

*These application notes are for general guidance and information only. Users will need to undertake independent analysis for specific sites.*

### Summary

Passive and active solar ventilation, heating and lighting systems that are integrated into a building can offer both an increase in occupant comfort and satisfaction and a decrease in energy consumption. Most of these systems would ideally suit single level facilities undergoing renovation or rebuilding, but with careful planning and design can be incorporated into larger, more complex buildings.

### Solar chimneys

Solar chimneys are used to help remove unwanted hot or stale air by drawing fresh cooler air from vents at low level. The building is cooled by means of the exchange of air through natural convection created as a result of solar energy heating air within the chimney moving heat to the outside. This effect makes solar chimneys most practical in warm to hot areas.

Heated air is forced from the top of the chimney by stack effect and is replaced by outside air through windows or vents elsewhere in the building. In winter the chimney vents can be closed and the hot air in the chimney redirected into the building using fans for heating purposes.

The solar chimney is a narrow chimney with a heat absorbing material on the inside behind a glazed north-facing front which terminates above the roof level. A vent at the top of the chimney allows heated air to exhaust without being overcome by the prevailing wind. Open stairwells and atria can be designed to act as solar chimneys but heat loss and space heating can be issues in winter.

### Transpired solar collector air heaters (Emerging technology)

Transpired solar collectors are air heaters made of a dark coloured, perforated, metal surface attached to the north face of a building. In winter, solar radiation is transferred from the heat collector surface to the thermal boundary layer of air. The thermal boundary layer of air is then drawn into the holes in the plate by an induction fan. This creates an efficient radiant-to-air heat exchanger that is a single pass process with no recirculation to the collector inlet. All collected air is passed into the building to provide either low grade space heating or ventilation preheating.

In summer, the collector shades the north wall and stack effect removes hot air from the collector when the bypass damper is opened.

Automatic controls ensure that air is introduced into the building only when the wall temperature is higher than the required interior temperature.

This system can be used in buildings with large ventilation requirements but the efficiency is reduced when weather is overcast. Careful design of the dampers and size of perforations is required to produce good performance. A limitation of the collector is that it uses north-facing walls that could otherwise be used for natural lighting from windows.

### Light pipe (Emerging technology)

Light pipes are available in both active and passive arrangements and are designed to reflect light through a shaft over extended distances. The passive light tube is simply a highly reflective coating on a tube run from the roof to the room to be lit. These can be up to twenty metres long depending upon the technology.

The active systems use a heliostat that tracks the sun, then concentrates light onto a mirror that directs the light into a focusing lens. When the lens is aligned in the correct axis, the light is refracted at multiple angles onto the interior of the light tube which is then directed to the inside of a building using a light shaft or fibre optics. This system exploits the maximum available sunshine by tracking the sun.

On overcast days the solar lighting may not be adequate and backup lighting managed by daylight sensing controls is necessary. These lighting systems can be used as a design feature to enhance aesthetics.

### References

IHEA/VHA. Energy conservation guidelines. Vol 1. Design and management checklist for existing buildings. 1984.

Sustainable Energy Authority Victoria. Building energy brief for commercial and public buildings. 2003

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