

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 Duke FMD.
- 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 Duke FMD. Designers are expected to review all load calculations and the factors and methods used in those calculations with Duke FMD.

2. References

- A. ASHRAE Fundamentals current edition
- B. ASHRAE Standard 90.1
- C. ASHRAE Standard 62
- D. North Carolina State Mechanical Code, 2018

3. Design Standards

- A. *The following information is intended to serve as a guideline. Where the designer believes other factors are appropriate, this should be discussed with Duke FMD.*
- B. Design Temperatures:
 - a. Outdoor design temperatures shall be based on ASHRAE Fundamentals Climate Data for Raleigh Durham International, NC.
 - i. Design conditions shall be from the 1% column for cooling, evaporation and dehumidification.
 - ii. Design conditions shall be from the 99.6% column for heating and humidification.
 - iii. **For critical areas**, heating calculations shall use 10°F for outdoor design temperature.
 - b. Indoor Design temperatures shall be 75°F for cooling and 70°F for heating.
 - c. For each project, engineer of record shall provide and record all specific user group temperature and humidity requirements into an owner's project requirement document (OPR), to be provided to Duke FMD for review prior to initial design drawings or schematic design.
- C. External Heat Gain Parameters:
 - a. Walls, roofs and other opaque elements:
 - i. U-values for walls, roofs and other opaque elements shall be calculated based on actual construction elements, not on assumed composite values.

- ii. Engineer shall review the Architect's wall sections during the progress of the project and adjust load calculations accordingly.
 - iii. Calculation of U-values shall take into account the effect of framing and support members.
 - b. Glazing:
 - i. 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.
 - ii. Fenestration unit U-values used for calculations shall include frame effect.
- D. Internal Heat Gain Parameters:
 - a. Occupancy:
 - i. Occupant density shall be based on actual values or Owner Project Requirements where available. Where occupant density information is not available, values from ASHRAE Standard 62.1, latest edition, may be used.
 - ii. Heat gain per occupant values shall be based on 2017 ASHRAE Fundamentals, Chapter 18, Table 1 or latest edition thereof.
 - b. Lighting:
 - i. 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 2017 ASHRAE Fundamentals, Chapter 18, Table 2 or latest edition thereof.
 - c. Equipment:
 - i. 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 2017 ASHRAE Fundamentals, Chapter 18, Tables 4-12 or latest edition thereof.
 - ii. Heat output for equipment may **not** be assumed to be equal to equipment faceplate power.
 - iii. A diversity factor may be applied where there are several items of equipment which are not expected to run concurrently. When a diversity factor is utilized, coordinate intentions and assumptions with Duke FMD for review.
- E. Ventilation and Infiltration:
 - a. Ventilation:
 - i. Ventilation airflow rates shall be based on ASHRAE Standard 62.1, latest edition, or on local code minimums, whichever is greater.
 - ii. Ventilation airflow rates shall take into account the multiple space calculation found in ASHRAE Standard 62.1.
 - iii. CO₂ based demand ventilation may be used to decrease energy use, but heat gain/loss calculations shall not take credit for airflow reduction.
 - b. Infiltration:
 - i. Heat gain/loss due to infiltration shall be considered 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. Provide a summary airflow balance sheet with assumed AHU outside air and exhaust ventilation airflow rates in all major system operational modes for review by Duke FMD not later than the 50% CD submittal.
- C. Load calculations and results shall be reviewed with Duke FMD 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 and as a separate .pdf.