

23 00 00.01 - Load Calculations

1. Introduction

- A. Heat gain and loss calculations shall be done for all projects, including equipment replacement, unless otherwise indicated by Duke Utilities & Engineering Services, Department of Engineering & Planning (DUES - Engineering).
- B. Designers shall make load calculations prior to DD submittal and shall recalculate each time there are significant changes to building design, including changes to expected occupancy and equipment.
- C. Designers should coordinate exact factors to be used with DUES - Engineering. Designers are expected to review all load calculations and the factors and methods used in those calculations with DUES - Engineering.

2. References

- A. ASHRAE Fundamentals, 2009 edition
- B. ASHRAE Standard 90.1
- C. ASHRAE Standard 62
- D. North Carolina State Mechanical Code, 2012

3. Design Standards

The following information is intended to serve as a guideline. Where the designer believes other factors are appropriate, this should be discussed with DUES-Engineering.

A. Design Temperatures:

- 1. Outdoor design temperatures shall be based on ASHRAE Fundamentals Climate Data for Raleigh Durham International, NC.
 - a. Design conditions shall be from the 1% column for cooling, evaporation and dehumidification.
 - b. Design conditions shall be from the 99.6% column for heating and humidification.
 - c. **For critical areas**, heating calculations shall use 12°F for outdoor design temperature.
- 2. Indoor Design temperatures shall be 72°F for cooling and 70°F for heating.

B. External Heat Gain Parameters:

1. Walls, roofs and other opaque elements:
 - a. U-values for walls, roofs and other opaque elements shall be calculated based on actual construction elements, not on assumed composite values.
 - b. Engineer shall review the Architect's wall sections during the progress of the project and adjust load calculations accordingly.
 - c. Calculation of U-values shall take into account the effect of framing and support members.
 2. Glazing:
 - a. Glazing heat gain factors shall be based on Architect's glazing specifications. If no specific glazing has been selected, the maximum U-value and solar heat gain coefficient allowable shall be cited in the fenestration specifications.
 - b. Fenestration unit U-values used for calculations shall include frame effect.
- C. Internal Heat Gain Parameters:
1. Occupancy:
 - a. Occupant density shall be based on actual values where available. Where occupant density information is not available, values from ASHRAE Standard 62.1, latest edition, may be used.
 - b. Heat gain per occupant values shall be based on 2009 ASHRAE Fundamentals, Chapter 18, Table 1 or latest edition thereof.
 2. Lighting:
 - a. Heat gain calculations for lighting shall be based on actual fixture types and fixture counts, if available. Where actual values are not available, as in the early stages of design, values shall be based on 2009 ASHRAE Fundamentals, Chapter 18, Table 2 or latest edition thereof.
 3. Equipment:
 - a. Heat gain calculations for equipment shall use actual equipment types and counts and manufacturer's heat output data, where available. Where actual information is not available, consult 2009 ASHRAE Fundamentals, Chapter 18, Tables 4-12 or latest edition thereof.
 - b. Heat output for equipment may **not** be assumed to be equal to equipment faceplate power.
 - c. A diversity factor may be applied where there are several items of equipment which are not expected to run concurrently.

D. Ventilation and Infiltration:

1. Ventilation:

- a. Ventilation airflow rates shall be based on ASHRAE Standard 62.1, latest edition, or on local code minimums, whichever is greater.
- b. Ventilation airflow rates shall take into account the multiple space calculation found in ASHRAE Standard 62.1.
- c. CO₂ based demand ventilation may be used to decrease energy use, but heat gain/loss calculations shall not take credit for airflow reduction.

2. Infiltration:

- a. Heat gain/loss due to infiltration shall be taken into account in the calculations. It is acknowledged that infiltration airflow rates are an estimate based on engineering judgment of the effects of construction tightness, envelope penetrations, stack effect and expected wind conditions.

4. Documentation and Review Requirements

- A. A summary of factors used in load calculations shall be submitted with the drawings at each review phase.
- B. Load calculations and results shall be reviewed with Duke Engineering not later than 50% CD submittal.

5. As-Built Requirements

- A. Designer shall submit with as-built drawings a summary of factors used in load calculations. This summary may be included on a drawing as part of a .dwg file or as a separate .pdf.