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Big Fans Keep Manufacturing Costs Down

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Productivity remains high

The Midwest is known for its muggy and blistering hot summer days, and winter can pump out some extreme days of her own. That makes a building the size of **Perfection Spring and Stamping** a real challenge to heat and cool. The 70,000 square foot (ft2) building is brick with a tar roof and was built in 1965, before builders were paying much attention to energy efficiency.

Joshua Kahn, vice president of Operations, says employees did what they could to keep cool during the summer months. "Typical of most companies," he says, "we used a lot of floor flans. I'd say we had about 60 of them."

And as is typical, the fans created more problems than they solved. "Employees would fight over them," says **Kahn**. "Some would complain that the fans weren't blowing on them enough; others would say the fans were blowing on them too much. We couldn't win."

Besides, the fans were always breaking down. "At any given time," says **Kahn**, "we had ten of them in the repair shop. They get dirty, the cords rip, and floor fans can also present a huge safety problem."

"We looked into air conditioning the building, but the costs were phenomenal–$180,000-$220,000 when you figure in insulation, duct work, and electricity."

Then **Kahn** came across an article about the "Big Ass Fans Company" in a trade magazine. To him, the physics of these high-volume/low-speed fans made sense.

The fans are big–ranging in diameter from 6 to 24 feet (ft). Each fan generates a column of air greater than its diameter beneath it. When the fan's air column hits the floor, its deep air jet radiates out in all directions. As the jet moves out from the center and hits walls and partitions, air moves to the ceiling and re-circulates through the fan. This creates convection-like currents that gain momentum over time. If several fans are mounted near one another in a very large space, the adjacent floor jets act like vertical partitions, and improve the impact of each individual fan.

Perfection Spring and Stamping installed four fans, but **Kahn** explains that is just the beginning, "We've discarded most of the floor fans. In fact, I think we only have four left, and we'll be able to get rid of them, too. We're adding more fans to areas we didn't think we could because of ceiling drops and columns."

"You don't have to be under it to feel the breeze," says **Kahn**. "You can be 30 ft away and still feel air movement. It can be 95 degrees in the plant, and with the fans, it's still 95 degrees, but it feels less hot with air moving over your skin."

Kahn knows that large or small, fans do not cool air. They do, however, work with the human cooling system. When perspiration evaporates off the body, it feels cool because evaporation moves body heat away from the body.

The airflow of a large-volume, low-speed fan allows the body's natural cooling mechanism to operate as effectively as possible. It also reduces humidity, which adds to the feeling of comfort.

Fans are great for cooling down employees, but fan speeds of over 300 fpm can create an air current that is unpleasant and disruptive. And, the air jet created by small high-speed fans **Kahn** had been using dissipates over a short distance, creating uneven air movement throughout the building. For this reason, a gentle breeze created by slow moving fan blades is more effective at cooling. Think of the fans swirling slowly above the heads of Humphrey Bogart and Ingrid Bergman in Casablanca. High-volume, low-speed fans work on the same principle.

Large fans can improve comfort even in air-conditioned spaces. The best-designed air conditioning system will generate an air throw of just over 10,000 cubic feet of air per minutes (cfm) per 100 tons, which is felt only by those working closest to the air registers. A single 24-ft diameter Powerfoil fan displaces air at a rate of about 337,000 cfm. The moving air can be felt at a minimum of 5,000 ft from the center of the fan.

To workers, this slow moving air can make the facility's air temperature feel 8 to 12 degrees cooler than the thermostat actually registers. This creates significant savings in operating costs. Conservatively, a facility realizes 5% savings in air conditioning costs for each degree the thermostat is raised. This means a 20% savings for a thermostat set at 82 degrees Fahrenheit instead of 78 degrees.

"We've eliminated floor fans, so we've saved in maintenance costs and in cooling costs," says **Kahn**. It's also eliminated tiffs among employees."

Bring on the Heat

Kahn says heating a plant like his is a big, expensive job. "We have 24-ft high ceilings," he says. "Heat rises, and we were spending lots of money heating a space where there were no workers. Besides that, all the heat was going out the roof. The fans have helped us bring the heat down to the floor." According to Michigan Consolidated Gas Company, compensating for this kind of stratification of air in high-ceilinged facilities is the single

biggest waste of energy in buildings today. With one to two horsepower motors (depending on fan size), Big Ass Fans offer a relatively inexpensive and efficient way to destratify the air, by bringing the heat down from a plant's upper reaches to mix with cooler floor-temperature air. That means turning down thermostats at floor level.

Fans that cool in summer and heat in winter seem counter-intuitive, but it all depends on the speed at which the fans rotate. The slower rotation of fans in the winter moves huge volumes of air more slowly than it does in summer conditions. By doing so, the fans force heat that collects near the ceiling to be distributed more evenly throughout the facility.

Kahn and his colleagues noticed the effects immediately. And although there has been no formal energy audit at the company, he feels they're saving several thousands of dollars in heating costs. "We had a $36,000 yearly gas bill. We can now keep thermostats set at a lower temperature. This saves us money."

Taking care of employee comfort means more than just saving money on energy costs. Research has proven that worker satisfaction with the plant environment translates to as much as a 15% increase in productivity. Improvements in climate conditions are the biggest contributing factor. That's because temperature, humidity, and air circulation make the most immediate and noticeable difference to employees. According to Carol Lomonaca and Dennis Miller, writing in the ASHRAE Journal, even as little as a 3% productivity gain can translate into nearly $3 million gain in a 500,000 ft2 facility.