prototype for an evaporative cooling roof

lafargeholcim next generation awards lab

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In application for the Research In Practice Grants
Atmospheres of Climate: Harnessing the absorption and transmission properties of water, which mirror that of low-E glass, the proposal allows light in the visible spectrum to provide natural daylighting while blocking ultraviolet and infrared radiation. A unique quality of light would be achieved, the gentle movement of the water above transmitting the atmosphere of the day outside within and allowing the expression of the temporal nature of climate.
Reconsidering Comfort: An evaporating layer of water on the roof approaches a wet bulb temperature of 12°C (a typical roof reaches 60-100°C), mitigating the albedo effect. Ambient indoor temperature is approx. 50% radiant heat from surface radiation and 50% air temperature. Interior space with a view factor to the roof only would be fully climatised. With an indoor air temperature of 25°C, a mean radiant temperature of roof and floor of 18.5°C, the ambient indoor temperature of 21°C is achieved.
Prototype Structure: A simple construction supports a 10mm water layer atop 97% transparent ETFE foil.

Interior Comfort: The evaporative water surface passively cools the interior through radiant cooling.
Daylighting: The transmission properties of water, which allow the passage of visible light while minimizing solar heat gains in the near infrared spectrum, reduce total energy use through natural daylighting.

Case Study for 240,000m² I-10 Logistics Centre: The evaporative potential was calculated to average 0.5mm/hr with the resultant energy removed averaging 355W/m².
Case Study for 240,000m² I-10 Logistics Centre: A circular plan maximizes the fully climatised area, with a semi-climatised loading zone at the perimeter, while the integrated climate device provokes potential for energy infrastructures as landscape.
Confronting the aesthetic and the performative: A one-to-one mock-up in the form of a 530sqft summer pavilion was installed in the courtyard of the Princeton University School of Architecture in May 2018.
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Performance: On a typical spring day in early May, the temperature of the underneath surface of the evaporative roof was recorded at 18.4 °C, while the brick facade of the adjacent building reached 28.5 °C. The amount of energy removed from the roof of the summer pavilion would equate to installing 47 window air conditioning in the facade of the brick building in order to achieve the same degree of cooling.