* lists six reasons why shades are more or less effectively operated, and only one of them (radiant energy protection) has anything to do with energy use or changing seasons: Radiant Energy Protection, Outward Vision, Privacy, Brightness Control, View Modification, and Sound Control. See *Handbook* at 31.54-55.

In reality, a home's occupant will operate shades for any number of these reasons, without thinking of the potential negative energy impacts. For example, interior shades should be operated to reflect radiant energy during the hottest months of the year. However, in northern climates, because glass temperatures during winter months can drop below room temperature, it is common practice to use shades *more often* during the winter months for the perceived insulating benefits. In addition, direct sunlight or reflected light can make occupants uncomfortable, leading to more shade usage (even in winter months).

Windows are often installed for a view of particular external geographical features, such as landscape or city views. A beautiful view or daylighting interest may induce an occupant to leave shades open year-round. In other cases, because of a home's proximity to other homes, certain windows may be shaded year-round for privacy concerns. Users may also install heavy draperies to reduce road noise or other sounds.

Every building will have unique shading characteristics based on the climate zone, shade type, window type, orientation, exterior shading, and most importantly, the occupant's priorities. Because there is no reliable data to support the current bias in the performance path, the shading fraction should be neutralized so that heating and cooling measures will be treated similarly. Moreover, given the lack of data as to actual operation,

the safer assumption is that shades are largely left open (justifying a higher fraction); after all, it is reasonable to assume that the average person buys windows for views and light. This proposal sets the assumption at a conservative 0.90, which means that the shades are blocking 10% of the solar heat gain annually. Another sensible option is to assume no interior shading, just as the standard reference design assumes no exterior shading.

Cost Impact: The code change proposal will not increase the cost of construction. This change is not intended to affect the overall stringency of the code.

Public Hearing:	Committee:	AS	AM	D
	Assembly:	ASF	AMF	DF

ICCFILENAME: PRINDLE-EC-33-T. 405.5.2(1)