MEBS6016 Energy Performance of Buildings

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Assignment 02: Calculations for Energy Efficient Technologies

(Please submit the assignment through the Moodle system on or before **24 Nov 2015 (Tue)**)

1. During energy monitoring of a building, the data in following table was obtained. Using linear regression analysis technique, determine the equation for the line of best fit for the energy consumption.

CDD	70	90	98	107	170	205	240	260	280	290	330	340
Energy	480	520	630	570	670	860	900	940	1000	1210	1020	1130

CDD = cooling degree days in °C; Energy = Electricity consumption in GJ

2. Determine the cost-effectiveness of replacing a 10-hp motor with an efficiency of 85 percent with a premium-efficiency motor with a rated full-load efficiency of 91.70 percent. Assume that:

   • The cost of electricity is $1.4/kWh.
   • The differential cost of a premium versus standard motor is $3000.
   • The average load factor of the motor is 0.80.
   • The average full-load operating hours of the motor are 4,000 hours/year.

3. Consider a building with total 200 luminaires of four 40W lamps/luminaire. Determine the energy saving after replacing those with two 32W high-efficiency lamps/luminaire. This building is operated 8 hours/day, 5 days/week, 50 weeks/year.

4. An existing chiller with a capacity of 800 kW and with an average seasonal COP of 3.5 is to be replaced by a new chiller with the same capacity but with an average seasonal COP of 4.5. Determine the simple payback period of the chiller replacement if the cost of electricity is $1.4/kWh and the cost differential of the new chiller is $120,000. Assume that the number of equivalent full-load hours for the chiller is 1,000 per year both before and after the replacement.

5. A displacement ventilation system is installed in a room of 3.5 m high. Estimate the likely sensible heat extraction by the system, based on the following information.

   - Maximum vertical temperature gradient = 3 K m^{-1}
   - Maximum air change rate = 3 h^{-1}
   - Density of air = 1.2 kg m^{-3}
   - Specific heat capacity of the air = 1.02 kJ kg^{-1} K^{-1}