**Residential Energy Load Computation**

Name and date submitted (3 pts):

Formulas for energy load computations

R-value = “Thermal Resistance” (hr ·°F · ft2/Btu · in) Rtotal = R1 + R2 + R3….

U-factor = “Coefficient of heat transmission” = 1/R

Q = “Rate of heat loss” (Btu/hr) Q = U · A · ∆T

How to use these formulas: 1) Add up the R-values of the wall system, 2) compute the value of ‘U’ = 1/R, and 3) calculate “Q” – the rate of heat transmission – by using Q = U · A · ∆T. Then, 4) do the same for the windows, roof, and floors, and 5) add up the total heat transmission “Q” for the building.

Instructions

In this assignment, you will compute the winter energy requirements in Btu/hr of a 2-story home. Then you will estimate the cost per hour to heat the house.

* Find the set of plans for “910 Country Club Lane”. It is posted next to this assignment on the student portal.
* You can calculate the square footages of walls, floors, windows, and roof from studying the plans…. OR you can go to sheet “ME 2-1” and find them there. They are highlighted in “yellow”.

Construction details:

* Walls: assume the exterior walls are framed with 2x4 studs. The exterior cladding is wood bevel siding/ over tar paper/ over ½” plywood; and the interior wall surface is 5/8” drywall. The wall cavities contain R-13 fiberglass insulation.
* Roof: assume the roof structure is wood framed. The roofing is asphalt shingles/ over tar paper/ over ½” plywood. The interior ceiling surface is 5/8” drywall. The roof structure contains R-30 fiberglass insulation.
* Concrete floor: assume the concrete slab-on-grade is 5” thick/ over earth at 55°F. (ignore any sand or gravel base)
* Wood framed floor: assume this portion of the floor structure is wood framed with R-19 insulation in the cavities. The floor surface consists of ½” hardwood flooring/ over ¾” plywood subfloor. Assume the air temperature under this part of the floor is the same as the outside air temperature.
* Windows: Windows are called “fenestration” on the plans. Assume all the windows have (2) sheets of glass with an inert gas in-between, and have a U-factor of 0.34.

Respond to the questions:

1. Winter: assume the outside air temperature is 50°F, and the inside air temperature needs to be maintained at 70°F. Using the R-values in the table below, compute the transmission heat loss “Q” from the home in Btu’s per hour.
2. Where is most of the heat being lost? (walls, floors, windows?)
3. Heating cost: assume the power company charges $1.27 per 100,000 Btu’s of natural gas. (100,000 Btu’s = 1 “Therm”) Calculate the cost per hour to heat the home assuming the winter conditions stated above.

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| **R-values of common materials** (R has units ofhr ·°F · ft2/Btu**)** |
| **Construction Material** | **R-Value**  |
|  1/2 in. Drywall | 0.45 |
| 5/8 in. Drywall | 0.56 |
| Particle Board – ½ in. | 0.63 |
| Particle Board – ¾ in. | 0.94 |
| Fiberboard ½ in. | 1.32 |
| Extruded Polystyrene, per inch | 4.00 |
| Foil-faced Polyisocyanurate 1 in. | 7.20 |
| 2 x 4 (long edge) | 4.38 |
| 2 x 6 (long edge) | 6.88 |
| Hardwood, per inch thickness | 0.90 |
| Concrete, cast in place, per inch thickness | 0.08 |
| Plywood, per inch thickness | 1.25 |
| **Masonry Systems** | **R-Value** |
| Brick 4 in. common | 0.80 |
| Brick 4 in. face | 0.44 |
| Concrete Block – Normal wt. 12 in. empty core | 1.23 |
| Concrete Block – Light wt. 12 in. empty core | 2.60 - 2.30 |
| Cement Mortar | 0.20 |
| Stucco, 7/8” nominal thickness | 0.20 |
| **Roofing** | **R-Value** |
| Asphalt Roll | 0.15 |
| Asphalt roofing paper (tar paper) | 0.06 |
| Asphalt Shingles | 0.44 |
| Slate | 0.05 |
| Wood Shingles | 0.94 |
| **Siding** | **R-Value** |
| Wood Shingles | 0.87 |
| Wood Bevel Siding - Lapped | 0.80 |
| Aluminum/Steel – Hollow | 0.61 |
| Aluminum/Steel – with 3/8 in. Backer | 1.82 |
| **Insulation** | **R-Value** |
| Fiberglass Batt, per inch thickness | 3.142 |
| Loose Fill – Cellulose, per inch thickness | 2.8 - 3.7 |
| Loose Fill – Fiberglass 0.7 lb/cu.ft, per inch thickness | 2.2 - 4.0 |
| Loose Fill – Rock Wool, per inch thickness | 3.1 |
| Loose Fill – Vermiculite, per inch thickness | 2.2 |
| Extruded Polystyrene, per inch thickness | 4.00 |
| Still Air (horizontal ceiling cavities in Winter) | 0.61 |
| Still Air (horizontal ceiling cavities in Summer) | 0.92 |
| Still Air (vertical wall cavities) | 0.68 |