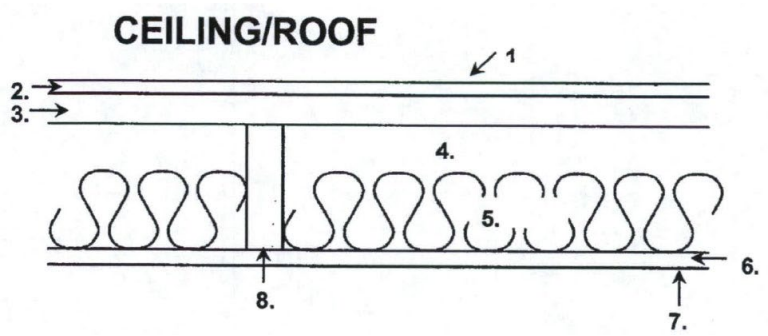
Homework #2 – Calculating Heat Loss in Buildings
Due: 8/30

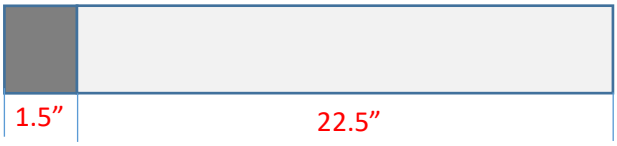
Name: Solution

1. Calculate the total heat loss due to transmission during a 24-hour period for a flat roof 90 ft X 135 ft. The roof is constructed per the detail below. The inside temperature is 70 °F and the outside temperature is 52 °F. Assume winter conditions. Show all calculations.



		R (Between joist)	R (At joist)
1.	Air film outside	0.17	0.17
2.	3/8 in. Built-up roofing	0.33	0.33
3.	5/8 in. Plywood Sheathing	0.77	0.77
4.	1 ½ in. Air space	1.00	---
5.	R-15 Fiberglass Batt Insulation	15.00	---
6.	5/8 in. Gypsum board	0.56	0.56
7.	Air film inside	0.68	0.68
8.	Nominal 2-in x 12-in Doug Fir Joist @ 24 in. o.c. . (1.5" x 11.25") R=1.00	---	11.25
	R_{Total}	18.51	13.76
	R_{Total} (Average)	18.21	
	U-Factor (Use Three Decimals)	0.055	

Determine the average U-Factor for the ceiling



R_{AVG} = (1.5"/24") x 13.76 + (22.5"/24") x 18.51 = 0.86 + 17.35 = 18.21
U_{AVG} = 1 / R_{AVG} = 1 / 18.21 = 0.055 Btu/hr x °F x ft^2

Total Heat Loss
Q = U x A x ΔT x 24 hr = 0.055 Btu/hr x °F x ft^2 x (90 ft x 135 ft) x (70°F - 52°F) x 24 hr = 12,029 BTU

2. An exterior wall is made up of 8" of stone (R= 0.08 per inch), 3" of foamed-in-place polyurethane, and 0.75" Plywood, and 5/8" gypsum board. Determine the total R-value and U-Factor for the wall. Use the lookup table provided in class. Assume winter.

Component	R-Value
Wall – Outside Air Film	0.17
8" stone	0.64
3" foamed-in-place polyurethane	18.75
¾" plywood	0.93
5/8" gypsum board	0.56
Inside Air Film	0.68
Total Wall Assembly R-Value	21.73
U-Factor (Use Three Decimals)	0.046

3. If the wall in problem 2 is 40 ft long and 12 ft. high what is the heat loss through the wall for an indoor winter design temperature of 78 °F and an outside temperature of 42°F?

Rate of Heat Loss

$q = U \times A \times \Delta T = 0.046$ Btu/hr x °F x ft^2 x (40 ft x 12 ft) x (78 °F - 42°F) = 795 Btuh

Heat loss per Day

$Q = U \times A \times \Delta T = 0.046$ Btu/hr x °F x ft^2 x (40 ft x 12 ft) x (78 °F - 42°F) x 24 hr = 19,080 Btu