Project #4: Heating up your Design Studio (20 points)

Issued: **30 January 2007**
Due: **6 February 2007** (at beginning of lecture)

Introduction

This project continues with an analysis of the personal studio space that was first introduced in Project # 1 and further addressed in Project #3. This project asks you to calculate the design heat loss for your studio space—using information from previous projects as well as newly collected data and newly formed assumptions/decisions. The objective of this project is to provide experience in estimating design heat loss and to encourage you to consider envelope-based responses to energy efficiency. Enter this project in a "business as usual" mindset; make decisions as you would do if you were in studio and having to make similar decisions.

This project naturally organizes itself around the various components of building heat loss and the equations that define such losses. You will, however, be adding much information about your specific building and constructions. *Do so in a way that permits easy review of your work. Supporting calculations must be provided (on supplemental sheets) for all work. Organize these sheets so that work is easily accessible and reviewable.* ***All assumptions and data sources must be noted.*** (4 points are allocated to this requirement)

Most of the data required to complete this project can be found in your textbook (MEEB). The WWW can also provide data. Decisions regarding roof construction can be facilitated by reference to any of numerous design/construction texts or the WWW. Finding appropriate data (and sorting through unnecessary data) is an intended and integral part of this project.

This is an individual project.

Use the ASHRAE 90.1 design exterior air temperature of 21°F as one end of the recurring ?t (temperature) value. The other end will be set by the design interior temperature that you believe is most appropriate for your studio. Note that since this is your studio reference to statistical comfort data may not be appropriate or necessary. The interior design temperature you selected for this analysis is: _____°F. This temperature was chosen because: _____
_____
_____(1 point).

You have information regarding wall and window types from previous projects. You will need to make decisions regarding roof and door types. Do not spend an inordinate amount of time making these decisions—simply select assemblies/components that make sense in the context of your studio project. A decision regarding floor type has been made for you (see below).

Part 1: Design Heat Loss (8 points)

Opaque Above-Ground Walls

Calculate the design heat loss (q = U A ?t) through all above-ground opaque walls. Show all your work neatly on an attached sheet. Apply the above equation separately to each type of wall (if applicable) and sum the losses through each wall type to obtain a total wall loss. Delete the area of doors and windows from the overall wall area.

Design Heat Loss through Opaque Walls = _____ Btu/hr

Doors

Calculate the design heat loss (q = U A ?t) through doors. Show all your work on an attached sheet. Apply the above equation separately to each type of door (if applicable) and sum the losses through all doors to obtain a total door loss.

Design Heat Loss through Doors = _____ Btu/hr

Windows

Calculate the design heat loss (q = U A ?t) through windows. Show all your work on an attached sheet. Apply the above equation separately to each type of window (if applicable) and sum the losses through all windows to obtain a total window loss.

Design Heat Loss through Windows = _____ Btu/hr

Skylights

Calculate the design heat loss (q = U A ?t) through skylights (if applicable). Show all your work on an attached sheet. Apply the above equation separately to each type of skylight (if applicable) and sum the losses through all skylights to obtain a total skylight loss.

Design Heat Loss through Skylights = _____ Btu/hr

Roofs

Calculate the design heat loss (q = U A ?t) through roof(s). Show all your work on an attached sheet. Apply the above equation separately to each type of roof (if applicable) and sum the losses through all roofs to obtain a total roof loss.

Design Heat Loss through Roofs = _____ Btu/hr

Floor (assume a slab-on-grade floor)

Calculate the design heat loss (q = F P ?t) through the slab-on-grade floor. Show all your work on an attached sheet.

Design Heat Loss through Floor = _____ Btu/hr

Infiltration (estimate using the air change method)

Calculate the design heat loss (q = cfm 1.1 ?t) due to infiltration. Show all your work on an attached sheet.

Design Heat Loss through Infiltration = _____ Btu/hr

Latent Heat Loss: assume that the relative humidity in the studio will not be intentionally controlled (which allows latent heat loss to be "ignored.")

Part 2: Total Heat Loss and Its Composition (4 points)

The total design heat loss for your studio (the sum of all the above constituent heat losses) is: _____ Btu/hr

This equates to: _____Btuh/ft^2

The following pie chart (you will develop and insert) shows the distribution of the total heat loss among its contributing components (walls, roof, floor, etc.) Show percentages used to derive chart.

Part 3: Reducing Heat Loss (3 points)

Whatever the total design heat loss value reported above ... you are now charged with reducing this design heat loss by 20%.

A. What specific design moves would you take to accomplish such a 20% reduction?

B. Why do you think the above moves will achieve a 20% reduction?

C. Was it "easy" to accomplish a 20% reduction? Would it be easy to accomplish a 50% reduction?