1.101 Introduction to Civil and Environmental Engineering Design
Fall, 2005
Project 3-Thermal Design
Engineering study of heat loss performance of an MIT building

Purpose:

To prepare an engineering report on the thermal performance of an MIT building (or a designated portion thereof). The report will be based on both calculations and field measurements, and should provide 1) an estimate of current overall thermal performance, 2) identification of any notable deficiencies identified in the study, and 3) suggested actions to remediate the deficiencies.

Procedure:

Teams will be the same as those constituted for the in-lab thermal experiments during the week of Dec 6. Each team will choose a subject structure, normally a portion of a building on the MIT campus for which wall and window construction information can be found.

Teams will analyze the thermal performance of the structure using heat loss calculations, and also using infrared measurements. In addition, specific possible defects are to be identified using thermal imagery.

Calculations will include estimation of R values for each exposed wall and window, which may be done on the basis of published data and, potentially, data from the heat loss experiments we will be doing in the lab. Total areas of each type of exposed surface need to be determined. Results should be reported as rate of heat loss during the specific day that you take thermal IR images (see below), as well as total energy loss during a 6000 degree-day heating season. Heat loss should be reported as total heat loss (use BTUs) for the section of building, as well as BTUs per square foot of exposed surface (for the purpose of comparison among buildings).

Infrared imagery should be used to:
1. Estimate radiant heat flux to the outside at the time of measurement (be sure to note actual outdoors conditions, including air temperature and IR background temperature)

2. Estimate skin temperature of building at the time of measurement; this should be compared with both the calculated value and, if the wall is accessible from the ground, with direct measurement (**no climbing up walls or leaning out windows is permitted**!). From these values of skin temperature, estimate heat loss at the time of measurement (you could use an R of 0.17 [BTU/ft^2-hr]$^{-1}$ for this purpose) and compare with calculations based on wall construction and total R values of the wall.

3. Using patterns that may be observable in the IR imagery, make any relevant observations concerning possible wall defects and heat loss hotspots.

<u>Report</u>

The report should be clear and professional in appearance, and include:

Statement of purpose of the report (enough so that someone unfamiliar with this assignment could pick it up and know what the study is about)

Identification of the structure, and description of available data. Appendices are good places to put diagrams, tables, etc,

Summary of methods used.

Findings

Recommendations

<u>Assignment Due Date</u>

Each team will turn in their report on or before Dec 14, 2005, and also present an approx. 10 minute oral summary to the class during the last week of classes. The exact schedule of oral presentations will be announced.