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Dealing with Heat and Humidity in Florida Homes

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Energy Note

Dealing with heat and humidity in Florida homes

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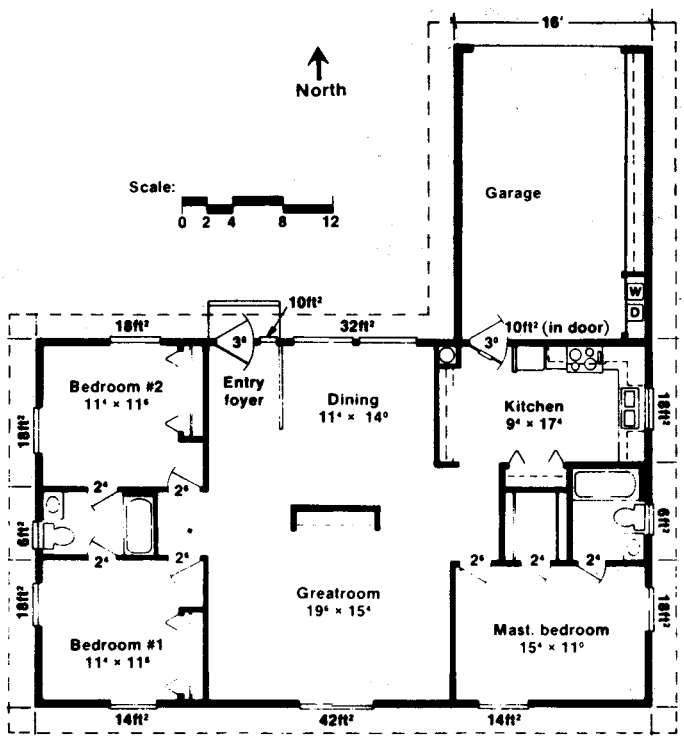
Energy conservation is the solution to the problem of high electric bills. Much is known about home heating conservation, but conservation measures for cooling are not as well-known or widely practiced. This energy note focuses on heat and humidity sources that cause Floridians to run their air conditioners. It also presents conservation techniques that will reduce those air-conditioning requirements.



Base case residence

To illustrate residential heat and humidity sources, we've modeled a "base case" house that is fairly representative of most new, single-family residences located in Central Florida. The residence has the following characteristics:

- Size: 1500 ft², plus garage
- Construction: 2x4 frame
- Roof: medium color, hipped, with 2' overhang on all sides
- Exterior finish: light, earth-tone color
- Insulation: R-11 walls, R-19 ceiling
- Exterior wall area:
  north and south - 330 ft² each
  east and west - 198 ft² each
- Windows: double glazed
- Window area (15% of floor area):
  north and south - 70 ft² each
  east and west - 42 ft² each
- Window covering: Light colored, close-weave draperies

Air-conditioning load sources

We simulated the existence of our base case home on a computer, using a detailed analysis program to determine the home's air-conditoning load. The load is the amount of heat and moisture that the air conditioner must remove from the building. The computer simulation assumed that the occupants were a family of two adults and two children, with one adult and one child home during the day and all four home in the evening and at night. Figure 1 shows the air-conditioning load sources for the base case residence.

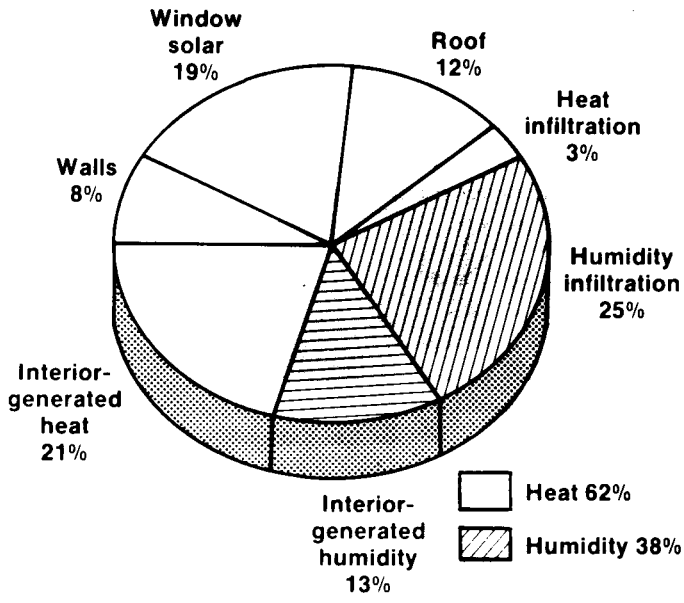


Figure 1. Annual air-conditioning load sources for base case residence in central Florida. Total Load = 23.4 KBtu/ft²

Note that fully one third of the load is generated within the residence. These internal loads are largely caused by heat and moisture given off by people. Appliances add to this load, particularly the refrigerator since it runs all the time. Cooking and bathing are two other load sources. Our model assumed that the clothes washer and dryer, along with the water heater, are located outside the conditioned space, otherwise these appliances would introduce more heat.

Infiltration of air into the house accounts for 28% of the load. The major portion of this load is humidity. The largest sources of infiltration are doors, windows, electrical outlets, penetrations through exterior walls, ducts, air handlers and wall sill plates that are not well sealed, and vent fan or fireplace dampers that do not totally seal.

Solar radiation through window glass is responsible for 19% of the air-conditioning load. The windows have two-foot overhangs and are shaded by interior draperies. Sixty two percent of the window area is on the north and south sides, where little direct solar radiation penetrates. Residences with less shading or different orientations could have much larger loads from solar radiation through windows.

Only 20% of the load is caused by solar-generated heat from the roof and exterior walls, although most people assume that these structural components account for a larger part of the cooling load. Less insulation or darker walls and roofs than in our base case house would result in a greater load. Simulation results show that the same residence with concrete block walls and R-2.7 wall insulation has an increased wall load of 88%; however, the total cooling load increases by only 8.5%.

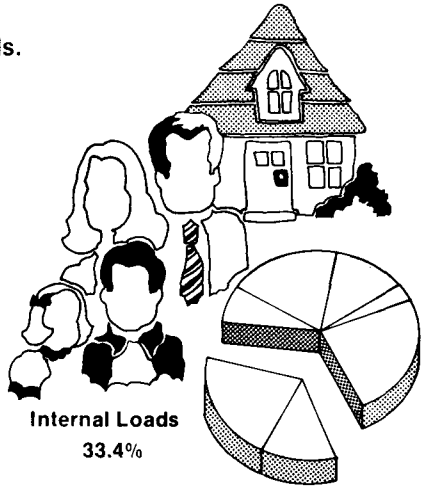
Figure 1 indicates that 38% of the air-conditioning energy in the base case house is used to remove moisture. A typical vapor-compression air conditioner would maintain an average relative humidity of between 60-65%. If the heat (not moisture) load were reduced, the air conditioner would not run as long, and the relative humidity in the house would be higher.

While this simulation was done for a house in Central Florida, simulation results for homes in other climate regions indicate that the basic distribution of air-conditioning load sources appears to be similar across the entire Southeast.

Conservation cooling remedies

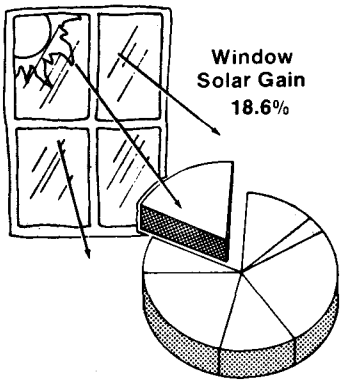
Now that we have identified air-conditioning load sources, we can determine possible heat gain prevention techniques for each source. Figure 2 lists remedies for each air-conditioning load source. Each remedy within a section is listed in approximate order of greatest return on initial cost when building a new home. As many of these remedies as possible should be included when building. Simulation results indicate that savings from these combined remedies can reduce the base case air-conditioning load by one third or more.

Figure 2. Remedies for reducing cooling loads.



Internal loads

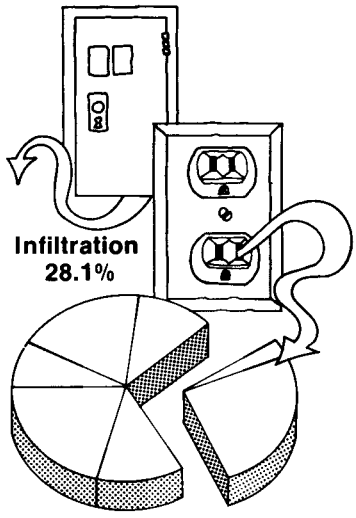
1. Put hot water tank, clothes washer, clothes dryer in un-conditioned space.
2. Turn off all appliances and lights when not in use.
3. Use fluorescent lighting instead of incandescent lighting.
4. Provide exhaust fans in bath and kitchen, preferably with time switches.
5. Purchase the most energy efficient appliances, especially the refrigerator.
6. Provide outdoor eating and cooking areas, and use a microwave oven whenever possible.



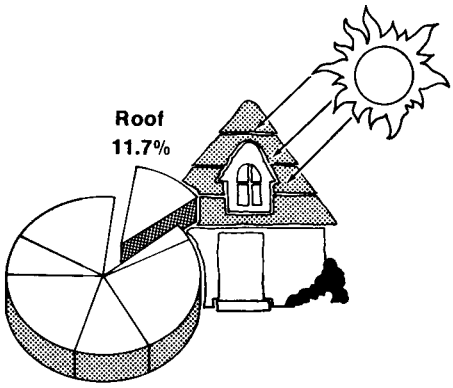
Windows

1. Reduce window area. Start by reducing or eliminating east and west windows.
2. Provide exterior shading. Use overhangs, trees, awnings, shutters or sun screens. Consider building wide porches all around the house.
3. Provide glass treatments for reflectance of solar gains — window films, window tint.
4. Provide interior treatments - white-backed opaque shades, blinds and draperies.

Infiltration



1. Caulk all holes in wall top plates and ceilings, where electrical and plumbing systems go into and out of attics.
2. Place air handler and duct work in conditioned space.
3. Caulk between wall sill plate and floor slab.
4. Ensure that all vents and fireplaces have dampers that totally seal.
5. Wrap outside of house with vapor permeable infiltration barrier.
6. Seal all exterior penetrations (bath, kitchen, and dry vents; fireplace dampers, chimney penetrations and outside faucets).
7. Caulk all window and door frames.
8. Provide glass doors and combustion air ducts for fireplaces to isolate the firebox from inside air.
9. Use windows with the lowest infiltration ratings, and use well sealed exterior doors.
10. Provide gaskets and child safety caps for all electrical outlets.

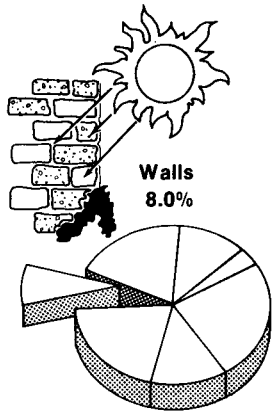


Roofs/attics

1. Use light colored roof materials.
2. Use radiant barrier roof system and R-19 ceiling insulation.
3. Provide ridge vents at all peaks and soffit vents at all eaves.
4. Save or plant tall trees around house to shade roof.

Walls

1. Orient house with longest walls facing due north and south, and reduce size of east and west wall areas.
2. Place unconditioned spaces (garages, closets and any other buffer spaces) on east and west sides.
3. Use calculated roof overhangs to shade the south wall in summer. They may also be used to help shade the other walls.
4. Use light colored exterior materials.
5. Save or plant trees and shrubs to shade walls.
6. Insulate all walls to R-11.
7. Use radiant barrier wall systems for unshaded east and west walls. Do not use radiant barrier systems on south walls.
8. Use screened or covered porch areas to shade walls of conditioned space.



Other remedies

There are other ways through which to reduce air-conditioning costs. These options include turning up thermostats, maintaining comfort by dressing for the season and using fans to increase airspeed. Installing high-efficiency air conditioners can greatly reduce air-conditioning bills. Using passive cooling techniques can offset air-conditioning use. Further information on these options is available by requesting the following free publications from the Public Information Office of the Florida Solar Energy Center.

A checklist for building an energy efficient home in Florida, by Michael Houston and Subrato Chandra. Order No. EN-10.

Designing and installing radiant barrier systems, by Philip Fairey. Order No. DN-7.

Fans to reduce cooling costs in the Southeast, by Subrato Chandra. Order No. EN-13.

Landscaping for energy conservation, by Magdy Girgis. Order No. EN-12.

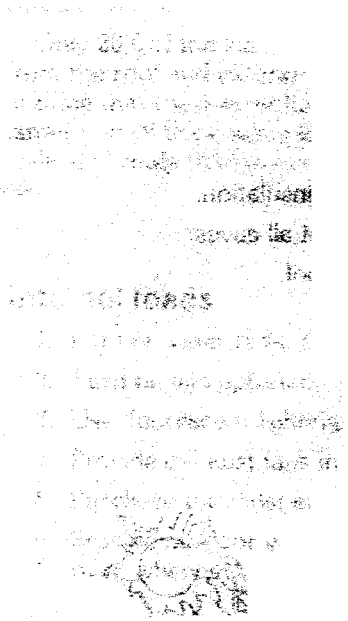
Passive cooling and human comfort, by Philip Fairey. Order No. DN-5.

Passive cooling ideas for the Southeast, by Chris Beck. Order No. EN-2.

Radiant energy transfer and radiant barrier systems in buildings, by Philip Fairey. Order No. DN-6.

Techniques for structural shading, by Philip Fairey and Ross McCluney. Order No. DN-2.

Window treatment for energy conservation, by Ross McCluney. Order No. EN-4.



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