EE 2: Improve Analysis of Heating & Cooling Needs During Design

Department of Buildings Forms; New York City Mechanical Code
Proposal developed by the Energy & Ventilation Committee

Summary

Issue:
Equipment used to heat and cool buildings is often over-sized, resulting in operating inefficiency. To size the equipment appropriately, it is important to accurately calculate the peak heating and cooling load demands of buildings.

Recommendation:
As part of the plans submitted to the Department of Buildings for approval, require detailed calculations of peak heating and cooling loads.

Proposed Legislation, Rule or Study

Changes to Department of Buildings Forms

To apply to all applications including heating and cooling equipment.

For heating equipment, add to DOB Form PW1C: Schedule C, Section 4 Boiler Specifications a check box certifying that the boiler capacity is consistent with peak load calculations included in plans per section 106.6 of the Mechanical Code.

For cooling equipment, add to DOB Form PW4: Equipment Use Application/Permit, Section 5 "Equipment Specifications" a check box certifying that the equipment capacities in BTU per hour are consistent with peak loads presented in the building plans per Section 106.8 of the Mechanical Code.

Amendments to the New York City Mechanical Code

1. Amend section 106.6 as follows:

106.6 Heating systems. Construction documents for heating systems shall include the temperature to be maintained in every room [and the output capacity in BTU per hour (0.2931 W) of the central heating source], the peak heating demand in BTU per hour in every room, the peak heating demand in BTU per hour in every zone, and the output capacity in BTU per hour of the central heating source. The peak load calculations shall be in accordance with the procedures described in the ASHRAE Fundamentals Handbook, and shall include the following:

1. Thermal transmission load, including thermal bridging of frames and mullions, exposed slab edges, parapets, balconies, concrete columns, steel members, and any other significant thermal connection between the conditioned space and the outdoor and underground environment;

2. Ventilation load, accounting for all specified mechanical ventilation but assuming that windows are closed;

3. Infiltration load, accounting for leakage around all doors, windows, and other envelope penetrations, but recognizing specified air barriers;

4. Internal heat gains when predictable, accountable and manageable; and

5. Solar gains, based on glazing characteristics.

Rooms that are identical with respect to these characteristics may be calculated and reported as aggregates within...
2. Amend section 106.8 as follows:

106.8 Air conditioning and ventilating systems. Construction documents for air conditioning and ventilating systems shall contain plans that include the following data and information:

1. The peak cooling load in BTU per hour in every room, the peak cooling demand in BTU per hour in every zone, and the peak cooling load in BTU per hour on the entire building. The peak load calculations shall be in accordance with the procedures described in the ASHRAE Fundamentals Handbook, and shall include the following:

   (a) Thermal transmission load, including thermal bridging of frames and mullions, exposed slab edges, parapets, balconies, concrete columns, steel members, and any other significant thermal connection between the conditioned space and the outdoor and underground environment;

   (b) Ventilation load, accounting for all specified mechanical ventilation but assuming that windows are closed;

   (c) Infiltration load, accounting for leakage around all doors, windows, and other envelope penetrations, but recognizing specified air barriers;

   (d) Internal heat gains when predictable, accountable and manageable; and

   (e) Solar gains, based on glazing characteristics.

   Rooms that are identical with respect to these characteristics may be calculated and reported as aggregates within zones.

   [1] The location and sizes of all ducts; the location of all fire and smoke dampers, motors, fans, and filters; the type, air capacity, and size of all equipment; and where not shown on accompanying structural plans, the operating weight and manner of support of equipment.


   [3] The location and size of the fresh air intake, the design population, and the required ventilation for each room or space.

   [4] The amount of air to be exhausted or supplied from each outlet for each room or space.

   [5] In the case of ventilating or exhaust systems for ranges, fryers, ovens, and other similar types of restaurant or bakery equipment, for which a hood is required, the plans shall also show the type of extinguishing system, the location of heat detection devices, nozzles, piping, gas controls, manual and automatic control valves, method of joining ducts, method and location of discharging exhaust from building, the location of break-glass controls, and the quantity in cfm designed for each hood.

Supporting Information

Issue - Expanded

This proposal will enforce good practice in the design of mechanical systems in buildings. In order to specify the correct equipment for a building, the detailed heating and cooling loads must be thoroughly understood. Many engineers currently guess or use rules of thumb or rely on manufacturers who sell the equipment to provide the sizing requirements. Without calculations on the drawings, important communication between the architect, the engineer, and the owner may not take place. Further, authorities having jurisdiction cannot easily review anticipated loads or readily discern whether a building will meet energy efficiency standards without the information called out in this proposal. One effect of this proposal will be to make the oversizing of systems less common. In the absence of careful load calculations, the designer is tempted to specify a generously sized boiler and AC system to ensure that there are no future complaints about failure to meet load on cold or hot days. But the result, especially for small and midsized equipment, is overly rapid cycling, which results in low efficiency and waste. (This is less of a problem with large equipment for which the output can be modulated to match the load.)

Environmental & Health Benefits

Environmental and health benefits will accrue as a result of reduced fuel and electricity consumption, but the savings will vary widely since the measure reduces bad practice, rather than changing any readily calculated metric.
This proposal was found to have a low, positive impact per building and to impact a small number of buildings. It was thus given an environmental score of 1.

This proposal was found to have a positive, indirect health impact.

Cost & Savings
As described in the Executive Summary, Bovis Lend Lease prepared cost estimates for each Task Force proposal in the context of well-defined construction projects in specific buildings. Where possible, members of the Technical Committees prepared savings estimates for some of these projects and buildings. These cost and savings estimates are presented in the February 1st draft version of Appendix A. The innate uncertainty in how construction and operation will vary from one building to another, the complexity of the Task Force proposals, and the wide range of applications in which the proposals may be realized mean these figures are truly estimates.

This proposal was estimated to increase first capital costs by 0.02% to 0.04%, depending on building type. It was thus categorized as incurring a low capital cost increment. This proposal was also estimated to generate financial savings that will pay for the capital costs in less than three years for some building types.

Precedents
This proposal includes a return to the standards of the 1968 code, which required in Article 17, §[C26-116.3] 27-182: *(a) Air Conditioning and Ventilation Systems.- Plans for air conditioning and ventilating systems shall contain at least the following data and information: (1) The location and sizes of all ducts the location of all fire dampers, motors, fans, and filters the type, air capacity, and size of all equipment; and . . . (e) Heating Systems.- Plans for heating systems shall contain at least the following data and information: (1) the temperature to be maintained in every room, and (2) the amount of heat in Btu per hour to be provided in every room, and the output capacity in Btu per hour of the central heat sources* §[C26-116.3] 27-182 Plans required, Article 17: Applications for Equipment Work Permits of Title 27, Chapter 1: Construction and Maintenance. It is not clear how well those code requirements were honored. This proposal contains an additional reporting requirement.

Although this measure will result in greater energy efficiency, it is a better fit to sections of the Mechanical Code than to the New York City Energy Code, since it involves system design and sizing.

LEED
There are no LEED credits directly affiliated with this proposal.

However, due to improved energy performance resulting from these measures, this proposal may assist in compliance with LEED prerequisites for Energy & Atmosphere under most of the rating systems. These prerequisites require that the scope of work for Minimum Energy Performance is in accordance with ANSI/ASHRAE/IESNA standard 90.1-2004, or the local energy code, whichever is more stringent. LEED 2009 will reference ANSI/ASHRAE/IESNA standard 90.1-2007.

These recommendations will also facilitate achieving LEED Energy and Atmosphere credits:

- LEED NC- EA cr.1 Optimize Energy Performance;
- LEED CI-EA cr. 1.3 Optimize Energy Performance, HVAC;
- LEED EB-EA cr.1 Optimize Energy Performance;
- LEED ND-GCT cr.2 Energy Efficiency in Buildings;
- LEED for Schools EA cr.1 Optimize Energy Performance;
- LEED for Homes EA cr.1 Optimize Energy Performance;
- Credits under LEED pilot programs.

These credits require exceeding the minimum standards established by the Energy and Atmosphere prerequisites.

The process of including this information in a project’s construction documents will expedite the LEED certification process, which requires submittal templates with detailed tables and calculations.

Implementation and Market Availability
There are no known implementation issues for this proposal. The practice was called for in the previous version of the Building Code.

Endnotes: