



BIG ASS FANS

**EXCEPTIONALLY
ENGINEERED**

BIG ASS FANS IMPROVE COMFORT, INCREASE OPERATIONAL EFFICIENCY IN WAREHOUSE NETWORKS

The implementation of fans is a cost-effective, repeatable way to provide a significant cooling effect and dramatically improve occupant thermal comfort; leading to reduced heat stress, increased productivity, and improved employee morale. This white paper summarizes the findings of an in-depth pilot project study BAF completed at a more than 1MM square-foot fulfillment center in the Pacific Northwest that was expanded across more than 50 similar facilities nationwide.

BACKGROUND:

Sortation and fulfillment areas in modern warehouse and distribution facilities can be extremely challenging work environments. As the amount of automated equipment and the number of associates increase to meet today's e-commerce and supply chain needs, the HVAC equipment in initially well-conditioned spaces can quickly become insufficient, leading to increased temperatures that decrease productivity and increase heat stress. For unconditioned facilities, the impact of high-heat work environments can be dramatic.

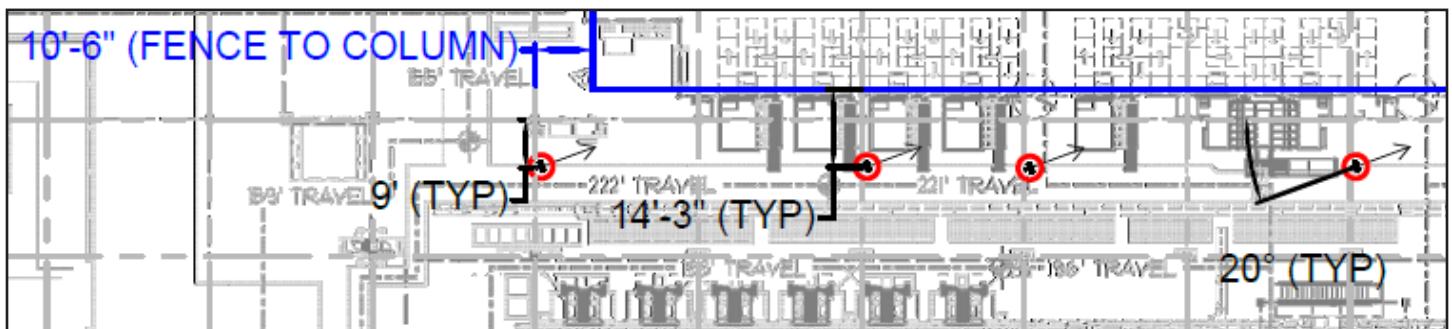


AirEye fans in testing locations on the 4th floor.

PROJECT SCOPE:

The primary areas of concern for the pilot facility focused on areas where equipment and associate density was the highest. Specifically, the upper levels of a mezzanine where associates pick and stow purchased or newly stocked items. Due to the high density of obstructions/occupants and the low ceiling heights in these mezzanine areas, overhead fans were not a viable option for employee cooling. Though the thermostat for the facility was set to 72 degrees Fahrenheit, operations management continued to receive complaints about the heat in these areas - particularly from the upper mezzanine levels.

BAF's proposed solution provided a 24-inch [AirEye](#) fan at an interval of approximately every three workstations. As a validation test, BAF conducted occupant thermal comfort surveys from associates in the designated testing area both before and after the test fans were installed. Additionally, air velocity, ambient air temperature, and relative humidity measurements were collected in the test area both before and after the test fans were installed using small data loggers and a hot wire anemometer. These test measures allowed for both a quantitative analysis (from ASHRAE 55 / [CBE thermal comfort calculations](#)) and a qualitative analysis (from employee surveys) that ensured the fans were providing a significant cooling benefit.



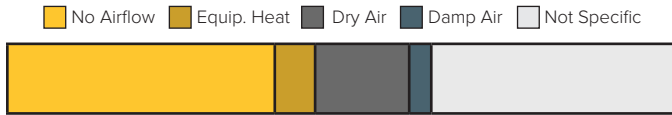
Typical fan positioning in pick/stow areas.



KEY DATA AND OUTCOMES:

More than 62% of occupants identified specific issues related to discomfort in their work environment that can be improved through the implementation of fans. It is known that fans can increase airflow. In addition, the airflow provided can disperse heat generated by nearby equipment, and improve the perception of overly damp and dry environments by disrupting stagnant microclimates that can develop in obstructed spaces. Furthermore, the afternoon and evening hours were identified as the most common times for discomfort, supporting the hypothesis that thermal stress is the root cause.

What Makes Your Work Area Uncomfortable?



When is Your Work Area Uncomfortable?



Following the installation of fans, employees were asked if they noticed the new fans. **The responses were overwhelmingly positive.** Only 3% of respondents identified a negative response to the implementation of the fans and while distinctively positive responses came in at 34%, the fact that the fan solution was not disruptive to existing workflows led to 62% of respondents identifying with either a neutral response or stating that they did not notice the fans at all; creating a comfortable environment without negatively impacting aesthetics or acoustics.

Did You Notice the New Fans?



A comprehensive occupant thermal comfort analysis was completed both before and after the installation of fans. The analysis showed both qualitative and quantitative improvements in thermal comfort. Occupant-level airspeeds were measured both before and after fan installation while indoor air temperature and relative humidity were tracked throughout. This was done to ensure the conditions within the facility were comparable and that any abnormal or sudden changes in conditions that can lead to changes in physiological and psychological perceptions of thermal comfort were accounted for (none were observed). The below summary shows the observed improvements in airspeed, observed conditions, occupant comfort, and resulting cooling effects.

Condition	Avg Temp / RH	Maximum Air Speed	Occupant Sensation	Pred. Mean Vote	Effective Temp
Pre-install	70.4 F / 32.7%	7 feet/min	Slightly Warm	0.51	81.2 F
Post-install	70.0 F / 34.6%	137 feet/min	Neutral	-0.5	72.7 F
Change	-0.4 F / +1.9%	+130 feet/min	Improved	-1.01	-8.5 F

These **improvements** in thermal comfort lead to significant **operational efficiency** improvement and **cost savings**. The mechanism for these savings is related to [extensive research](#) that shows when your employees suffer, so does their work (and your bottom line). Heat stress in environments where the effective temperature is above 77 degrees Fahrenheit leads to productivity losses (e.g. productivity at 85F is 8.8% less than at 77F). By reducing the effective temperature with cooling air movement from fans, **productivity losses can be mitigated**, occupants can produce more, with fewer errors, and in a safer environment. **While exact savings will depend on the number of employees, their hourly wages, and local conditions, the aforementioned facility in the Pacific Northwest is estimated to save in excess of six figures per year.**

FURTHER ACTIONS:

Occupants and stakeholders across all levels of the organization were so pleased with the solution performance at the pilot facility in the Pacific Northwest that the project was used as the basis of design for more than 50 other locations nationwide. BAF partnered with other working groups in the customer's organization and outside contractors to develop easy-to-follow design standards for similar facilities and functional areas. **The development of these standards dramatically reduces the amount of design time spent for subsequent BAF projects in your organization; maximizing return on investment for each site while making the rapid network-wide implementation of a solution a reality.**

