HARVARD
CENTER FOR GREEN
BUILDINGS AND CITIES

Mass & Material-Architecture:

The Antidote to Air-Conditioning?

PROBLEM

During the era of electrification, demand for artificial light far outstripped any energy savings from improved light bulbs. The same is happening today with artificial cold. Globally, energy for cooling is set to exceed energy for heating by 2060. More efficient versions of the same buildings will not buck the trend.

In the right climates, office buildings can be designed without air-conditioning or bulky HVAC infrastructure. This is possible because of recent revisions to thermal comfort standards and advances in the theory and practice of buoyancy ventilation. To make these 'breathing buildings' feasible in a wider-range of climates, their envelopes must be put to work as heat-exchangers. That is, they must temper the incoming air and interior climate, using geometry and material properties to better exploit low-grade sources of thermal energy. If these designs are to spread across the industry, they should be open-source, adaptable to local circumstance, and made—or 'architectured'—from standard materials.

Figure 1. Termite mounds can be studied to understand how climate control can be achieved without recourse to air conditioning.

GUIDING QUESTIONS

This project reviews the state-of-the-art in heat-exchanger design and materials design, looking for ways to apply the important findings and insights in architecture.

Which heat-exchanger design correlations work for 'breathing building' envelopes?

What are the scaling rules for coupling buoyancy ventilation & thermal mass?

What can we learn from termite mound * climate-control techniques?

*and can heat-exchanger theory help to characterize their performance?

PROJECT DESCRIPTION

The aim is to make natural ventilation feasible for a wider range of building types in a wider range of climates. To achieve this, the idea is to develop innovative designs for buildings envelopes using standard materials based on principles of heat-exchanger design.

IMPACT

This work hopes to inspire an open-source 'commons' of innovative heat-exchange designs for breathing buildings, which can be made from standard materials, and adapted to local circumstances, including in-lab and in-situ performance data.

Provide innovative, robust alternatives to building designs centered on fossil-fuelled air-conditioning.

Promote collaboration between architects and engineers, by uncovering links between geometry, materials and environmental performance.

Anchor green building design in deeper, more meaningful thermodynamic principles.

HARVARD
CENTER FOR GREEN
BUILDINGS AND CITIES

CONTACT

20 Sumner Road
Cambridge, MA 02138
tel. 617-495-8807
fax. 617-496-4408
email: cgbc@gsd.harvard.edu