

Sector: Residential

Category/Practice: Energy Efficiency / Heating + Cooling System Design

Proposed GB Practice

Description

Add these provisions to code requirements for heating and cooling system design:

- Design load calculations must include room-by-room heating and cooling loads.
- Central air conditioner evaporator coils, central air conditioner condensing units and air handlers (furnaces) must be matched; an Air-Conditioning, Heating, and Refrigeration Institute (AHRI) certificate must be submitted.
- Key design parameters must be documented.

Applicability

New Construction: Applies in full

Existing Buildings/Additions:

- Applies in full when the addition work scope includes a new heating/cooling system serving the addition alone
- Applies in full when the existing building's heating/cooling system is extended to serve the addition and the heating/cooling equipment must be resized to meet the loads.
- Applies in part when the existing building's heating/cooling system is extended to serve the addition and the existing heating/cooling equipment is adequate to meet the loads; room-by-room load calculations are not required.

Existing Buildings/Alterations: Applies in part to heating/cooling equipment replacement.

Exceptions: Room-by-room heating and cooling load calculations and AHRI-matched components are not required.

Intent

Design heating and cooling systems that satisfy comfort needs and perform in accordance with manufacturer specifications.

Benefits and Costs

Triple Bottom Line Benefits

People:

- Improved thermal comfort
- Improved sense of control over heating and cooling of living spaces

Economic:

- Potential for savings due to reduced size of "right-sized" equipment (reflected in "Costs Passed to Owner," below)

- Energy savings due to improved installed efficiency of heating and cooling equipment operating correctly in conjunction with the distribution system. Savings estimate for the combination of more careful design and commissioning (i.e. this amendment + HVAC Commissioning amendment): 5% to 10% reduction in heating + cooling energy use, ~\$30-60 per year.
- Enhanced durability of heating/cooling equipment operating within manufacturer specifications.

Environment: Environmental benefits associated with reduced energy use.

Costs Passed to Owner

“Low” cost (\$200 maximum). The proposed changes are small refinements to current practice and code requirements. Little additional time will be required on the part of the HVAC contractor. There are potential first cost savings if more careful design results in smaller equipment and/or ductwork. There may be some increased material cost associated with lower-pressure-drop duct transitions.

Lost Opportunity

Quality performance begins with quality design. It can be difficult and expensive to try to improve performance of a poorly designed system after the fact.

Implementation

Availability of Products and/or Services

Many local HVAC contractors are capable of meeting these additional requirements or are already doing so as a matter of practice.

Practicality

The proposed requirements are a small refinement of existing code requirements; see “Context” below.

Certification Issues

None

Enforcement Procedures

Permit application/plan review: The additional information required by the proposed amendment (including the AHRI certificate) will be submitted by the builder or HVAC contractor with heating/cooling design information required by the existing code.

Field inspection: Building inspectors will check to see that specified components have been installed.

Certificate of Occupancy: N/A

Support Materials Needs

Form to document submittal requirements.

Training Needs – Industry

Training will be needed by some HVAC contractors on heating/cooling system design, installation and commissioning; the training will cover the details addressed by these proposed requirements.

Training Needs – Staff

A small amount of training will be required to be able to review the submitted documentation.

Background

Current Practice

HVAC contractors complete and submit whole-building design load calculations and duct designs for new construction, in accordance with code requirements. The calculations often include room-by-room design loads.

When heating/cooling equipment is replaced in existing buildings, the Building Department does not require design load calculations. Some HVAC contractors perform these calculations, others do not.

Matched heating and cooling equipment components have not been required by code. It is unknown what proportion of systems use matched components.

Context

In the past, heating and cooling system design was largely based on rules-of-thumb that have proven to be unacceptable. Results have included oversized equipment, poor matches between equipment and distribution systems, equipment that doesn't operate within manufacturer specifications, poor thermal comfort and, among many occupants, a sense that they have little control over their heating and cooling systems. These observations were documented in a [survey of Fort Collins homes built in the mid- to late-1990s](#). They are not exclusive to Fort Collins; similar issues have been observed nationally.

Awareness of these issues has markedly increased in the past decade with information and training. Code revisions have gradually tightened requirements for heating/cooling system design. The 2009 IRC requires that heating + cooling equipment be sized in accordance with design building loads calculated with ACCA Manual J and ACCA Manual S and that ductwork be designed in accordance with ACCA Manual D or equivalent procedures (ACCA is the Air Conditioning Contractors of America, a national trade association of HVAC contractors). The City has sponsored design load calculation training.

Since 2002, contractors designing systems for new construction have submitted Manual J design load calculations and a Manual D ductwork design as part of the permit application. Building Department staff has limited expertise to review the submittals.

The same issues experienced locally have been observed nationally. Research has gradually improved understanding of effective design, installation and testing procedures to improve the installed performance of heating and cooling systems. The Consortium for Energy Efficiency and ACCA worked together to develop an ANSI-approved national standard: *HVAC Quality Installation Specification*, ANSI/ACCA 5 QI-2007. It follows a systems approach, from design through installation, performance testing, documentation and owner education.

ENERGY STAR New Homes Version 3 guidelines (which will be fully effective by January 2012), include an approach in alignment with the ACCA Quality Installation standard. ENERGY STAR's new checklists for HVAC contractors and energy raters provide a practical, organized means for fulfilling the standard's requirements. The contractor checklist documents design parameters on one side; on the back side, performance measurements are documented, the contractor answers pass/fail questions about meeting the standard and signs the form. The City could choose to use or adapt this public domain model.

Other voluntary green building rating systems, such as LEED/Homes and NGBS, include subsets or variations of these requirements.

The proposed requirements add some relatively minor provisions to the code so that it more closely matches the ACCA Quality Installation standard.

Related Green Building Practices

This proposal ties closely to the HVAC Commissioning proposal.

Known Objections

None identified