ME 4465

Design Problem #1 Thermal Fluid Systems Design Fall 2018

Due Monday, 9/24/17 by 12:00pm (noon)

Project Total Points – 128pts

You have been asked to design a piping system to deliver 100 gpm of water (T = 140^{o}F) from a pump discharge (*point A*) to a holding tank (*point B*) – however, you cannot cross the property boundary (see figure at the bottom of this write up). The overall size of the plot is 60ft x 140ft with 10ft between the 27ft diameter tank and the right boundary. The pump provides sufficient pressure to overcome 50 psi of piping pressure loss; the piping into the tank is open to atmospheric pressure. It is given that:

- The piping will be horizontal and of constant diameter
- Schedule 40 pipe will be adequate (not PVC pipe)
- After the pump discharge, a globe valve and check valve will be needed
- The max allowable flow velocity inside the pipe is 15 ft/s
- Piping cannot be attached to any building/tank
- All piping must stay within the property boundary confinement

The sketch below shows the relative location of points A & B as well as areas of piping exclusion.

As part of your design, you are required to determine:

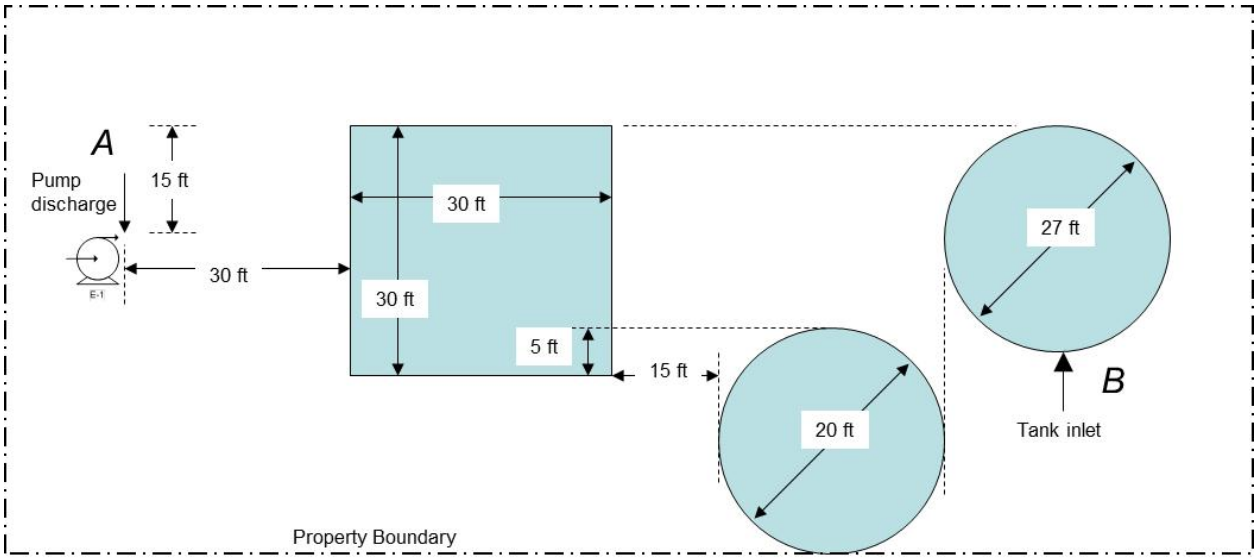
- Minimum pipe diameter to minimize total length of pipe between points A & B
- Layout, including location of the piping run, supports, and connections
- Type (screwed, flanged, welded, etc.) and number of connections (fittings, valves, etc)

Perform the design for the allowable pressure drop and then provide proof that the flow velocity does not exceed the maximum value. Also, do not forget about exit loses from the piping to the tank.

As **part** of the deliverable for this problem, include:

- A layout of your piping design (in P&ID format)
- Layout, using SW, including all dimensions for the piping system, including piping supports. Include outline of buildings and tanks and distances between pipe and buildings/tanks.
- Verification of minimizing pipe diameter for minimizing total length of system.
- A table of loss coefficients (K values) for all fittings & components.
- A table of piping supports used.
- Information needed to find and verification of the pipe friction factor (via equations).
- Adequate references for all values (e.g., fluid properties, K values, etc.)
- Adequate calculated proof demonstrating that your design meets the requirements (acceptable pressure drop for the given flow rate and determined diameter, corresponding flow velocity, etc.).
- For all iterations, provide a summary table of results (e.g., pipe diameter, pressure drop, flow velocity, etc.).

Use of computer tools (SW, Matlab, Maple, Excel, Engineering Toolbox, etc) is required for the project. No hand sketches. Include any programs developed.



Top View Showing Horizontal Plane