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Docket Number:	17-BSTD-01
Project Title:	2019 Building Energy Efficiency Standards PreRulemaking
TN #:	219225
Document Title:	Comments on the Proposed Residential High Performance Windows Measures Presented at the June 1, 2017 Staff Workshop
Description:	N/A
Filer:	System
Organization:	Eric DeVito
Submitter Role:	Public
Submission Date:	6/16/2017 4:07:07 PM
Docketed Date:	6/16/2017

Comment Received From: Eric DeVito
Submitted On: 6/16/2017
Docket Number: 17-BSTD-01

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Additional submitted attachment is included below.

Before the California Energy Commission
Docket No. 17-BSTD-01
2019 Building Energy Efficiency Standards Pre-Rulemaking

Comments on the Proposed Residential High Performance Windows Measures Presented at the June 1, 2017 Staff Workshop

I am writing to submit the following comments, including our recommendations, regarding the proposals on residential high performance window and glazed door measures that were presented by the CASE Study Group for consideration at the June 1st 2017 Staff Workshop for the 2019 Building Energy Efficiency Standards. In particular, we will address below both the primary Proposal presented as well as the "Alternative" Proposal.

Our firm has participated in the development of the fenestration requirements of the Title 24 Standards for many years. We have extensive experience representing energy efficient building product manufacturers (including fenestration) and other energy efficiency interests in model and state energy code development and adoption nationwide since the 1990s, and we offer our perspective and recommendations based on this experience.

I. Summary of Recommendations

In response to the proposals outlined at the workshop, we offer the following conclusions and recommendations related to residential glazed fenestration in the next version of the Standards:

Recommendation #1: We **SUPPORT** the primary Proposal and recommend that the Standards be updated with the U-factor and SHGC maximum prescriptive requirements that were proposed at the Staff Workshop:

CLIMATE ZONE	1, 3, 5 and 16	2, 4, 6-15
Maximum U-Factor	0.30	
Maximum SHGC	NR	0.23

The primary Proposal is a reasonable continuation and extension of the current requirements in the Standards and reflects the characteristics of the high performance window that is readily and broadly available in California at this time. However, we offer a word of caution that modifying CZ 16 as proposed (moving it from a max SHGC to an NR SHGC zone) is debatable and potentially problematic and should be carefully considered due to potential unintended consequences, which we explain further below.

Recommendation #2: We **RECOMMEND AGAINST** the "Alternative" Proposal that would establish a minimum prescriptive SHGC requirement of 0.35 in Climate Zones 1, 3, 5 and 16. We recommend retaining the "NR" SHGC prescriptive requirement in those

heating-dominated climate zones; this has been the approach used for many years in California and in other energy codes in the United States for heating-dominated climates.

Instead of setting a minimum prescriptive SHGC requirement, we recommend what we believe is a much better option for accomplishing the goals of the Alternative Proposal. Specifically, we **SUPPORT** revising the Standard Design so that the base case window for performance compliance will be set at a 0.23 SHGC for all climate zones, including those where the prescriptive SHGC prescriptive requirement is "NR." (This would lower the current 0.50 value referenced in the ACM Manual to 0.23 for the NR zones.)

II. Reasons in Support of Our Recommendations

A. Support for the High Performance Glazed Fenestration Prescriptive Values in the Primary Proposal.

Strengthening the requirements for fenestration as proposed in the primary Proposal at the Staff Workshop (maximum 0.30 U-factor for the entire state; maximum 0.23 SHGC for CZs 2, 4 and 6-15; and "NR" SHGC for CZs 1, 3, 5 and 16) is a reasonable improvement to the Standards and represents a reasonable extension of and update to the current requirements. These proposed values will fully utilize the characteristics of the best double pane low-emissivity technology currently widely available in the California marketplace from numerous suppliers to reduce solar gain as well as increase insulating value.

i. Window Products Are Readily Available to Meet the Proposed Values and Will Save Energy, Lower Peak Demand and Improve Comfort.

In our view, the California high performance window market has evolved to be able to achieve on a mass scale the proposed maximum 0.30 U-factor and maximum 0.23 SHGC. Our view was reinforced by the presentation at the June 1st Staff Workshop, who confirmed that these values are reasonable and capable of being achieved with current widespread market technology. Although many products in the market already achieve these proposed values, it is important to ratchet down the Standards to capture these lower values as the baseline prescriptive standard. Doing so will save energy by not allowing "free riders" already using the lower values to be able to take credit under the performance compliance method. Also, as the presentation's LCC TDV results show, there are meaningful savings generated by these lower values.

The presentation at the June 1st Workshop also included comparisons to the International Energy Conservation Code (IECC) and EPA's Energy Star program for windows, which both have evolved to require windows with at least a 0.30 maximum U-factor in the coldest zones and a 0.25 maximum SHGC in the zones with significant cooling load. The recommended values at the

Workshop of a 0.30 maximum U-factor and a 0.23 maximum SHGC will keep California requirements consistent with and/or a step ahead of the current nationally recognized standards.

In addition to the LCC TDV savings, there are other benefits from these performance levels, like occupant comfort and reduced peak demand. Occupant comfort is an important goal in its own right. Moreover, occupant discomfort is likely to lead to more energy use as the occupant adjusts the thermostat to attain desired comfort levels. An occupant's probability of discomfort has a direct correlation to a product's U-factor and SHGC. The lower the U-factor and the lower the SHGC, the lower the risk of discomfort, and vice versa. Similarly, given the impacts of windows on electric system peak demands, reduction of peak demand is a separate, but important, objective to be addressed in establishing reasonable window requirements. Lastly, there will be economic efficiencies resulting in lower costs to consumers from standardized values across the State.

ii. There Are Practical Considerations that Support Retaining a Maximum SHGC Requirement in Climate Zone 16 (instead of NR).

We offer one qualifying observation on one aspect of the primary Proposal that seeks to shift Climate Zone 16 from its current 0.25 maximum SHGC requirement to "NR." We recommend that the Commission carefully consider whether this particular change is truly in the public interest at this time. This zone currently has a maximum 0.25 SHGC requirement, and the CASE Study shows that there is significant cooling load in CZ16. Even though this year's LCC TDV calculations may support it, such a change could have unintended consequences and could cause a "yo-yo" effect for those builders, homeowners, and retailers meeting the current Standards and understanding that solar control is warranted in CZ16. Given that the analysis for the 2016 Standards supported the maximum 0.25 SHGC requirement, it is reasonable to believe that the LCC TDV valuations may change back in a future cycle. That truly would have a detrimental effect for those trying to "keep score at home." For these reasons, we suspect that it would be a better decision for the long term to retain a maximum SHGC requirement in CZ16 for the 2019 Standards and revisit this issue if necessary in a future update.

In addition to a consistent message from prior Standards, retaining a maximum prescriptive SHGC in CZ16 also makes sense from the standpoint of encouraging proper passive solar design. To the degree solar gain is beneficial in CZ16 with appropriate design, this benefit would best be achieved through compliance under the performance method. In other words, if CZ16 continues to have a maximum prescriptive SHGC requirement (such as the 0.23 SHGC that has been proposed for other climates), then the Standard Design would be modeled with a 0.23 SHGC, and any passive solar benefits could be captured through the performance method. It would help ensure that a house seeking to take advantage of a passive solar credit would effectively take into consideration proper window orientation, overhangs, and other design details to guard

against increased cooling energy use, increased peak demand, and decreased comfort that could otherwise result.

B. Concerns With the Minimum Prescriptive SHGC Specified in the "Alternative" Proposal

We are very concerned by and opposed to the Alternative Proposal presented at the June 1st Workshop that would eliminate the current "NR" requirement in Climate Zones 1, 3, 5 and 16 by implementing a minimum prescriptive 0.35 SHGC requirement in those zones. Our understanding of the impetus for such a change is the ACM Manual's current specification of a 0.50 SHGC for the "Standard Design" performance baseline in the NR climate zones. Some stakeholders have commented that using a 0.50 SHGC baseline value for these climate zones does not allow adequate credit when using high solar gain windows in heating-dominated climates. Others suggest that using a 0.50 SHGC baseline value in NR zones is an unfair penalty to fenestration with SHGCs lower than 0.50, even though there is no particular prescriptive SHGC required in those zones.

While we are mindful of the concerns that have been raised over the treatment of various low-e windows in heating-dominated climate zones, we do not believe implementing a minimum prescriptive SHGC requirement is the solution.

i. Establishing a Minimum Prescriptive SHGC Would Unnecessarily Preclude the Use of Typical High Performance Windows in these Climate Zones for Prescriptive Compliance and as Replacement Windows.

Under the current Standards in the NR SHGC climate zones, no low-e product is precluded by the prescriptive requirements, which is the common approach nationwide for codes and standards in heating-dominated climate zones. Like California's current Standards, the IECC does not specify a minimum SHGC under any circumstances, and no other state energy code that we know of sets a minimum prescriptive SHGC. We submit that California should not move in this direction.

By setting a minimum SHGC requirement, low solar gain low-e windows would be banned outright under the prescriptive path and as replacement windows in CZs 1, 3, 5 and 16, when in fact such windows may very well be appropriate based on the design of the home and for comfort reasons. Such an approach would be a drastic shift for California and would be disruptive to the efficient window market transformation that has occurred. It also would be a far harsher penalty for a typical high performance window used in these zones than the current performance penalty resulting from the 0.50 SHGC assumed in the Standard Design. Instead of solving the perceived problem, setting a minimum prescriptive SHGC as the resolution could create a different, but bigger problem.

Another very important reason to not set a minimum prescriptive SHGC is because high solar gain glass should not be prescribed in all orientations and building designs. Prescribing high SHGC glass for certain orientations, particularly east- and west-facing, and without other aspects of passive solar design, is a bad idea and can result in occupant discomfort, increased peak demand and more energy use, even in heating-dominated climates. (The primary benefits from high SHGC glazing are derived from south orientations, particularly with overhangs.) Due to the fact that the effects of solar gain in heating-dominated climate zones depend heavily on specific design issues like orientation, solar mass, and overhangs, it is very difficult to appropriately capture positive attributes of solar gain and avoid the negative attributes through a prescriptive measure. Instead, the best (and in our view only) place to assess the use of high solar gain windows when appropriate is with the simulated performance compliance method – not through prescriptive limits.

ii. Retaining the Current Prescriptive NR SHGC Requirement and Fixing the Standard Design Baseline in Climate Zones 1, 3, 5 and 16 Are the Recommended Solutions.

The Standards have employed a prescriptive "NR" for heating-dominated climate zones successfully for many years and the approach works well for prescriptive compliance. Establishing a prescriptive minimum SHGC sends the wrong message for California as a whole and in particular, for CZ16, which is currently a low solar gain low-E zone. Stability in the Standards to enable a consistent energy efficiency message for consumers is a very important policy objective. Switching from a maximum or no SHGC requirement to a minimum SHGC is very problematic in both technical and public information and education contexts. While designing for solar gain benefits may be warranted in some locations if properly planned for and accommodated in the home's design, the performance method is the place to evaluate the benefits of proposed passive solar home—a minimum prescriptive requirement for high solar windows simply tosses aside those design fundamentals.

To summarize, we believe shifting from an "NR" to a *minimum* SHGC would result in bad outcomes and unintended consequences including the following:

- Create substantial confusion with and undercut the message established by the Standards of a *maximum* SHGC of 0.23 in the remaining climate zones.

- Act as an outright ban on the appropriate use of low solar gain glazing in certain circumstances. For example, an optimal home in these zones would have high SHGC glass facing south and low SHGC glass facing west—but a minimum prescriptive requirement for all orientations could preclude this approach under prescriptive compliance and certainly would for replacement windows. Requiring high SHGC windows for certain orientations (particularly west-facing)

can result in substantial occupant discomfort and resulting negative consequences as certain rooms are overheated and result in increased summer peak electric demands.

- Cause particularly problematic outcomes for the replacement window market, where houses likely were not designed to take advantage of passive solar gains and there is no control over the orientation.

- Make it more difficult and costly in many instances to achieve a 0.30 maximum U-factor with high solar gain glazing because high solar gain, low-e glass generally produces higher (weaker) U-factors (a 0.30 U-factor would be very hard to achieve with high solar gain glass without other improvements to the insulating glass unit and/or the frame). Giving away the certainty of energy savings from a better a U-factor for the uncertain savings associated with higher solar gain is not a reasonable trade (for example, SHGC benefits in winter are only achieved if the occupant opens the drapes at the correct times).

- Increase costs since the typical standard glazing widely available throughout California is currently low solar gain.

C. Support for Setting a 0.23 SHGC as the Standard Design Baseline in "NR" Climate Zones.

We submit that a much better way to address the comments and concerns that have been expressed over the value in the Standards used to calculate solar gain performance is to fix the problem at its source. Instead of eliminating the NR prescriptive SHGC requirement, we recommend modifying the ACM Manual's 0.50 SHGC that currently is set for the Standard Design SHGC in the NR climate zones.

The type of low-e coating that likely will be used to achieve a maximum 0.30 U-factor typically will produce an SHGC far lower than 0.50. As described above, and was confirmed by the presentation at the Staff Workshop, the typical window products available throughout most of California will have U-factors at or below 0.30 and SHGCs at or below 0.23. In this regard, reducing the SHGC from 0.50 to the proposed 0.35 for the Standard Design represents a modest improvement and could be adopted. However, we think it would be more appropriate for the Standard Design to set an SHGC value that represents the most common windows that will be used to achieve the 0.30 U-factor requirement, which is a low solar gain, low-e window (around 0.23 SHGC).

As a result, if the value in the Standard Design is to be changed, we recommend setting the Standard Design baseline value in the "NR" zones at a 0.23 SHGC level consistent with

specifications for the rest of the state and the predominant product in the state. Alternatively, the value should be set no higher than 0.30, rather than 0.35, since a 0.30 U-factor is a much better dividing point between moderate SHGC and low SHGC fenestration than a 0.35. We note that the IECC takes the same approach by specifying a baseline SHGC value in the Standard Reference Design when there is an "NR" in the prescriptive SHGC requirements (see Table R4405.5.2(1) of the 2015 IECC).

The next section outlines our suggested changes to the language of the Standards and the ACM Manual to implement our recommendations with regard to revising the Standard Design performance baseline for fenestration under the Standards in climate zones where the prescriptive SHGC value is "NR."

D. Proposed Language Changes to the Standards to Implement Our Recommendations to Address the SHGC Specified in the Standard Design

The sections below are excerpts from the 2016 Standards and the 2016 ACM Manual that we have identified for potential changes to implement our recommendation of revising the Standard Design SHGC from its current value of 0.50 to our proposed value of 0.23 (in underline/strikethrough format for changes to be added or ~~deleted~~). While we have inserted a 0.23 SHGC per our recommendations in these comments, an alternative value could be inserted if deemed appropriate (as noted above, a 0.30 SHGC in the Standard Design would be our recommended alternative if 0.23 is determined to be not acceptable).

Proposed Changes:

SUBCHAPTER 8
LOW-RISE RESIDENTIAL BUILDINGS

SECTION 150.1 – PERFORMANCE AND PRESCRIPTIVE COMPLIANCE APPROACHES FOR LOW-RISE RESIDENTIAL BUILDINGS

* * *

4. **Shading.** Where TABLE 150.1-A requires a Maximum Solar Heat Gain Coefficient (SHGC), the requirements shall be met by one of the following:
   - A. Complying with the required SHGC pursuant to Section 150.1(c)3A; or
   - B. An exterior operable shading louver or other exterior shading device that meets the required SHGC; or
   - C. A combination of Items A and B to achieve the same performance as achieved in Section 150.1(c)3A.
   - D. For south-facing glazing only, optimal overhangs shall be installed so that the south-facing glazing is fully shaded at solar noon on August 21 and substantially exposed to direct sunlight at solar noon on December 21.

E. Exterior shading devices must be permanently secured with attachments or fasteners that are not intended for removal.

EXCEPTION to Section 150.1(c)4A: Where Table 150.1-A indicates NR (no requirement) for SHGC, the SHGC shall be set at 0.23 for the Standard Design.

EXCEPTION to Section 150.1(c)4E: Where the California Building Code (CBC) requires emergency egress or where compliance would conflict with Health and Safety regulations.

2016 RESIDENTIAL ALTERNATIVE CALCULATION METHOD REFERENCE MANUAL FOR THE 2016 BUILDING ENERGY EFFICIENCY STANDARDS

2.5 CONDITIONED ZONES

* * *

2.5.6.6 Fenestration

* * *

STANDARD DESIGN

If the proposed design fenestration area is less than 20 percent of the conditioned floor area, the standard design fenestration area is set equal to the proposed design fenestration area. Otherwise, the standard design fenestration area is set equal to 20 percent of the conditioned floor area. The standard design fenestration area is distributed equally between the four main compass points— north, east, south and west.

The standard design has no skylights.

The net wall area on each orientation is reduced by the fenestration area and door area on each facade. The U-factor and SHGC performance factors for the standard design are taken from Section 150.1(c) and Table 150.1-A (Package A). Where Package A has no requirement (NR), the SHGC is set to 0.23~~0.50~~.

III. Conclusion

In summary, we support the recommendation in the primary Proposal from the June 1, 2017 Staff Workshop to implement a maximum prescriptive 0.30 U-factor across the state, a maximum prescriptive 0.23 SHGC in Climate Zones 2, 4 and 6-15, and a prescriptive NR SHGC in Climate

Zones 1, 3, 5 and 16. (However, we suggest that the proposed SHGC change in CZ16 be carefully evaluated and that consideration be given to retaining a maximum prescriptive SHGC requirement in this zone.) We also support changing the SHGC used for the Standard Design in "NR" climate zones from 0.50 to a lower number, preferably 0.23. We strongly recommend that the Commission not establish a prescriptive minimum SHGC in any climate zone.

We thank you for the opportunity to provide these comments.

Respectfully submitted,

Eric M. DeVito
STONE MATTHEIS XENOPOULOS & BREW, PC
1025 Thomas Jefferson Street, NW
Eighth Floor West Tower
Washington, DC 20007
(202) 342-0800
Eric.DeVito@smxblaw.com

June 16, 2017