CMGT 235 – Mechanical and Electrical Systems

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| Homework #3 | Due: 9/1 |

**Show all work for full credit.**

20 pts total

Solution

**Name**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Calculate the rate of heat loss due to transmission, infiltration, and ventilation for a 96 ft x 100 ft. single story office building. The ceiling height is 12 feet, and the maximum occupancy is 80 people. The ACH = 6.0. The required ventilation rate per person is 15 CFM. Inside temperature is 72°F and the outside temperature is 45°F. Use 3-decimals for all U-factors. Neglect the heat loss due to the flat roof.  
   **Round all calculations for q to whole numbers. Show all calculations for full credit.**  
     
   Complete the following:
2. **Heat Loss Due to Transmission**

|  |  |
| --- | --- |
| Specifications | Calculate the U-Factor (3-decimals) |
| Walls R-19 (6” insulation) | 0.053 |
| Ceilings R-30 (10” insulation) | 0.033 |
| Windows R-3.13 | 0.319 |
| Doors R-3.70 | 0.270 |

Floor SOG (2 in thick edge insulation, R=5)

Gross Wall Area = 2 x 96 ft x 12 ft + 2 x 100 ft x 12 ft = 2304 ft2 + 2400 ft2 = 4704 ft2

Window Area = 1600 ft2

Door Area = 320 ft2

Ceiling Area = 9600 ft2

4704 ft2 - 1600 ft2 - 320 ft2 = 2784 ft2

Calculate the Net Wall Area = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

qtransmission = U x A x ∆T

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Building Element | U-Factor | Area (ft2) | ∆T (°F) | q (BTUH) |
| Walls | 0.053 | 2784 | 27 | 3,956 |
| Windows | 0.319 | 1600 | 27 | 13,802 |
| Doors | 0.270 | 320 | 27 | 2,335 |
| Ceiling | 0.033 | 9600 | 27 | 8,554 |
| Slab = Uf x L | 30 x (2 x 96 ft + 2 x 100 ft) = 30 x 392 (Using < 30 okay too) | | | 11,760 |
| Total Heat Loss Due to Transmission | | | | 40,407 |

Continued on Back

1. **Heat Loss Due to Infiltration**

qinfililtration = C x ACH x V x ∆T

= (0.018 Btu/ft3 x °F) x (6.0 ACH) x (96 ft x 100 ft x 12 ft) x (72°F - 45°F)

= 335,923 BTUH

1. **Heat Loss Due to Ventilation**

qventilation = 1.1 x Qairflow x ∆T

Qairflow = 15 CFM/person x 80 persons = 1200 CFM

qventilation = 1.1 x 1200 CFM x (72°F - 45°F) = 35,640 BTUH

1. Calculate the Total Rate of Heat Loss for the Office Building

|  |  |
| --- | --- |
| qtransmission | 46,291 BTUH |
| qinfililtration | 335,923 BTUH |
| qventilation | 35,640 BTUH |
| qtotal | 417,854 BTUH |