Architecture 4.411
Building Technology Laboratory
Spring 2004

Assignment 2   Solar Heating and Building Thermal Dynamics

February 11 and 12, 2004

The second phase of our first lab consists of three parts:

1. Mr. Potato Head. Please calculate the thermal time constant, in minutes, from your experimental data, using the three methods to be given in lab this week. In addition, please estimate the time constant using thermal property data from the ASHRAE handout. This will require that you measure the dimensions, volume and weight of our potato.

2. Construction of solar building. Please complete the construction of your solar building, using the design specifications given in lab last week. Launch and install two Hobo temperature loggers and deploy your building on the roof of Building 3, with the help of the instructor and teaching assistant. BE SURE THAT THE TEMPERATURE SENSORS ARE ADEQUATELY SEALED TO KEEP THEM FROM GETTING WET AND THAT THEY ARE INSTALLED IN A WAY THAT THEY WILL NOT SEE DIRECT SUN.

3. Estimation of air temperature inside your elfhouse. Please estimate the inside air temperature from the time of installation on the roof to the time the temperature logger is removed, in lab next week. Use the provided spreadsheet program or the computation engine of your choice or crafting, along with thermal property data from the ASHRAE handout. Please account for your materials (type, dimension, mass) and actual weather (temperature and solar radiation).

The third part of the assignment is intended to require a reasonable amount of work. The better you can characterize the construction of your elfhouse and the environmental conditions, the more accurate your estimate of indoor temperature. Because you will not have perfect knowledge, you should produce three estimates: your best guess as well as upper and lower bounds. For temperature, you can use daily highs and lows (from newspapers or such online services as weather.com) and fit a sinusoid. Alternatively, you will find temperature data from a Community Boating web site, www.cbiwind.org. For solar radiation, at a minimum please keep track of sky conditions several times each day and use tabulated SHGFs to estimate the radiation your house receives. During cloudy periods, for example, the south façade might receive about the same radiation as what the SHGF indicates for the north façade. You may also check out from the teaching assistant a hand-held photometer or pyranometer.   Instruction for these meters will be provided in lab.

Please bring your hourly temperature estimates to lab next week, printed out in graphical form, and hand them in before downloading the temperature data.