Investigation of Potential Daylight Energy Savings Attributed to the Use of Skylights in Florida Residential Buildings

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Research Question:

Are daylighting energy savings from installed skylights in new Florida single-family home construction significant enough that credit should be provided in the Florida residential energy conservation code?

Code Relevance and Background:

The results may establish a cost-effective opportunity for saving Florida residents long-term energy savings associated with reduced electric interior lighting. Skylights provide a natural light path through the roof down into the building and can be an effective way of providing natural light to spaces without natural light through vertical windows (also known as sidelighting).

Using natural daylight to illuminate the indoors (daylighting) can be an energy-efficient method of providing illumination when done properly. Currently, electric light control criteria are stated for daylight zone control in commercial building codes, but not in residential buildings. Lighting control technology has steadily advanced and costs have come down over the past decade. This proposal will focus solely on daylighting provided only by skylights over areas with automatic electric light control.

Scope of Work:

A literature review will be completed that will seek available performance information on skylights such as U-factor, solar heat gain coefficient (SHGC) and visible light transmittance (VLT). The literature search will also use guidance from standards such as ASHRAE 90.1 and other applicable standards that define and address daylighting in commercial energy codes. After the literature review is completed, gathered information will be used to establish a testing baseline and specific skylight scenarios to be tested in simulation work.

An energy and lighting simulation study will be conducted to determine annual energy impacts of skylight installed in interior residential spaces such as hallways or rooms without any other direct sources of natural light. Potential reductions in electric lighting energy will be determined compared to a baseline with LED or fluorescent lighting and accepted residential lighting schedules. In addition, the simulation will estimate increases or decreases in heating and cooling loads due to the change in electric lighting load.

Optimal energy use will be determined using whole building energy simulation program and an optimization tool called Genopt. The optimization algorithm will be used to determine the optimal skylight size to be able to deliver the minimum required illuminance level for the defined interior room geometries. At least two common skylight designs will be evaluated. One will be the tubular shaft design with highly reflective interior surface, and the second design will be the square or rectangular shaft design that uses a painted drywall constructed shaft.

Deliverables:

A final report will be prepared that explains the purpose, methods, and results of the research. The final report will include an analysis of energy saving potential and cost-effectiveness. If the authors feel it is warranted, recommendations for code changes will be provided. As a result of this research, Florida Code may be improved to take into account cost-effective and energy-efficient skylight applications.

Budget:

Budget total is $26,000 and covers all costs for labor and overhead.