HVAC Systems: *Size Matters*

Builder's Experience

EASE OF INSTALLATION
DIFFICULT — EASY

SPEED OF CONSTRUCTION
SLOWER — FASTER

COST EFFECTIVENESS
POOR — EXCELLENT

RETURN ON INVESTMENT
IMMEDIATE — DEFERRED

COMPETITIVE EDGE
NONE — SIGNIFICANT

HOMEOWNER INTEREST
LOW — HIGH

Challenges: Educating HVAC contractors on the importance of proper sizing.

Would he do it again? Yes

PATH Attributes:

- Affordability
- Energy Efficiency
- Environmental Performance

Builder Tips: "Evaluate the whole house before making improvements."

Remodeler:
Carl Seville
Principal, Seville Consulting
Decatur, Georgia

Remodeler Type:
Green Building Consultant

The Technology:
Right-sized HVAC Systems

The Project:
Historic Home Renovation
This 1918 home in an historic district in Atlanta was expanded by 2,400 sq. ft. using energy efficiency principles. Proper HVAC practices significantly reduced the home's energy use and improved indoor air quality. The project won the 2006 NAHB Green Project of the Year award.

"We've been in situations where we could take a ton or more off the HVAC system by doing a careful and accurate Manual J load calculation."

– Carl Seville

SEVILLE'S STORY

"When I remodel a house, I look for every opportunity to incorporate energy efficiency because I know this will result in a quality, healthy home—which appeals to every homeowner," says Carl Seville. "One key step is properly sizing the HVAC system using the industry standard, Manual J."

The Air Conditioning Contractors of America's (ACCA) *Manual J, Residential Load Calculations*, is the accepted industry standard, approved by the American National Standards Institute, for the proper sizing and selection of HVAC equipment in residential homes.

"How many customers have asked for a Manual J calculation?" asks Seville. "To date: exactly none. My customers may not realize the mechanics behind the scenes, but they sure are happy with the end result."

HVAC and ducts are located in conditioned space because of insulation in the roof line. The unit was also strategically placed in the middle of the attic to shorten duct runs.

"Properly sizing HVAC systems in well sealed and well insulated homes leads to satisfied and comfortable customers, lower initial and operating costs, reduced callbacks, and healthier indoor air quality."

COST

"Is it faster to skip the load calculations and use a rule of thumb? Yes," says Seville. "Does it compromise the home's quality? Absolutely."

"The less time a remodeler takes to make a sale, the better off he is from a business standpoint, but to really evaluate a house you need time. And time costs. Then again, we've been in situations where we could take a ton or more off the HVAC system by properly designing a system based on insulation and air-infiltration rates—and that means significant cost savings on the equipment."

Carl Seville founded and served for over 25 years as vice president of SawHorse, Inc., an Atlanta-based residential renovation firm. Seville developed the EarthCraft House Renovation Program with the Southface Energy Institute. His current firm, Seville Consulting, provides training, speaking, and consulting services in sustainable building practices. Seville serves on the NAHB Green Building Subcommittee and the National Association of the Remodeling Industry's Green Remodeling Education Committee.

Why he uses right-sized HVAC systems:

"You avoid oversizing (and overspending) on the initial installation. Utility costs are lower, the house is healthier and more comfortable, and the equipment lasts longer."

Before remodeling.

SIZING ESSENTIALS

Most of the information needed for sizing cooling loads in new homes can be taken directly from house plans. Essential information includes solar gain, which is a function of window area; orientation of the house; window type and glazing (such as low-e, low solar heat gain coefficient, gas-filled); shading from landscaping and building overhangs; and shingle and siding type and color. Load calculations should be done on a room-by-room basis so that ductwork can be sized accordingly. Use ACCA's *Manual D, Residential Duct Systems* as your guide.

Read the PATH Tech Spec on ducts in conditioned space.

"Load calculations cost approximately $100 or $200 per house and take between one and two hours for an average home. This cost is often recouped immediately because the system can typically be downsized. If a number of homes with similar plans are being calculated, costs are even lower."

BENEFITS

"The real pay-off for the remodeler is counted in customer satisfaction," says Seville. "When the equipment functions properly, the home is more comfortable and the air quality is better. The homeowners notice that immediately. Then they start to see the impact on their utility bills. Rising energy prices make this improvement even more valuable."

"Renovating this historic home doubled its size from 2,300 sq. ft. to 4,700 sq. ft, yet the energy bills remained virtually the same. That's huge."

"A right-sized system combined with proper air sealing creates a healthier house. Together, the two will maintain a comfortable humidity level, reduce the occurrences of allergy-causing mold and help keep dust and pollen outdoors. The health ramifications are significant."

"This remodeling project resulted in a very healthy, air-tight home. Many green building programs set a target of changing one-third of the air from indoors to outdoors, or 0.33 air changes per hour. I got it down to 0.27 changes per hour in this home. That's a difference the homeowner will feel."

CONVINCING THE CONTRACTOR

When it comes to sizing the HVAC system, bigger is not always better. This notion defies conventional rules of thumb. It can take some convincing to get contractors on board.

"Air conditioners cool a house first, then dehumidify it," says Seville. "In a humid climate like Atlanta's, this function is particularly important. If an HVAC unit is too large, it will short cycle. That is, it will turn on, cool the house down, and turn off again before removing much humidity from the air. Frequent starting and stopping increases energy consumption, makes the home uncomfortable, and contributes to mold and indoor air quality problems."

"So builders, remodelers, and their HVAC contractors need to do more than rely on rules of thumb that suggest a standard number of square foot of living space per ton of air conditioning. Instead, they should match each HVAC unit to specific characteristics, including the air-infiltration rate, of each house."

"Many HVAC contractors don't understand that the system has to be right-sized to dehumidify well. They are afraid of under-sizing the system because they don't want their customers to complain about being hot in the summer. But a house simply won't be dehumidified properly if the HVAC is oversized. We've seen situations where the owners have to keep a house at 65 degrees in the summer to keep it dry."

TECHNOLOGY HIGHLIGHTS

This project also included the following PATH-profiled technologies:

- Advanced framing techniques
- Energy-efficient lighting, including compact fluorescent bulbs and dimmer switches
- HVAC "smart" zoning controls
- Right-sized HVAC systems
- Spray foam insulation
- Tankless water heater

MANUAL J, THE INDUSTRY STANDARD

Right-sized systems reduce callbacks. That's a compelling reason for contractors to conduct Manual J calculations.

"Manual J can help remodelers and contractors properly size HVAC equipment," says Seville.

"Using Manual J, a contractor calculates heat loss from the house through walls, ceilings, and leaky ductwork, and infiltration through windows, doors, and other penetrations. Manual J also helps calculate heat gain into the house from sunlight, people, lights and appliances, doors, walls, and windows."

"Load calculation software is typically used by home raters, HVAC contractors, and engineers. Most remodelers don't own the software and perform the loads themselves. But there is always the risk that someone who knows how to use the software may not correctly size a system for a particularly well sealed and efficient house. That's why the remodeler or builder needs to be involved: to make sure that the load calculation is accurate."

CAREFUL PLANNING PAYS

"To properly design the HVAC system, it's critical to determine how the house will be renovated and what materials will be used," says Seville. "If you change insulation types or make the house tighter or more leaky than you planned to, you may find that the system you install is not the right size, even though you used Manual J. For example, if you have the system installed, then afterwards decide to upgrade to spray-foam insulation, the system will probably be too large and it will not be the fault of the person that did the load calculation. This is because the house is tighter and better insulated than expected."

When the HVAC contractor understands the big picture, he can effectively evaluate the situation and recommend a range of improvements that provide the best solution for the client. Without this information, the contractor may simply suggest replacement equipment—and that equipment may not be properly sized.

After remodeling.

The Partnership for Advancing Technology in Housing (PATH) brings together builders, manufacturers, researchers, government agencies, and other members of the housing industry. PATH partners work to improve the quality and affordability of new and existing homes. The program is administered by the U.S. Department of Housing and Urban Development's Office of Policy Development and Research.

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