

Research Topic Acceptance Request

Title: Thermal and Optical Analysis of Cylindrical Skylights

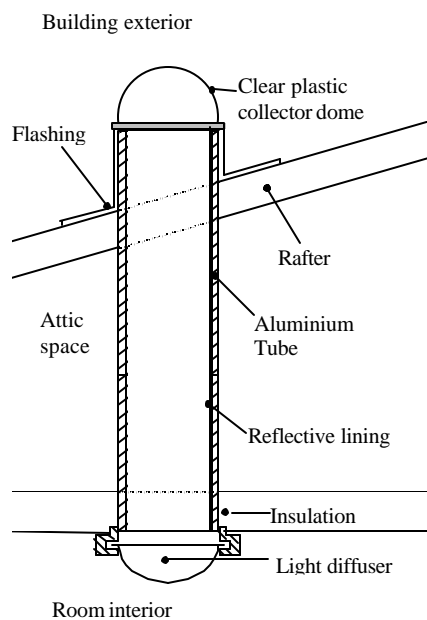
TC/TG Submitting: TC 4.5 Fenestration

Research Category: Energy Conservation

Research Classification: Basic Applied

TC/TG Priority: high

Background



Cylindrical skylights are being widely marketed in North America as a replacement for conventional skylights and electric luminaires [1].

Cylindrical skylights are normally used to bring natural daylight into areas of buildings that are not accessible by windows or conventional ceiling mounted skylights. They typically consist of a cylindrical tube coated on the interior with a highly reflective surface and capped on the ends by plastic domes or plates, (see figure). The exterior dome is usually clear to allow the maximum light transmission while sealing the skylight from the elements. At the building interior, the unit is fitted with a translucent diffuser. Through this arrangement, natural daylight is admitted into the interior of a building space.

Justification

The increased use of these new daylighting devices has created a need for theoretical and empirical data to describe their performance. In addition, information on their overall energy benefits, i.e., the lighting levels provided, energy savings, solar heat gain, and heat losses, are required. There is, however, little test data currently available to describe the lighting and thermal properties of these products. This is due, in part, to a lack of accepted evaluation methods.

A number of competing products are currently being manufactured by companies in North America and overseas. Standardised performance data would allow building and lighting designers to effectively incorporate these new lighting devices into their designs, allow for the comparison of competing products, and evaluate their energy benefits.

Objective

The objectives of this study are to:

- i) conduct tests on typical cylindrical skylights to evaluate new test methods and document typical performance characteristics;
- ii) undertake theoretical analysis of the optical and thermal properties of generic cylindrical skylight designs to arrive at simplified design methods that account for tube geometry, optical properties, climatic conditions and geographic location;
- iii) produce standardised performance indices and design guidelines that could be used in the design of residential and commercial installations and the prediction of energy benefits and costs.
- iv) develop standardised test methods for evaluating the illumination and thermal performance of commercially available cylindrical skylights;

References

1. Allen, T., Conventional and Tubular Skylights: An Evaluation of the Daylighting Systems at Two ACT² Commercial Buildings, The 22nd National Passive Solar Conference, Washington, DC, 1997.