

FLORIDA SOLAR



ENERGY CENTER®

Fans to Reduce Cooling Costs in the Southeast

Author

Chandra, Subrato

Publication Number

FSEC-EN-13-85

Copyright

Copyright © Florida Solar Energy Center/University of Central Florida
1679 Clearlake Road, Cocoa, Florida 32922, USA
(321) 638-1000
All rights reserved.

Disclaimer

The Florida Solar Energy Center/University of Central Florida nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the Florida Solar Energy Center/University of Central Florida or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the Florida Solar Energy Center/University of Central Florida or any agency thereof.



Fans to reduce cooling costs in the Southeast

Subrato Chandra Ph.D.
 Director of Research & Development
 Florida Solar Energy Center

FSEC-EN-13-85
 October 1985

During the hot, humid summer months in the southeastern U.S., air conditioning costs are a substantial part of the average home's utility bill. In Florida, for example, air conditioning accounts for about 30 percent of the annual utility bill for an all-electric house. Fans can help lower air conditioning costs.

There are three generic types of fans to reduce summer air conditioning costs: air circulating fans to create air motion which increases comfort, whole house fans to promote fresh air exchange, and attic vent fans to lower attic temperatures.

Air circulating fans

Air circulating fans, such as ceiling, oscillating or box fans, create air motion that permits comfort at higher temperature and humidity levels. See Figures 1, 2 and 3. This effect allows the air conditioner thermostat settings to be raised 2-6°F, and each degree of increase saves about 8 percent in cooling costs. For example, a 4°F increase saves 32 percent in air conditioning costs. Air circulation fans can also extend the natural ventilation season by allowing homeowners to keep air conditioners off during more pleasant summer days.

A do-it-yourself homeowner can install four ceiling fans and purchase two oscillating fans (to use in kitchen or patio areas) for about \$300. If they are installed in an average Florida household with an air

conditioning bill of \$350/year (\$.10/kWh), they will pay for themselves in energy savings in less than three years. Payback periods depend on a home's location, the efficiency of its air conditioner and the homeowner's personal preferences. See Table 1 for the power consumption of air circulating and other types of fans.

Table 1. Power consumption of air conditioning fans (Watts)

	Fan Speed Setting		
	High	Medium	Low
48" ceiling fan	75	40	15
12" oscillating fan	42	34	27
20" box fan	160	104	74

As you can see ceiling and oscillating fans consume less energy than an ordinary light bulb. However, tests reveal that box fans consume more power than do ceiling fans or oscillating fans, so box fans are not recommended. Oscillating fans are convenient for kitchen or dining areas and may be wall mounted if floor or counter space is at a premium. Ceiling fans do not take up floor space, but they can be difficult to install, particularly if the room has no ceiling light fixture. See the October 1984

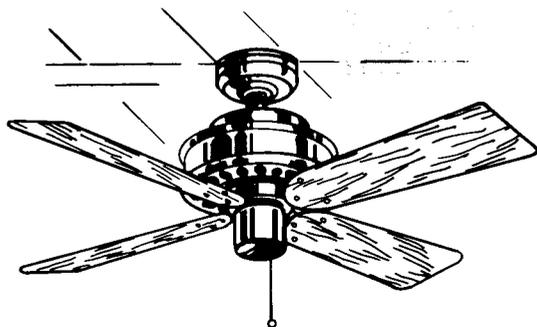


Figure 1. Ceiling fan

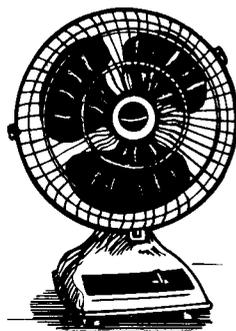


Figure 2. Oscillating fan

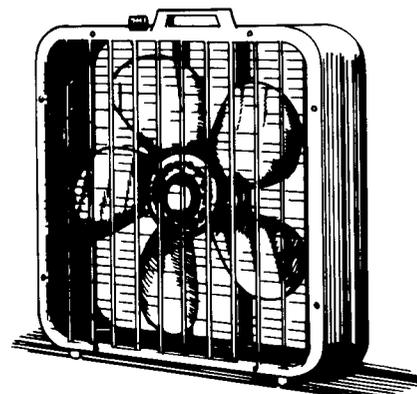


Figure 3. Box fan

issue of *Popular Science* magazine for tips on mounting ceiling fans in difficult locations.

What size fan do you need?

Air circulating fans are not subject to a standard industry rating system. Typically, ceiling fans are effective 4-6 ft. from center; however, their ability to move air varies from manufacturer to manufacturer. Top-of-the-line 52-in. fans can be effective 8-10 ft. from the fan's center. See Figure 4. In general, larger fans create better air movement. In bedrooms, 36-in. ceiling fans are adequate if the bed is directly under the fan. However, 48 to 56-in. ceiling fans are recommended for family and living areas. Two ceiling fans are needed in rooms longer than 18 ft. See Table 2 for minimum recommended ceiling fan sizes for a given room size.

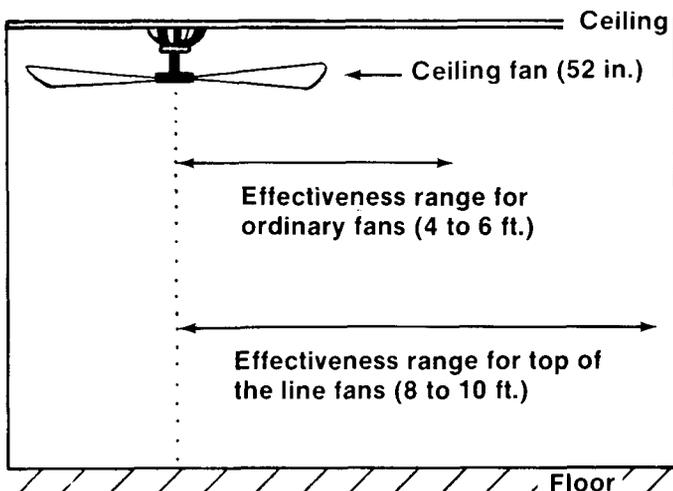


Figure 4. Distance (effectiveness range) for which ceiling fans are effective.

Twelve-inch oscillating fans are adequate for kitchen or dining areas. Use 16-in. oscillating fans for patios or larger rooms. See the July 1982 issue of *Consumer Reports* for brand-name fan ratings.

For maximum performance, ceiling fans must maintain an adequate clearance between the fan blades and floor, and between the fan blades and the ceiling. A minimum clearance of 7 ft. between the fan blades and the floor is recommended for safety. FSEC tests show that air circulation increases when the blade-to-ceiling clearance increases. A 6-in. clearance is a bare minimum, because fan performance drops sharply when the blade-to-ceiling clearance is less. FSEC tests also show that "ceiling-hugger" fans provide 40 percent less air motion than do standard ceiling fans, even when a 6-in. clearance is maintained. Thus, standard ceiling fans with 8-10 in. blade-to-ceiling clearance are recommended.

Table 2. Ceiling fan sizing chart

Largest Dimension of Room	Minimum Fan Diameter (in)
12 ft or less	36
12 - 16 ft	48
16 - 17.5 ft	52
17.5 - 18.5 ft	56
18.5 ft - or more	2 fans

Largest Dimension of Room	Minimum Fan Diameter (in)
12 ft or less	36
12 - 16 ft	48
16 - 17.5 ft	52
17.5 - 18.5 ft	56
18.5 ft - or more	2 fans

What about reversible ceiling fans?

Reversible ceiling fans have a switch that changes the direction of fan blade rotation. This feature is standard on many of today's brands.

In theory, reverse fan rotation is good for winter use because the fan blows air up, creating very little air motion between the fan blades and the floor. The upward air motion supposedly reduces room air stratification by forcing hot air downward, thus allowing lower thermostat settings and reduced heating bills. Reverse fan operation may be beneficial in rooms with high, vaulted ceilings, such as churches, but operating data measured in U.S. Air Force hangars disproves this theory.

In high, cathedral-ceiling spaces where direct solar window gain can cause extensive thermal stratification of the air, ceiling fans operating at low speed can be beneficial as a means of moving warm air down in winter. However, even under these circumstances, ceiling fans should probably not be operated in reverse mode. For normal 8 ft. ceilings, reversible operation of ceiling fans is not recommended.

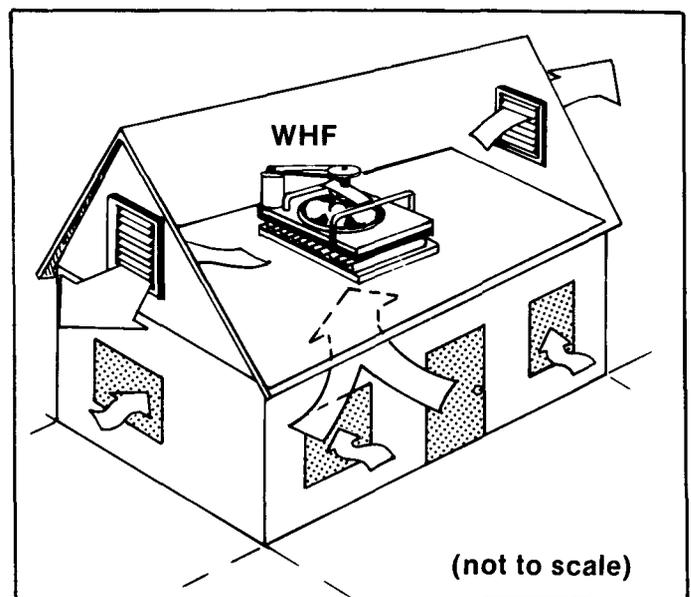


Figure 5. Whole house fan

Whole house fans

Whole house fans (WHF) can ventilate and cool buildings in locations where calm winds prevent ventilation through open windows alone. Although WHFs create some air motion, ceiling fans and oscillating fans are still recommended for comfort cooling in homes with whole house fans.

WHFs operate by pulling air in through windows and exhausting it through ceilings and attics. See Figure 5. A WHF that is centrally located in a home draws air in from all over the house, and it is not necessary to fully open windows to ventilate with a WHF. Windows can be opened only 4 or 5 inches and fixed in a secure position with stops or window locks. For effective ventilation, the total open window area should be approximately twice the open area of the WHF if the windows do not have insect screens. For example, a WHF with a 24-in. blade diameter has an open area of $3.14 \times 576/4 = 452$ square inches. The open window area should be three times the WHF open area if the windows have insect screens.

Attic vents must be larger than normal for effective WHF ventilation. The free-exhaust vent area should be approximately twice that of the WHF area. A total vent cutout area (add all cutout areas for gables, turbine vents, ridge vents, etc.) equal to four times the WHF open area can satisfy this requirement.

WHFs might be noisy, and they consume between 300 and 500 watts of electricity. WHFs may also be difficult to install. Usually ceilings and trusses must be cut and electric boxes installed. A do-it-yourself homeowner can purchase a WHF for about \$250. Installed costs run between \$400 and \$500. Despite the installation difficulties and the cost, WHFs can be a viable alternative in windless locations, densely developed neighborhoods or townhouses. See the July/August 1980 issue of *Rodale's New Shelter* magazine for more information on the purchase and installation of whole house fans.

What size WHF do you need?

Whole house fans can provide about 20 air changes per hour or 0.33 air changes per minute. We recommend sizing WHFs using a cubic-foot-per-minute (CFM) rating that is equal to multiplying the house volume (square footage of floor area x ceiling height in feet) by 0.33. The manufacturer's CFM rating should be equal to or greater than the calculated rating. For example, a home with an 8-ft. ceiling and 1500 square feet of floor area has a volume equal to 12,000 cubic feet. Therefore, the CFM rating required is $0.33 \times 12,000 = 3960$.

A 24-in. WHF would be generally adequate for this example.

WHF manufacturers use two types of CFM ratings. Some manufacturers list the free-air CFM rating, which is the maximum CFM possible. Others give the CFM rating under a static pressure (SP) drop of 0.1 inch of water. Use this 0.1-in. rating to select a WHF. If the manufacturer's CFM rating does not state the pressure drop, assume that the rating is for free air. Subtract 15-20 percent from the free-air CFM to get the 0.1-in. SP rating.

What about window mounted box fans?

As a low-cost alternative to WHFs, many homeowners mount ordinary box fans in windows to draw outside air in. This practice is not recommended. During rainstorms, window-mounted box fans are subject to electrical shorts that can create fire or shock hazards. Instead, consider exhaust fans that are specially designed for window mounting. Such fans exhaust air out through one window while drawing fresh air in through other open windows.

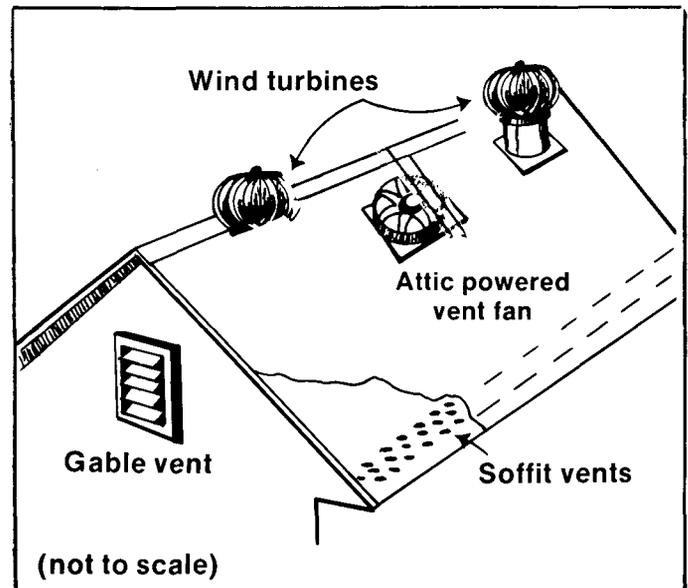


Figure 6. Powered attic vent fan and wind turbines

Attic vent fans

Powered attic vent fans ventilate just the attic and not the interior of the house. See Figure 6. Frequently, attic vent fans are thermostat controlled and run only when the attic gets hot. Attic vent fans operated by a manual switch are also available.

Data measured at FSEC and elsewhere show that attics with nominal natural ventilation and R-19 ceiling

insulation do not need powered vent fans. Such fans cost more to operate than they save in reduced cooling costs, so they are not recommended.

Consider the following alternatives in place of attic vent fans:

1. In new houses, install R-19 ceiling insulation with an attic radiant barrier. In existing homes, install an attic radiant barrier. See FSEC publications DN-6 and DN-7 for tips on using and installing radiant barriers.

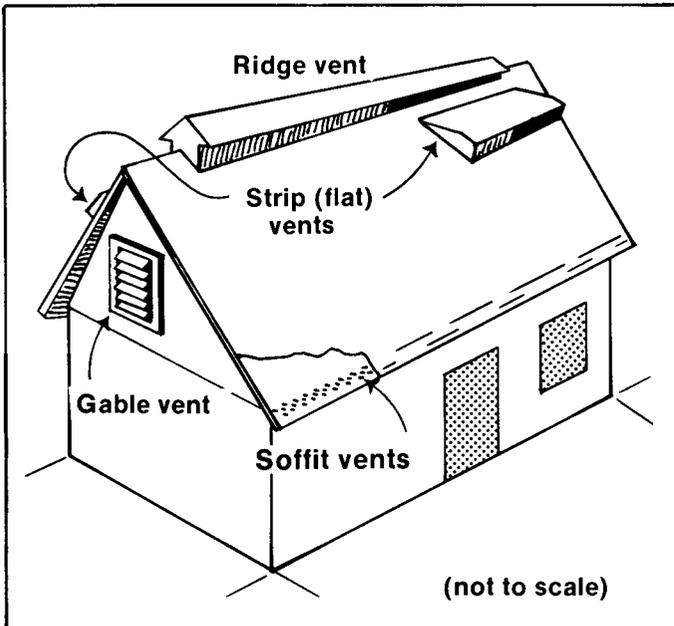


Figure 7. Ridge, gable and strip (flat) vents

2. Use continuous soffit vents at eaves and ridge vents at the roof peak to increase natural attic ventilation. For gabled roofs, gable vents may also be used. In all cases, use vents near the peak of the roof (either well-installed ridge vents at roof peak or strip vents near the roof peak). See Figure 7. Avoid wind turbines. They work when new, but often become noisy and leaky after a few years.

Conclusion

In the hot, humid Southeast, fans can make people more comfortable and reduce air conditioning costs. They can improve interior ventilation and allow thermostat settings to be raised without sacrificing comfort. The use of ceiling fans and oscillating fans are effective cooling measures that should be considered and implemented where feasible by any homeowner in the Southeast.

© Copyright 1985 by Florida Solar Energy Center.



"Renewable Energy for Florida"

FLORIDA SOLAR ENERGY CENTER
State University System of Florida