

BLOWING HOT AIR: THE USE OF CEILING FANS IN AN ATRIUM SPACE

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OVERVIEW

Building atria contain a high ratio of air to floor surface area presenting a challenge when seeking to provide consistent thermal comfort for occupants. The Hedco Education Building, situated on the southwest side of the University of Oregon campus (THA Architects) was completed in spring 2009. The atrium lobby of the 100,000 ft² facility provides a perfect opportunity to examine the efficacy of a design response to this condition. The northeast entrance of the building has a monumental brick clock tower which bisects a wall of glazing and protrudes into a double height atrium space. At the base of the tower a hearth provides an enjoyable place to sit within the atrium. THA Architects utilized several environmental control systems to maintain thermal comfort within the large volume, including radiant heating from the subfloor and brick tower, HVAC and ceiling fans at the height of the atrium. We were interested in examining the efficacy of fans to de-stratify air and maintain a more even temperature gradient for this investigation. While there are multiple strategies employed for thermal conditioning of the atrium, the scope of this project will address only the use of the fans as a tool for conditioning the atrium space.

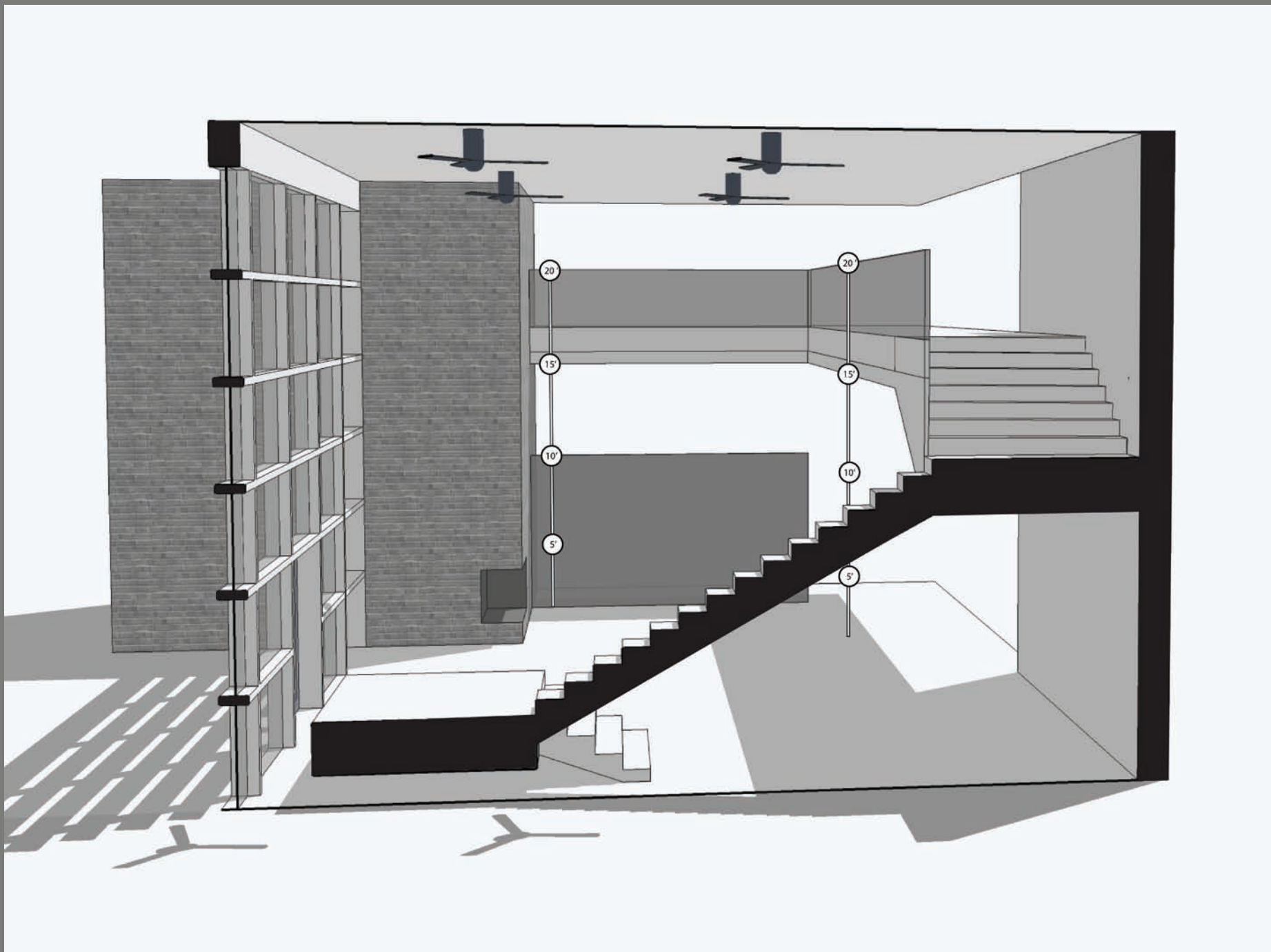


HYPOTHESIS

The ceiling fans in the atrium of the Hedco Education Building reduce the sensible heat temperature difference between floors to two degrees Fahrenheit.

METHODOLOGY

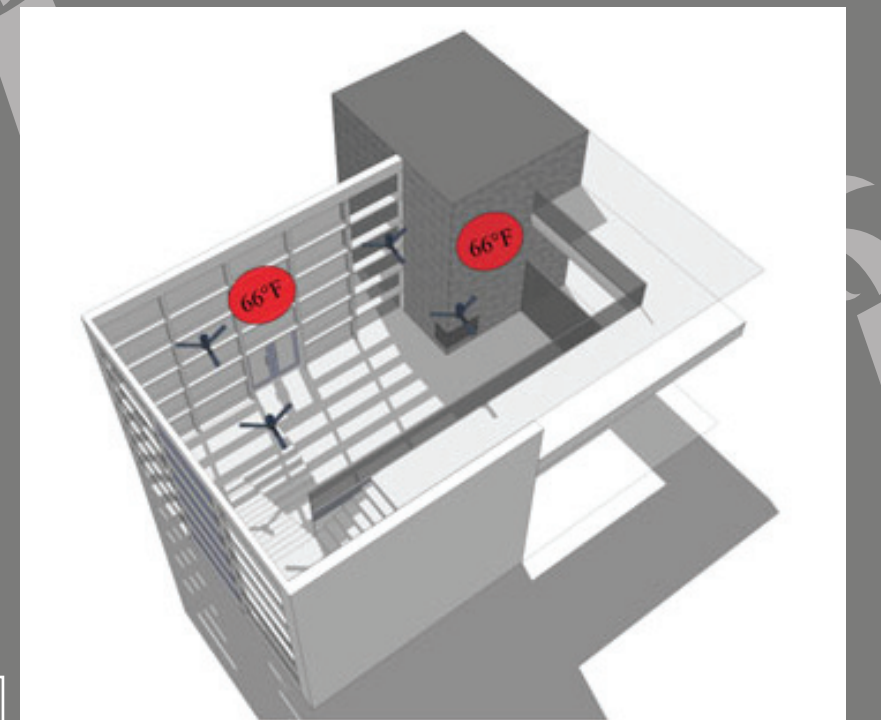
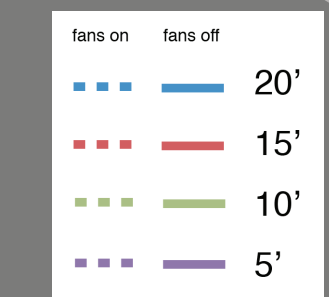
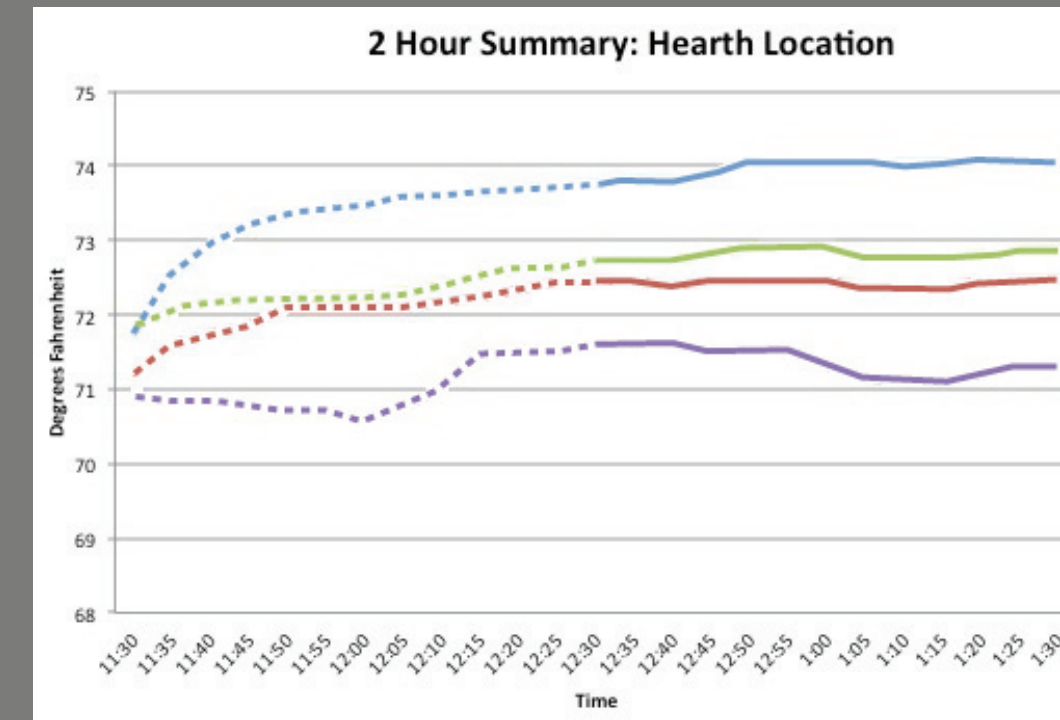
8 HOBO U12 data loggers were placed in 5 foot increments in two different locations. The HOBOS recorded the air temperature at 5 minute intervals. Data was collected for one hour with the fans on and one hour with the fans off in a 2 hour period. We used an IR camera and Raytek temperature gun to map the heat sources within the space.



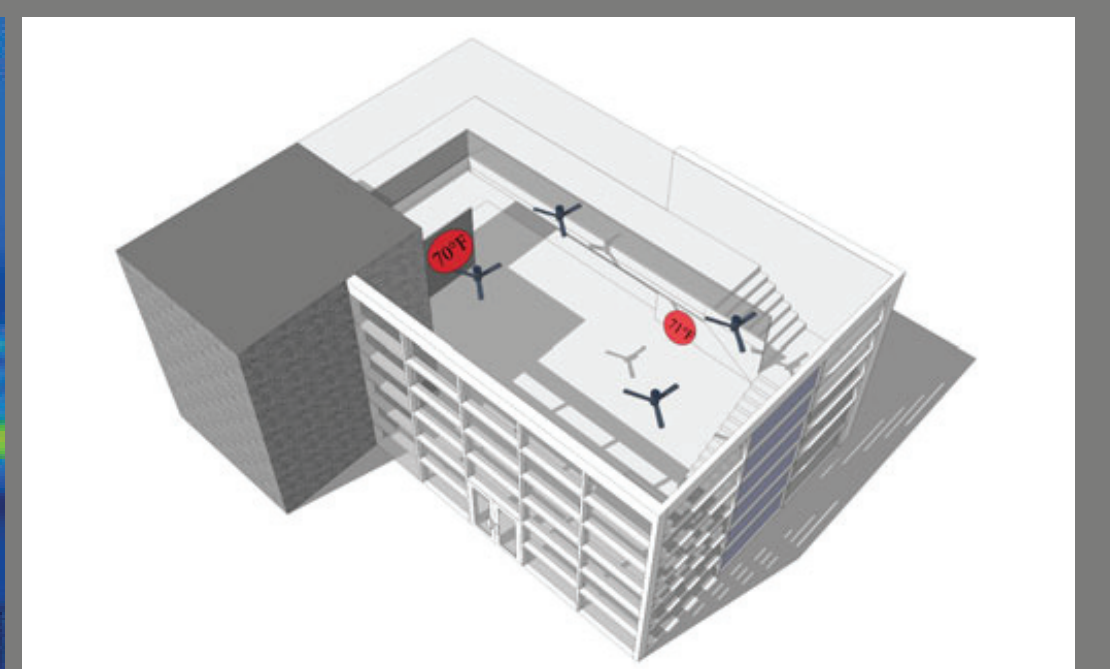
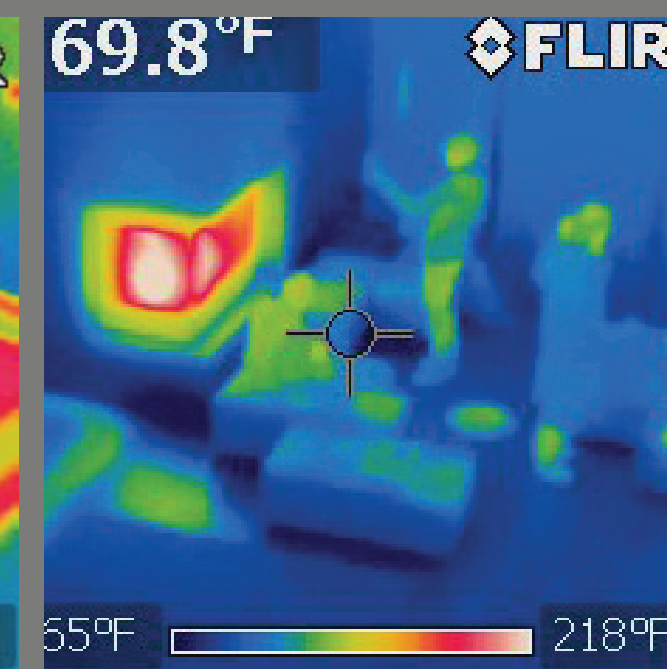
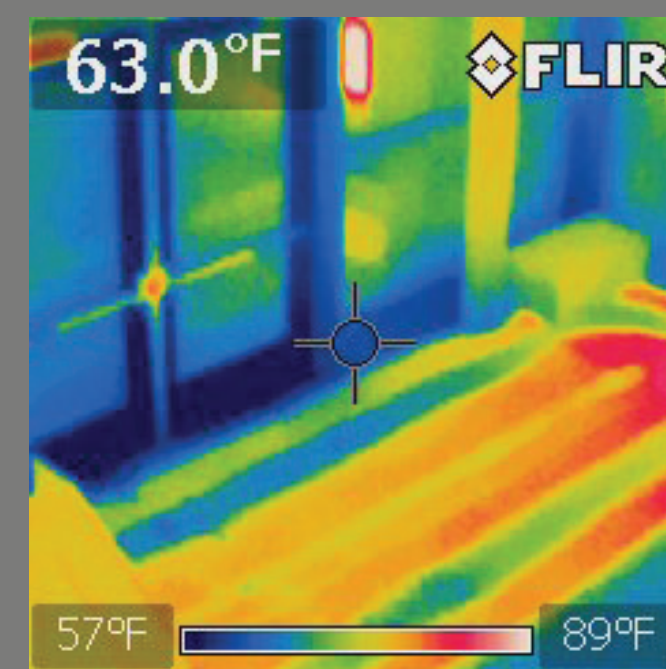
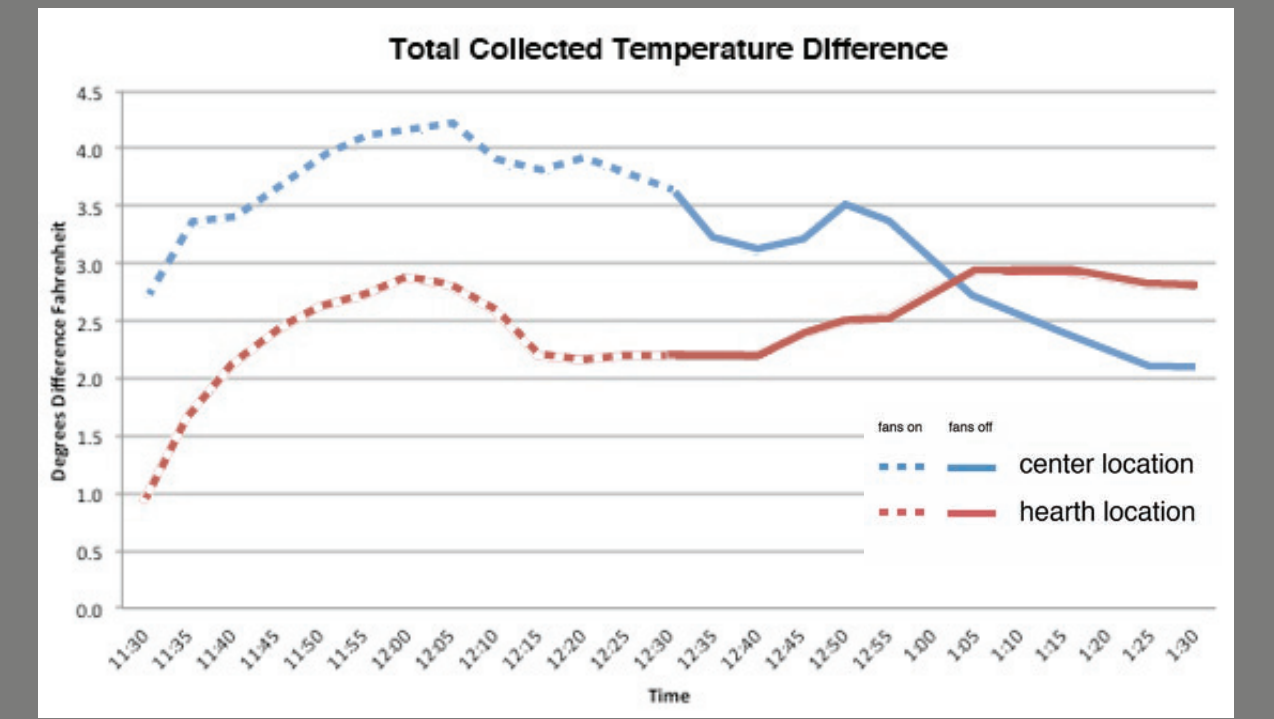
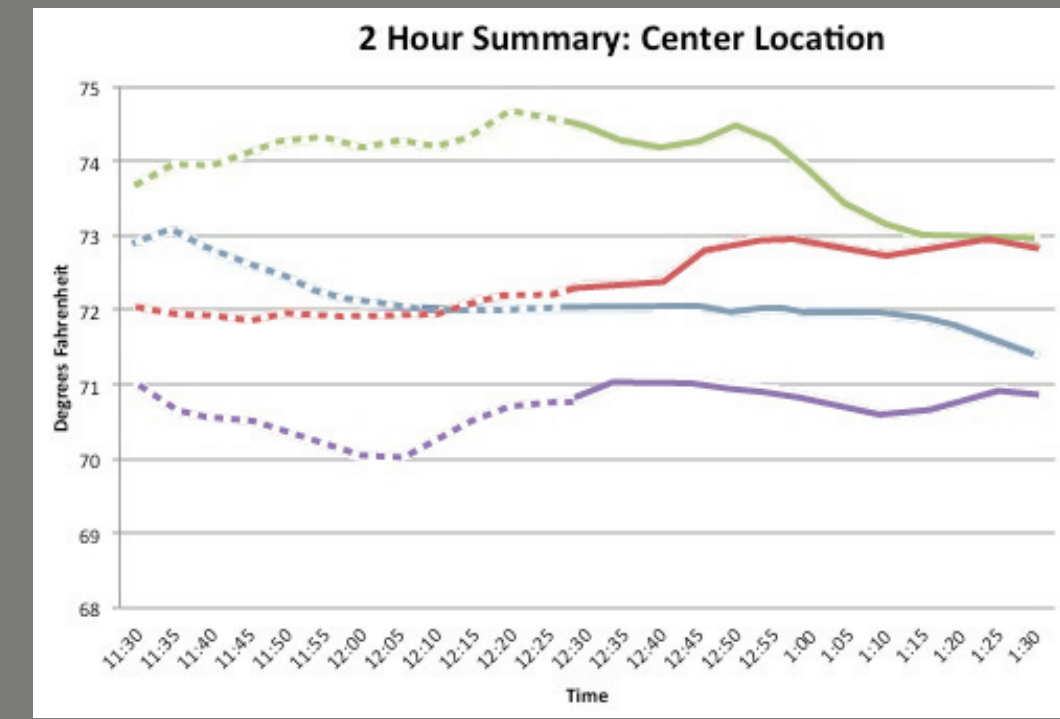
THE FINDINGS

Our data shows that the greatest vertical difference in temperature of the atrium space is more than 2 ° F with the fans on. The temperature difference was lower with the fans off, and after an hour of equilibration, even converged to 1.163° F.

The hypothesis that the vertical temperature differences would be diminished to within 2° F when the fans were on was disproved based on this small sample of data. In fact, temperature differences were within 2° F when the fans were off, but reached a maximum difference of 4.22° F when the fans were on and the highest temperatures were centered around the 10' Hobo placement.



Surface Temperatures



Surface Temperatures

CONCLUSION

There is a vertical temperature gradient in the space which is readily identifiable; however, with the use of the fans, the maximum vertical temperature differences were greater than 2 ° F. In fact, with the fans on, the middle zone was greater than 4° F. We believe that the fans are affecting the downward movement of warmer air; however, this does not appear to contribute to a diminished vertical temperature difference, but rather a concentration of warmer air in the center of the atrium space. Furthermore, the observed effect is primarily statistical, but not practical, since the temperatures at the 5' placement, the occupant level, stay consistent whether the fans are on or off.

In conclusion, this hypothesis was proven incorrect, in that the vertical temperature gradient of the atrium was greater than 2° F with the ceiling fans off and even greater than 4° F with the fans on. Further investigation is warranted to be able to trend this more conclusively, as well as determine the movement of the air within the space. If these trends are corroborated, then the energy expenditure for the use of the fans may not be warranted.