ME 1065: Group Design Project
Fall 2008

For Part 2 of the Design Project:

(Since each group has its own specific design, not all of the following specifications will apply to each project.)

Piping/Duct Networks

For every large[1] piping/air duct network that runs throughout your building, specify the materials and relevant geometries, and calculate:

1) The **total** head loss (include major and minor losses) and resulting pressure drop,
2) The volumetric flow rate,
3) The heat losses, and
4) The pressure and temperature at each outlet.

You do NOT need to calculate the heat loss and temperature for any cold water supply systems.

Off-the-Shelf Heat Pumps/Air-Conditioners

For every installation-ready heat pump or a/c unit, you must analyze the system within the unit. That includes specifying the general configuration, component efficiencies, and thermodynamic properties ($\dot{m}$, T, P, h, and s) at each transition point in the cycle (i.e., flowing from a heat exchanger to a valve, a pump to a heat exchanger, etc.). You must also analyze the components within the unit as specified in the following sections (heat exchangers, pumps, etc.). If you have multiple, identical units in your building, you only need to perform these analyses for one of them.

Heat Exchangers

Each heat exchanger must be appropriately sized. This means that you should determine:

1) The physical configuration and materials (including insulation around your heat exchanger, if necessary),
2) The desired mass flow rates and inlet/outlet temperatures,
3) The overall heat transfer coefficient (including sub-calculations/specifications for conductivities and convection coefficients),
4) The overall area and resulting heat exchanger size/volume, and
5) The total rate of heat transfer.

[1] "Large" is defined as having a total system length of approximately greater than 2 m.

Boilers/Furnaces

Boilers and furnaces are a simplified subset of the heat exchanger analysis delineated above. The main differences are that (1) the geometry is usually quite basic, and (2) not all of the heat from the hot "stream" is necessarily assumed to be transferred to the cold "stream." Insulation also plays a more significant role in this analysis, particularly for water heaters.

Pumps/Compressors

For every pump (or compressor, which can be analyzed like a pump), specify/calculate:

1) The pump overall efficiency,
2) The hydraulic, volumetric, and mechanical efficiencies,
3) The desired flow rate and corresponding increase in head, and
4) The flow/capacity, head, and power coefficients.

Insulation

Anywhere that insulation plays a significant role in heat retention, give the insulation thickness and overall R-value. Provide details as to how you calculated/found that R-value.

Photovoltaics

For all PV cells, specify the general generation rate, dimensions, solar energy insolation for your location (average, minimum, and maximum for each season or month), actual rate/level of electrical generation, and detailed plans for energy storage or sale when the generation is greater than the consumption rate.

Wind Turbines

Provide the wind turbine geometry/size, expected wind speed/capacity for your location (including seasonal variations), power coefficient, turbine efficiency, actual rate/level of electrical generation, and detailed plans for energy storage or sale when the generation is greater than the consumption rate.

The written report for Part 2 is due on November 10, and is worth 15% of your grade.