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Chapter 11 – Series Pipeline Systems

What we do from now onwards is the application of what we did so far.

Final examination will have problems from Chapter 11 and after 11.

System analysis and design problems can be classified into three categories:

Class I – The system is completely defined in terms of the size of pipes, the types of minor losses that are present, and the volume flow rate of fluid in the system.

The typical objective is to compute the pressure at some point of interest, to compute the total head on a pump, or compute the elevation of a source of fluid to produce a desired flow rate or pressure at selected points in the system.

Class II – The system is completely defined in terms of its elevations, pipe sizes, valves and fittings, and allowable pressure drop at key points in the system.

The objective is to know the volume flow rate of fluid that could be delivered by the given system.

Class III – The general layout of the system is known along with desired volume flow rate.

The size of pipe required to carry a given flow rate of a given fluid is to be determined.

[These days if you have to do such problems as practicing engineers, most likely you will use some software like Excel., but in class and exam we will only do problems that can be solved using a calculator.]

[TODO – Class I System Diagram]

The energy equation (from earlier chapters)

Using the surface of each reservoir as reference points 1 and 2.

$$\frac{P_1}{\gamma} + Z_1 + \frac{V_1^2}{2g} + h_A - h_L = \frac{P_2}{\gamma} + Z_2 + \frac{V_2^2}{2g}$$

h_A is the energy added to the fluid by the pump.

Practicing engineers use the word “Total Head” on the pump to describe h_A, and the total head is an important parameter for selecting pumps.

h_L is the total energy loss from the system between points 1 and 2.

{You should be able to judge from a sketch what are those energy losses.)

h_L is the sum of several losses
- Entrance loss
- Friction loss
- Energy loss in valves

- Energy loss in bends (elbows)
- Exit loss

Class II System: We want to know the volumetric flow rate of the fluid that could be delivered by a given system [TODO]

The system is completely defined in terms of its elevations, valves and fittings, and allowable pressure drop at key points in the system.

Typically, three methods are used by practicing engineers to solve class II problems.

Method II:A - Use for a series system in which only pipe friction losses are considered.

Method II:B – Used for a series system in which relatively small minor losses exist along with a relatively large friction losses –

So, essentially this adds a step to the solution process of II:A. Ignore the minor losses initially and then account for them.

Method II:C – Used for a series system in which minor losses are significant in comparison with friction losses and for which a high level of precision in the analysis is desired.

Usually iteration is required in this method.

[TODO]

So, if a problem needs iteration, you just complete the first step)

Kind of problems you should be able to do from the chapter

[TODO – Problem 11.1]