

**ES 71- THE BUILDING ENVELOPE**  
**Final Project- it is acceptable to work in groups of 2!!**

**PART 1:**

Perform a heat transfer analysis of a sample residential building. This building has the following characteristics:

- Roof has R-11 insulation and is cedar shake construction; roof area is 2,200 square feet.
- Exterior walls are 3 5/8" wood stud construction with stucco exterior and **no internal insulation**. Interior surface of wall is wallpapered. Exposed, exterior wall area is 1,350 square feet.
- Assume floor is concrete construction and is "slab-on-grade"; floor  $U = 0.60$ . Floor area is 1,800 square feet.
- Windows are single pane with aluminum frame;  $U = 1.10$ ; Window area is 750 square feet.
- Exterior doors are solid core wood and are weatherstripped;  $U = 0.40$ ; there are 5 doors, each door is 3 ft wide by 7 feet tall.

NOTE: This analysis will establish "baseline" condition for the remainder of the problem. Don't forget to include surface film R values where necessary!

**Other IMPORTANT PROJECT info:**

1. assume natural gas heating of house; \$ 0.75/THERM utility rate; furnace used to heat home is 80% efficient.
2. Assume worst case outside design temperature of 25 F and inside design temperature of 72 F. Average ground surface temperature is 55 F.
3. Assume heating "Degree Days" of 3600.

**PART 2:**

**Your assignment is to perform a simple payback analysis for ONLY TWO of the following building envelope upgrades:**

1. Upgrade the roof insulation to R-30; note assumptions made/used to come up with approximate initial first cost of insulation upgrade.
2. Upgrade the walls to incorporate R-11 insulation (either fiberglass batts or blown-in cellulose). Note assumptions used to come up with approximate first cost of upgrade.
3. Upgrade the windows to double-pane glass;  $U = 0.45$ . Note assumptions used to come up with replacement costs of windows.

**PART 3:** **(NUMERICAL ANALYSIS NOT NECESSARY !!)**

If this house was located at Lake Tahoe where the heating Degree Days is 5,900 and the outside design temperature is 15 F; what do you think would happen to the payback analysis for each of these alternates? Explain why.

If you feel that you are missing information in order to complete your assignment **MAKE ASSUMPTIONS AND CLARIFY THEM FOR ME!!**