Thermodynamic Conditioning Surface

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The Thermodynamic Conditioning Surface is an ongoing project that imagines the possibility of a materially integrated building air distribution system coupled with thermographic sensing technology and closed loop intelligent control systems to produce a demand based response to human thermal comfort requirements. The system operates within the Modernist ideal of modularity and is compatible with conventional construction practices allowing existing building systems to be adapted and retrofitted. The benefits of the system include greater user control over environmental conditions and reduced overall energy consumption in buildings. The Thermodynamic Conditioning Surface proffers a model for communicating air in buildings in which multiple differentiated atmospheres are privileged above a centralized, uniform standard of thermal comfort.

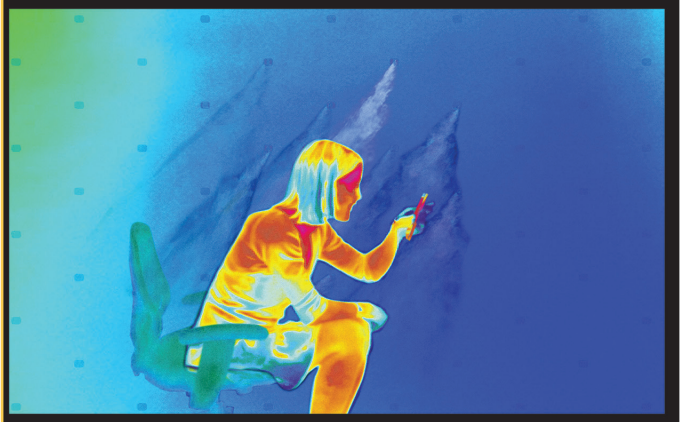
Innovative building skin systems have emerged as a recent obsession for architects. Perhaps because, in the context of the digital project, a building's skin provides near ideal conditions for exploring the parametric qualities of form and performance; it modulates sunlight, engages structural systems, and regulates the exchanges between interior and outside. As a result, the leitmotif of skin as architectural production tends to privilege geometry and shape. While it is difficult to describe architecture without referring to its delineated boundaries –its walls, its floors, its envelopes, its skins –an important, and perhaps neglected, aspect of one's sensorial experience of buildings is the result of invisible exchanges, such as the exchange of heat between the body and its environment. This system of heat transfer defines a thermodynamic boundary that operates at the relatively small scale of the human body, yet most contemporary practices in building design seek to enlarge this thermodynamic system so that it is commensurate with the architectural wrapper; to condition the entire volume within the building envelope to the ideals of human comfort.

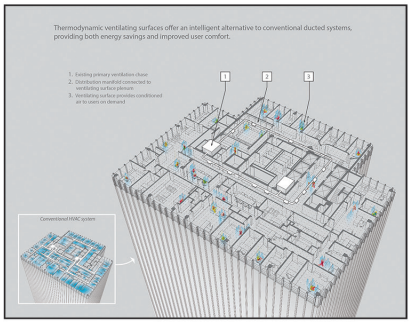
In differentiating between the tent and the campfire, Reynor Banham offers two distinct models of environmental behavior; that of the tent which provides an enveloping membrane and a materially explicit separation between inside and outside, and that of the campfire with an invisible radiant field that sponsors a gradient of human activities. From early examples, such as the Roman hypocaust, to the modern central heating ventilation and air conditioning (HVAC) system, building design tends to privilege the creation of interiors with uniformly conditioned spaces; Banham's tent persists as the dominant metaphor for how we imagine thermal comfort in buildings.

The Thermodynamic Conditioning Surface (TCS) project explores Banham's campfire as a conceptual model for imagining materially integrated sensing technologies that produce differential environmental behavior within buildings. It engages standardized building material systems and implicates relationships between locative media, machine cognition, and conventional HVAC systems. The Thermodynamic Conditioning Surface is deployed as a thermotropic field that sponsors the creation of multiple co-isolated climates within a building.

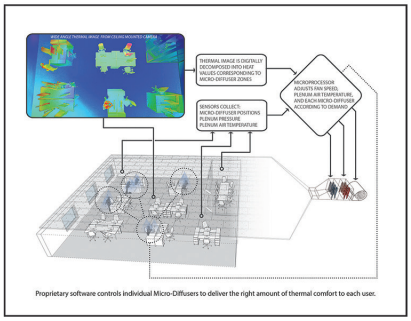
Thermodynamic Ventilating Surface

SENSOR-BASED INTELLIGENT HVAC DISTRIBUTION SYSTEM FOR BUILDINGS



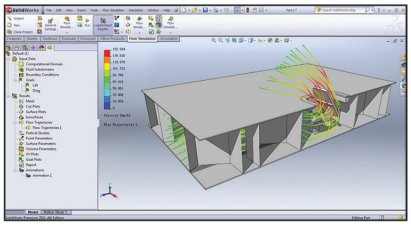


Within many cities, there is a legacy of older office buildings with obsolete and inefficient HVAC systems (such as the Seagram Building in New York which earned an Energy Star rating of 3, compared to a median rating of 58 for similar buildings). In addition to their inherent inefficiencies, these legacy environmental systems tend to have little capacity to respond or adapt to user needs, resulting in imbalanced environments and the familiar fight for control of the thermostat. By contrast, Thermal Ventilating Tiles actively create a microclimate of conditioned air around the user that accompanies them as they move from space to space within a building based on their specific temperature preference, allowing for increased individual thermal comfort and resulting in increased productivity.

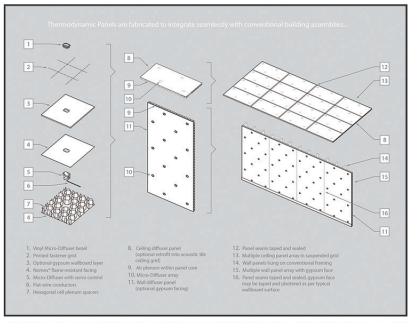


Proprietary software controls individual Micro-Diffusers to deliver the right amount of thermal comfort to each user.

Is it possible to imagine a more intelligent way of providing thermal comfort to workspace users while simultaneously conserving energy? With the shift toward solid-state lighting and low demand appliances and equipment, workspaces have become more energy efficient, yet HVAC (heating ventilation and air conditioning) systems continue to operate according to principles developed during the Industrial Revolution. In order to realize the potential of adaptive and intelligent materials in in workplace environments, we have developed a software/hardware system –Thermodynamic Ventilating Tiles –to reimagine the way we evaluate and temper the environments of our buildings. The Thermodynamic Ventilating Tile Project seeks to replace the conventional air distribution system of ductwork and registers with an intelligent sensing surface of Micro-Diffusers that provide variable amounts of conditioned air in response to localized user demands.



Emerging material systems must engage and transform the buildings we've inherited from Modernism and examine opportunities for strategic adaptation within their established material orders. The Thermodynamic Ventilating Tiles are designed to seamlessly integrate into existing office building material systems and can be configured to replace the acoustic tile ceiling grids or gypsum wallboard surfaces of a room without compromising sound transmission or fire resistance requirements. The Thermodynamic Ventilating Tile system is engineered to interface with existing ductwork and requires minor upgrades –such as the installation of variable fan speed technology –to plug into an existing heating and cooling plant. Because of this compatibility with existing material and mechanical systems, along with the inherent energy efficiency and enhanced environmental comfort for users.



The Thermodynamic Ventilating Tiles combine an architectural product –the panelized system –with computational intelligence –the sensors, controls, and software –to holistically provide comfortable interior environments. Depending on the size and configuration of the Thermodynamic Ventilating Surface, one or more thermal imaging cameras are integrated into the surface to record the presence of any thermal bodies (such as a person). Data collected from the sensors and thermal cameras is processed by proprietary software which analyzes thermal bodies and other inputs, selectively activating Micro-Diffusers based on demand. Through real-time locating system technology, users are able to set temperature preferences in their smart phone and the proprietary software recognizes their position within the thermal image data, adjusting the Thermodynamic Ventilating Surface's response according to their preferences.