# Evaluating the Impact of Overhangs and Sidefins

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## Introduction

Sidefins, overhangs and recessed windows are traditional building forms and when properly designed can reduce or eliminate the need for low transmission glass while providing solar control and enhancing daylighting. Most energy codes and standards do little to encourage side fins or overhangs and can in fact discourage them. In contrast, the 1992 California standards and ASHRAE 90.1-1989 incorporate methods similar to those described here.

Energy codes and standards generally specify a maximum shading coefficient for commercial building fenestration. While ASHRAE 90-75, ASHRAE 90-80, the Model Energy Standard and other codes use Overall Thermal Transmittance Value (OTTV), the shading coefficient in the OTTV equation is by far the most significant, so in effect, OTTV standards are largely shading coefficient standards.

Many simplified energy models (such as degree day methods or bin calculations) use shading coefficient in their calculations but do not have the capability of considering shading from fixed devices such as overhangs and sidefins and designers are, therefore, unable to easily evaluate their benefits.

This paper presents a simple method of crediting fixed shading devices such as overhangs and sidefins. The credit is offered as an adjustment to the shading coefficient, and can be incorporated into all codes and standards that use OTTV or similar methods. It can also be incorporated into simple energy models that use shading coefficient.

## Projection Factor

Overhangs and side fins can be characterized in terms of a projection factor. For overhangs the projection factor is the ratio of the projection of the overhang from the window surface to the distance from the window sill to the bottom of the overhang (see Figure 1). While projection factor is not a perfect characterization of an overhang, it does a good job for most buildings. It does not, for instance, consider the distance from the top of the window to the bottom of the overhang or the extension of the overhang past the window jambs.

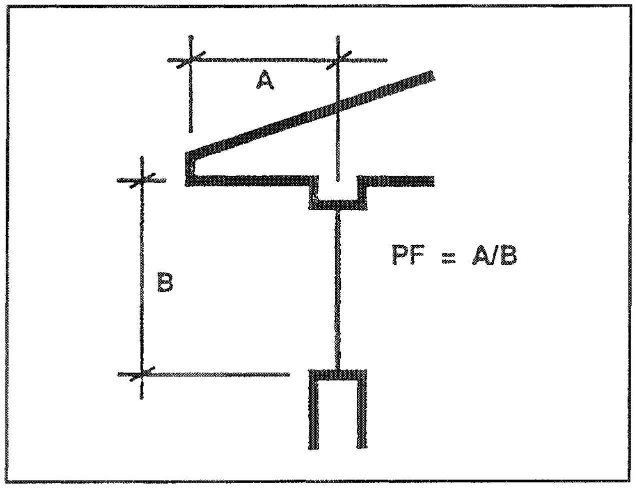


*Figure 1. Overhang Projection Factor*

For sidefins the projection factor is similarly defined, but in this case it is the ratio of the projection of the side fin from the surface of the fenestration to its distance from the opposite side of the window (see Figure 2). It is possible to have a different projection factor on the left and right sides of the window, and in some cases, it is common for the sidefins to be separated from the fenestration by some distance. Methods have been developed for dealing with the special cases, but are not presented here (Eley 1991).

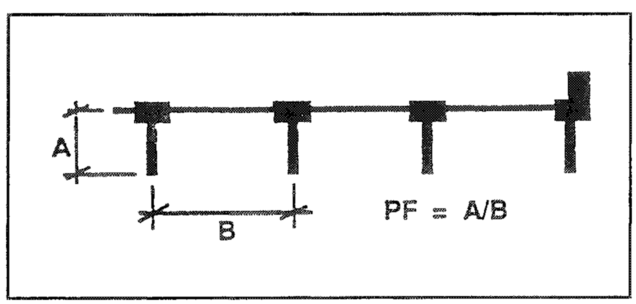


*Figure 2. Sidefin Projection Factor*

## Relative Solar Heat Gain

Relative solar heat gain for a fenestration system with an overhang or sidefin is defined as the shading coefficient of a plain sheet of glass of equal area (without overhangs or sidefins) that results in equal cooling energy:

$$RSHG = SC \times M \qquad (1)$$

where

RSHG = Relative solar heat gain
SC = Shading coefficient of the glazing
M = A multiplier to account for the shading benefit of a sidefin or overhang

The multiplier term is given as a quadratic equation based on the projection factor of the overhang or sidefin:

$$M = 1 + a(PF) + b(PF)^2 \qquad (2)$$

The terms "a" and "b" are calculated for a number of cities and shown in Table 1.

The shading coefficient multiplier can be plotted as shown in Figure 3 for Washington, DC.

## Methodology

The equations for overhang multiplier are calculated as shown in Figure 4. Energy functions are determined for the no overhang case and for overhang (or sidefin) projection factors within the range of interest, in this case 0.25, 0.50 and 1.00. The energy functions explain changes in cooling energy in terms of the shading coefficient of the glazing. Separate functions are determined for each overhang case. Figure 4 is for south facing glass, a window wall ratio of 30% and the Washington, DC climate.

Once the energy functions are established, they can be used to find the "no overhang" shading coefficient that results in equal cooling energy as the case with an overhang. In Figure 4, a shading coefficient of about 0.82 and a projection factor of 0.25 is equivalent to a shading coefficient of 0.60 and no overhang. The RSHG for an SC of 0.82 and a projection factor of 0.25 is, therefore, 0.60 and the shading coefficient multiplier, "M", is 0.60 divided by the starting shading coefficient of 0.82, or M = 0.73.

The "M" term is calculated for a variety of fixed shading conditions (overhang and sidefin sizes), for a variety of window wall ratios and for a variety of fenestration types. From these data the coefficients "a" and "b" are calculated through regression analysis.

The energy functions themselves are also determined through regression analysis of DOE-2 simulation results. The model used for the analysis is a simple five zone building: an interior zone and four perimeter zones, one facing each of the major compass points. Single zone packaged HVAC systems are assumed so that energy use can be tabulated by orientation (zone). For each climate zone and window wall ratio, at least 12 computer runs are made: three glass types for four different overhang conditions. For hotter climates additional computer runs are made for large overhangs. The energy functions are determined through regression against the computer generated data.

## References

Eley Associates. 1992. *Technical Appendices, Hawaii Model Energy Code.*

ASHRAE SSPC 90.1. 1989. *ASHRAE/IES Standard 90.1-1989, Energy Design of New Buildings Except New Low-Rise Residential Buildings.* American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

*Table 1. Shading Multiplier Coefficients*

| Shade Type | Location | Coefficient | N | S | E | W |
|---|---|---|---|---|---|---|
| Overhang | Oakland, CA | a | -0.49 | -1.17 | -1.02 | -0.88 |
| | | b | 0.19 | 0.51 | 0.42 | 0.25 |
| | San Diego, CA | a | -0.79 | -1.23 | -1.04 | -0.87 |
| | | b | 0.45 | 0.65 | 0.53 | 0.31 |
| | Fresno, CA | a | -0.31 | -1.27 | -0.96 | -0.82 |
| | | b | 0.12 | 0.74 | 0.46 | 0.24 |
| | El Centro, CA | a | -0.24 | -1.14 | -0.90 | -0.83 |
| | | b | 0.08 | 0.64 | 0.42 | 0.29 |
| | Mt. Shasta, CA | a | -0.21 | -1.30 | -0.96 | -0.89 |
| | | b | 0.16 | 0.76 | 0.34 | 0.21 |
| | Lake Charles, LA | a | -0.65 | -1.20 | -0.86 | -0.76 |
| | | b | 0.34 | 0.54 | 0.25 | 0.21 |
| | Madison, WI | a | -0.59 | -1.19 | -0.82 | -0.76 |
| | | b | 0.23 | 0.61 | 0.33 | 0.16 |
| | Phoenix, AZ | a | -0.46 | -1.37 | -0.89 | -0.88 |
| | | b | 0.25 | 0.55 | 0.36 | 0.29 |
| | Portland, OR | a | -0.66 | -1.13 | -1.04 | -0.92 |
| | | b | 0.34 | 0.48 | 0.52 | 0.29 |
| | Washington, DC | a | -0.62 | -1.20 | -0.84 | -0.93 |
| | | b | 0.27 | 0.54 | 0.22 | 0.29 |
| | Honolulu, HI | a | -0.44 | -0.94 | -0.86 | -0.72 |
| | | b | 0.12 | 0.29 | 0.26 | 0.18 |
| | Hong Kong | a | -0.50 | -0.78 | -0.74 | -0.77 |
| | | b | 0.12 | 0.25 | 0.20 | 0.20 |
| Sidefin | Honolulu, HI | a | -0.81 | -0.65 | -0.51 | -0.61 |
| | | b | 0.27 | 0.16 | 0.13 | 0.16 |
| | Hong Kong | a | -0.92 | -0.77 | -0.54 | -0.54 |
| | | b | 0.29 | 0.23 | 0.13 | 0.15 |

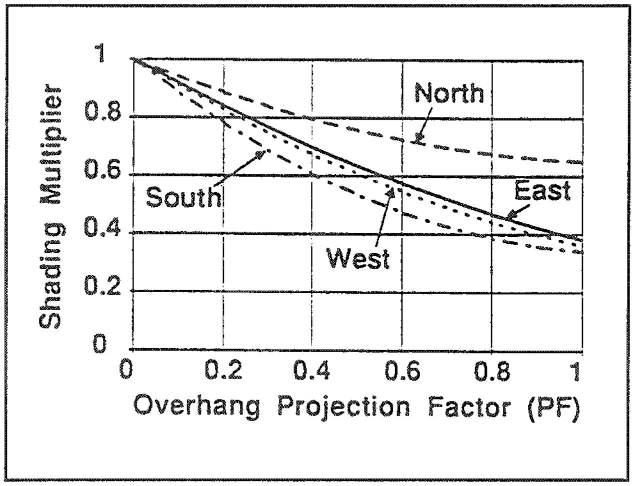


*Figure 3. Overhang Shading Multiplier by Orientation. Washington, D.C.*

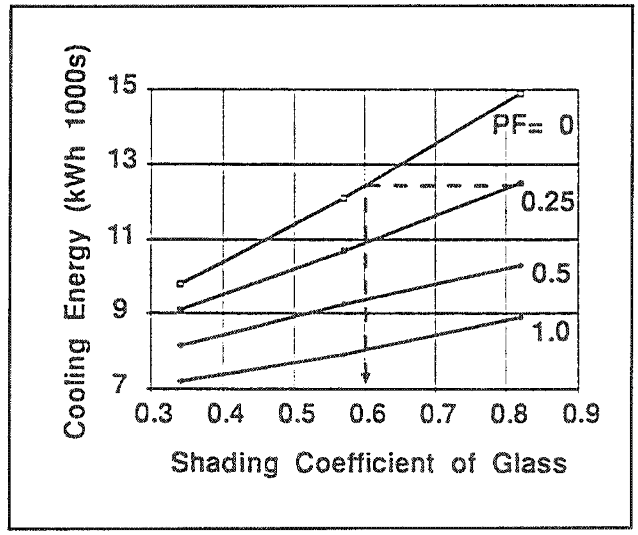


*Figure 4. Illustration of Relative Solar Heat Gain Calculation. Washington, D.C.*